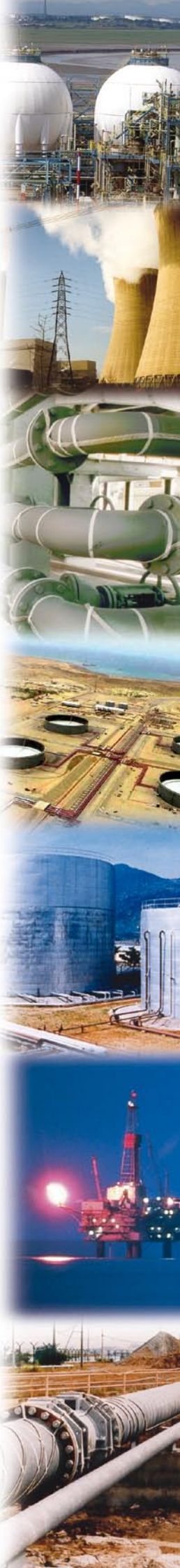
HEAT TRACE™

SETTING THE STANDARDS LEADING THE WAY

A Guide to Industrial Electric Heat Tracing



The Heat Tracing Authority™

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The Past, the Present, ...and the Future

The Past

When Heat Trace Limited was founded in 1974, electric heat tracing was in it's infancy – most heat tracing used steam as its heat source at that time.

In the three decades and more since, electric heat tracing has grown into an industry in its own right. Heat Trace Limited has played a prominent role in its growth throughout as a Leader in Innovation.

From the start, Heat Trace developed products and systems meeting Heat Trace's own corporate objectives of improving

safety, efficiency, reliability and performance.

The world's first parallel resistance cut-to-length Heat Tracer heating cable was patented, developed, and launched by Heat Trace Limited in 1975. It remains within our product range after more then 30 years bearing testament to the significance of this invention.

Heat Trace Limited were perhaps the first surface heating company to recognise the important link between control technology and the "safety, efficiency, reliability and performance" of heat tracing installations.

The company patented Powermatch, a self-regulating proportional controller that turns heater power up or down in response to changes in heat losses. Although launched almost 20 years ago, the benefits of proportional control to safety and efficiency have only recently been recognised on a global basis.

Innovation-led technology resulted
in Heat Trace becoming.....

The **Heat Tracing Authority™**

The Present

Heat Trace's Innovation Culture has culminated in its position as the Technology Leader within our Industry today. This position is demonstrated by:-

1. **The largest and best range of self-regulating heating cables**

- Highest continuous 'maintain' temperature (200ºC)
- Highest continuous 'withstand' temperature (250ºC)
- Widest voltage range (12 to 1000V)

Heat Trace's range of self-regulating heating cables cater for most heat tracing applications

2. **The highest temperature cut-to-length Heat Tracer in the world.**

Heat Trace's patented mineral insulated, metal sheathed, type AHT heating cable can withstand 425ºC continuously, and deliver up to 200W/m.

The AHT tracer can cater for virtually all applications outside the capability of the self-regulating tracer range.

3. **EVOLUTION - the world's most advanced heat tracing Design Tool (See section 6).**

Additionally, Heat Trace's range of electronic control and monitoring equipment extends from simple thermostats to microprocessor controls capable of integrating into overall plant SCADA and DCS systems.

Today, Heat Trace Limited is a global company providing complete heat tracing solutions. In addition to systems manufacture, services include consultancy, system design, installation and commissioning, project management, maintenance and training.

Heat Trace Limited has continued to be...

The **Heat Tracing Authority™**

The Future

Heat Trace's emphasis on an Innovation Culture has resulted in an extensive and active Research and Development Department.

At the time that this brochure went to press, Heat Trace Limited had multiple patents/patent applications in the course of development, and an extensive Product Development project list, mainly involving semi-conductive polymer formulations.

These projects will result in many new and unique products and processes over the forthcoming decade ensuring Heat Trace Limited's position as the Technology Leader within its industry sector….

Heat Trace Limited will remain…

***The* Heat Tracing Authority™**

Heat Trace Limited ..... In the U.K.

Heat Trace Ltd has been manufacturing electrical heating cables in the U.K. for over 30 years.

The main manufacturing facility and headquarters of the company is at Helsby in the North West of England. This factory houses the main processing equipment for the manufacture of semi-conductive self-regulating heating cables; core compounding, heating matrix extrusion, and other more recognised standard cable making processes. The main item of capital equipment is the Electron Beam Unit – one of only two similar units in the U.K., and one of only a few in Europe.

The Helsby Headquarters handles sales to all countries (except the U.K.) around the world. Exports account for over 90% of Heat Trace sales.

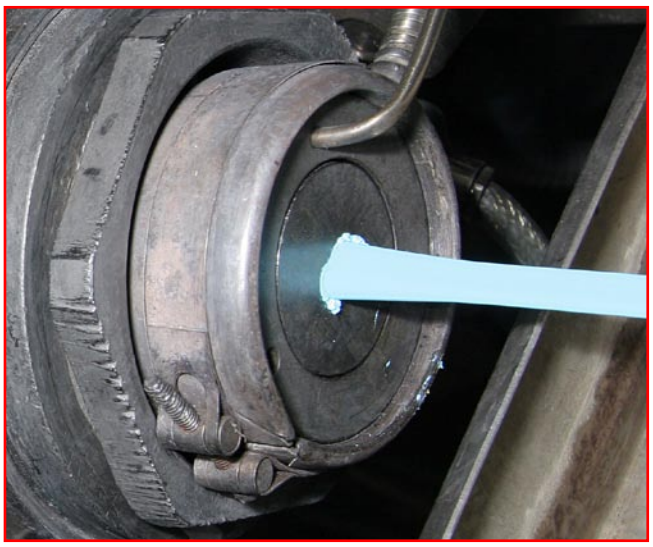
A second manufacturing facility is located at Bredbury, Stockport, some 56 km from the Helsby headquarters. The Bredbury complex has been a Heat Trace owned premises for 20 years, and constant power heating cables are made here.

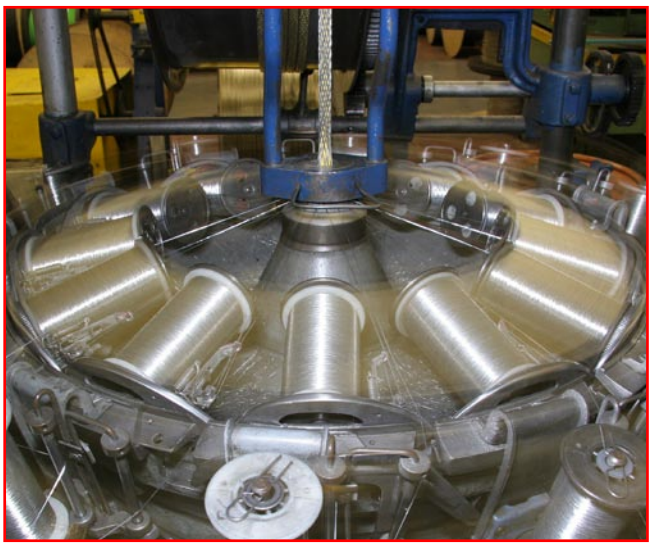
Sales in the U.K. are processed from Heat Trace (UK) Limited located in Sunderland in the North East of England.

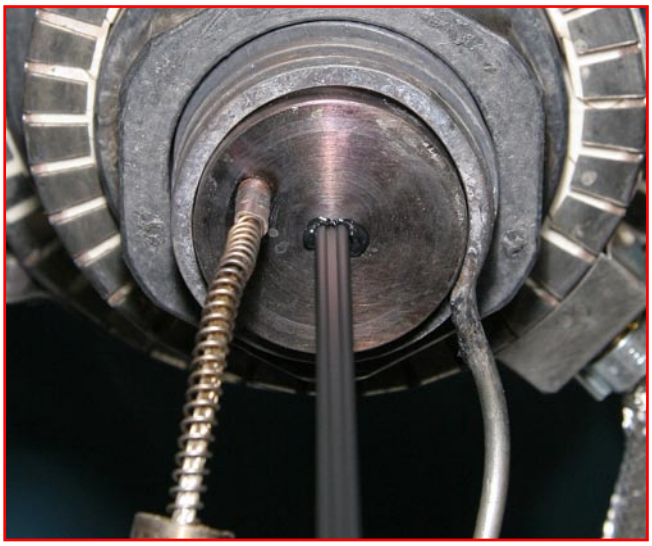
Helsby Headquarters

Bredbury Plant

Heat Trace (UK) Limited







INDUSTRIAL HEAT TRACING – An Introduction

Heat Tracing – What is it?

Heat Tracing (or Trace Heating, or Surface Heating) is the method of applying heat to a body, or to a product (liquid, powder, or gas) contained within a system (pipework, vessel or equipment) for storage or transportation, in order to avoid processing problems or difficulties.

Heat may be applied, for example, to:-

- **Liquids**
  - to prevent freezing
  - to enable pumping by reducing the viscosity of the liquid
- **Powders**
  - to eliminate condensation from the walls of equipment that could result in 'clogging' of the product
- **Gases**
  - to prevent hydration due to a drop in gas pressure across pipework fittings such as valves

Heat Tracing – What is its purpose?

Heat Tracing is usually provided to maintain a product or equipment at a temperature that will prevent processing problems. For example :-

- Above 5ºC – to freeze protect water or aqueous solutions
- Above, for example, 50ºC – to prevent oil from becoming too viscous to pump
- To maintain surfaces above a dew point temperature below which condensation could form on a surface and potentially create 'clogging' of a powder.

Heat Tracing may also be required to heat raise products or equipment from cold to the required maintain temperature. For example :-

- A pipeline is used infrequently to deliver fuel oil from an off-loading berth into a plant area. In such a case, the pipeline and its contents may be raised from the ambient temperature to the fuel oil pumping temperature over a period of, for example, 24 hours prior to the delivery of the fuel oil.

Heat Tracing – The Need

Whenever the contents of a pipe or equipment are maintained at a process temperature exceeding the ambient temperature, there will be a flow of heat from the product or equipment through the thermal insulation to the external air, and *the rate of heat loss varies directly with changes in ambient temperature.*

In order to prevent the temperature of the product from falling below its required level, this ***variable*** heat loss must be compensated for by heat tracing the pipeline or equipment.

Heat Tracing – Steam or Electric?

The energy source for heat tracing is most commonly electricity or steam.

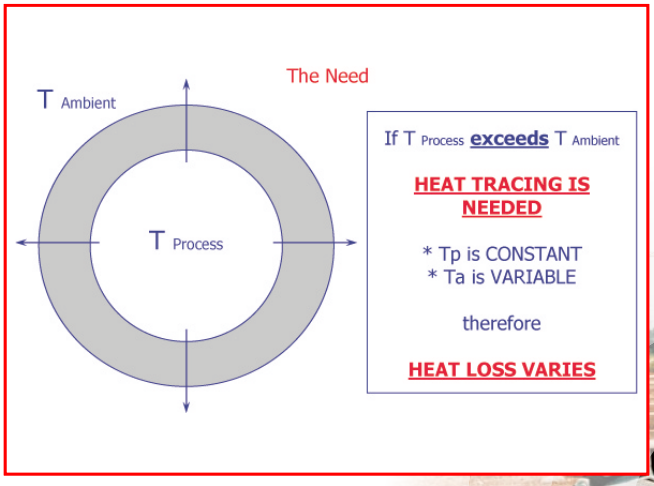
When excess steam is available, it may, incorrectly, be perceived to be 'free'. But steam tracing is rarely controlled and may typically deliver six times the quantity of heat required to provide freeze protection to a pipe. Additionally, it has high running and maintenance costs due to leaks from steam traps.

In such circumstances, often the most efficient course of action is to use the excess steam to generate electricity, which is then used as the energy source for a controlled and highly efficient electric heat tracing system.

Heat Tracing – The System

An electric heat tracing system often comprises:-

- heating cable(s) together with termination components
- ancillary items such as junction boxes and fixing materials
- temperature control devices (sometimes / optional)
- monitoring / alarm facilities (sometimes / optional)
- power distribution / circuit protection facilities



Heat Tracing – Safe Practice

A heat tracing installation should provide the highest appropriate levels of Safety. This is mainly provided for by:-

- ensuring temperature safety
- over-current circuit protection
- earth-leakage protection

This is discussed in more detail in SECTION 3 – System Design.

Heat Tracing – Applicable Standards

Electric heat tracing is governed by a number of International and National Standards covering Industrial (Safe) and Industrial (Hazardous) locations. A list of the most important standards, to which many of Heat Trace's products are approved, are shown in the table below

Although Heat Trace can design and supply equipment approved to most national standards, for purposes of clarity, this document focuses on the standards developed especially for Electric heat tracing:-

- IEC62395 - Electric Heat Tracing for Safe Industrial locations *and*
- IEC60079-30 - Electric Heat Tracing for Hazardous locations (formerly IEC62086)

This is because these are the most recent publications, and are truly international, the International Electro-technical Commission comprising most industrialised nations from all continents.

Industrial	Hazardous (Classified Locations)
IEC62395-1 & -2 Electric resistance heat tracing systems for industrial and commercial applications 1. General and testing requirements 2. Recommendations for system design, installation and maintenance	**IEC 60079-30-1 & -2** (formerly IEC 62086-1 & -2) Electrical apparatus for explosive gas atmospheres. Electrical resistance heat tracing 1. General and testing requirements 2. Application guide for design, installation and maintenance
IEEE515 (U.S.A. national standard) IEEE Standard for the Testing, Design, Installation and maintenance of electrical Heat Tracing for Industrial Applications	
IEEE Std. 844 Recommended Practice for Electrical Impedance, Induction and Skin Effect heating of Pipelines and Vessels	
CSA - C22.2 No. 130-03 (Canadian national standard) Requirements for Electrical Resistance Heating Cables and Heating Device Sets	
IEC 60519-10 Safety in Electroheat installations - Part 10 Particular requirements for electrical resistance trace heating systems for industrial and commercial applications	

Typical Applications / market sectors

Bakery equipment
- heating fuel oil pipes to the ovens
- bread fat heating
- anti-condensation for flour storage
- heating glucose and sucrose products

Brewing
- heating malt, glucose and water pipes and tanks
- fuel oil systems

Chemicals
- heating numerous viscous liquids and/or gases
- research projects
- many refinery applications

Ceramic industry
- heating fuel oil
- paint and varnish heating

Chocolate and sweets
- heating chocolate in pipes and vats
- heating chocolate in road tankers
- heating liquid sugars
- heating cocoa butter and fats

Detergent and soaps
- heating various viscous liquids
- general frost protection

Medicine
- many applications especially in the pharmaceutical industry where waxes, tallows and stearates are used.

Non-ferrous metal industries
- fuel oil heating and frost protection
- Oil industry
- fuel oil heating
- lubrication oil heating
- grease line heating
- oil additives heating
- many refinery processes require tracing

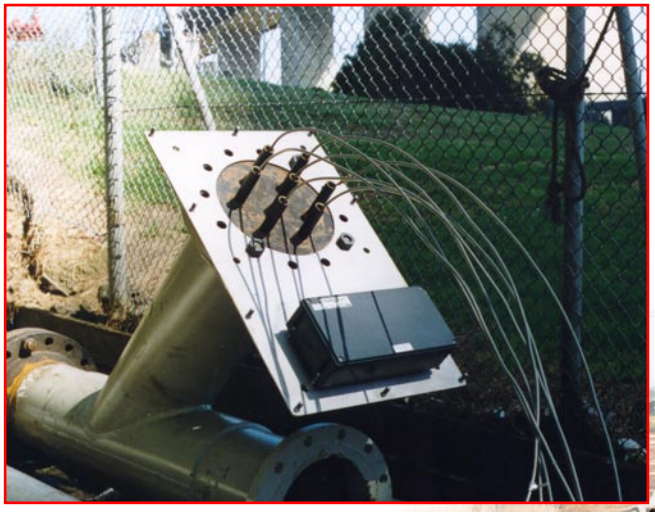
Drying and cleaning
- heating fuel oil
- dyestuffs manufacture

Electric motors
- curing glass-fibre banding tape
- heating commutators during manufacture
- anti-condensation heating

Electric transformers
- curing glass-fibre banding tapes
- drying out oil-filled transformers
- frost protection of water-filled transformers

Tank base heating

Pipe tracing



Internal pipe tracing

Typical Applications / market sectors

Tank Wall de-icing

Tank heating

Buried pipeline tracing

Food processing
- heating many food process materials, eg malt, sugars, molasses, sauces, honeys, jams,
- Chocolates, waxes, fats, cooking oils
- keeping powdered food dry
- heating storage tanks
- tracing refrigeration rooms

Fertiliser industry
- tracing liquids used in manufacturing inorganic fertiliser

Power generation stations
- boron water
- carbon dioxide
- fuel oil
- caustic solutions
- instrument lines
- frost protection
- pre-heating steam lines to prevent stress
- Precipitator - fly ash hoppers and silos
- flue gas desulphurisation processes, ie frost protection and liquid sulphur temperature maintenance

Road construction
- heating asphalt (bituminous tar) and pitch in road stone plants
- fuel oil
- frost protection of sand and aggregate in storage hoppers

Iron and steel
- fuel oil systems
- frost protection
- grease pipelines
- hopper heating

Printing
- inks and dyes during manufacture and storage

Plastics industry
- curing thermosetting resins
- accelerated curing of glass fibre

Paints
- paints and varnishes during manufacture and in paint spray applications

Refrigeration
- heating drain lines and drip trays
- heating refrigerator doors
- anti-frost heave of concrete floors

Rubber
- curing rubber sections and fabrications

Sprinkler & fire system manufacture
- frost protection of water-filled lines

Tar distilleries
- heating bituminous materials
- heating road tankers

Objective - a Safe system that works

A heat tracing installation should provide the highest appropriate levels of Safety. This is mainly provided for by:-

- **ensuring temperature safety**
- **over-current circuit protection**
- **earth-leakage protection**

Temperature safety is ensured by preventing the surface of the heat tracer from exceeding the limiting temperature. This limiting temperature may be the maximum rating of the tracer itself, or, for example, the Temperature Classification where the installation is within a hazardous area.

● Ensuring temperature safety

Temperature safety may be provided in a number of ways. The choice open to a specifier, in descending order of preference are:-

- **Inherently temperature-safe heat tracers.**

Many self-regulating tracers are inherently temperature safe, their power output reducing with rising temperature such that limiting temperatures e.g. Temperature Classification or temperature withstand of the heater, cannot be exceeded due to the heat produced by the tracer. *Inherently temperature-safe heat tracers therefore provide the highest level of temperature safety.*

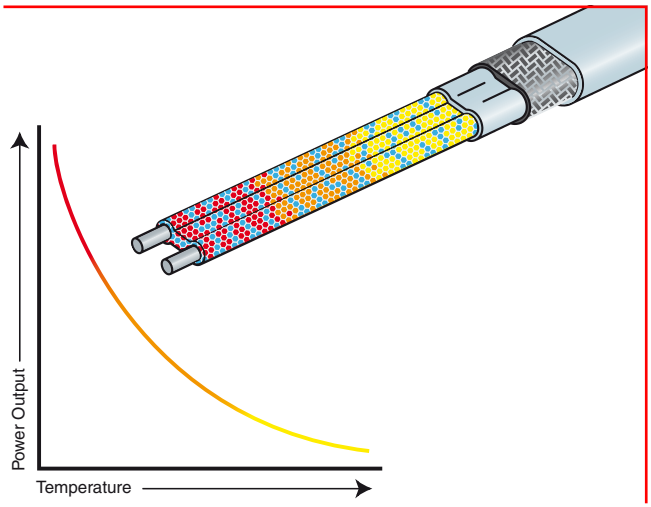
- **Stabilised Design**

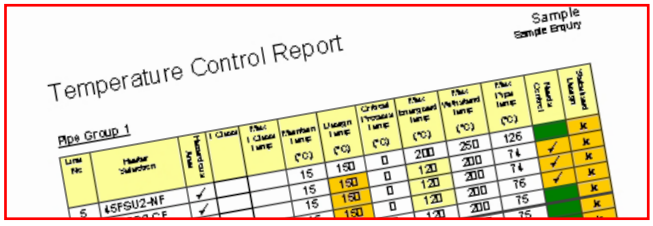
Here, a calculation is made to ensure that, under the worst case conditions, a tracer always operates at below the limiting temperature, without the need for external temperature control. Where inherently temperature-safe heat tracers are not available, stabilised design provides the favoured form of temperature safety

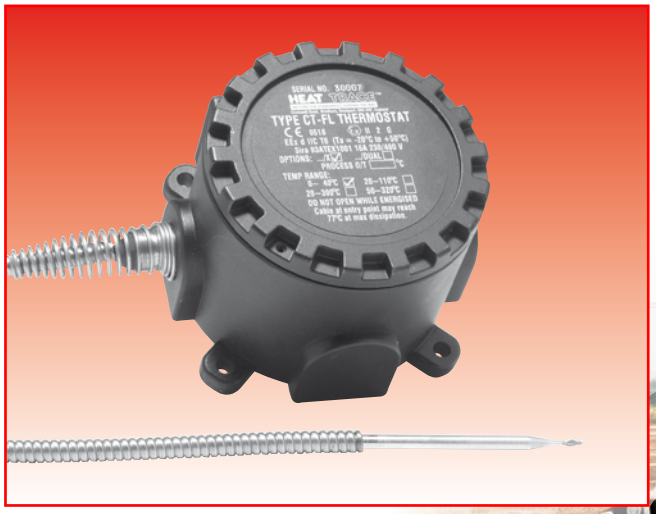
- **Temperature control**

Where a stabilised design cannot be assured, it is then necessary to employ temperature control. Here the safety of the system is reliant on the correct functioning of the controller and the correct location and operation of the temperature sensor. *This is therefore the least safe option.*

Specifiers should guard against being offered such designs, which may have capital benefits but with attendant safety risks.







Circuit Over-current Protection

Each heating circuit should be provided with over-current protection. Maximum safety is provided by a circuit breaker having a rating close to the operating current of the circuit.

Some self-regulating heat tracers exhibit a high in-rush current on start up from cold and require the use of a highly rated circuit breaker with a delayed breaker action. This reduces the level of safety provided.

Safety is maximised when Heat Trace Limited self-regulating heat tracers are specified and circuits are designed to incorporate the patented SSD SoftStart device. The SSD reduces in-rush currents by up to 50% and allows the use of circuit breakers having lower ratings more closely matched to the operating current.

Circuit Earth Leakage Protection

Each heating circuit should be provided with earth leakage protection.

