

# **Industrial Process Heating Equipment**

## **Foreword**

A family owned and operated firm, A.K. Waugh has supplied industry with heating equipment for Oils and for other process fluids for more than 80 years

Our philosophy is simple - always build equipment that comfortably exceeds the minimum requirements of current standards. The longevity of our equipment is testament to the care with which we apply our experience.

## **Fuel Oil Heating**



separate catalogues)

We manufacture Oil Immersion, Oil Outflow and Oil In-Line Heaters. Heaters are individually manufactured to suit your application, and may use several heat sources, the most popular of which is electricity. Use of Steam, Hot Water or Thermal Oil as a primary or additional energy source can be incorporated. ( Outflow and In-Line Heaters - see

## **Other Fluids**

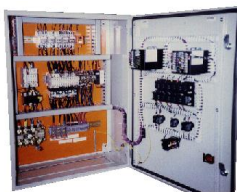
When we are required to manufacture equipment for use with water, acid or alkali this is easily accommodated using different materials than those normally used for oil. Build and testing generally follows the same stringent procedures used for our oil heater products, for the sake of reliability.

## **Pumping and Heating Units**



We provide a complete and integrated Pumping and Heating service. Normally we do not advertise specific systems since most of our equipment is customised in some fashion or other for individual tasks. If this type of equipment is of interest please ask for further information. We will be pleased to help.

## **Control Panels**



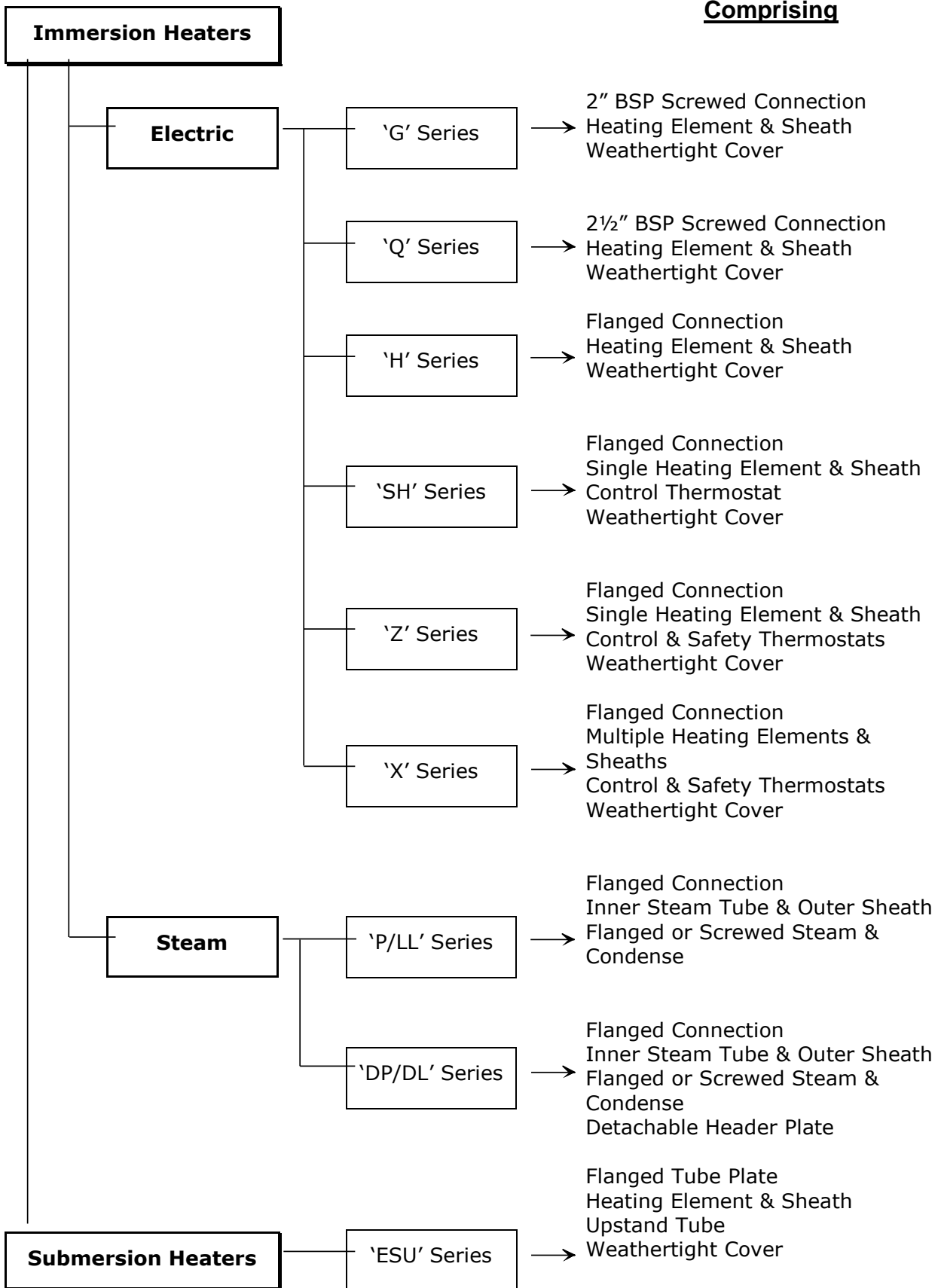
.A.K. Waugh provides a comprehensive range of custom-built panels to suit heaters and P&H sets. These are available with a wide range of options and can be supplied for heater outputs ranging from 3kW to over 350 kW, also manufactured for various climatic zones throughout the world. Detailed specifications are available upon request.

## **In General**

A.K. Waugh is here to provide you with technical assistance so that you may choose the best heater or combination of heaters for the job in hand. We will give you up to date advice on the fluid you wish to heat, and will work with you towards an effective and efficient solution for your heating needs. Our work is backed up where required by the design and testing services of organisations such as Lloyds Register or DNV. We work to a defined quality system as necessary.

# GUIDE TO IMMERSION HEATER RANGES

## Comprising



## Electric Immersion Heaters for Heavy Oil Storage Tanks - Mild Steel versions



**'G' Series - 2" BSP - Single Tube**  
**'Q' Series - 2½" BSP - Single Tube**  
**'H' Series - Flanged PN6 - Single Tube**

All units have a Watts Rating appropriate to the oil type used, between 6 and 8 W/in<sup>2</sup> ( 0.9 and 1.2 W/cm<sup>2</sup>)

List Number	Rating (Watts) @ 0.9 W/cm <sup>2</sup> (6 W/in <sup>2</sup> )	Immersed Length (mm)	Inactive Length (mm)	Overall Length (mm)	Price for G / Q type	Add for H type	Add for SS sheath All types
G/Q/H 1	1,2	500	50	650			
G/Q/H 2	1,2	750	50	900			
G/Q/H 3	1,6	1,000	50	1,150			
G/Q/H 4	2,0	1,250	50	1,400			
G/Q/H 5	2,4	1,500	100	1,700			
G/Q/H 6	2,7	1,750	100	1,950			
G/Q/H 7	3,1	2,000	100	2,200			
G/Q/H 8	3,5	2,250	100	2,450			
G/Q/H 9	3,9	2,500	100	2,700			
G/Q/H 10	4,7	3,000	150	3,250			

*Higher Kilowatt loadings available on request, built to special Order only.*

*Note that 1 kilowatt will raise 6 gallons (27 litres) through 100°F (55°C) per hour or pro rata*

The range shown above comprises the standard units made. We can accommodate reasonable variations within the specifications above.

The heaters shown are all for **Horizontal Fitting**. Special arrangements can be made to enable vertical fitting, but advice on this matter must be given prior to manufacture. In all cases the overall length of the heater is the Immersed Length plus 100 mm (4") approx. Inactive Length, as shown, may be varied to suit the particular application with a suitable adjustment made to the heater output if necessary. This would apply to a heavily insulated tank, for instance, where the head of the heater could be as much as 150mm from the tank wall.

Standard Equipment	:	Removable Core type Heating Element Weathertight Terminal Cover arrangement with cable entry.
'G' Series	:	2" BSP Tank Fitting, 16 swg element sheath. Hex head 3.1/8" A/F
'Q' Series	:	2½" BSP Tank Fitting, heavy wall element sheath. Hex head 3.3/8" A/F
'H' Series	:	BS4504 PN6 Flange fitting, heavy wall element sheath. BS4504 PN16 available as an option at extra cost Stainless Steel Fittings available at extra cost
Prices	:	Are Ex. works, packed for UK destinations only.
Notes	:	For Heaters above 1500mm long, it is recommended that supports be used in the tank.