The residual current device should normally have a sensitivity of 30mA and operate within 30ms. Exceptionally, for example where long heating circuits apply, it may be necessary to increase the sensitivity level to avoid ‘nuisance’ tripping.

Considerations in Hazardous Areas

Design and equipment selection for use in hazardous areas will be influenced by:-

- the area classification
- the gas group
- the temperature classification and equipment selected providing an appropriate type of protection

As stated above, this document focuses on the international standards developed especially for electric heat tracing, IEC62395 – for Safe Industrial locations and IEC60079-30 – for Hazardous locations.

Area Classification
The probability of explosive conditions being present is defined by zone classification

- **Zone 0** may have explosive gas-air mixtures present continuously or for long periods. Heat tracing is rarely, if ever, used in Zone 0 areas.
- **Zone 1** may have explosive gas-air mixtures present in normal operation.
- **Zone 2** may have explosive gas-air mixtures present only under abnormal conditions.

Gas Groups
Gas groups relevant to heat tracing in hazardous locations are:-

- **IIA** – Acetone, benzene, butane, ethane, methane, propane, etc.
- **IIB** - Ethylene, town gas etc.
- **IIC** – Acetylene, hydrogen

Temperature Classification

The maximum surface temperature of the heater must be kept below the auto ignition temperature of the explosive gas or vapour mixtures which could be present. The classifications are:-

T-Class	Maximum admissible surface temp ˚C
T1 – 450ºC.	440ºC
T2 – 300ºC.	290ºC
T3 – 200ºC.	195ºC
T4 – 135ºC.	130ºC
T5 – 100ºC.	95ºC
T6 – 85ºC.	80ºC

In reality, most gases encountered will have an ignition temperature of T1 or T2. However, it will be recognised that the lower the operating temperature of the heater, the safer the system will be.

For this reason, self-regulating heaters which are inherently safe should be the preferred safety option. When this is not possible, a calculated stabilised design is preferable to a system that relies on temperature controls for the safety of the system.

Types of Protection

As non-sparking devices, most heaters are likely to be approved to the concept ‘e’ – increased safety (EExe).

Sparking devices such as thermostats or circuit breakers are most commonly approved to the concept ‘d’ – flameproof (EExd), although concepts ‘i’ – intrinsic safety (EExi), and ‘p’ – pressurised apparatus (EExp) are also sometimes appropriate.

Sometimes, distribution boards and control panels can be located outside the hazardous area to avoid the need for the additional costly protection.

Heating Loads - Pipelines

Heat Trace's Evolution design software is able to automatically calculate the appropriate heating load in order to compensate for heat losses from a pipe, vessel, and line equipment, or to heat raise the temperature of the equipment and its contents.

However, the following is a simplistic method for calculation of heating loads for pipes and vessels.

It should be stressed that the heat losses from pipeline fittings, such as valves, flanges, strainers, filters, pumps, are often significant, accounting for typically an additional 25% of the pipework heating load requirements. Also, pipe supports, which are rarely detailed on drawings, can also account for significant heat losses unless the supports are thermally insulated.

Heat loss compensation for pipelines

As its name implies, this form of heating is used to balance or compensate for heat losses from a pipeline to the surrounding atmosphere. The following method may be used to calculate the amount of heat required:

1. Table 1a - select loss factor for pipe size and insulation thickness.
2. Table 1 b - multiply the selected loss factor by the 'K' value of insulation used.
3. Multiply the resultant from Tables 1a and 1b by the temperature difference between lowest ambient and required temp (Δt°C).
4. Multiply - by an appropriate safety factor - typically 1.2
5. **The resultant number x is the heating load in watts/ metre of pipe**

It should be noted that this heating load is only needed when the ambient temperature is at it's minimum design level. At all other times the heating load will be greater than necessary. ***The excess heating load is normally accommodated by the temperature control system.***

Raising temperature of pipelines

In the majority of cases, it is more economic to maintain the heating over short shutdown periods, eg. weekends, than to make provision for heating up from cold. Where it is essential to provide sufficient heat for warming up in addition to heat loss compensation, the time allowed for warming up should be at least 12-24 hours, as shorter periods normally involve inconveniently high loadings.

Heat required for warming up can be calculated as follows:

Formula 1

$$W = \frac{(P \times S + C \times Q) \times \Delta T}{E \times H \times 3600} \quad W/m$$

where
- W = heating required in watts/metre
- P = weight of pipework in kg/m
- S = specific heat of pipework in J/kg°C
- C = weight of contents in kg/m
- Q = specific heat of contents in J/kg°C
- ΔT = temperature rise °C
- H = time allowed in hours
- E = efficiency factor, use 0.73 but may vary

This figure must be added to the heat loss compensation calculated previously. It is not necessary to work on the full temperature because, during the heating-up period, the pipe temperature will be below the final temperature, therefore the following equation should be applied:

Total Load = heating up load + 2/3 steady loss at final temperature

Table 1a

Pipe nominal bore	Pipe O.D	Insulation thickness 12	25	37	50	75	100	125	150mm
		1/2	1	1 1/2	2	3	4	5	6 in
in	mm	Normalised loss factor							
1/2	21.35	8.01	5.16	4.13	3.58				
3/4	26.7	9.39	5.89	4.65	4.00	3.30			
1	33.4	11.34	6.91	5.36	4.56	3.71			
1 1/2	48.3	14.86	8.74	6.63	5.54	4.41			
2	60.3	17.88	10.28	7.69	6.36	4.98	4.26		
2 1/2	73.05	21.05	11.89	8.79	7.21	5.57	4.72		
3	88.9	25.00	13.90	10.15	8.24	6.29	5.28		
4	114.3		17.08	12.30	9.88	7.42	6.15		
6	169.3		23.82	16.82	13.30	9.74	7.93	6.83	
8	219.1		30.13	21.04	16.50	11.89	9.57	8.16	7.20
10	273		36.82	25.53	19.86	14.17	11.29	9.55	8.38
12	324		43.12	29.73	23.03	16.29	12.90	10.85	9.47
14	355		47.05	32.36	25.00	17.60	13.90	11.66	10.15
16	406		53.35	36.56	28.16	19.73	15.50	12.90	11.20
18	457		59.64	40.76	31.31	21.84	17.08	14.22	12.30
20	508		65.92	44.96	34.46	23.95	18.67	15.49	13.37
24	609		78.50	53.35	40.76	28.16	21.84	18.04	15.50
30	762		97.36	65.92	50.20	34.60	26.58	21.84	18.60

Heat loss compensation for tanks, vessels & hoppers

Similarly the design criteria for calculating heat loss compensating and/or raising and maintaining temperature associated with tanks, vessels, or hoppers are as follows:

Formula 2a (for flat surfaces)

$$\text{Loading required} = \frac{A \times K \times (T_1 - T_2)}{E \times t} \text{ watts}$$

2b (for cylindrical surfaces)

$$\text{Loading required} = \frac{2.72 \times K \times L \times (T_1 - T_2)}{E \times \log_{10} (D/d)} \text{ watts}$$

where
- A = total surface area of tank, vessel, etc to be heated in square metres (m^2)
- K = thermal conductivity of the insulation in W/m°C
- T_1 = temperature to be maintained °C
- T_2 = min ambient temperature °C
- t = thermal insulation thickness in mm
- L = length of surface
- D = diameter across insulation
- d = outside diameter of pipe
- E = efficiency factor, use 0.73 but may vary

Raising temperature of tanks, vessels and hoppers

Formula 3

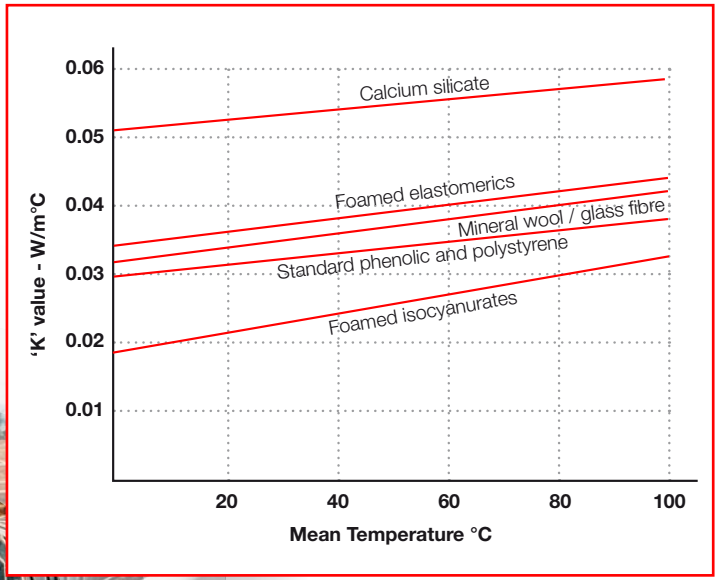
Kilowatt loading required =

$$\frac{\text{mass(kg)} \times \text{sp heat (J/kg°C)} \times \text{temp rise °C}}{E(0.73) \times 1000 \times \text{hours} \times 3600} \text{ kW}$$

After raising the contents to the required level, it will be necessary to allow for heat losses as in FORMULAE 2a or 2b. Therefore the total heat required = Amount of heat to raise temperature of contents + $^2/_3$ of amount of heat to maintain temperature.

Types of thermal insulation used for pipelines and vessels together with thermal conductivity, ie 'K' factor, are shown in Table 1b.

Table 1b



Temperature Control

Temperature control may be provided to a system in order to:-

- Ensure temperature safety or
- Provide process temperature accuracy

Ensuring temperature safety

As previously stated, it is recommended that the provision of temperature controls to ensure that limiting temperatures are not exceeded should only be considered when the use of inherently safe heaters or a stabilised design is not possible.

Where this form of temperature safety cannot be avoided, it is necessary that:-

- In safe areas, a controller provided for process control may also act as over temperature controller
- In Zone 2 areas, two controllers, process temperature plus over-temperature are required, and
- In Zone 1 areas, two controllers, process temperature plus over-temperature are required, where the over-temperature device is a manually re-settable lock-out type, unless a monitored alarm is provided.

It is important that the sensor of the over-temperature controller is fitted to the pipe or workpiece to limit the pipe to a temperature level at which the heater will not exceed the maximum limiting temperature.

Warning
It is legal to fit the sensor of the over-temperature controller to the surface of the heater itself. However, this is a practice that Heat Trace Ltd. does not recommend because:-

- It will rarely be known to be sensing the hottest point of the heater (which is likely to be where the heater is out of contact with the equipment) and
- When the sensor is removed, for example during maintenance work, it cannot be guaranteed to be returned to the hottest part of the heater

The practice of fitting a temperature sensor to the heater to ensure temperature safety is dangerous!

Process temperature accuracy

The IEC electric heat tracing standards define 3 levels of process temperature accuracy

Type I

A Type I process is one in which the temperature should be maintained ***above a minimum point***. No temperature control or simple ambient sensing control may be acceptable. Large blocks of power may be controlled by means of a single device.

Type II

A Type II process is one in which the temperature should be maintained ***within a moderate band***.

Type III

A Type III process is one in which the temperature should be controlled ***within a narrow band***. Type III systems require strict adherence to flow patterns if surface sensing controls are utilised.

Circuit Monitoring

If failure of a heater can result in a safety or process problem, then the heat tracing system may be considered to be critical to the total process. The temperature control and circuit monitoring requirements of an application are defined by the IEC Electric Heat Tracing standards according to the temperature control types as previously described, together with the circuit monitoring criticality as described in the table below.

Is heat tracing a critical component of the process?	**Desired accuracy of process temperature control**		
	Maintain above a minimum point Type I	Maintain within a moderate band Type II	Maintain within a narrow band Type III
Yes = Critical (C)	C – I	C – II	C – III
No = Non-critical (NC)	NC – I	NC – II	NC – III

Process types

When heat tracing is critical to the process, circuit monitoring for correct operation is recommended. Malfunction alarms, and back-up (redundant) heat tracers may also be considered. Spare or back-up controllers can be specified to be automatically activated in the event of a fault being indicated by the monitoring / alarm system. This is sometimes known as “redundancy”. Back-up heat tracers will maintain availability and may allow maintenance or repairs to be performed without a process shutdown.

Heating Cables - Generic types

There are four generic types of heat tracer

- Parallel Self-Regulating
- Parallel Constant Power
- Series Resistance
- Skin-Trace

Parallel Self-Regulating

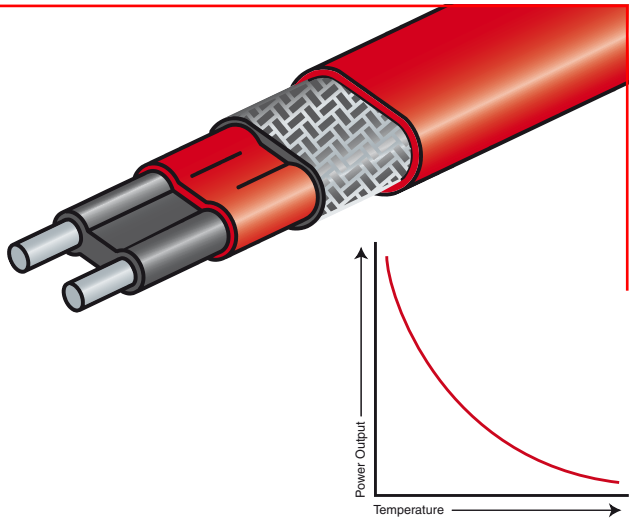
Self-Regulating (or self-limiting) tracers are most popular, as they can conveniently be cut-to-length and are often inherently temperature safe, due to the positive temperature coefficient heating matrix.Thus temperature control is not usually needed to provide temperature safety.

Until recently, their availability for only low or moderate temperatures limited their use. Now though, Heat Trace Ltd. have pioneered new generation semi-conductive **FSU** tracers able to withstand 200ºC energised, and 250ºC power off. So now, Self-Regulating tracers can fulfil 80-90% of all applications within industrial heat tracing – but currently only from Heat Trace!

Ever since the introduction of self-regulating tracers, the high currents on start up from cold have created a problem requiring the need for larger than necessary feed cables and switchgear. Additionally, safety was compromised, as circuit protection had to be sized in excess of operating currents. Now however, Heat Trace has made significant reductions in start currents, thereby improving safety, and reducing distribution costs.

A patented **SoftStart** device (see illustrations below) having NTC (negative temperature coefficient) characteristics negates the PTC (positive temperature coefficient) of the heating matrix. Start currents are reduced by about 50% (see Figure below). This is further aided by a patented processing method known as Directional Conductivity. Here the conductive particles within the heating matrix are dispersed and distributed in such a way as to control the direction of current flow.

Self-Regulating tracers are typically limited in circuit length to 100 or 200 metres, and so are used mainly for in-plant applications



Heat Trace's range of self regulating heat tracers

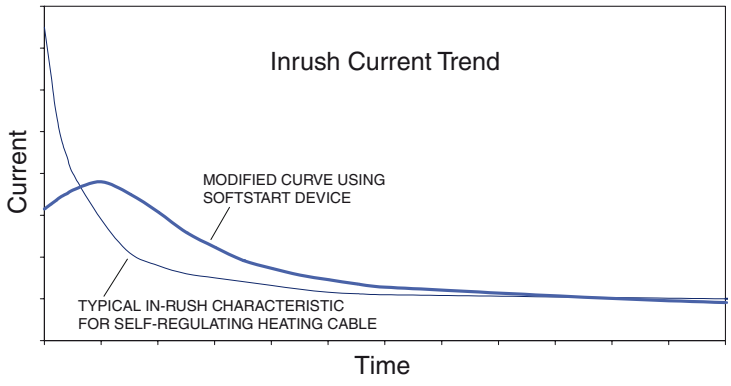
Heat Trace Limited is able to produce self-regulating tracers within the following range

12 - 1000 Volts
Up to 250ºC withstand temperature
Up to 100 W/m

Datasheets of some of the standard Heat Trace range are provided, pages 26 - 31 inclusive

Temperature ranges

Low	Medium	High
FSM	FSE	FSS
FSLe	FSP	FSU
FSR		



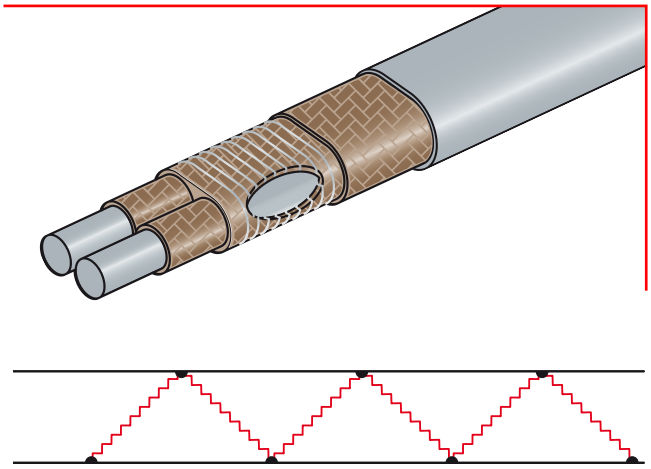
Parallel Constant Power

Parallel Constant Power (zonal) tracers can be conveniently cut-to-length, but are less popular than Self-Regulating heaters, because they often require thermostatic control to ensure temperature safety, (although sometimes a calculated temperature-safe stabilised design is possible).

Until recently, all constant power tracers were polymeric, and so were limited in temperature capability. However, Heat Trace has patented a parallel resistance, convenient cut-to-length metal sheathed, mineral insulated (MI) heater having a withstand temperature of 425 deg. C. This type **AHT** product caters for most applications that the new high temperature Self-Regulating heaters still can't handle. Thus cut-to-length parallel tracers are now available for virtually all heat tracing applications.

This is particularly beneficial in the case of instrument lines, the lengths of which are usually not known at the design stage of a project, and which are site run according to convenience.

Parallel Constant Power tracers are typically limited in circuit length to 100 or 200 metres, and so are used mainly for in-plant applications



Parallel heating zones

Heat Trace's range of Parallel Constant Power heat tracers

Heat Trace Limited is able to produce tracers within the following limitations

Up to 425ºC withstand temperature
Up to 200 W/m

Datasheets of some of the standard Heat Trace range are provided, pages 32 - 35 inclusive

Temperature ranges

Medium	High
MTF	PHT
EMTF	AHT

Heating Cables - Generic types

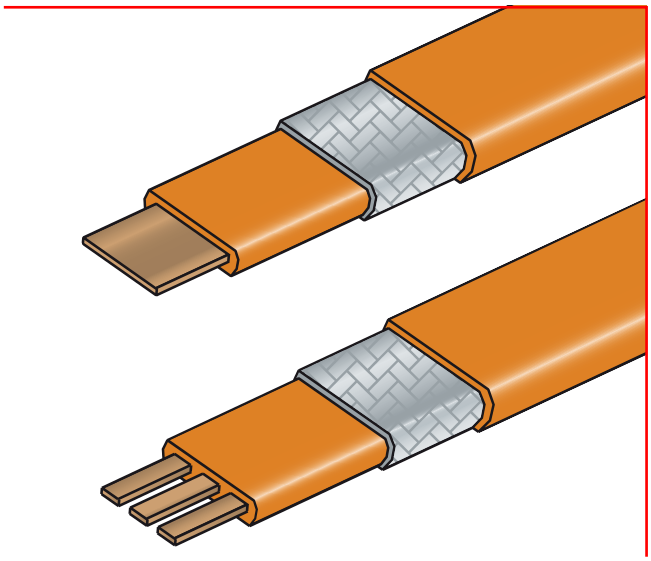
Series Resistance Tracers

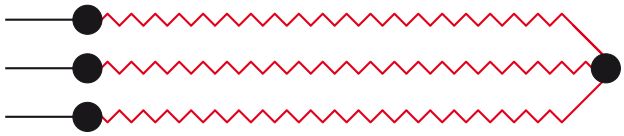
Series Resistance Tracers have to be individually designed into particular length/load configurations and so are not so versatile as parallel types.

However, an advantage is that long circuit lengths are possible – typically 3 phase '**Longline**' tracers require electric supply points only at multi-kilometre intervals. So the major outlet for series heaters is long pipelines.

Traditionally, metal sheathed, mineral insulated (MI) series cables were used when process temperatures exceeded the capability of the more convenient polymeric parallel tracers. However, the introduction of Heat Trace's cut-to-length parallel type **AHT** MI tracer virtually eliminates the need for series MI tracers which require skill to terminate and are costly.

Series Resistance Tracers often require temperature controls to ensure temperature safety.





Heating Circuit Configuration

Heat Trace's range of series 'Longline' heat tracers

Heat Trace Limited is able to produce tracers within the following limitations

Up to 1000 Volts 3 phase
Up to 230ºC withstand temperature
Up to 60 W/m

Datasheets of some of the standard Heat Trace range are provided, pages 36 - 39 inclusive

Temperature ranges

Low	Medium
HTP3F	HTS3F
HTP1F	HTS1F

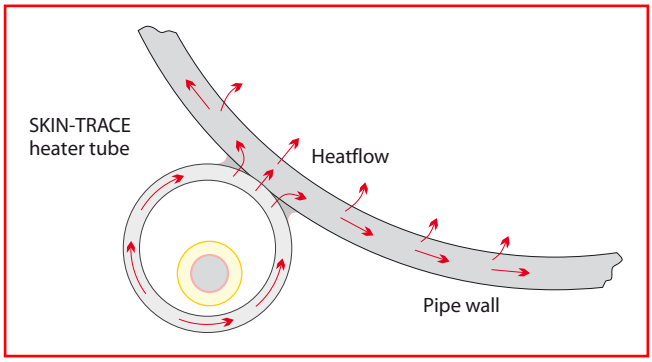
Skin-Trace

Skin-Trace is induction-resistive heat tracing based on skin and proximity effects of an AC current within a ferromagnetic tube.

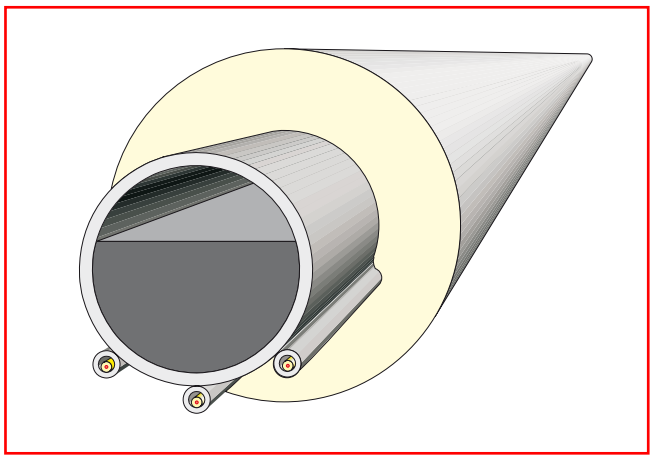
The heating element comprises a carbon steel tube into which is inserted an insulated non-magnetic conductor. The conductor and the steel tube are connected together at one end. At the other end an AC voltage is applied between the conductor and the tube. The relationship of conductor/tube sizes and voltage determines the output power developed.