**Please see our discussion on BS799 - to be found in a separate publication.**

# Electric Immersion Heaters for Steel / Plastic / GRP Storage Tanks

**Medium to Heavy Oils - Mild Steel versions  
Acids / Alkalis – Stainless Steel versions**



## ‘SH’ Series - Flanged PN6 - Single Tube

All units have a Watts Rating appropriate to the fluid type used between 4 and 10 W/in<sup>2</sup> (0.6 and 1.5 W/cm<sup>2</sup>)

List Number	Rating (Watts) @0.6 W/cm <sup>2</sup> (4 W/in <sup>2</sup> )	Immersed Length (mm)	Inactive Length (mm)	Overall Length (mm)	Price (Mild Steel)	Price (Stainless)
SH 1	1000	1000	100	1200	-	
SH 2	2000	1000	100	1200		
SH 3	3000	1000	100	1200		
SH 4	4000	1500	100	1700		
SH 5	5000	1500	100	1700		
SH 6	6000	1500	100	1700		

*Higher Kilowatt loadings available on request, built to special Order only.*

*Note that 1 kilowatt will raise 6 gallons (27 litres) through 100°F (55°C) per hour or pro rata*

The range shown above comprises the standard units made. We can accommodate reasonable variations within the specifications above. Materials are chosen to suit the fluid being heated. Please see Notes at the end of this document.

The heaters shown are all for **Horizontal Fitting**. Special arrangements can be made to enable vertical fitting, but advice on this matter must be given prior to manufacture. In all cases the overall length of the heater is the Immersed Length plus 100 mm (4") approx. Inactive Length, as shown, may be varied to suit the particular application with a suitable adjustment made to the heater output if necessary. This would apply to a heavily insulated tank, for instance, where the head of the heater could be as much as 150mm from the tank wall.

- Standard Equipment : Removable Core type Heating Element  
Control Thermostat as appropriate  
Safety Thermostat as appropriate  
Weathertight Terminal Cover arrangement with cable entry.
- Extra Items : Change of Flange specification i.e from BS to ASTM
- Prices : Are Ex. works, packed for UK destinations only.
- Notes : For Heaters above 1500mm long, it is recommended that supports be used in the tank.

**Please see our discussion on BS799 - to be found in a separate publication.**

# Electric Immersion Heaters for Steel or Plastic / GRP Storage Tanks

**Medium to Heavy Oils - Mild Steel versions  
Acids / Alkalis - Stainless Steel versions**



## 'Z' Series - Flanged PN16

All units have a Watts Rating appropriate to the fluid type used between 4 and 20 W/in<sup>2</sup> (0.6 and 3.1 W/cm<sup>2</sup>)

List Number	Rating Watts	Immersed Length (mm)	Inactive Length (mm)	Price (Mild Steel)	Price (Stainless)
Z1	1000	1000	100		
Z2	2000	1000	100		
Z3	3000	1000	100		
Z4	4000	1500	100		
Z5	5000	1500	100		
Z6	6000	1500	100		
Z7	7000	2000	100		
Z8	8000	2000	100		

*Higher Kilowatt loadings available on request, built to special Order only.*

*Note that 1 kilowatt will raise 3 gallons (14 litres) through 100°F (55°C) per hour or pro rata*

The range shown above comprises the standard units made. We can accommodate reasonable variations within the specifications above. It should be noted that the systems specified are calculated to provide long life and trouble free operation and as such are built with the best available materials. A short note of material specifications versus fluid types is given at the end of the catalogue.

- Standard Equipment : Removable Core type Heating Element  
Control Thermostat as appropriate  
Safety Thermostat as appropriate  
Weathertight Terminal Cover arrangement with cable entry.
- Extra Items : Change of Flange specification i.e from BS to ASTM
- Prices : Are Ex. works, packed for UK destinations only.
- Notes : For Heaters above 1500mm long, it is recommended that supports be used in the tank.

**Please see our discussion on BS799 - to be found in a separate publication.**

## Electric Immersion Heaters for Steel Storage Tanks



**Medium to Heavy Oils - Mild Steel versions  
Acids / Alkalis - Stainless Steel versions**

**'X' Series - Multiple Tube - Flanged PN16**

All units have a Watts Rating appropriate to the oil type used of not more than 8 W/in<sup>2</sup> (1.22 W/cm<sup>2</sup>)

List Number	Rating Watts	Length Immersed (mm)	Inactive Length (mm)	Min. Tank Bore Reqd.	Price (Mild Steel)	Price (Stainless)
X1	6000	800mm	150	150mm		
X2	8000	900mm	150	150mm		
X3	12000	1500mm	150	150mm		
X4	15000	2000mm	150	150mm		
X5	18000	2500mm	150	150mm		
X6	24000	2500mm	150	250mm		
X7	30000	2000mm	150	250mm		
X8	36000	2500mm	150	250mm		
X9	42000	2000mm	150	300mm		
X10	48000	2500mm	150	300mm		
X11	54000	2500mm	150	300mm		

*Higher Kilowatt loadings available on request, built to special Order only.*

The range shown above comprises the standard units made. We can accommodate reasonable variations within the specifications above. It should be noted that the systems specified are calculated to provide long life and trouble free operation and as such are built with the best available materials. A short note of material specifications versus fluid types is given at the end of the catalogue.

- Standard Equipment : Removable Core type Heating Element  
Control Thermostat as appropriate  
Safety Thermostat as appropriate  
Weathertight Terminal Cover arrangement with cable entry.
- Extra Items : Change of Flange specification i.e from BS to ASTM  
Multi-Stage operation  
Fluid Level switch
- Prices : Are Ex. works, packed for UK destinations only.
- Notes : For Heaters above 1500mm long, it is recommended that supports be used in the tank.

**Please see our discussion on BS799 - to be found in a separate publication.**

**Steam Immersion Heaters  
for  
Steel Storage Tanks  
Medium to Heavy Oils - Mild Steel versions**

**'P' & 'LL' Series - Flanged - SingleTube  
'DP' & 'DL' Series - Flanged - SingleTube -  
Detachable Header Plate**

List Number	Heating Surface (sq.ft.)	Length Immersed	Flange Size and Rating	Min. Tank Bore Req'd.	Price
LL/DL 2	2	760mm	BS4504 PN6	50mm	P.O.A.
LL/DL 4	4	1525mm	BS4504 PN6	50mm	P.O.A.
LL/DL 6	6	2290mm	BS4504 PN6	50mm	P.O.A.
LL/DL 8	8	3050mm	BS4504 PN6	50mm	P.O.A.
LL/DL 9	9	3650mm	BS4504 PN6	50mm	P.O.A.
P/DP 3	3	915mm	BS4504 PN6	65mm	P.O.A.
P/DP 5	5	1525mm	BS4504 PN6	65mm	P.O.A.
P/DP 6	6	1830mm	BS4504 PN6	65mm	P.O.A.
P/DP 10	10	3050mm	BS4504 PN6	65mm	P.O.A.
P/DP 12	12	3650mm	BS4504 PN6	65mm	P.O.A.

Steam Immersion Heaters have been developed for the heating of oil in storage tanks in a similar manner to electric immersion heaters.

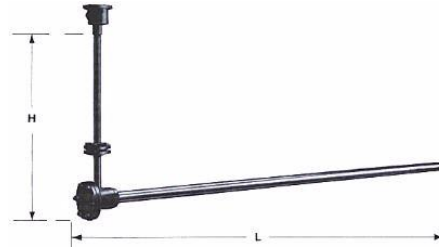
Alternative designs are available with the DL & DP having a *Detachable Header Plate* for cleaning or inspection of the interior without draining down the storage tank.

The range shown above comprises the standard units made. We can accommodate reasonable variations within the specifications above.

Flange connections are available in a most formats - if a non - standard item is needed then please advise us.

Extra Items : Change of Flange specification  
: Steam Control Equipment (Regulator, Valve, Trap set etc.)

# Electric Immersion Heaters SUBMERSION Type for Steel Storage Tanks Medium to Heavy Oils - Mild Steel versions



## ‘ESU’ Series - Single / Multiple Tube

All units have a Watts Rating appropriate to the oil type used of not more than 8 W/in<sup>2</sup> (1.22 W/cm<sup>2</sup>)

List Number	Rating kW	Length Immersed	Price
ESU1	1	1000mm	
ESU2	2	1000mm	
ESU3	3	1500mm	
ESU4	4	2000mm	
ESU5	5	2500mm	
ESU6	6	3000mm	
ESU7	7	3000mm	
ESU8	8	3000mm	
ESU9	9	3000mm	
ESU10	10	3000mm	

*Higher Kilowatt loadings available on request, built to special Order only.*

*Note that 1 kilowatt will raise 3 gallons (14 litres) through 100°F (55°C) per hour or pro rata*

The ESU Series is designed to be installed where it is impossible to fit conventional heaters, or where a tank is of the underground variety. The heater is installed via a suitable manhole, with an upstand pipe taking the heater cabling to the top of the tank. Connections are all gasketed or welded and therefore oiltight. Dimension "H" can only be stated once the tank dimensions are provided. Dimension "L" may vary depending upon tank width or diameter.