The skin effect of the magnetic tube results in the current being concentrated towards the tube's inner surface, the potential to the outside being zero.

Skin-Trace's advantage is that extremely long circuit lengths are possible – typically a pipeline of up to 30km may be heated from a single electric supply point. So Skin-Trace is most appropriate for the heating of cross-country pipelines.



- Up to 30 km lines heated from one supply point
- The most effective method for heating long distance pipelines
- Robust and reliable system with outputs up to 120W/m
- Suitable for up to 200ºC operating temperature
- Suitable for use in hazardous areas



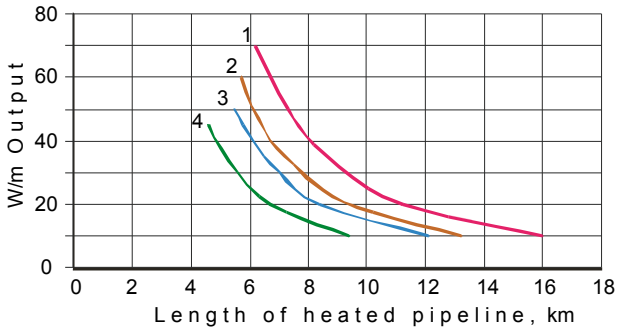
Depending on the heating power required and the pipeline length, SKIN-TRACE may consist of either one, two, or three, heater tubes (see image above).

OPERATING TEMPERATURE -40ºC to +200ºC

POWER SUPPLY up to 3kV AC 50 or 60 Hz

POWER OUTPUT

Rated power output of one heating element



Rated Power output of one heater tube, W/m

Heater Tube Dimension

1 40mm
2 25mm
3 19mm
4 10mm

Heating Cables – Selection Guide

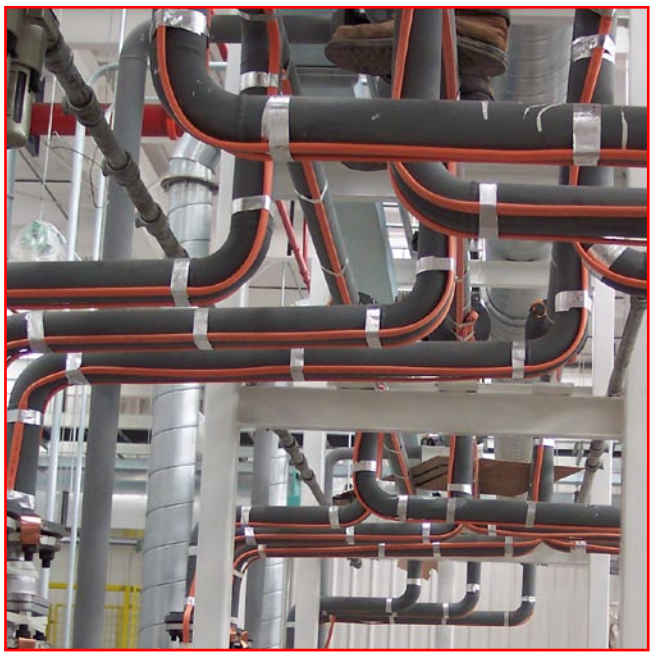
In-plant areas

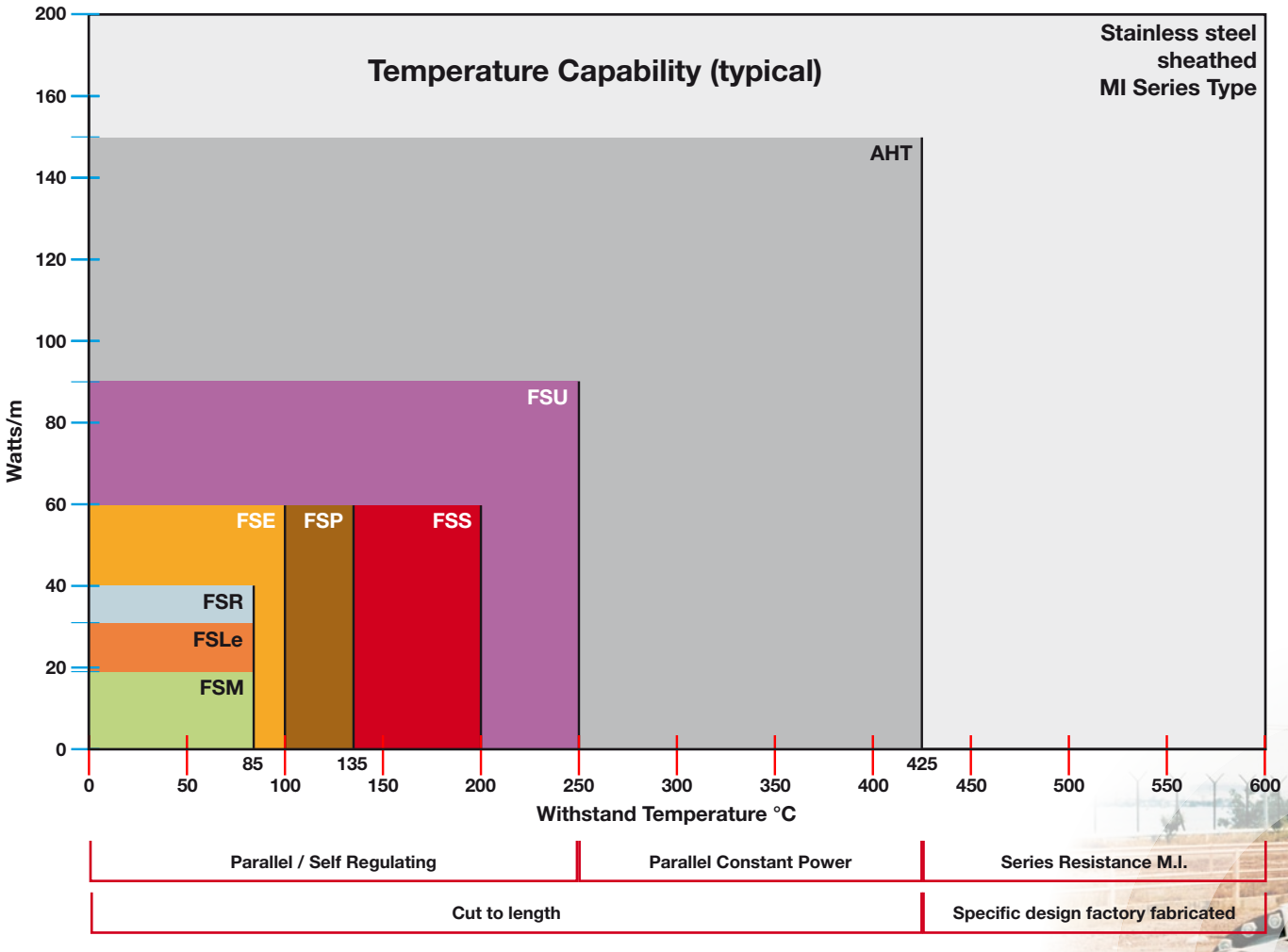
Heat tracers for in-plant areas are usually selected according to the maximum temperature to which the tracer will be subjected, and the power output required from the tracer.

The following table shows the relationship between temperature withstand and power output for various self-regulating, constant power, and series MI tracers. It may be seen that self-regulating tracers which can be conveniently cut-to-length and which are usually temperature safe, are available for exposure temperatures up to 250ºC.

AHT constant power tracers can cater for higher exposure temperatures up to 425ºC and high power outputs up to 200W/m.

Only exceptionally is it necessary to employ series MI cables, which must be specifically designed for a particular length and output.





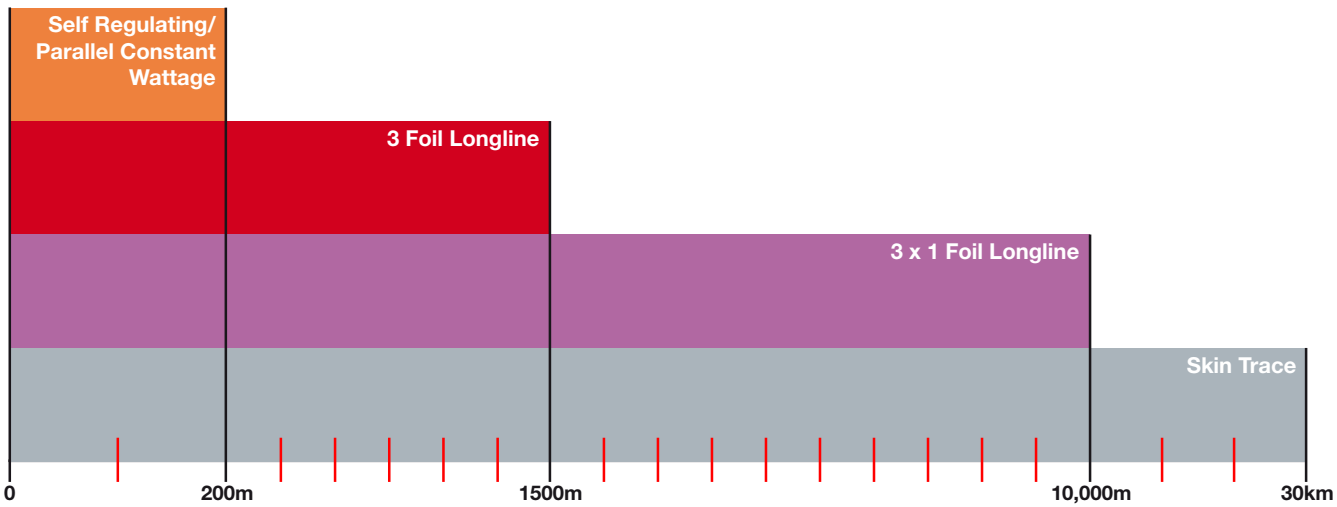
Transfer and long pipe runs

Heat tracers for long pipelines are usually selected according to the pipe length, and the ability of the chosen tracer to minimise the number of electrical feed points, and hence distribution costs.

The following table shows that, in ascending order of maximum circuit length, tracer choice is likely to be:-

a) parallel tracers (self-regulating or constant power)
b) 3 foil 'Longline' tracers
c) single foil 'Longline' tracers
d) Skin-Trace system

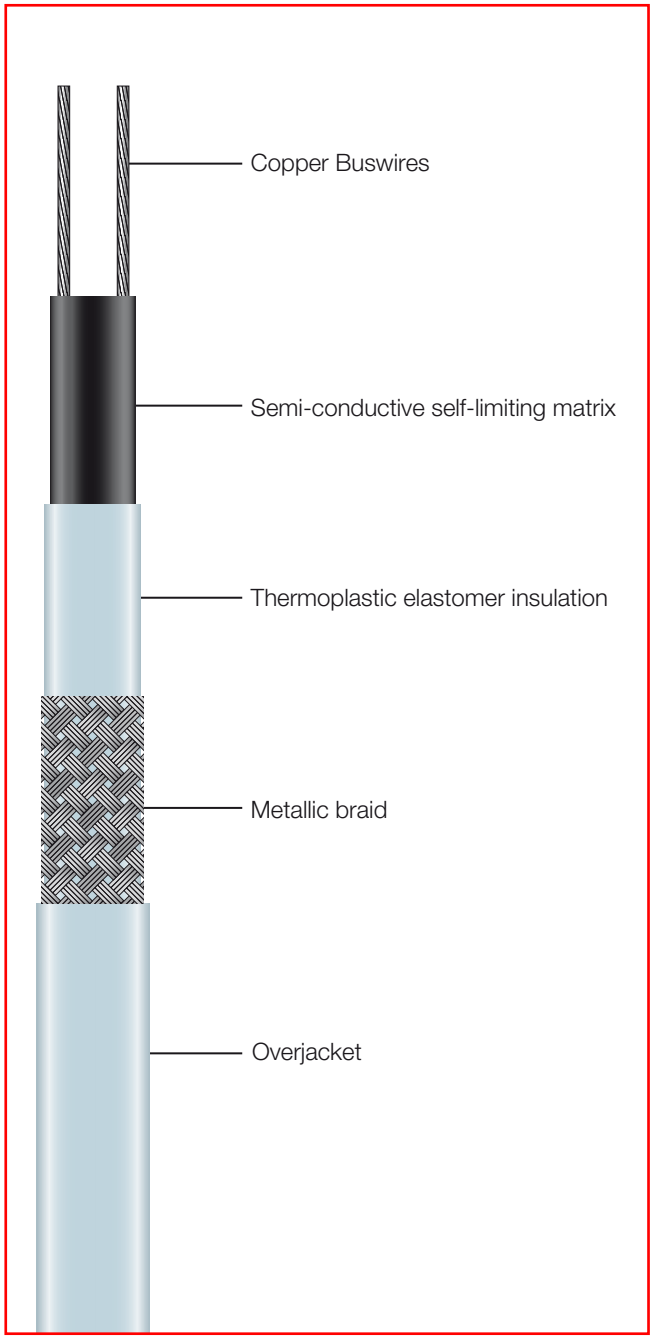
Circuit Length (typical) - Metres



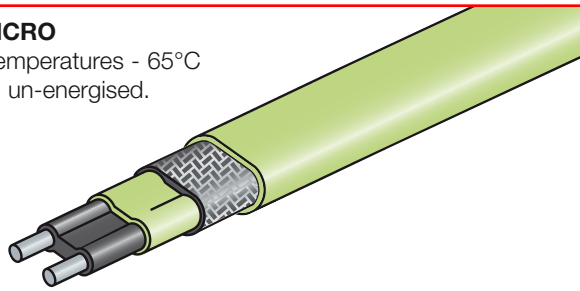
Product Data - Parallel Self-Regulating Heaters

FREEZSTOP - Low Temperature Range
Self-Regulating Heating Cables for exposure temperatures up to 85°C

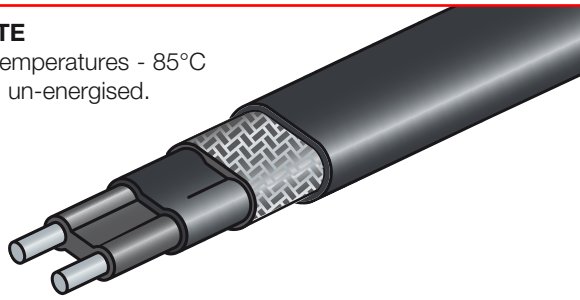
A versatile range of industrial grade self-regulating heating cables for freeze protection and **low** process temperature maintenance duties. All cables are available with metallic braid, braid with thermoplastic jacket, or braid with fluoropolymer jacket. Approved for use in both safe and hazardous areas. Available for voltages 100 – 120VAC and 208 – 277VAC.



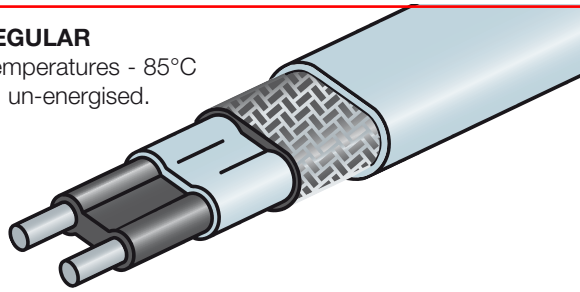
FREEZSTOP MICRO
FSM withstand temperatures - 65°C energised / 85°C un-energised.



FREEZSTOP LITE
FSLe withstand temperatures - 85°C energised / 85°C un-energised.



FREEZSTOP REGULAR
FSR withstand temperatures - 85°C energised / 85°C un-energised.



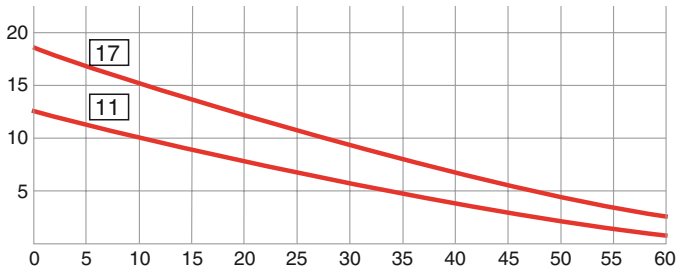
- **Use Type D motor rated circuit breakers**
- **Maximum circuit lengths are based on a start up temperature of 10ºC**
- **If circuits are started up when heaters are below 10ºC, circuit breakers may trip. If this happens, re-energise the circuits until the heaters warm up, and circuit breakers remain switched on**
- **For maximum circuit lengths for start up temperatures below 10ºC, please consult Heat Trace Limited**
- **THERMAL RATINGS**
  Nominal power output at 115V or 230V when installed on insulated metal pipes.

Low Temperature - 85°C

MICRO - FSM Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

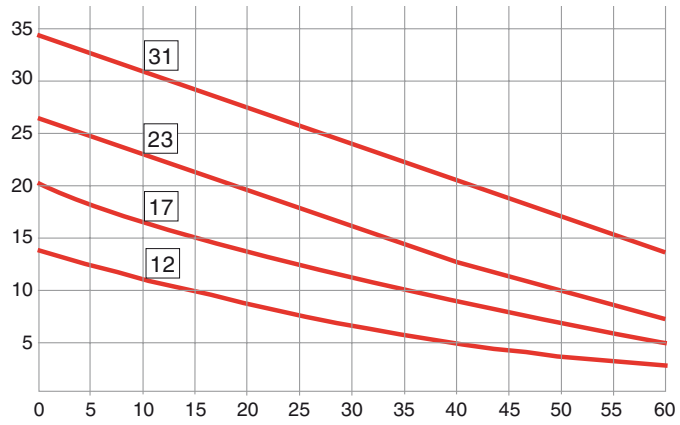
Cat	115V		230V	
Ref	**6A**	**16A**	**6A**	**16A**
11FSM	38	64	76	128
17FSM	27	51	54	102



LITE - FSLe Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

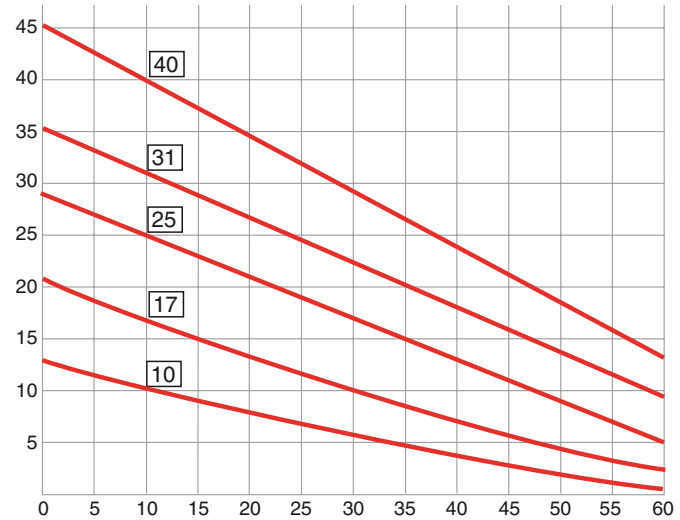
Cat	115V			230V		
Ref	**6A**	**16A**	**20A**	**6A**	**16A**	**20A**
12FSLe	38	90	-	78	180	-
17FSLe	31	73	-	62	146	-
23FSLe	23	62	-	46	124	-
31FSLe	17	46	51	34	92	102



REGULAR - FSR Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

Cat	115V			230V		
Ref	**16A**	**20A**	**25A**	**16A**	**20A**	**25A**
10FSR	99	-	-	198	-	-
17FSR	77	-	-	154	-	-
25FSR	62	-	-	124	-	-
31FSR	37	46	55	74	92	110
40FSR	28	35	44	56	70	88

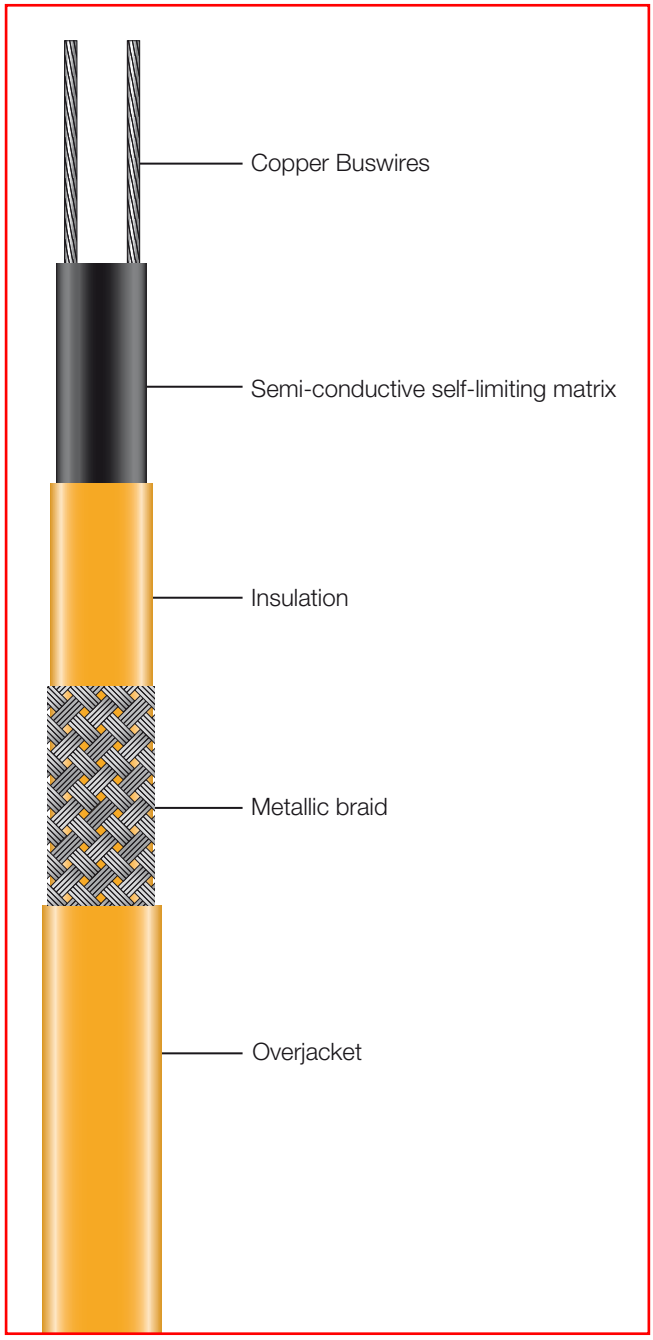


FULL TECHNICAL DATA SHEETS ARE AVAILABLE ON OUR WEBSITE FOR ALL PRODUCTS
www.heat-trace.com

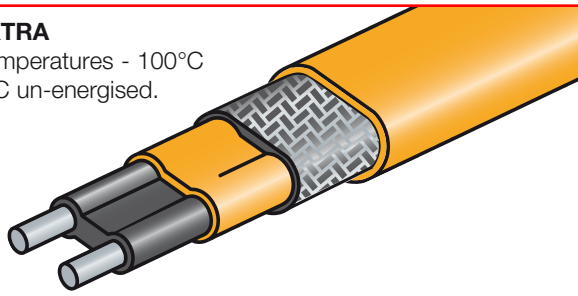
Product Data - Parallel Self-Regulating Heaters

FREEZSTOP - Medium Temperature Range Self-Regulating Heating Cables for exposure temperatures up to 135°C

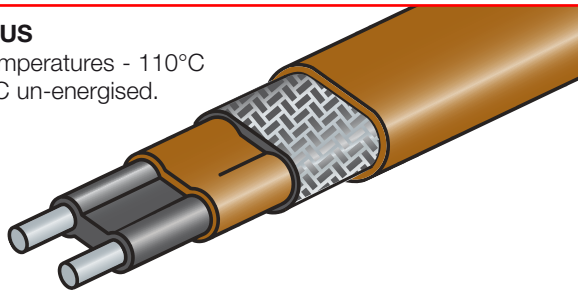
A versatile range of industrial grade self-regulating heating cables for freeze protection and **medium** process temperature maintenance duties. All cables are available with metallic braid, braid and thermoplastic jacket, or braid and fluoropolymer jacket. Approved for use in both safe and hazardous areas. Available for voltages 100 – 120VAC and 208 – 277VAC.