Supports are usually required in order to raise the heater assembly approximately 150mm (6") from the base of the tank to clear any sludge present, and to properly support the length of the heating element for the avoidance of the element bending with age, heating and gravity.

Note that as with all oil storage tanks the requirement to keep the heating element covered in oil applies. This "dead volume" should be borne in mind when calculating usable tank capacity.

Standard Equipment	:	Removable Core type Heating Element Weathertight terminal cover arrangement
Extra Items	:	Controlling and Safety Thermostats as appropriate Delivery UK - although this is usually a nominal charge only.

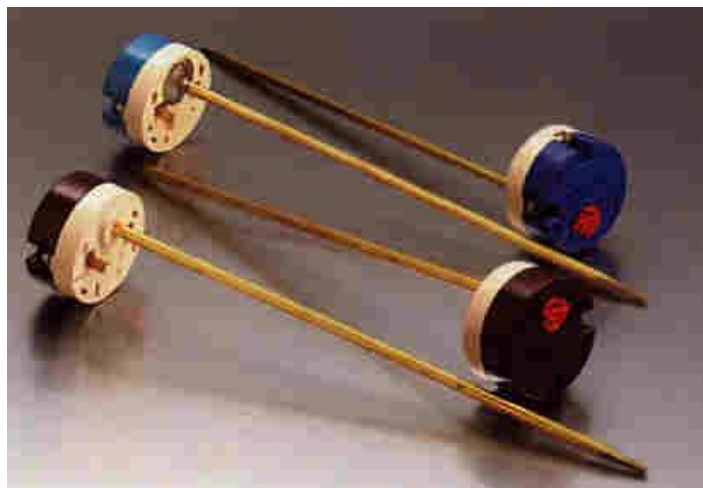


# Thermostats

We use a wide range of thermostats to suit the various applications we encounter.

These are from major suppliers such as Cotherm and Maclaren.

Typical examples :



All have adjustable dials and are available in a range of operation bands. Generally we would supply thermostats to suit the mid-range of the available settings, as this is usually the most accurate and has the lowest hysteresis.

## Information & Brief installation guidelines

### **Information**

All heaters discussed in this catalogue are for HORIZONTAL Installation.

If you wish to have a VERTICALLY Installed heater, let us know and we will make one to suit.

It is important to note that there are differences between the two types such that a Vertical unit can be used as Horizontal, but not the other way about. For further information, please telephone us.

It is worth mentioning is that Oil is generally perceived to be capable of great damage if it is abused by overheating, where a water based fluid is not. Due to this false perception we feel that aqueous solutions have not been given proper respect with regard to controls and safety measures, except in exceptional circumstances. Up until recently, for instance, it was not considered practical to include a safety thermostat in a heater specification because since water solutions don't explode, what's the point ?.

However, a lack of explosion or outward physical sign does not necessarily indicate that everything is going well with the fluid or process in question. As an example a solution may be required to maintain a set temperature otherwise it may break down chemically, or go from a colloidal solution to a separated solution.

Recognising the dangers involved, and working closely with our customers on numerous difficult projects we have decided to offer heaters for aqueous solutions only with Control AND Safety thermostats. Such heaters avoid any possible question as to control / safety strategy - a point which has been borne out more than once in recent years.

### **Installation Guidelines**

Upon request we will supply diagrams or sketches appropriate to your particular installation, rather than providing a more general sketch which gives insufficient detail and may only serve to confuse.

- a) The Oil Draw Off from the tank should always be **ABOVE** the level of the heater and thermostat(s) to prevent these becoming uncovered.
- b) Heaters are normally installed at the Oil Draw Off end of the tank unless required to give background heating at the opposite end, or in long tanks, heaters may be fitted at both ends to maintain the contents at a more even temperature than might be the case with heaters only fitted in one end.
- c) With LONG Immersion heaters of the Screw-in type (G & Q types and older versions) it is sometimes difficult to engage the heater in the screwed boss in the tank due to the weight of the overhang, unless the heater is supported from inside the tank. With Flanged heaters (H / SH / Z etc.) the problem is mainly overcome. However, it is important that these are installed in the correct orientation so it's better to support the heater regardless.
- d) In the past we have supplied Screw-in heaters with thermostats incorporated. We no longer supply these as it is impractical to maintain the design, which is now superseded by better and more up to date designs.
- e) Where Thermostats are called for to be integral with the heater we ONLY supply BOTH CONTROL and SAFETY (Manual Hand-Reset) types with the unit. In the case of the 'Z' type the two are accommodated within the heater terminal chamber. For the SH type we supply the Control in the terminal chamber and the Safety as a separate (pocketed and weathertight) item. In the case of the 'H' flanged heater both thermostats are supplied with pockets and weathertight covers, as there is no thermostat fitted on the flange.

# Installation Instructions for Immersion Heaters

## 1.0 INSTALLATION

The immersion heater supplied is only suitable for horizontal mounting. Adequate withdrawal space must be provided, allowing - in the case of electric heaters, element cores and heater sheath or battery to be removed. Withdrawal distance is approximately the length of the heater, since normally there is little room for manipulation at the tank stub.

## 2.0 ELECTRICAL CONNECTIONS

A cable entry is provided on the terminal box to allow site connection of a suitable supply. Note that 3 phases and 1 neutral cable, plus a 2 - core control circuit must be wired in.

### 3.0a METHOD OF OPERATION - Electrical Heaters

Heat is transferred to the liquid by means of removable ceramic heating element cores fitted into a sheath or tube. The element and sheath are closely matched to provide a good fit and therefore good heat transfer.

### 3.0b METHOD OF OPERATION - Steam Heaters

Heat is transferred to the liquid by the condensation of steam on the inner surface of the heater probe / sheath. The condensed liquid along with remaining steam then passes to an outlet.

### 4.0a SETTING OF THERMOSTATS - Electric Heaters

**General** Thermostats fitted have adjustable scales covering the temperature range required. Each thermostat is fitted in a pocket which enables replacement without draining down the vessel contents. It should be noted that in most cases the thermostat will sense a higher temperature than the bulk temperature since it will be in close proximity to the convective flow of liquid from the heater element sheath.

**Control Stat** This will be found generally on the TOP LEFT, as you look inside. The setting can be varied as required.

**Master Stat** One master, or safety, thermostat is fitted to each heater in compliance with British Standards. This thermostat has a reset button visible and is located generally on the TOP RIGHT. The setting can be varied as required but should be 15-20°C above the Control setting. If the fluid temperature exceeds this value the thermostat will automatically switch off the entire circuit. It is necessary to manually reset this thermostat after correction of any fault.

### 4.0b SETTING OF THERMOSTATS - Steam Heaters

**General** A Steam Thermostat is required to regulate the flow of steam, and hence the temperature, of the steam heater. A fine control can be achieved with the added benefit of known maximum surface temperatures equating to the pressure of the steam used. The Steam Thermostat acts on a Control Valve in the Steam Inlet line, and is adjustable within a specified range. As there is an absolute maximum temperature limit there is no requirement for a Safety Thermostat in most cases.

## 5.0 MAINTENANCE

Maintenance is limited solely to electrical testing of the installation. If the earth insulation and where applicable the phase/phase insulation of the unit is not better than 1 ohm then the element must be removed and further tested. If the unit has been subjected to a period of disuse in a damp environment, gentle drying may correct any poor insulation values.

### 5.1 SPARES ORDERING INFORMATION

It is essential when ordering spares to quote **all** the details given on the nameplate :

**SERIAL NUMBER      DATE      KILOWATT RATING**

# British Standards & Fuel Oils

## From BS 799 : Part 5 : 1975

(Note : This supersedes completely the 1962 edition.)

### 8. Heaters for Oil Storage Tanks

8.1. *General - Heaters may be of the following types.*

- a) The immersion type inserted through the outlet end of the tank.
- b) The submersion type inserted through the top of the tank.
- c) The outflow type, where the heating elements are concentrated around the outlet.

Details of typical tank heater arrangements are shown in Figure 5. (not available)

The means of heating may be electricity, steam or hot water.

8.2. *Electric Heaters.*

The electric loading shall not exceed  $1.6 \text{ W/cm}^2$  ( $10 \text{ W/in}^2$ ) of element sheath surface. Thermostatic control shall be employed; for outflow heaters a safety cut out shall be provided in addition as specified in Part 4 of this standard. Elements and thermostats shall be of the dry type so that they can be withdrawn without emptying the tank. The element sheath or pocket shall be of sufficient strength to prevent damage to the element and shall be supported as necessary along its length by cradles or other supports. Heaters fitted to tanks placed in the open air shall be provided with weatherproof terminal covers.