FREEZSTOP EXTRA
FSE withstand temperatures - 100°C energised / 100°C un-energised.



FREEZSTOP PLUS
FSP withstand temperatures - 110°C energised / 135°C un-energised.



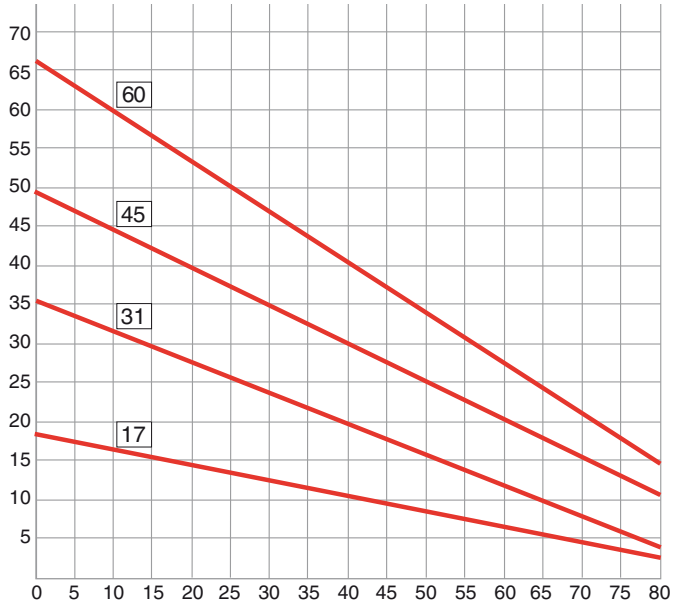
- **Use Type D motor rated circuit breakers**
- **Maximum circuit lengths are based on a start up temperature of 10ºC**
- **If circuits are started up when heaters are below 10ºC, circuit breakers may trip. If this happens, re-energise the circuits until the heaters warm up, and circuit breakers remain switched on**
- **For maximum circuit lengths for start up temperatures below 10ºC, please consult Heat Trace Limited**
- **THERMAL RATINGS**
  Nominal power output at 115V or 230V when installed on insulated metal pipes.

Medium Temperature - 135°C

EXTRA - FSE Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

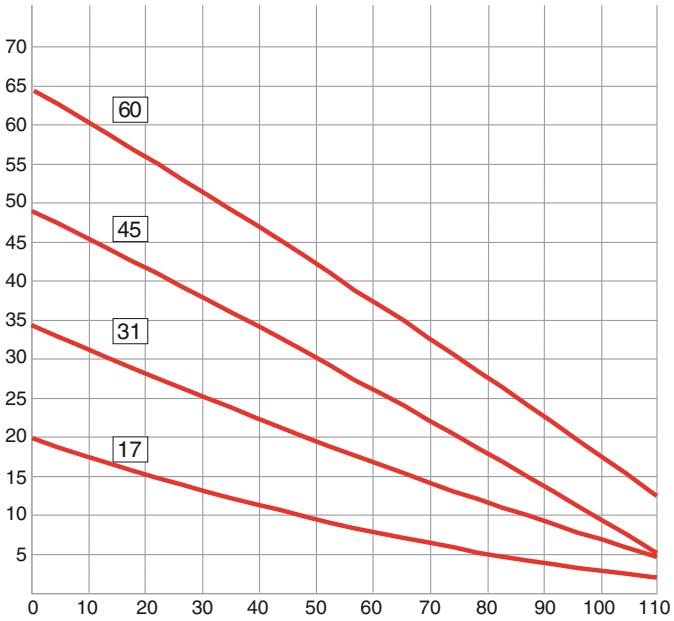
Cat	115V			230V		
Ref	**16A**	**20A**	**25A**	**16A**	**20A**	**25A**
17FSE	60	74	-	120	148	-
31FSE	41	55	-	82	104	110
45FSEw	31	38	48	62	76	96
60FSEw	26	33	41	52	66	82



PLUS - FSP Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

Cat	115V			230V		
Ref	**16A**	**20A**	**25A**	**16A**	**20A**	**25A**
17FSP(t)	77	-	-	154	-	-
31FSP(t)	51	55	-	102	110	-
45FSP(t)w	30	38	48	60	76	96
60FSP(t)w	26	33	41	52	66	82



Medium Temperature - 135°C

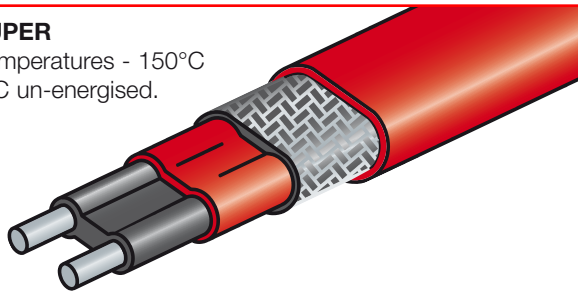
FULL TECHNICAL DATA SHEETS ARE AVAILABLE ON OUR WEBSITE FOR ALL PRODUCTS
www.heat-trace.com

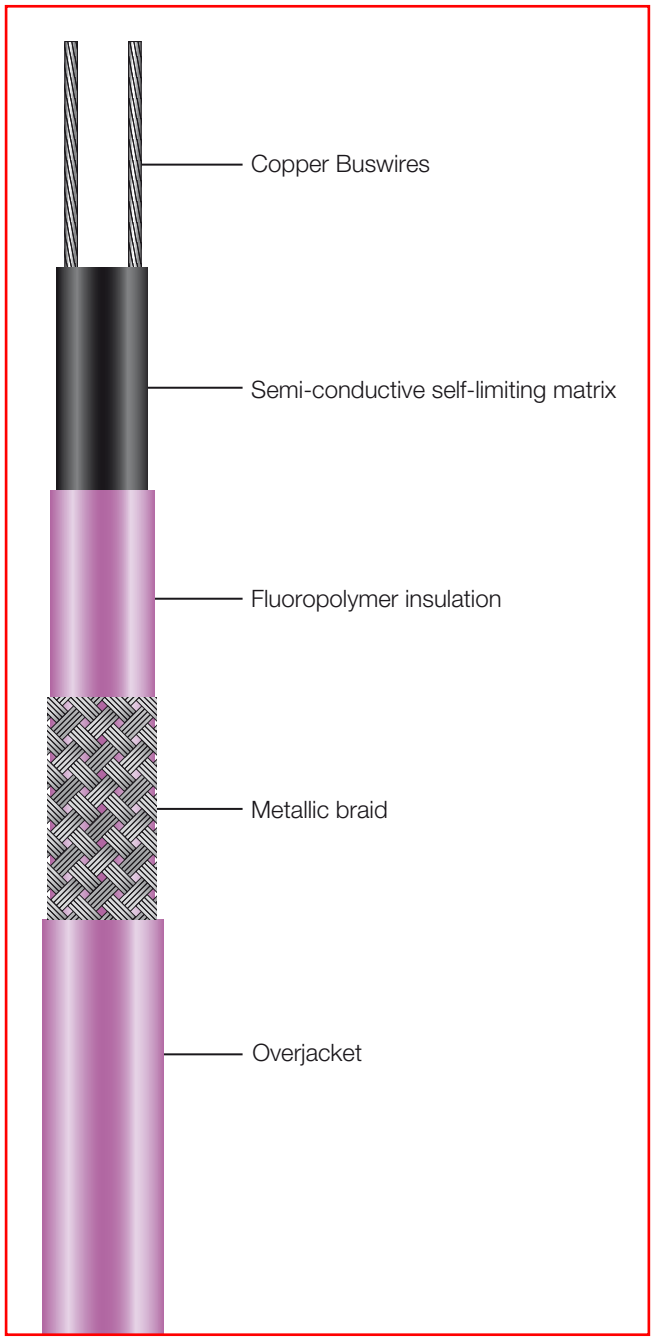
Product Data - Parallel Self-Regulating Heaters

FREEZSTOP - High Temperature Range
Self-Regulating Heating Cables for exposure temperatures up to 250°C

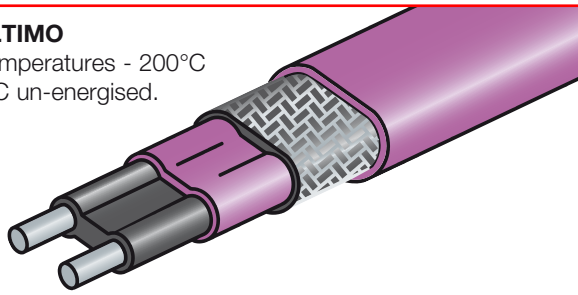
A versatile range of industrial grade self-regulating heating cables for freeze protection and **high** process temperature maintenance duties. All cables are available with metallic braid, or braid and fluoropolymer jacket. Approved for use in both safe and hazardous areas. Available for voltages 100 – 120VAC and 208 – 277VAC.

FREEZSTOP SUPER
FSS withstand temperatures - 150°C energised / 200°C un-energised.

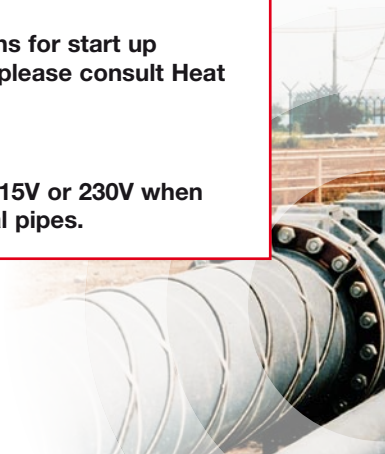




FREEZSTOP ULTIMO
FSU withstand temperatures - 200°C energised / 250°C un-energised.



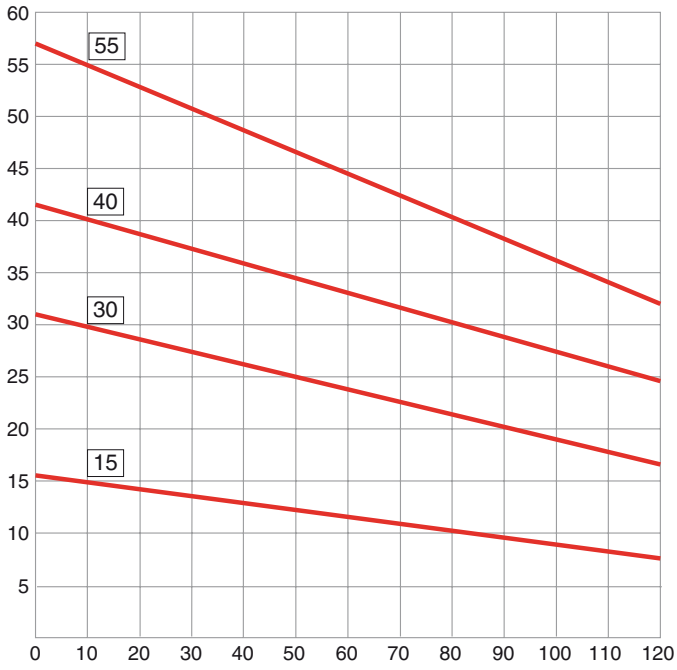
- **Use Type D motor rated circuit breakers**
- **Maximum circuit lengths are based on a start up temperature of 10ºC**
- **If circuits are started up when heaters are below 10ºC, circuit breakers may trip. If this happens, re-energise the circuits until the heaters warm up, and circuit breakers remain switched on**
- **For maximum circuit lengths for start up temperatures below 10ºC, please consult Heat Trace Limited**
- **THERMAL RATINGS**
  Nominal power output at 115V or 230V when installed on insulated metal pipes.



SUPER - FSS Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

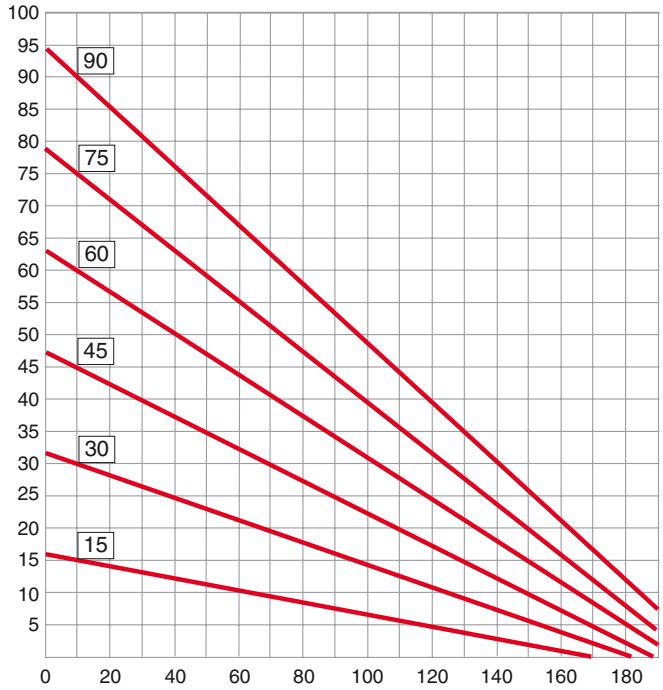
Cat	115V			230V		
Ref	**16A**	**20A**	**25A**	**16A**	**20A**	**25A**
15FSS	81	-	-	162	-	-
30FSS	46	57	-	92	114	-
40FSS	33	42	49	66	84	98
55FSS	26	32	40	52	64	80



ULTIMO - FSU Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

Cat	115V				230V			
Ref	**16A**	**20A**	**25A**	**32A**	**16A**	**20A**	**25A**	**32A**
15FSU	63	77	-	-	126	154	-	-
30FSU	36	41	51	-	72	82	102	-
45FSU	31	39	44	-	62	78	88	-
60FSU	25	31	38	-	50	62	76	-
75FSU	21	26	32	41	42	52	64	82
90FSU	17	21	27	34	34	42	54	68



FULL TECHNICAL DATA SHEETS ARE AVAILABLE ON OUR WEBSITE FOR ALL PRODUCTS
www.heat-trace.com

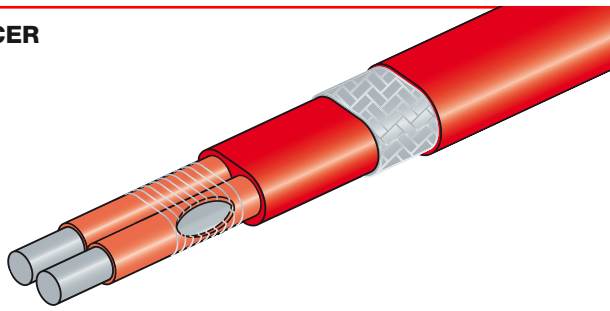
Product Data - Parallel Constant Power Heaters

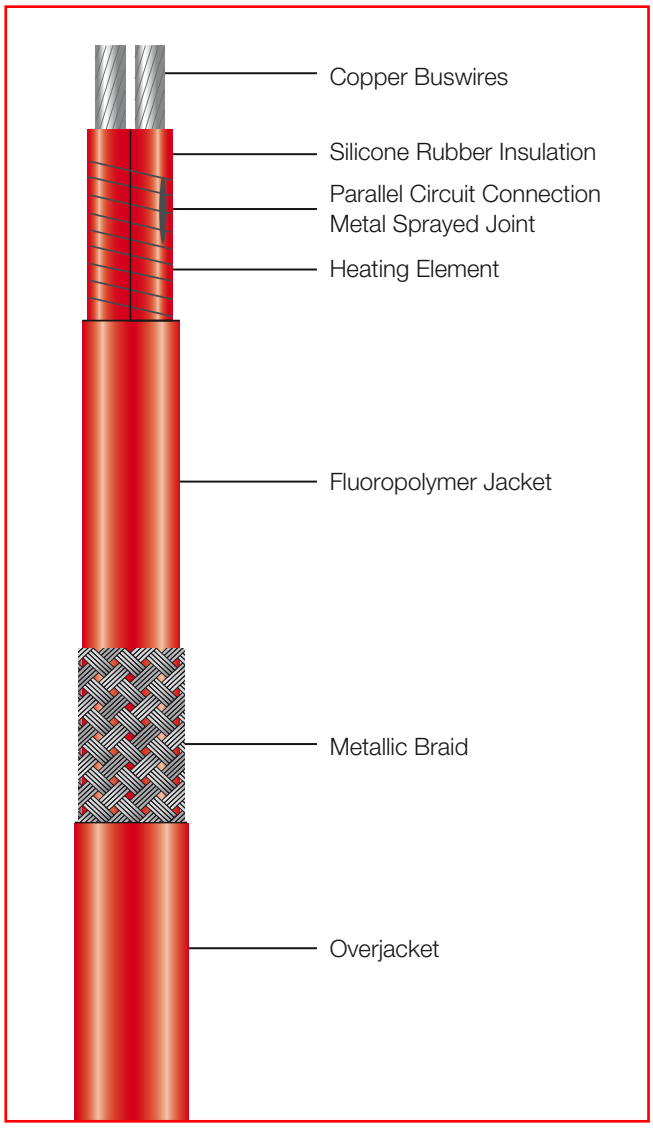
MINITRACER - Low to Medium Temperature Range Parallel Constant Power Heating Cables for exposure temperatures up to 200°C

Types MTF and EMTF are parallel resistance, constant wattage, cut-to-length heating cables that can be used for freeze protection or low to medium process heating of pipework and vessels. They can be cut to length at site and easily terminated. Suitable for use in both safe and hazardous areas. MTF and EMTF heaters are available with metallic braid, or braid and fluoropolymer outer jacket.

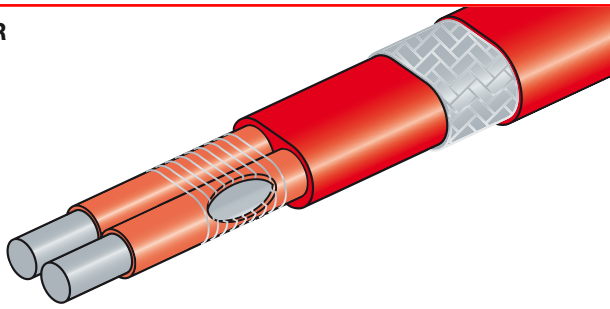
Available for 100/120 and 208/240VAC Installation of the heating cables is quick and simple and requires no special skills or tools. Termination and power connection components are all provided in convenient kits.

MICROTRACER





MINITRACER



Low - Medium Temperature - 200°C

EMTF Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

OUTPUT (W/m)	MAX. CIRCUIT LENGTH* 115V	230V
6.5	82	164
13	58	116
23	44	87
33	36	73
50	30	59

*** For ±10% end to end power output variation**

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

NOM. OUTPUT (W/m)	EMTF-C	EMTF-CF
6.5	190	190
13	175	185
23	145	155
33	100	100
50	60	70

MTF Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

OUTPUT (W/m)	MAX. CIRCUIT LENGTH* 115V	230V
6.5	106	212
13	75	150
23	56	113
33	47	94
50	38	76

*** For ±10% end to end power output variation**

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

CAT REF	NOM. OUTPUT (W/m)	AREA CLASSIFICATION HAZARDOUS T6	T5	T4	T3	T2	T1	SAFE
MTF..C	6.5	60	75	120	190	190	190	190
	13	40	55	95	175	180	180	180
	23	-	30	65	155	155	155	155
	33	-	-	40	115	120	120	120
	50	-	-	-	70	80	80	80
MTF..CF	6.5	60	80	125	190	190	190	190
	13	35	50	100	185	185	185	185
	23	-	25	55	160	165	165	165
	33	-	-	35	115	120	120	120
	50	-	-	-	80	85	85	85

POWER CONVERSION FACTORS

115V HEATING CABLE		230V HEATING CABLE	
125V	Multiply output by 1.18	277V	Multiply output by 1.45
120V	Multiply output by 1.09	240V	Multiply output by 1.09
110V	Multiply output by 0.91	220V	Multiply output by 0.91
100V	Multiply output by 0.76	208V	Multiply output by 0.82

For conditions other than worst case, or pipes of other materials (eg. plastic, stainless steel, etc.), consult Heat Trace Ltd. Tolerances: Voltage +10%; Resistance +10%; -0%

FULL TECHNICAL DATA SHEETS ARE AVAILABLE ON OUR WEBSITE FOR ALL PRODUCTS
www.heat-trace.com

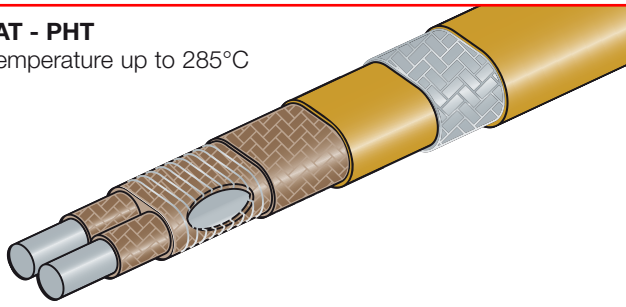
Product Data - Parallel Constant Power Heaters

POWERHEAT - High Temperature Range
Parallel Constant Power Heating Cables for exposure temperatures up to 425°C

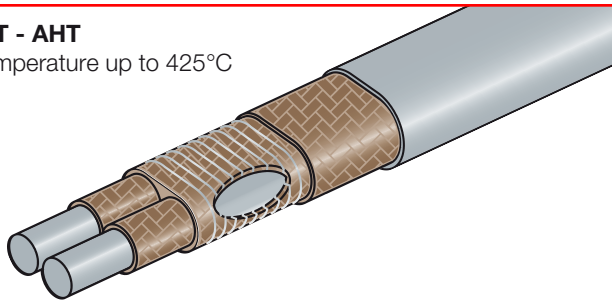
Powerheat range PHT and AHT are parallel circuit, mineral insulated, cut-to-length, constant power heating cables. They are used for freeze protection and process heating of pipework and vessels, where very high withstand temperatures, or where high power outputs are required. Their cut-to-length capability means they can be easily terminated at site. They are suitable for use in both safe and hazardous areas.