8.3. *Steam and Hot Water Heaters or coils. (Including High Pressure Hot Water Heaters)*

These shall be constructed of seamless steel tube and preferably without joints within the tank. Where such joints are unavoidable they shall be welded. Heaters shall be designed to allow free expansion and shall be supported as necessary along their length by cradles or other supports. Steam heaters shall be arranged to drain freely and not be subject to water hammer. Water heaters shall be so designed that any entrapped air is vented automatically. The maximum temperature of the heating medium shall not exceed  $175^\circ\text{C}$  ( $350^\circ\text{F}$  @ 150 psi)

8.4. *Location.*

All heaters and controlling thermostats shall be so located in relation to the draw-off level that their surfaces shall not become exposed.

8.5. *Test Conditions.*

All parts of the heater subject to internal pressure shall be tested hydraulically at 1.5 times the maximum working pressure or 7 bar gauge, whichever is the greater. Electric heaters shall be independently earthed. The insulation resistance between the elements and the heater, when measured at room temperature with a voltage of not less than 500 v.d.c. shall be not less than 1 megohm.

8.6. *Marking.*

The following information shall be permanently and clearly marked on each heater.

Manufacturers name or trademark and identification mark or serial number  
Test pressure and date of test  
Maximum working pressure.

On heaters containing electric elements, also : Voltage, Wattage and a diagram of electrical connections where there are more than two terminals exclusive of the earthing terminal.

# British Standards & Fuel Oils

## From BS5410 Pt.3 1976

### *Section three - Selection and application of oil burners*

#### *10 - Choice of grade of fuel*

##### *10.2 - Minimum heat input rate*

The minimum rate at which complete combustion can be achieved increases as the viscosity of the fuel increases.

#### *14 - Combustion and safety controls*

##### *14.1 - General*

To ensure its safe working, oil burning equipment is fitted with protective devices, described below, which should be in accordance with the requirements of BS799:Parts 3 and 4.

##### *14.4 - Failure of electricity supply and voltage variations*

With all systems, including fully automatic systems (see 5.4 of BS799:Pat.4:1972), provision should be made to ensure that, in the event of any electricity supply failure or of excessive voltage drop which will interfere with the safe operation of the plant, the fuel supply will be shut off. (The conditions under which the burner may then restart should receive careful consideration at the design stage.)

##### *14.6 - Excess temperature*

In the event that a normal temperature control can fail to function and a process temperature continue to rise, provision should be made for a limiting temperature control, set at a higher temperature, to shut off the burner. The limiting temperature control should be of the hand reset type and if necessary the shut off should be coupled to an alarm.

##### *14.8 - High or low temperature change*

In installations using fuels requiring preheating it is most important that the selected temperature remains as constant as possible to avoid changes in the viscosity of the fuel. The preheating device should always be under the control of a suitable thermostat. A further limiting thermostat with manual reset should also be installed to guard against excess oil temperature. A minimum temperature thermostat to prevent the burner starting until the oil is raised to the required temperature is recommended. The position of such a thermostat will probably be part of the burner and be fitted by the manufacturer.

### *Section five - Oil handling systems from storage tank to burner*

#### *33 - Heated oil fuel systems (classes E,F,G and H)*

##### *33.2.2 - Pumped Ring Main*

###### *33.2.2.1*

From a storage or service tank oil flows by gravity to a ring main pump. A circulatory system from the ring main pump delivery comprises a flow line up to all sets of burner equipment served and a return line from the last set to the oil tank or pump suction.

A pressure control device is normally fitted on the downstream side of the last burner served to maintain the required supply pressure to all burners under all oil flow rates.

The ring main can incorporate oil heaters to bring the oil supplied to the burners to the required temperature and the system can thus cater for oil supply to the burners at temperatures between oil storage temperature and atomising temperature.

Subcirculating loops can be taken from the ring main to feed oil to the burners and to return excess oil to the return side of the ring main. Burners that do not require to return excess oil to the return line may be connected by short dead-legs to the flow side of the ring main. These dead-legs should be as short as practicable and be trace heated.

###### *33.2.2.2*

The circulation temperature (hence viscosity) should be selected to suit the temperature required at the entry into the oil burner equipment allowing suitable margins for the operation of the oil heater thermostat control (discussion ref. burners ensues)

## British Standards & Fuel Oils

### From BS5410 Pt.3 1976

#### 33.2.2.5

Where it is evident from the design of the system that a large amount of oil would be liable to be returned to the pump suction and where the storage tank may not provide an adequate head to prevent the formation of vapour pockets at the pump entry, the head of oil should be supplemented by installing an additional pump in the line from the tank to the ring main pump suction. Alternatively the return can be taken back to the tank if the oil temperature is not excessive for this arrangement.

A permanent vent, connected back to the top of the tank, may in some cases be fitted in the return line to release any air and vapour pockets.