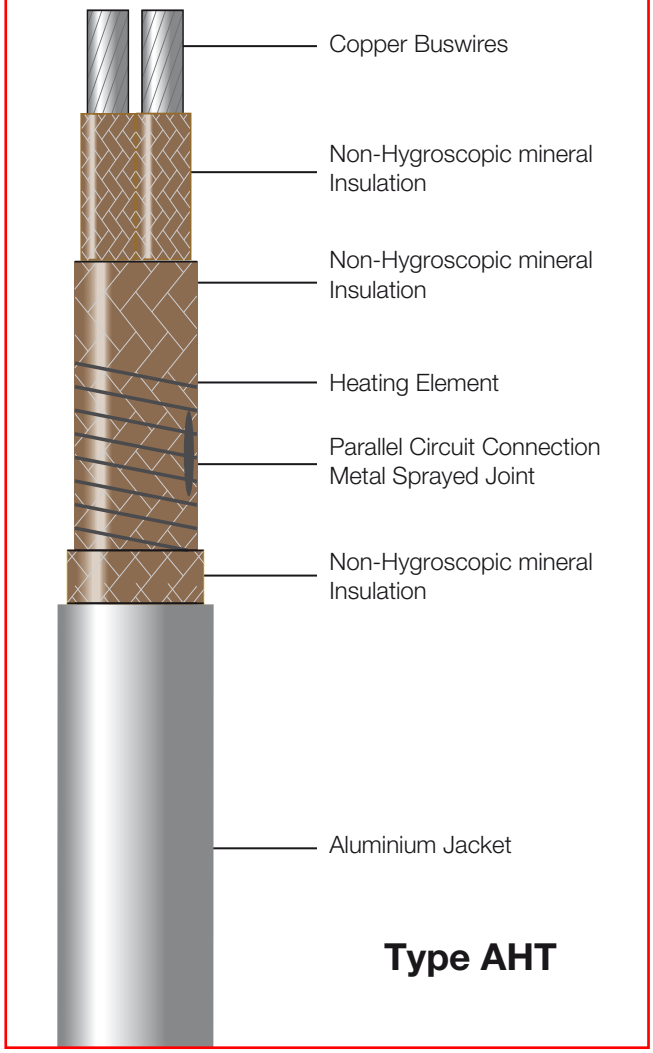
Powerheat cables are insulated with multiple layers of non-hygroscopic mineral materials to withstand high temperatures. PHT is available with a metallic braid, or braid and fluoropolymer outer jacket. AHT cables have an aluminium outer jacket, giving a high mechanical strength, yet still retaining flexibility. Available for 100/120 and 208/277VAC.

POWERHEAT - PHT
Withstand Temperature up to 285°C



POWERHEAT - AHT
Withstand Temperature up to 425°C





Type AHT

High Temperature - 425°C

PHT Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

OUTPUT (W/m)	MAX. CIRCUIT LENGTH* 115V	230V
10	79	152
30	46	88
50	35	68
70	30	56

*** For ±10% end to end power output variation**

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

CAT REF	NOM. OUTPUT (W/m)	AREA CLASSIFICATION HAZARDOUS T6	T5	T4	T3	T2	T1	SAFE
PHT..N	10	44	61	102	180	275	275	275
	30	-	-	24	116	241	241	241
	50	-	-	-	48	190	190	190
	70	-	-	-	-	129	129	129
PHT..NF	10	40	60	105	186	275	275	275
	30	-	-	22	132	249	249	249
	50	-	-	-	63	204	204	204
	70	-	-	-	-	147	147	147

AHT Specification Data

MAXIMUM LENGTH (m) vs. CIRCUIT BREAKER SIZE

OUTPUT (W/m)	MAX. CIRCUIT LENGTH* 115V	230V
15	59	118
30	42	83
50	32	64
100	23	46
150	19	37

*** For ±10% end to end power output variation**

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

CAT REF	NOM. OUTPUT (W/m)	AREA CLASSIFICATION HAZARDOUS T6	T5	T4	T3	T2	T1	SAFE
AHT	15	-	36	71	160	289	350	350
	30	-	11	28	100	246	323	323
	50	-	-	-	39	178	276	276
	100	-	-	-	-	48	140	140
	150	-	-	-	-	-	36	36

POWER CONVERSION FACTORS

115V HEATING CABLE		230V HEATING CABLE	
125V	Multiply output by 1.18	277V	Multiply output by 1.45
120V	Multiply output by 1.09	240V	Multiply output by 1.09
110V	Multiply output by 0.91	220V	Multiply output by 0.91
100V	Multiply output by 0.76	208V	Multiply output by 0.82

For conditions other than worst case, or pipes of other materials (eg. plastic, stainless steel, etc.), consult Heat Trace Ltd. Tolerances: Voltage +10%; Resistance +10%; -0%

FULL TECHNICAL DATA SHEETS ARE AVAILABLE ON OUR WEBSITE FOR ALL PRODUCTS
www.heat-trace.com

Product Data - Series Resistance Heaters

LONGLINE - Low Temperature Range
Series constant power heating cables for long pipelines. Exposure temperatures up to 125°C

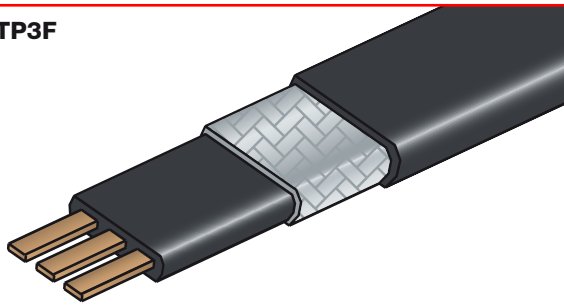
Longline HTP3F and HTP1F are series resistance, constant power heating cables used for freeze protection, or, process temperature maintenance of long pipelines where low temperatures are encountered.

HTP3F cables are used typically for pipelines up to 2km between supply points. HTP1F cables are used where there is approx 10km between supply points.

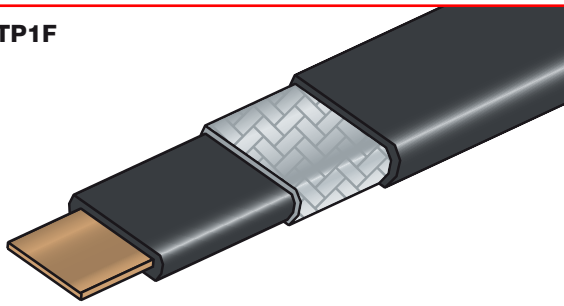
Longline series heating cables minimise the number of electrical supplies needed and so minimise supply cabling / distribution equipment costs. Circuits are often fed at the pipe ends only. All cables are available with metallic braid, braid and thermoplastic jacket, or braid and fluoropolymer jacket.

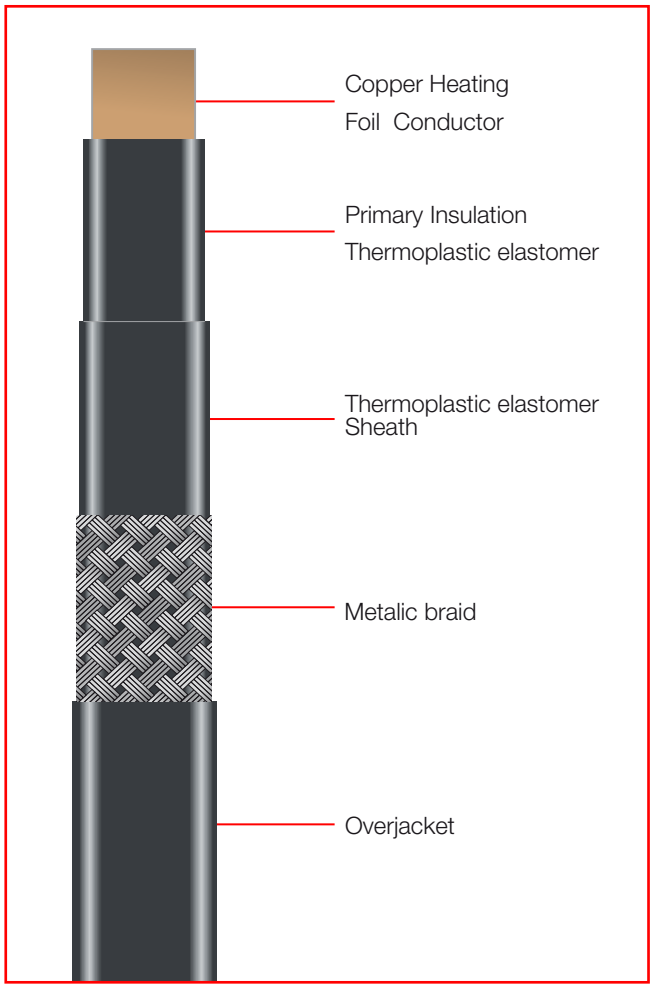
This style of cable is specifically designed to suit each application. The output of the heater is a function of the circuit length, the size of the conductor foils and the supply voltage.

LONGLINE - HTP3F



LONGLINE - HTP1F





Low Temperature - 125°C

HTP3F Specification Data

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

NOM. OUTPUT (W/m)	HTP3F-C	HTP3F-CT/CF
10	109	100
15	95	85
23	80	70

For conditions other than worst case, or pipes of other materials (eg. plastic, stainless steel, etc.), consult Heat Trace Ltd.

Tolerances: Voltage +10%; Resistance +10%; -0%

HTP1F Specification Data

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

NOM. OUTPUT (W/m)	HTP1F-C	HTP1F-CT/CF
10	109	100
15	95	85
23	80	70

For conditions other than worst case, or pipes of other materials (eg. plastic, stainless steel, etc.), consult Heat Trace Ltd.

Tolerances: Voltage +10%; Resistance +10%; -0%

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www.heat-trace.com

Product Data - Series Resistance Heaters

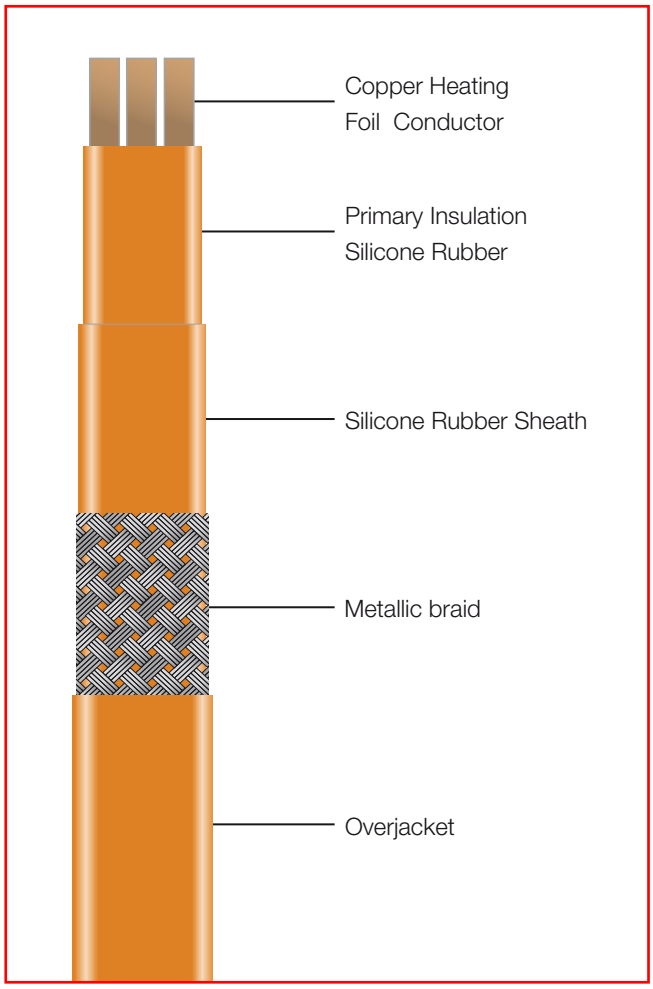
LONGLINE - Medium Temperature Range
Series constant power heating cables for long pipelines. Exposure temperatures up to 230°C

Longline HTS3F and HTS1F are series resistance, constant power heating cables with silicone insulation, used for freeze protection, or process temperature maintenance of long pipelines where medium temperatures are encountered.

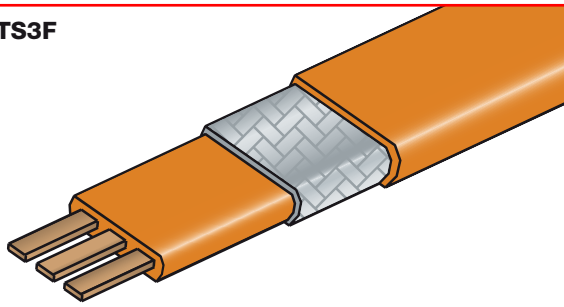
HTS3F cables are used generally for long pipelines up to 2km between supply points.

HTS1F cables are typically used where there is approx up to 10km between supply points. Longline series heating cables minimise the number of electrical supplies needed and so minimises supply cabling / distribution equipment costs. Circuits are often fed at the pipe ends only. All cables are available with metallic braid, braid and thermoplastic jacket, or braid and fluoropolymer jacket.

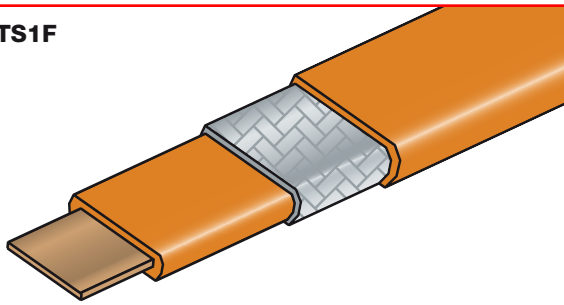
This style of cable is specifically designed to suit each application. The output of the heater is a function of the circuit length, the size of the conductor foils and the supply voltage.



LONGLINE - HTS3F



LONGLINE - HTS1F



Medium Temperature - 230°C

HTS3F Specification Data

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

CAT REF	NOM. OUTPUT (W/m)	AREA CLASSIFICATION HAZARDOUS T6	T5	T4	T3	T2	T1	SAFE
HTS3F-C	10	48	66	107	181	218	218	218
	20	–	32	75	158	191	191	191
	30	–	–	41	133	164	164	164
	40	–	–	–	109	134	134	134
	50	–	–	–	76	97	97	97
	60	–	–	–	30	46	46	46
HTS3F-CS	10	58	74	112	181	208	208	208
	20	37	54	94	166	180	180	180
	30	–	31	74	153	158	158	158
	40	–	–	51	127	127	127	127
	50	–	–	27	93	93	93	93
	60	–	–	–	–	–	–	57
HTS3F-CF	10	58	74	112	181	192	192	192
	20	37	54	94	166	178	178	178
	30	–	31	74	153	165	165	165
	40	–	–	51	127	127	127	127
	50	–	–	27	93	9 3	93	93
	60	–	–	–	–	–	–	57

For conditions other than worst case, or pipes of other materials (eg. plastic, stainless steel, etc.), consult Heat Trace Ltd.

Tolerances: Voltage +10%; Resistance +10%; -0%

HTS1F Specification Data

MAXIMUM PIPE / WORKPIECE TEMPERATURES (°C)

NOM.OUTPUT (W/m)	HTS1F-C	HTS1F-CS	HTS1F-CF
10	218	208	192
20	191	180	178
30	164	158	165
40	134	127	127
50	97	93	93
60	46	57	57

For conditions other than worst case, or pipes of other materials (eg. plastic, stainless steel, etc.), consult Heat Trace Ltd.

Tolerances: Voltage +10%; Resistance +10%; -0%

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Termination Components

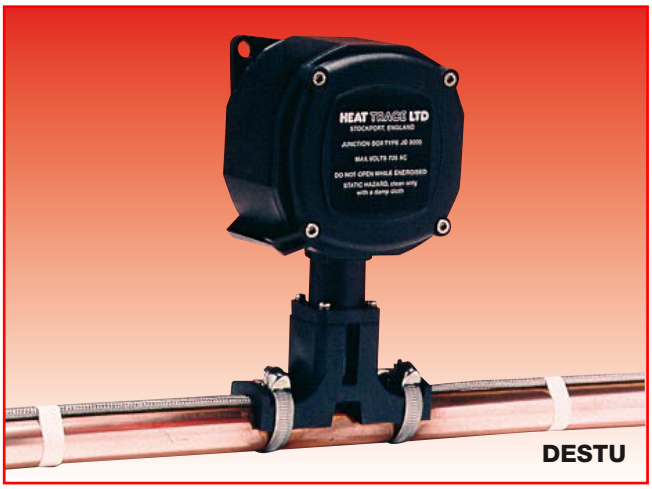
Terminations – power end

Heat Trace have three different methods for the termination of its parallel heat tracers at the power supply. All methods are available for both safe and hazardous locations:-

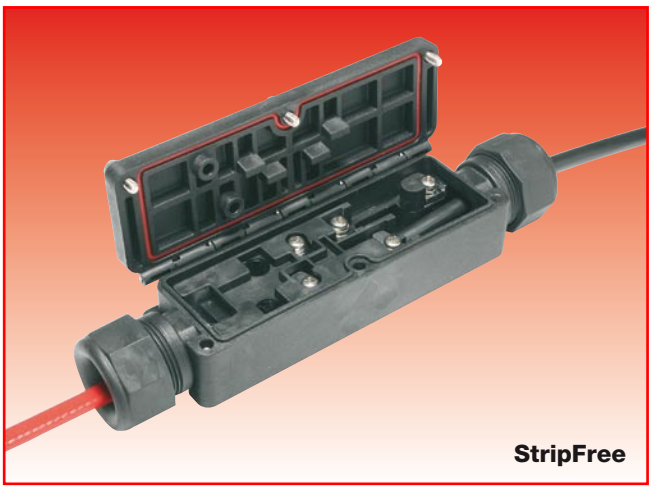
- **Direct Entry Sealed Termination Unit (DESTU)** – This is an improved method, where the junction box is connected to the DESTU, which is mounted onto the pipe surface. The tracer passes through the DESTU into the junction box, avoiding the possibility of damage to the tracer where it exits the thermal insulation.

- **StripFree Unit** – The StripFree connection box has been specially developed by Heat Trace to reduce installation time and component costs. Tracers can be terminated without the need to strip the ends of self-regulating tracers. StripFree units are available for connection to the power supply and also for series and tee connections. StripFree boxes are particularly useful for small diameter instrument lines which cannot support large junction boxes.

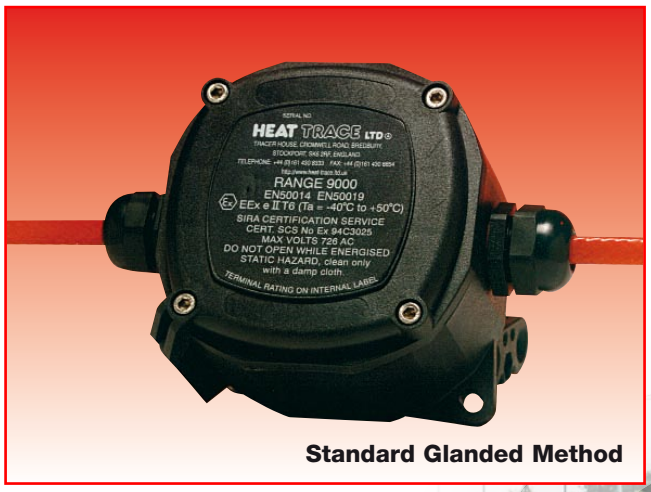
- **Standard Method** – This uses tracer termination gland components and a junction box. To avoid the possibility of damage to the tracer where it exits from the thermal insulation, a separate lagging entry kit is required.



DESTU



StripFree



Standard Glanded Method

Terminations – remote end

Heat Trace have three different methods for the termination of its parallel heat tracers at the remote end. All methods are available for both safe and hazardous locations:-

- **Moulded end seal** – The silicone rubber end seal is fixed with an adhesive. It is a simple and low cost form of sealing.
- **StripFree end seal** – The StripFree end seal has been specially developed by Heat Trace to reduce installation time. The end of the tracer is simply pushed into the end seal which immediately seals. It cannot be removed without a tool, and therefore provides additional safety. This seal is considered to be the best form of end-sealing.
- **Heat Shrink seal** – The fitting of shrink seals require the use of a hot air gun. This may not be practical in a hazardous area.

Moulded Endseal

StripFree

Heatshrink Endseal

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TEMPERATURE CONTROL – Selection Guide

The selection of an appropriate temperature control system is dictated by its purpose or objective. This guide to selection considers two forms of control:-

- **Air-sensing**, where the air temperature is monitored and the heating load is either:

a) fully applied at a set temperature, as traditionally used for freeze protection installations, or,

b) varied with changes in ambient temperature, and hence heat losses *(called PowerMatching)*.

- **Pipe or surface sensing**, where the controller sensor is located directly on the pipe or equipment surface. This method has been traditionally employed for all temperature maintenance duties.