#### 33.2.3

For oil ring main installations the requirements of BS799:parts 2 to 5 in respect of materials and components will apply and in addition the following recommendations are made.

- (i) All components such as pumps, heaters, oil meters and filters should be provided with isolating valves and union or flanged connections to facilitate removal for maintenance.
- (k) Relief valves should be fitted in all positions where a rise in pressure may occur due to a rise in temperature of oil enclosed within heaters etc., or traced pipelines fitted with manually operated valves.
- (p) Oil line heaters may employ steam, water, thermal oil, electricity or combinations thereof as heating media, or for large installations may be specially designed and gas fired or oil fired.

For start up purposes consideration should be given to the provision of electric heating facilities.

Generally, condensate from oil heating coils or heaters should be run to waste and not returned to the boiler or feed water system. For installations using a large amount of oil condensate, recovery may be required (See clause 28)

Care should be taken to ensure that any oil contamination is trapped and that any coil failure will not result in discharge of oil to any drainage system or waterways. If the heating medium is steam at medium pressure which is less than the oil pressure in the heater it is desirable to fit a non-return valve in the steam supply line in order to prevent oil being forced into the line in the event of a heater failure.

Where medium or high pressure hot water is used as the primary oil heating medium, an intermediate water/steam or water/water heat exchanger system should be used so that the oil heating coils or heaters are fed with low pressure steam or hot water to eliminate any danger of oil entering the circulating mains boiler system in the event of accidental leakage.

The oil heaters should be selected to allow for the maximum permitted pressure drop based on the oil circulation rate (not on the oil burning rate). The heater manufacturer should be advised of the oil circulation rate, the maximum oil burning rate, the maximum pressure drop and the oil temperature rise required.

Heaters should be thermostatically controlled to maintain the oil fuel at the desired temperature with the minimum practicable temperature difference and be fitted with pressure relief valve(s) and thermometer(s).

#### *59 - Control of oil heating (see also clause 12)*

Storage tank immersion and outflow heaters and line heaters should be provided with operating thermostats and manual reset thermostats. Pipe line trace heating should be separately controlled by surface thermostats for the different temperature requirements of suction lines and ring mains. Where several heaters are used, indicating pilot lights should be fitted to show which heaters are operating. Where very accurate temperature control is required, an external close temperature differential control thermostat should be fitted in the heater outlet piping. Where heaters may be subject to vibration from external sources built-in thermostats should be replaced by remote bulb types.

## **British Standards & Fuel Oils**

### **From BS5410 Pt.3 1976**

#### *65 - Suppliers' and / or installers' responsibilities*

Suppliers and/or installers should offer routine maintenance contracts and emergency service. The maintenance instructions should be provided by the suppliers and/or the installers. The instruction should include details of the required frequency of servicing and information on the individual components of the equipment where applicable. They should also include flow diagrams, wiring diagrams and other relevant data.

### Recommended Power Density Ratings

Material	Operating Temp. (°C)	Max. Power Density kW/m <sup>2</sup>	Watts/cm <sup>2</sup>	Watts/in <sup>2</sup>
Alkali Solutions	100	60	6	38.71
Asphalt, Tar etc.	98-260	12.5	1.25	8.06
Caustic Soda (75%)	82	40	3	25.81
Citrus Juices (Acid)	85	30	3	19.35
Degreasing Solution Vapour	135	30	3	19.35
Dowtherm A	316	30	3	19.35
Ethylene Glycol	149	15	1.5	9.68
Fatty Acids	66	30	3	19.35
Fuel Oil	71	15	1.5	9.68
Fuel Oil Preheating	82	15	1.5	9.68
Freon	149	5	0.5	3.23
Gasoline	149	5	0.5	3.23
Glycerine	10	60	6	38.71
Industrial Water Heaters	100	80	8	51.61
Kerosene	149	5	0.5	3.23
Lead Stereo type pot	316	50	5	32.26
Linseed Oil	66	80	8	51.61
Metal Melting Pots	260-482	35	3.5	22.58
Molasses	38	5	0.5	3.23
Molten Salt baths	427-510	45	4.5	29.03
Molten Tin	316	30	3	19.35
Mineral Oil	93-204	25	2.5	16.13
Oil Quench Bath	204-316	35	3.5	22.58
Paraffin or Wax	66	20	2	12.9
Propylene Glycol	66	30	3	19.35
Trichloro ethylene	66	30	3	19.35
Vegetable Oil	204	55	5.5	35.48