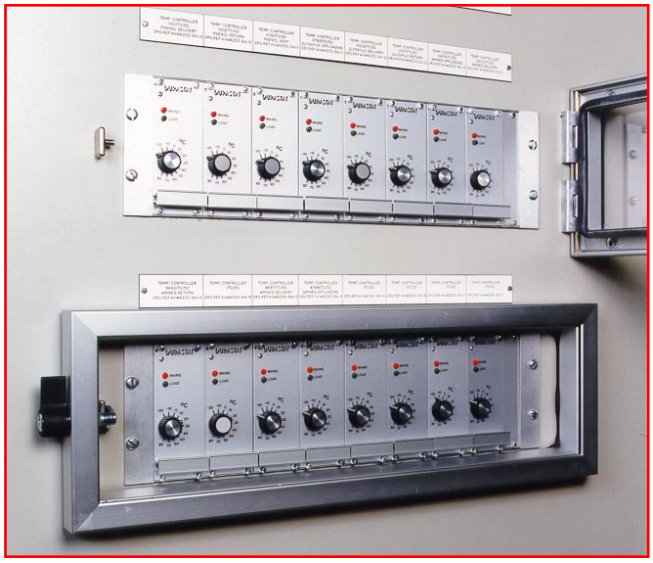
The purpose or objective of the temperature control system may be any one or more of the following:-

1. Ensuring temperature safety

It has already been stated in Section 2 (page 11) that **temperature control to ensure temperature safety is the least favoured option** – inherently temperature safe self-regulating heaters, or a stabilised design provide greater safety. But where necessary for ensuring temperature safety, pipe or surface sensing is almost always required. Care is required to ensure that all pipes which can experience differing flow conditions are controlled independently – this may result in a large number of heating circuits.

2. Process temperature accuracy

The three levels of process temperature accuracy defined in IEC heat tracing standards, types I, II, and III, are explained in Section 3 (page 17). The approach to selecting the best control system for each type of process is described on pg42.



3. Energy efficiency

The highest levels of energy efficiency have usually required a pipe or surface sensing form of control system. This again often results in multiple heating circuits to accommodate the many permutations of flow conditions. In this case, sections of pipe having differing flow conditions need to be controlled independently.

The degree of energy efficiency is also influenced by the accuracy of the controller – electronic devices are often more accurate than mechanical types.

4. Low capital costs

The lowest capital costs will usually result from a temperature control system having the fewest number of heating circuits. This is normally achieved by an air-sensing form of temperature control system.

Type I process control – maintaining above a minimum temperature level

It should be recognised that a Type I control system will be extremely energy wasteful. For example, a freeze protection installation controlled by an air-sensing thermostat will be 100% energised at all times when the ambient temperature falls below the thermostat setting (typically 2 or 3ºC). However, the average heating requirement over the number of winter hours that the system is energised is likely to be less than 20%, i.e. ***over 80% of the delivered heat will be wasted.***

Most of this waste heat can be avoided by upgrading the system to a Type II process, achieved at a very modest cost, where energy savings recover the additional cost in a very short period of time.

FOR THIS REASON, HEAT TRACE RARELY RECOMMEND A TYPE I TEMPERATURE CONTROL SYSTEM.

Type II process control – maintaining within a broad temperature band

This has traditionally been achieved by means of mechanical capillary thermostats, having their sensors located on the pipe surface.

However, in-plant piping systems are often complex, having multiple flow permutations. To control all possible permutations, a separate thermostat is required for each section of pipe having differing flow conditions. This results in many heating circuits within an expensive distribution system.

To meet the requirements of a Type II process, whilst at the same time reducing to a minimum the number of heating circuits, and hence, distribution and control panel costs, Heat Trace is able to recommend a heat tracing system where:-

a) the tracers are spiralled to the pipes to just compensate for heat losses at the minimum ambient design temperature.
b) the controller is Heat Trace's unique PowerMatch unit. This monitors the ambient temperature and varies the heat delivered by the tracer according to changes in ambient temperature, and hence, heat losses.

By monitoring the air rather than the pipe surface temperature, only one controller is needed for each different 'maintain' temperature. The system can be used equally for either freeze protection of process temperature maintenance.

This system may occasionally result in heat being delivered unnecessarily to some sections of pipe having flow conditions. However, the system is an excellent balance of process temperature accuracy, energy efficiency, and low capital costs.

Type III process control – maintaining within a narrow temperature band

To control all sections of a piping system within a narrow temperature band of 2ºC, as required for temperature sensitive materials (e.g. chocolate), has traditionally required the use of numerous high accuracy electronic controllers, controlling several sections of pipe which may have differing flow conditions. This has necessarily been provided at a high capital cost.

However, Type III process temperature accuracy can now be achieved with the same PowerMatching control system described for Type II systems above, but with the addition of a fine tuning temperature control.

Again, the heating load delivered at any time is matched to losses according to the ambient conditions. To ensure a narrow band process accuracy, a further sensor is located on a short heated 'dummy' line incorporated into the piping system.

SUMMARY

Type I process control – maintaining above a minimum temperature level

- is very energy wasteful. Not recommended – upgrade to Type II process control

Type II process control – maintaining within a broad temperature band

- can be achieved by air-sensing PowerMatch control to provide good energy efficiency from the fewest number of heating circuits i.e. least capital cost

Type III process control – maintaining within a narrow temperature band

- can be achieved by air-sensing PowerMatch control plus fine-tune line control to provide good energy efficiency from the fewest number of heating circuits.

Type I Process Control - Maintain above a minimum point

Type	Description	Area Location	Air or pipe/ Equipment Sensing
AT-F AIRSTAT	**The AT-F AIRSTAT is a non-adjustable controller that energises the heating circuit when the sensor temperature falls to +2°C. The system then de-energises as the sensor temperature rises above +5°C. It has a MAINS ON and HEATER ON indication.**	Safe Areas	Air Sensing
CT CAPSTAT	**The CAPSTAT is a temperature adjustable ON-OFF thermostat comprising a liquid filled sensing bulb connected to an electrical switch via a capillary tube. Expansion of the liquid on rise in temperature causes the switch to open and on cooling, it closes. The CAPSTAT sensing bulb may be positioned to sense the air temperature.**	Safe Areas	Air Sensing
CT-FL CAPSTAT	**The CAPSTAT CT-FL and CT-FL/DUAL are temperature adjustable ON-OFF thermostats but for use in Zone 1 and Zone 2 hazardous areas, with enclosures suitable for Gas Groups IIA, IIB and IIC . The sensing bulb may be positioned to sense the air temperature.**	Hazardous Areas Zone 1 & Zone 2 Areas	Air Sensing

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Type I Process Control - Maintain above a minimum point

Switch Rating	Comments	
8 amps direct switching, or via suitably rated contactor.	• AT-F AirStat is non-adjustable • Must be located indoors • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • Least efficient form of control	
16 amps direct switching, or via suitably rated contactor.	• CT Capstat is adjustable in the range 0-40°C • Suitable for outdoor use • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • Least efficient form of control	
16 amps direct switching, or via suitably rated contactor.	• CT-FL Capstat is adjustable in the range 0-40°C • Suitable for outdoor use • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • Least efficient form of control	

Type II Process Control - Maintain within a broad band

Type	Description	Area Location	Air or pipe/ Equipment Sensing
POWERMATCH Micro	**The POWERMATCH Micro is an electronic digital controller that senses changes in air temperature and then automatically adjusts the ratio of the periods in which the heaters are energised and switched off so that the heat delivered matches heat losses.**	Safe Area - For hazardous areas protection is required	Air Sensing
POWERMATCH	**The POWERMATCH is an electronic control system that senses ambient temperatures and automatically adjusts the percentage of power output from the heaters to directly match heat losses. It uses a Pt100 sensor to measure the ambient temperature.**	Safe Area - For hazardous areas protection is required	Air Sensing
CT CT-FL CT-FL/Dual	**The CAPSTAT is a temperature adjustable ON-OFF thermostat comprising a liquid filled sensing bulb connected to an electrical switch via a capillary tube. Expansion of the liquid on rise in temperature causes the switch to open and on cooling, it closes. The CAPSTAT sensing bulb may be positioned to sense the line tempaerature or surface temperature of a vessel.**	Safe Area Hazardous Area Zones 1 & 2	Line Sensing

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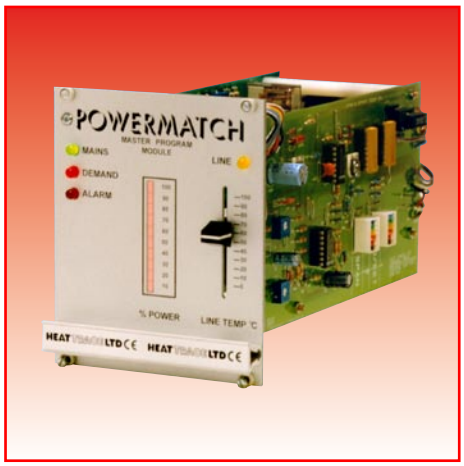
Type II Process Control - Maintain within a broad band

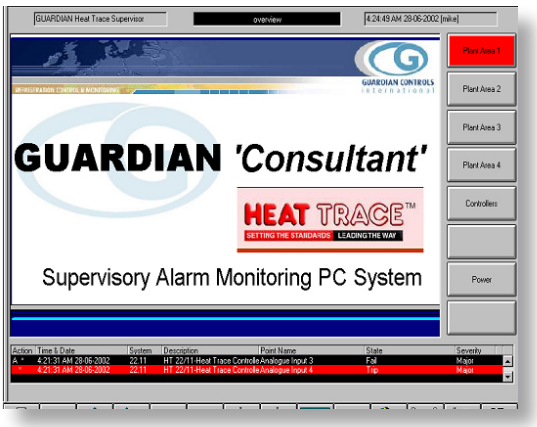
Switch Rating	Comments	
8 amps direct switching, or via suitably rated contactor	• Unit located in control panel • Powermatching is significantly more efficient than conventional air sensing thermostats • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • May be used with self regulating heating cables • Temperature range -50 to +80ºC	
Switching via solid state relays or thyristor drives up to 250 amps per phase and up to 1000 Volts	• Unit located in control panel • Powermatching is significantly more efficient than conventional air sensing thermostats • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • Ideal for large 3 phase heating loads such as long pipeline heating circuits • Temperature range -50 to +80ºC	
16 amps direct switching, or via suitably rated contactor.	• CT and CT-FL are adjustable thermostats with 3 temperature ranges: **Type A** 0–40°C **Type B** 20–110°C **Type C** 20–300°C • Suitable for outdoor use • One thermostat is required for each pipeline - more heating circuits may be required	

Type III Process Control - Maintain within a narrow band

Type	Description	Area Location	Air or pipe/ Equipment Sensing
POWERMATCH Micro	**The POWERMATCH Micro is an electronic digital controller that senses changes in air temperature and then automatically adjusts the ratio of the periods in which the heaters are energised and switched off so that the heat delivered matches heat losses.** **A separate line sensing controller provides fine tune control. This sensor may be located on a "dummy" heated pipe section having no flow (dead leg).**	Safe Area - For hazardous areas protection is required	Air Sensing and line sensing
POWERMATCH	**The POWERMATCH is an electronic control system that senses ambient temperatures and automatically adjusts the percentage of power output from the heaters to directly match heat losses. It uses a Pt100 sensor to measure the ambient temperature.** **A separate line sensor provides fine tune control. This sensor may be located on a "dummy" heated pipe section having no flow (dead leg).**	Safe Area - For hazardous areas protection is required	Air Sensing and line sensing
DURASTAT & CENTURION	**The DURASTAT and CENTURION units are proportional electronic temperature controllers offering set point accuracy and temperature control with line sensors.**	Safe Area - For hazardous areas protection is required	Line sensing
GUARDIAN ENERGY MANAGEMENT SYSTEM	**Guardian is an 8 channel, computer assisted energy management, control and auditing system for large / critical heat tracing installations. It may be provided as a stand alone system or integrated into the plant's SCADA or DCS system. Details of the auditing / monitoring facilities are provided on pages 50 / 51**	Safe Area - For hazardous areas protection is required	Line sensing

FULL TECHNICAL DATA SHEETS ARE AVAILABLE ON OUR WEBSITE FOR ALL PRODUCTS
www.heat-trace.com

Type III Process Control - Maintain within a narrow band

Switch Rating	Comments	
16 amps direct switching, or via suitably rated contactor.	• Unit located in control panel • Powermatching is significantly more efficient than conventional air sensing thermostats. Type III accuracy is provided by the additional line sensing control • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • May be used with self regulating heating cables • Temperature range -50 to +80ºC	
Switching via solid state relays or thyristor drives up to 250 amps per phase and up to 1000 Volts	• Unit located in control panel • Powermatching is significantly more efficient than conventional air sensing thermostats. Type III accuracy is provided by the additional line sensing control • Large blocks of heating may be switched from a single controller - fewer heating circuits are required • Ideal for large 3 phase heating loads such as long pipeline heating circuits • Temperature range -50 to +80ºC	
ET Direct Switching 20 Amps MS Direct Switching 30 Amps	• ET and MS are adjustable thermostats with 3 temperature ranges: -20 to +80°C 70 to 170°C 160 to 260°C • One thermostat is required for each pipeline - more heating circuits may be required	
Suitably rated relay or contactor	• Guardian is temperature adjustable • One thermostat is required for each pipeline - more heating circuits may be required	

Circuit Monitoring

Circuit Monitoring of smaller heat tracing installations

Where critical to the process, circuit health monitoring is provided by Heat Trace's Watchdog system. This is located in the control and monitoring panel and periodically energises the circuits to ensure that they are operating correctly. In the event of damage to a tracer, an alarm is raised to enable corrective action. This can often take place before the pipeline has time to cool to an unacceptable level.

Watchdog is available as a single or 5 circuit device.

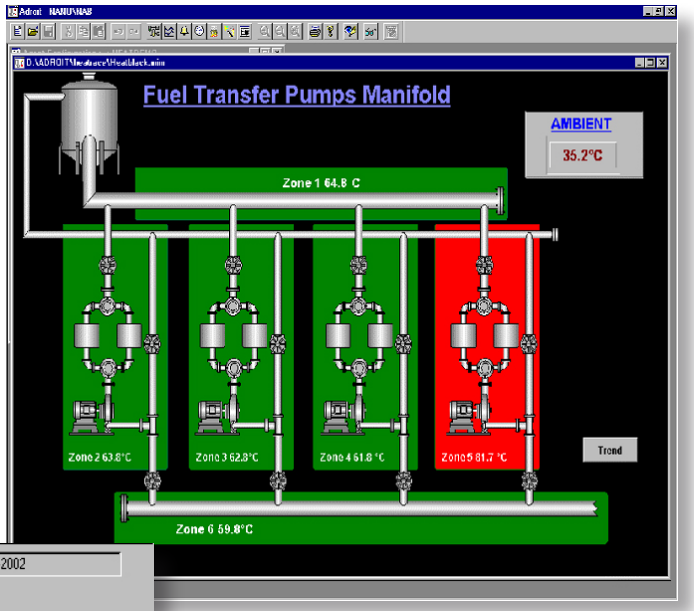
Circuit Monitoring of large heat tracing installations

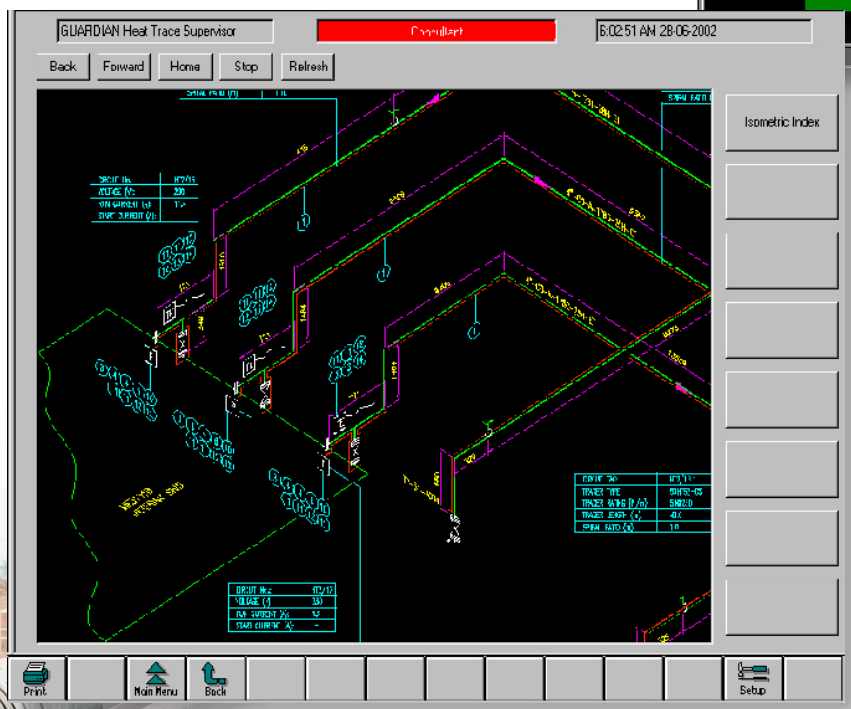
Large heat tracing installations, when critical to the process, may be monitored by the 5 circuit Watchdog monitoring devices shown opposite.

However, when the Guardian computer assisted energy management control and auditing system is selected, this provides the user with the ultimate in monitoring facilities. This SCADA type control has all the benefits of electronic control, complemented by the addition of computerisation. This development allows two-way communication between the control system and a remotely located computer. Additionally, all control parameters, collected data system drawings and system information can be stored and retrieved, and full visual indication is available.

Heating circuits are continuously monitored for correct function and temperature. Circuit currents and supply voltage may be measured and used by the software package to calculate the individual circuit power and running costs. Alarms are raised in the event of any non-compliance. A data link to the main process computer is also available, with the option of an internet protocol module for providing communications over TCP/IP and HTTP for web pages, or emailing of alarm messages.

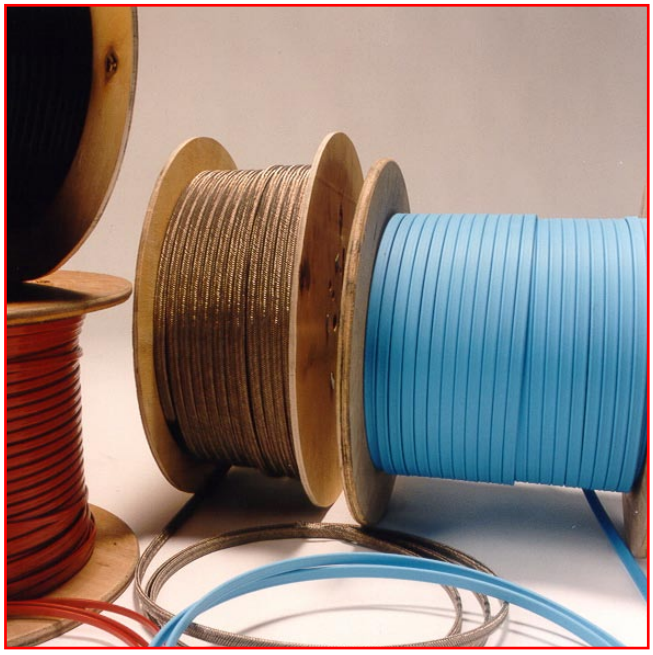
Control and monitoring parameters may be inputted either remotely or locally as required. System parameters are stored in the computer and in each Guardian controller. This gives ultimate reliability, as all parameters are capable of being downloaded to replacement units.





Pre-installation

It is essential that the heat tracing system is correctly installed, tested, commissioned, and maintained. Heat Trace will provide comprehensive instructions for the installation of the system equipment. However, we would recommend that the following points are taken into consideration:-



Personnel

Persons involved in the installation and testing of electric heat tracing systems should be suitably trained in all special techniques required. Installation should be carried out under the supervision of a qualified electrician who has undergone supplementary training in electric heat tracing systems. Where systems are for use in explosive gas atmospheres, additional qualifications apply, such as knowledge of system certifications.

Equipment verification

Prior to installation, the design data used for the heat tracing design should be verified and the as-built piping and other equipment should be checked against the enquiry drawings.

The installation of the heat tracing system should be coordinated with the piping, thermal insulation and instrument disciplines.

Pre-installation testing

Pre-installation tests shall be performed and documented on a checklist similar to that opposite. This also helps verify the heat tracing design.

a) Heat tracers shall be visually checked for damage. Continuity and insulation checks should be made and insulation resistance measured from heat tracer conductors to the metallic braid or sheath, with a minimum 500 Vdc test voltage. The measured insulation resistance shall not be less than 20 MΩ.

b) Controls shall be tested to ensure correct calibration of, for example, set points, operating temperature range and span.

c) Control panels shall include documentation certifying that all wiring, layout and functions are correct and have been tested. A general inspection of the panels shall confirm that no damage has occurred in transit.

Table 1 - Pre-installation checks

	Items to be checked	Remarks
1	Is the workpiece fully erected and tested and all temporary supports removed? Is the surface to be heated free from sharp edges, weld spatter and rough surfaces?	Any welding or pressure testing after the installation of a heat tracer could damage the device
2	Is the surface upon which the heat tracer is to be applied normal steel or non-metallic?	If the surface is of polished stainless steel, very thin-walled pipe or non-metallic of any kind, special precautions may be necessary
3	Do the items to be heated correspond in size, position, etc. with the design?	It is sometimes difficult to be sure that the correct pipe is being heated. A suitable line numbering system may be of assistance
4	Has it been specified that metallic foil be installed before the application of the heat tracer?	This may be used to aid heat distribution
5	Has it been specified that metallic foil be installed after the application of the heat tracer?	This may be used to prevent insulation from surrounding the heat tracer or to aid heat distribution
6	Can flow of product under normal or abnormal conditions reach temperatures greater than those that the heat tracer can withstand?	This would normally be covered in the design stage; however, further discussion with staff at the plant may show that incorrect or out-of-date information has been used
7	Is the heat tracing system documentation (working drawings, designs, and instructions) available?	No change should be contemplated without reviewing the heat tracing system documentation, as careful calculations are necessary to ensure safe operation
8	Can pipes or surfaces expand and contract so as to cause stress on any part of the heat tracing installation?	In this case precautions are necessary to avoid damage
9	Can sensors of temperature controllers be affected by external influences?	An adjacent heating circuit could affect the sensor
10	Is the heat tracer to be spiralled or zigzagged onto the workpiece, according to the design?	Check design loading per unit length of pipe (or surface area) to determine if spiral or zigzag application is necessary
11	Are cold leads, when fitted, suitable for contact with the heated surface?	If the cold lead is to be buried under the insulation, it has to be able to withstand the temperature
12	Is the pipework hung from a pipe rack?	In this case, special precautions are required to ensure the weatherproofing of the insulation at points of suspension
13	Does pipework have its full complement of supports?	The addition of intermediate supports at a later stage could damage the heating system
14	Are sample lines/bleed lines, etc. at the plant but not on drawings?	These could obstruct or prevent the fitting of the heat tracer, and a review of the heat tracing system documentation may be necessary
15	Are other parameters used in the design of the equipment as specified by the design documentation?	
16	Are the heat tracers, controllers, junction boxes, switches, cable glands, etc., suitable for the environmental conditions and are they protected as necessary against corrosion and the ingress of liquids and particulate matter?	

Installation of heat tracers - General

Heat tracers should be attached to clean piping and equipment in accordance with the instructions. Care should be taken at flanges and fittings to position heaters so as to avoid damage. Check that the heater assembly can accommodate movement and vibration.

The installer should allow the appropriate amount of heater to compensate for additional heat losses from pipeline fittings, as allocated by the *Evolution* design software.

A heat tracer should be kept in as intimate a contact as possible to the heated surface. Where close contact is not possible, such as on valves, a heat-conductive covering of metal foil may be used.

It is recommended that the heat tracer is not folded, twisted, or allowed to overlap, cross or touch itself. Attention should be given to the minimum bending radius.

Where heat tracers cross possible sources of leaks, for example, flanges, they should be positioned to minimize contact with the leaking medium.

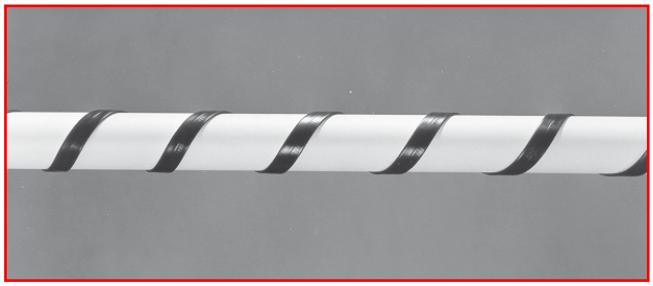
Only genuine Heat Trace components may be used or else the system certification will be invalidated.

- **Straight tracing runs on pipe**

Single straight traced runs are usually positioned at the underside of the pipe, fixed at 300mm centres, using only the correct Heat Trace fixing tape.

Multiple straight heat tracers should be equally spaced around the circumference of the pipe. Extra lengths of heat tracer will have been provided for in the design to compensate for the additional heat losses at pipe fittings, valves etc.

- **Spiral tracing runs on pipe**



The pipe and equipment should be marked at the design spiral pitch. Then apply the heat tracer in a uniform spiral from the power supply point maintaining slight tension in the tracer as it is applied. Fix at no more than 2 metre centres using only the correct Heat Trace fixing tape.

Spiral tracing runs should be applied in such a way that valves, etc., can be easily removed or replaced.

Connections and terminations

It is essential that all heat tracers are terminated correctly with approved components to Heat Trace's instructions.

Longline heat tracers intended for site termination should be checked to ensure that the installed lengths correspond to the design length and loading.

Connection of the heat tracer to the power supply should be such as to prevent physical damage, and positioned to prevent the ingress of water.

Heat tracing circuits are connected into Heat Trace junction boxes specifically designed for connection of the tracer. The boxes provide appropriate protection and certification. Junction box lids should not be left open at any time.

The metallic braid or sheath of the heat tracer must be bonded to the earthing system to provide for an effective ground path.

Tracer end seals must be securely fitted to Heat Trace's instructions and protected to avoid mechanical damage and ingress of water.

Marking and tagging

After installation, all the circuits must be properly marked / tagged, as follows:-

a) Branch circuit breaker
b) Monitor and alarm apparatus
c) Heat tracer power connection
d) Circuit number and set point for each temperature controller

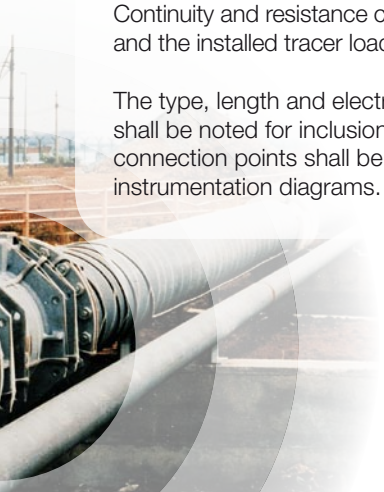
Marking shall be carried out for each heat tracing circuit, on the respective junction box.

Post installation testing

The pre-installation insulation resistance test described above shall be repeated on all heat tracer circuits after installation, using a minimum 500Vdc megger. The measured insulation resistance shall not be less than 20 MΩ.

Continuity and resistance checks shall be made for each circuit and the installed tracer load confirmed with the design load.

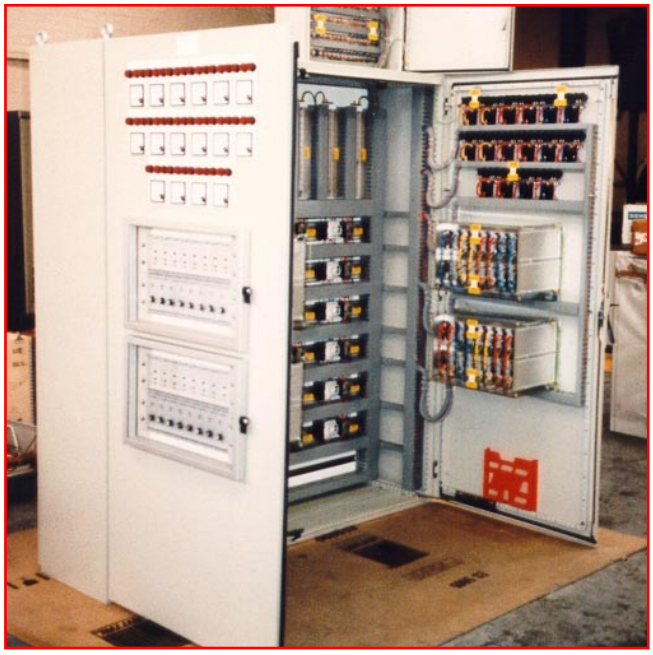
The type, length and electrical data of each heat tracer shall be noted for inclusion in the final documentation. The connection points shall be recorded for entry in the piping and instrumentation diagrams.



Installation of control and monitoring equipment

General

The installer is usually responsible for fixing the control and monitoring and distribution panels. These will, as a minimum, provide over-current and earth-leakage protection as well as means of isolation. Some form of temperature control or limitation is usually provided to ensure safe temperatures or for energy efficiency purposes.



Verification of equipment suitability

The supplied controllers, thermostats, sensors, and related devices shall be checked to match those specified in the design with regard to the service temperature, the IP rating, and,for hazardous areas, certification. The certification of heat tracing systems may prescribe the use of specific components. In these cases it is mandatory to use only parts specified by Heat Trace.

Temperature controller and monitoring devices

The sensors of the temperature controllers may be air sensing or applied directly to the pipe. The sensors are usually resistance temperature detectors, or capillary tube thermostats.

Water and corrosive vapour intrusion can cause failure of temperature controllers. The cover or lid of a controller housing should always be closed after installation, except when required for access.

General sensor installation

The sensor for surface temperature control is installed onto the surface of the pipe or equipment in accordance with the designer's instructions in a position that will provide a temperature representative of the overall circuit. The sensor should be positioned so as not to be influenced by the temperature of the heat tracer, or other factors such as heat sinks and solar gain.

Ambient temperature-sensing controllers should be sited in the most exposed position for the installation.

Line sensors should be strapped in good thermal contact with the pipe or equipment and protected so that thermal insulation cannot be trapped between the sensor and the heated surface. Care should be taken not to damage the capillary tube, or RTD leads, or to distort the sensor and thereby cause calibration error.

Care should be taken to ensure that the capillary tube, or RTD leads emerge from the thermal insulation in a manner that will not allow the ingress of moisture.

Sensor installation for temperature limiting device

When a system has to employ a temperature controller in order to ensure temperature safety, then clearly the positioning of the sensor is critical to the safety of the plant.

The sensor for the temperature limiting controller is installed onto the surface of the pipe or equipment in a position that will provide a temperature representative of the overall circuit. In order to assure that the safety temperature controller can accurately react to the maximum heat tracer surface temperature, particular attention must be paid to the location, method of attachment and set point. This method of sensor installation is based on the known relationship between the equipment temperature and the heater sheath temperature at a given power output.

It is important that the controller is set such that the heater sheath temperature does not exceed the limiting temperature under worst-case conditions (e.g. voltage +10%, tracer at upper limit of manufacturing power tolerance, heater out of contact with the pipe/equipment, high ambient, no external convection).

Warning
Some heat tracing companies offer low cost series resistance heaters of minimal mechanical strength that are designed for use with voltage regulating devices. These require the sensor of the over-temperature controller to be fitted to the surface of the heater itself. However, this is a practice that Heat Trace Ltd. does not recommend because:-

- It will rarely be known to be sensing the hottest point of the heater (which is likely to be where the heater is out of contact with the equipment) and
- When the sensor is removed, for example during maintenance work, it cannot be guaranteed to be returned to the hottest part of the heater

The practice of fitting a temperature sensor to the heater to ensure temperature safety is dangerous!

Installation of thermal insulation system

Precautions must be taken to protect tracers from mechanical damage and moisture intrusion after they have been installed and prior to the application of thermal insulation. The installation supervisor shall coordinate with the thermal insulation contractor, so that the thermal insulation is applied as soon as possible after the installation and testing of heat tracers.

It should be confirmed that the thermal insulation to be installed is of the size, specification and thickness used for the design of the heat tracing system.

The thermal insulation installation crew should be experienced /trained in fitting insulation over tracers, particularly with a view to avoiding mechanical damage, which is most likely when cutting and forming sheet metal cladding around flanges and other line equipment.

Warning labels must be fixed to the cladding at 6m intervals advising that electric tracers are installed beneath the thermal insulation and fitted to the cladding over each valve or item of equipment that may require periodic maintenance.

Field circuit insulation resistance test

The test procedure described above shall be conducted on all heat tracer circuits after lagging, with the requirement that the measured insulation resistance shall not be less than 5 MΩ.

Visual inspection

Carry out a visual inspection of the thermally insulated system to ensure that:

1. moisture cannot penetrate the insulation
2. screws used for fastening cladding are short enough to preclude any possibility of damage to tracers or temperature sensors.
3. entry cut-outs in the cladding for heat tracers, temperature sensors, etc., are dimensioned so as to render contact impossible.
4. cladding joints and thermal insulation entries are properly sealed with an elastic, non-hardening sealant resistant to chemical attack.

Documentation

The thermal insulation material and its thickness shall be documented.

The branch circuit wiring of each heat tracing circuit requires an over-current protective device. The size and type of distribution wiring, and the ratings of the branch circuit protective devices is based on heater start-up currents and their duration at the minimum temperature that the heat tracing device may experience.

An earth fault protective device RCD shall also be provided Check that protective devices are sized correctly to the rated current and, where applicable, have appropriate certificates.

A FULL INSTALLATION, TESTING AND MAINTENANCE MANUAL IS AVAILABLE ON OUR WEBSITE
www.heat-trace.com

Commissioning & Documentation

Functional check and final documentation

The heat tracing system(s) shall be commissioned after the thermal insulation has been installed and the electrical distribution is completed. The heat tracer commissioning record given in Table 2 shall be completed and retained.

a) Close all branch circuits and verify proper current. A temporary bypass may be required for the temperature control device.
b) Verify that monitor or alarm circuits are operable. A bypass may be required at field contacts.
c) Fill out the heat tracer commissioning record (Table 2) for each circuit. This shall clearly document all testing and commissioning data.
d) Record the electrical insulation resistance values for each measurement taken.
e) Record the applied voltage and resulting current after five minutes of energization, and pipe temperature if required.
f) Verify that the alarm and monitor components operate as intended.
g) Verify that the calibration check at the temperature controller setpoint has been performed and the controller has been set at this value.

Final documentation

Adequate and uniform documentation of the electric heat tracing circuits is an essential precondition for economical maintenance of this equipment. This is especially important to facilitate rapid troubleshooting in the event of circuit problems. It also provides the basis for simpler, faster and less costly handling of any desired modifications and expansions by a specialist for electric heat tracing systems.

The documentation of each heating circuit of a heat tracing system shall include the following elements:

Design and testing documentation:

a) Table of contents
b) Piping diagram showing the heat tracing circuits and the location of power points, connections, splices, tees, end terminations, and temperature sensors for control and limitation
c) For vessels: layout of the heat tracing
d) Pipe and insulation list
e) Individual circuit length of heat tracers
f) Calculation and dimensioning data
g) Material list
h) Heat tracer installation instructions
i) Heater cabling plan
j) Description of and installation instructions for temperature sensors
k) Heater commissioning record (Table 2)
l) Temperature profile measurement
m) Installation certificate

Circuit diagrams:

a) Wiring and circuit diagram
b) Terminal connection diagrams, switchgear with parts list
c) Installation instructions

Other:

a) Technical descriptions and instruction manuals for the individual pieces of equipment
b) Functional diagram as agreed to with the design engineer
c) Certificates or declarations of conformity from a certification agency for explosive gas atmosphere equipment, as required

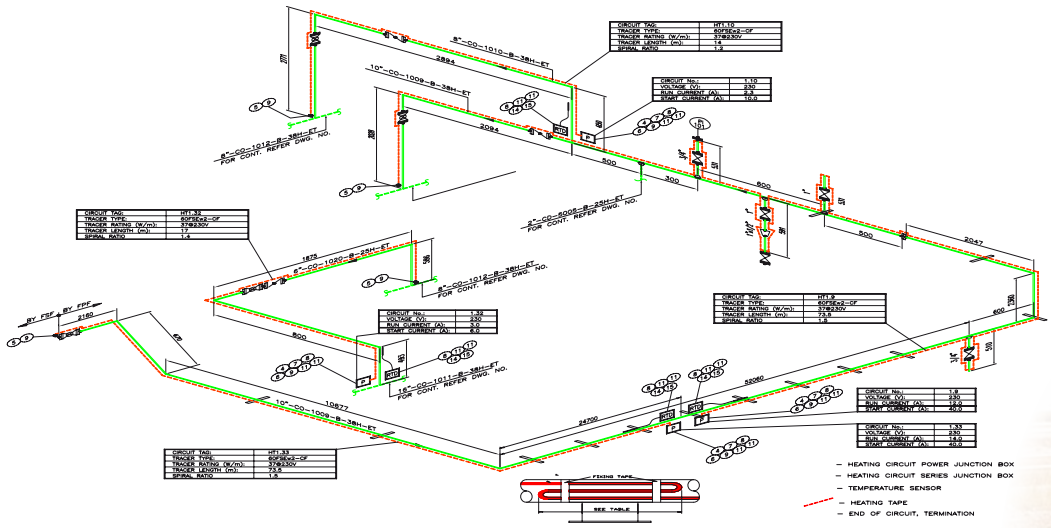


Table 2 - Heat tracer commissioning record

Location		System		Project number	
Reference drawing(s)		Line number		Heat tracer number	
Corrosive atmosphere?		Sheath temp. limitation °C		Panel number	
Location		Circuit number		Circuit amps/voltage	
Heat tracer type		Heat tracer model			
Heat tracer wattage unit length/voltage rating					
Megohm meter manufacturer/model		Voltage setting		Accuracy/full scale	
Megohm meter date of last calibration					
Multimeter manufacturer/model		Ohm setting		Accuracy/full scale	
HEAT TRACER TESTING					
Test value/remarks		Date		Initials	
NOTE The minimum acceptable insulation resistance is 20 MW. Minimum acceptable test voltage is 500 V d.c.However, 1 000 V d.c. recommended for MI, 2 500 V d.c. for polymeric heat tracers.					
1	Receipt of material on reel				
	Continuity test on reel				
	Insulation resistance test on reel				
2	Piping completed (approval to start heat tracer installation)				
3	Continuity test after installation				
4	Heat tracer installed (approval to start thermal insulation installation)				
	Heat tracer correctly installed on pipe, vessel or equipment				
	Heat tracer correctly installed at valves, pipe supports, other heat sinks				
	Components correctly installed and terminated (power, tee-end seal)				
	Installation agrees with supplier's instructions and circuit design				
5	Thermal insulation installation complete				
	Continuity test after thermal insulation				
	Insulation resistance test after thermal insulation				
SYSTEM INSPECTED:					
6	Marking, tagging and identification complete				
7	Heat tracer effectively earthed				
8	Temperature controls properly installed and set points verified				
9	Circuit monitoring devices correctly set up				
10	Junction boxes properly marked and closed				
11	Thermal insulation weather tight (all penetrations sealed)				
12	End seals, covered splices marked on insulation outer cladding				
13	Control panels installed and comissioned				
14	Drawings, documentation marked as-built				
Performed by:		Company		Date	
Witnessed by:		Company		Date	
Accepted by:		Company		Date	
Approved by:		Company		Date	

Maintenance

General

It is recommended that the maintenance schedule given in Table 3 should be undertaken each year. All maintenance activities should be recorded in a maintenance log (such as that shown in Table 3) and retained in the system documentation.

Fault location

Specialized methods of fault location are necessary to find faults in electric heat tracing systems covered by thermal insulation and metallic cladding, and advice should be sought from the electric heat tracing system designer. Most commonly, faults are caused by mechanical damage, corrosion, overheating or ingress of moisture.

Fault rectification

When the fault has been located, the defective component should be replaced or repaired. Those parts of the installation that have been disturbed should be checked in accordance with Table 2 and recorded in accordance with Table 3.

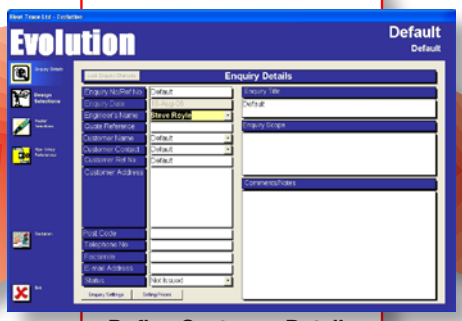
Table 3 – Maintenance schedule and log record

Location system		System		Reference drawing(s)			
CIRCUIT INFORMATION							
Heat tracer number		Circuit length		Breaker panel no.			
Power connection		Design voltage		Breaker pole(s) no.			
Tee connection		Residual current protection (type)					
Splice connection		Residual current trip setting					
Process control type I, II or III		Heating controller type					
Circuit Monitoring	YES / NO						
VISUAL							
Panel no.	Circuit no.						
	Date						
	Initial						
Thermal insulation							
Damaged insulation/ lagging							
Water seal acceptable							
Insulation/lagging missing							
Presence of moisture							
Heating system components							
Enclosures, boxes sealed							
Presence of moisture							
Signs of corrosion							
Heat tracer lead discolouration							
Heating and/or high limit controller							
Operating properly							
Controller set point							
ELECTRICAL							
Insulation resistance testing (bypass controller if necessary)							
Test voltage							
Megger value, MW							
Heat tracer supply voltage							
Value at power source							
Value at field connection							
Heat tracer circuit current reading							
Amps reading at 2 to 5 min							
Amps reading after 15 min							
Ground-fault current							
Comments and actions							
Performed by:		Company		Date			
Approved by:		Company		Date			

Evolution

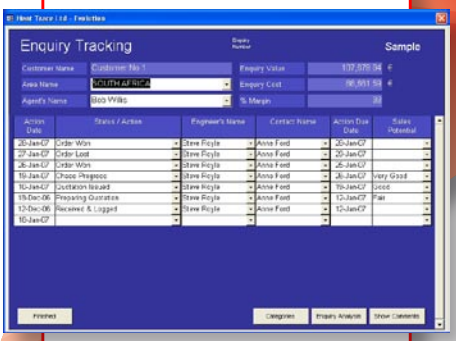
The Complete Heat Tracing System Design Suite

Enquiry Details



Define Customer Details and Selling Prices

Enquiry Tracking

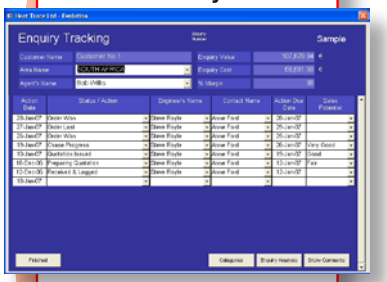


All Enquiries Logged

Design Selections

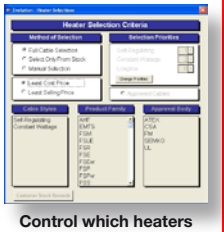
Select your product Preferences

Enquiry Tracking and Analysis



Finally analyse and track your enquiry

Heater Selections

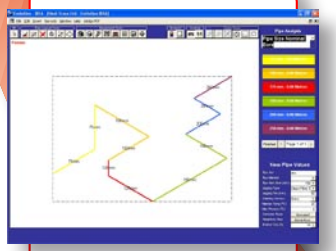


Control which heaters are selected

Pipe Groups

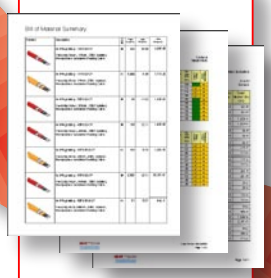
Multiple applications and sections of your enquiry

IDEA



Sketch and design your pipe layouts with Intuitive designs

Documentation

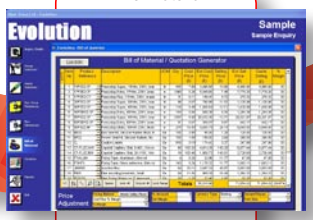


Produce custom Documents, Quotations and Reports

Pipe Dimensions

Import Data from Excel and PDMS

Bill of Material



Collate and Analyse Costs and Selling Prices for your Enquiry

Evolution – The Complete Heat Tracing System Design Suite

Heat Trace Ltd has taken it's 33 years of experience in design, manufacturing, installation and innovation and used it to produce an Evolutionary step forward in Heat Tracing Design.

All our years of acquired knowledge and unrivalled understanding of Heat Tracing systems have been used to develop the most advanced and complete Heat Tracing Software Design Suite.

Heat Trace's Evolution Software has been designed and written by Heat Trace utilising our understanding of the way in which Heat Tracing enquiries and projects are received, designed and installed. Evolution was not written by a software company having only limited understanding and appreciation of heat tracing system design.

The software is of value to users, engineering houses and contractors alike. From their own line lists, they can produce heat tracing budgets and a simple shopping list of requirements. Alternatively, the software can be used to validate a supplier's bid.

The software includes an intuitive drawing package having AutoCAD compatibility. Isometric pipe layout drawings, which have traditionally required a high design input and involved large costs, may be produced quickly and Evolution will determine heat losses, heat tracer selections, bills of material, and the final installation drawings.

The following pages of this brochure give a flavour of what Evolution is capable of and what Heat Trace's Innovation culture has meant to Heat Tracing design. It extends not only to our products but also to the support and services that we provide to our customers.

Evolution differs in a number of fundamental ways from our competitor's software:

- Calculations and product selections are performed on all generic types of heat tracer: Parallel Self-Regulating, Parallel Constant Power and Series Resistance.
- Evolution can design systems for both Safe and Hazardous Areas, considering stabilised and temperature controlled designs.
- Heating applications such as Freeze Protection, Temperature Maintenance, Heat Raising, Long Pipes, Tanks and Vessels can all be calculated in a single piece of software.
- An enquiry entered into Evolution can be broken down into different sections or groups depending on the user's preferences. Individual bills of material can be produced for each group. This allows the user to break the quotation into different sections according to the format required.

  For Example:
  – The customer may wish that Plant Area 1 be itemised separately from Plant Area 2
  – The user may wish to offer options for the customer to choose from.

  This can now be done automatically under the same enquiry. The flexibility of the reports allows the user to present the quotation in an appropriate format.
- Large or small, simple or complex enquiries can be designed and quoted accurately, confidently, quickly and efficiently.
- Data is usually supplied in an electronic format. Whether typed into Microsoft Excel or exported from a Pipe Design Management System, it can be imported directly into Evolution. This saves time and eliminates data input errors.
- There are no messages requesting you contact the manufacturer's design engineer for advice. For many applications, there is no need for a design engineer at all.

  Evolution empowers the user to design heat tracing systems with the knowledge that the system will be the safest system that works, and having the greatest commercial advantages.
- Evolution goes beyond engineering principles, calculations and product selections.

  Evolution is firstly a piece of computer software. It is simple to use and does not require knowledge of heat tracing or electrical engineering. In the hands of a heat tracing engineer it becomes even more powerful and allows the design engineer to spend more time designing and less time on clerical activities.

  Secondly the software has been written from a Customer Perspective, providing tools and applications to manage all the peripheral activities.

A Customer's Perspective

Evolution has been written with our customers in mind. Unlike other software Evolution is not limited to calculations and product selection. It contains many programs to allow the user to consolidate all activities related to the preparation of designs, reports and quotations into a single piece of software.

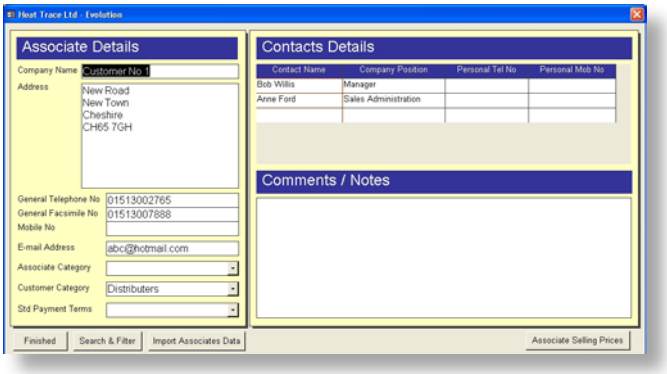
Programs to manage customer and contact information, pricing structures, product stock records, graphical product libraries, and a document designer can all be used to minimise time spent producing quotations and to maximise productivity.

Evolution can also be tailored to meet the requirements of the user. The user can modify software defaults, manipulate how Evolution performs calculations and makes product selections, further reducing data entry and time spent preparing quotations.

Collectively these programs empower the user to design heat tracing systems and produce professional quotations all within a single piece of software. Product knowledge, catalogues, datasheets are no longer required. As a result, mistakes, time spent entering data and preparing quotations is substantially reduced and accuracy and productivity of expensive engineering resources are significantly increased.

Associates Database

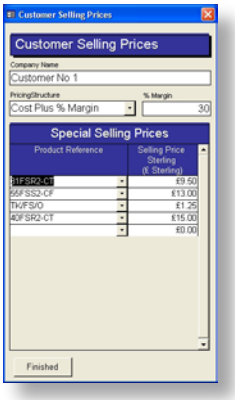
The *Associates Database* allows the user to enter their customer addresses and contact details. The customer can then be selected from a drop down list when a new enquiry is entered. Address details will then be copied from the *Associates Database* into the enquiry, saving time and improving accuracy and data integrity. The address data can be edited as necessary.



Pricing Structures

The Associates Database can be extended further to include a pricing structure. *Pricing Structures* allow Evolution to determine the selling price for the products selected when the bill of material is compiled. This ensures that the correct prices are used and removes the need to enter prices for each quotation.

Pricing Structures can be simple or complex. Simple *Pricing Structures* take the form of Cost plus a percentage margin or a List Price less a percentage discount. Complex *Pricing Structures* allow the user to also add specific prices for individual products.



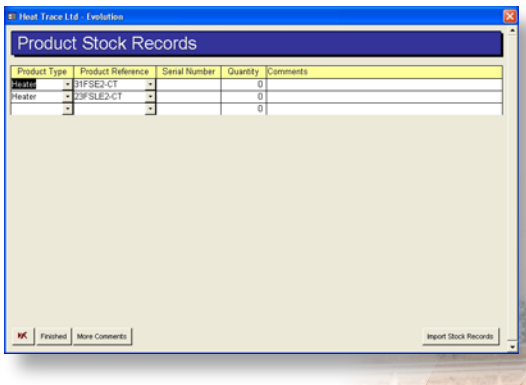
When a customer is selected from the *Associates Database*, the *Pricing Structure* is copied along with the address. The *Pricing Structure* can be modified for each individual enquiry.

Product Stock Records

Product Stock Records allow the user to record Heat Trace products held in stock. Evolution is capable of importing stock data from most resource management or stock control systems.

Evolution can be instructed to design a heat tracing system using only cables that are currently in stock. This is particularly useful when quick delivery is required for the heat tracing system. It can also be beneficial when the user carries only a certain range of cables and wants the software to use those cables. If no solution exists from cables in stock then Evolution advises that no cable could be selected.

Product Stock Records can also be used to check against the bill of material to determine if the user has sufficient stock to supply the heat tracing system.

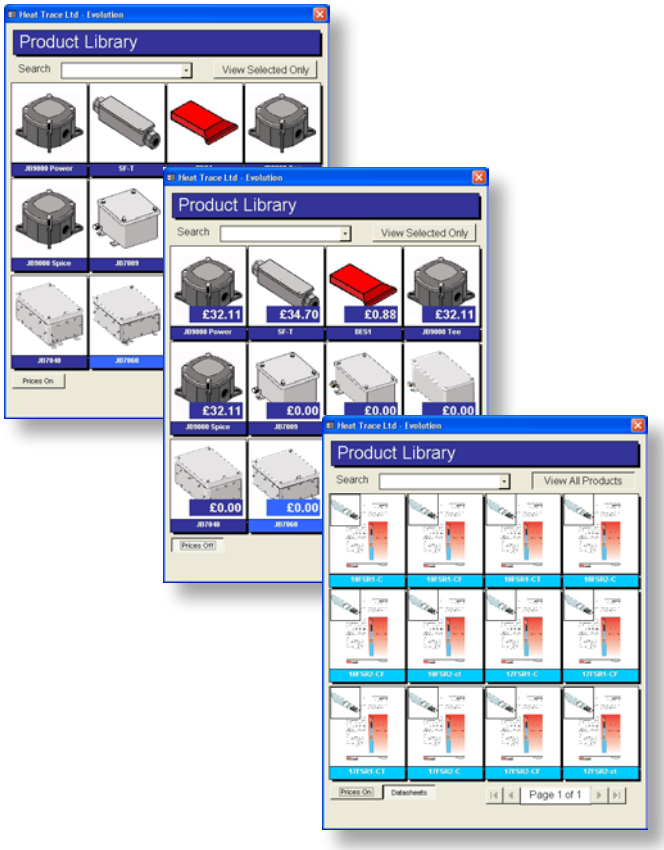


Product Libraries

Evolution has a graphical *Product Library* that can be used to identify a particular product. A flexible search facility gives the user the ability to find the appropriate product quickly without the need for product knowledge.

Having identified the product, the user is only a click away from product datasheets, images, videos and literature. There is no longer the need to shuffle through catalogues and datasheets to find the information required.

Images, Videos, literature and articles, contained within Evolution, can be used to compile the user's own literature and documentation.

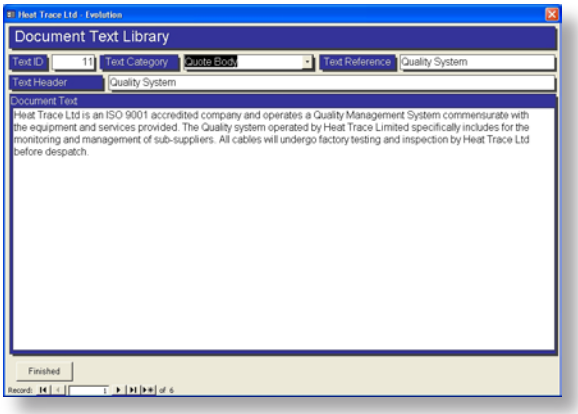


Data Tables

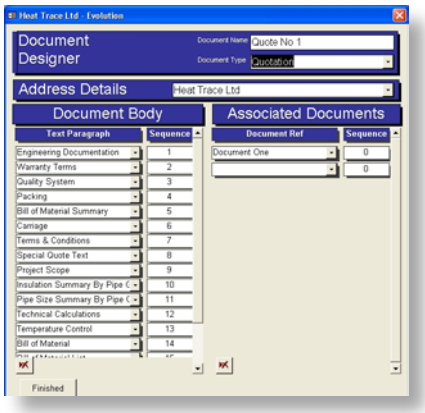
Data Tables of fluid materials, pipe sizes, insulation types can all be amended and added to by the user. This further empowers the user to use the software without reference to Heat Trace.

Document Designer

The *Document Designer* allows the setting up of templates for quotations. The templates are constructed on a "copy and paste" basis. The user enters a number of paragraphs in the text editor. Entering the text can be done by typing or copy/ pasting the text from the user's current quotations.



The necessary paragraphs may then be selected in the *Document Designer* reports such as *Bills of Material* or other special text fields. The user can create as many quotation templates as required. A quotation template may be selected for a given enquiry. Evolution will do the rest, compiling and collating your quotation.



In addition to the *Document Designer*, the user can also automatically generate a Microsoft Word document to use as a cover sheet for the quotation. The Word document is created with address, contact, reference numbers and enquiry titles already completed. The user simply adds additional text specific to the enquiry document.

Datasheets and user documents complete the document design package.

Enquiry Management

General Principles

Each Enquiry consists of sections: Enquiry Details, Design Selections, Heater Selections, Pipe Groups, Pipe Dimensions, Bill of Material and Quotation.

An Enquiry can have as many different pipe groups as required and each pipe group can have as many pipe line items dimensioned as necessary.

Enquiries and enquiry sections can be added to or amended at any time.

There is no practical limit to the number of enquiries, pipe groups and pipe line items that can be entered into Evolution.

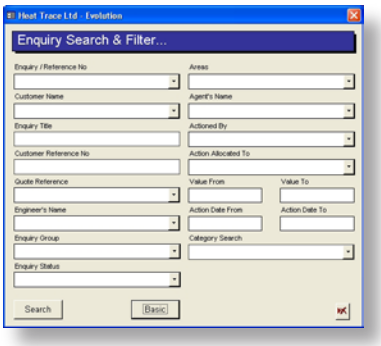
Evolution is, generally speaking, a collection of databases with an interface to bind them together. The nature of this interface is that the user never needs to remember to press a button to save the data. The data is saved automatically as the user proceeds through the enquiry.

A backup facility allows the user to create small text files that contain the input data required to re-build an enquiry in the event of a disaster. Even deleting Evolution only requires the user to re-install the software and import backup files. Within a few minutes Evolution is back up and running. It is important to be disciplined and backup often. Evolution allows the user to backup any number of enquiries in a single operation.

Enquiry Database

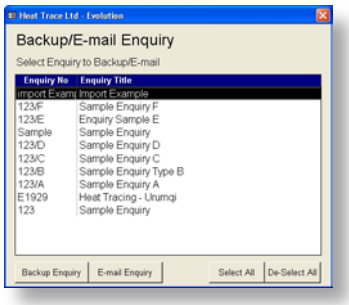
The *Enquiry Database* manages all enquiries, allowing easy location and access to each. Enquiries are listed in descending date order so that the last one created appears at the top of the list. The list displays the main fields for identification and also displays the status and value of the enquiry. The information is useful for enquiry tracking and progressing.

Enquiry Search



The *Enquiry Search* function allows the user to search and filter out enquiries according to the content of specific fields. For example, the user can enter a customer name and the enquiry list will be filtered to display all enquires for the selected customer, again in descending date order, so that the most recent enquiries are at the top.

Backup Enquiry

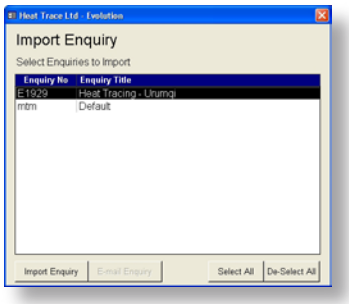


It is important to backup data. The *Backup Enquiry* facility allows this to be done in Evolution.

The backup facility is also used when new releases of the software are installed. Simply backup all enquiries and when the new software is installed, the backup files can be imported.

An additional feature of *Backup Enquiry* is that the backup file can be e-mailed directly to another user.
This allows the user to get support from Heat Trace for an enquiry, or the user could send the file to a customer who also has a copy of Evolution, for review.

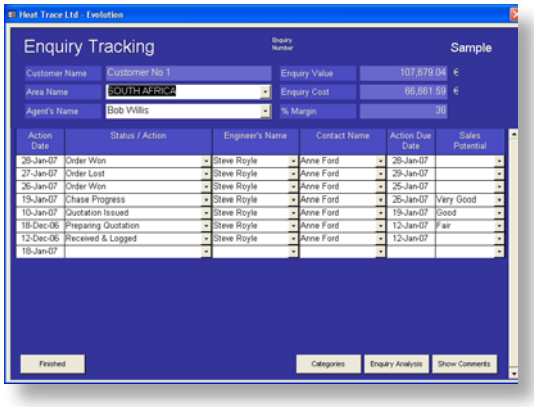
Import Enquiry



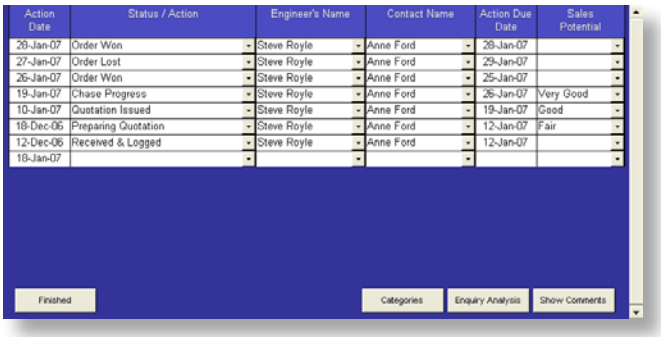
The *Import Enquiry* facility allows the user to import backup files, or to import an enquiry that has been sent to them by another user, as detailed above.

Enquiry Tracking

Enquiry Tracking allows the user to manage the progress of enquiries and analyse the content of enquiries.



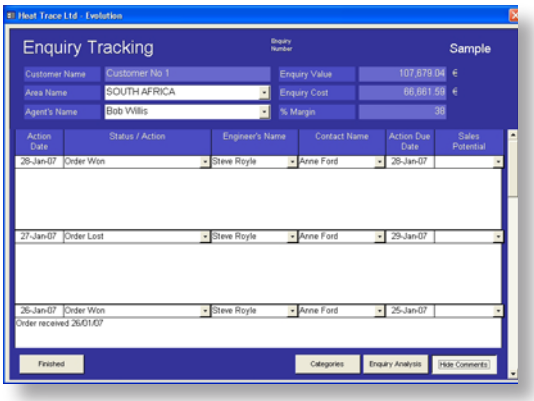
Enquiries can be allocated to an *Area* and to an agent or salesman. In Evolution, *Area* relates to countries of the world but the user can define the *Areas*. The *Areas* could be changed to represent regions of a country, or a type of enquiry.



The example above shows various actions recorded against the enquiry, allowing the user to know the status of each enquiry, when the next action should be completed and a sales potential factor.

Evolution contains various status/admin items in the progress of an enquiry. The user can change these to tailor *Enquiry Tracking*.

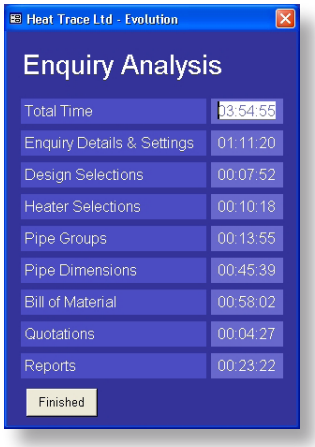
The user can record comments against each status/action to detail conversations with the customer or actions required.



Adding categories to your enquiry tracking allows the user to further analyse enquiries. Categories group similar enquiries together. All categories are defined by the user.

The user can produce various reports detailing the status of enquiries, critical dates, extent of work and analysing the content and value of the enquiries.

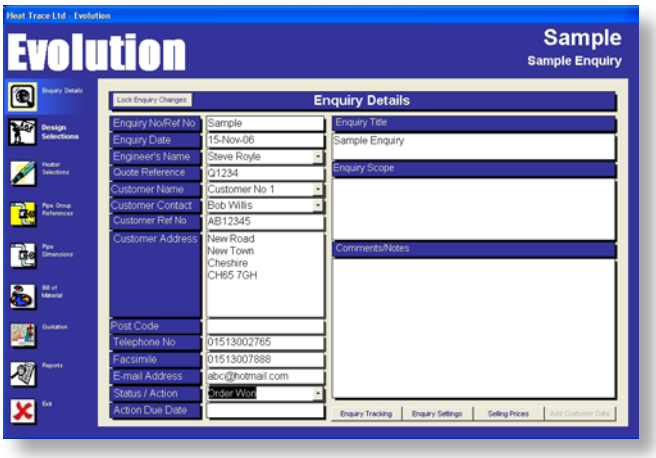
The user can also analyse the success or failure to convert enquiries into orders. Collectively reports can be used to determine which enquiries the user is most likely to win and therefore allocate resource.



Enquiry Details

In the *Enquiry Details* screen the user can enter details of the enquiry such as reference numbers and customer details. The customer details can be selected from a drop down list of customers from the *Associates Database.*

This form also contains an *Enquiry Status* field that allows the user to track his enquiry by selecting a status such as Order Won, Order Lost, Pending and follow up.



Selling Price Structures

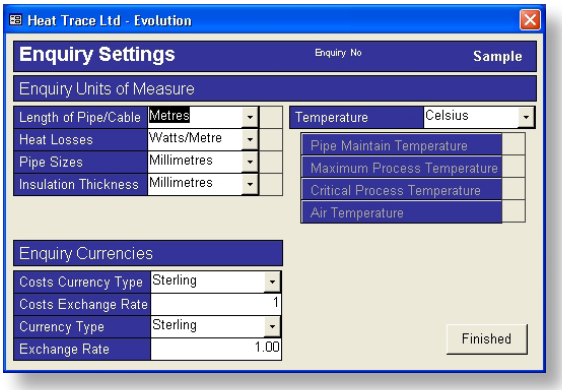
If the customer has been selected from the drop down list then the *Pricing Structure* for that customer will have been added to this enquiry.

The *Pricing Structure* can be individually set for each enquiry. Modifications are applied only to the individual enquiry.

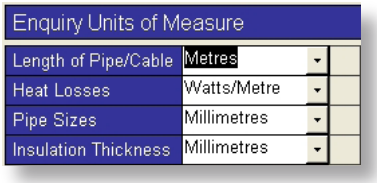
Enquiry Settings

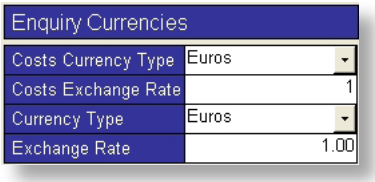
The *Enquiry Settings* screen allows you to choose the units of measure for your pipe data. The software allows the use of various units of measure:

Property	Options
Temperature	Degrees Celsius (°C) Degrees Fahrenheit (°F)
Length	Metres (m) Feet (ft)
Output or Heat Loss	Watts/Metre (W/m) Watts/Foot (W/ft)
Insulation Thickness	Millimetres (mm) Inches (“ins)
Pipe Size	Millimetres (mm) Inches (“ins)



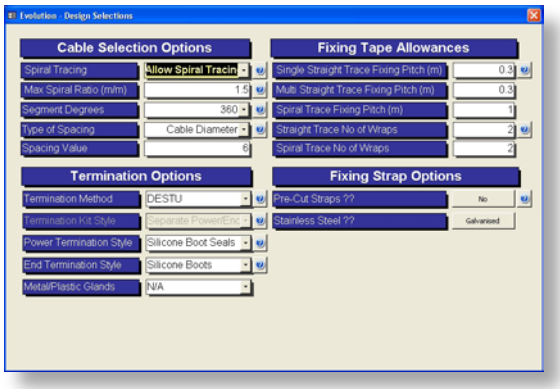
The user can use any combination of options. Users can also change settings at any time. If the pipe length was entered as metres, but it should have been feet, then simply change the unit of measure and you can choose whether Evolution converts all the numbers you have entered.





Enquiry Settings also allows the user to change the currency type used for costs and selling prices. The user can then set the exchange rates to be used for this enquiry.

The *Design Selections* screen allows the user to influence how Evolution determines which products and what quantity of product are calculated.



For example the user can:

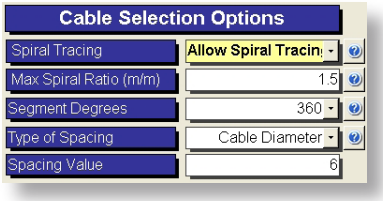
- Choose whether cables are to be spiral traced around pipes or straight traced.
- Select the preferred termination method: Standard, DESTU or StripFree.

- Select fixing methods and calculation allowances

These options significantly increase the flexibility of the design, allowing the user to manipulate the system design determined by Evolution.

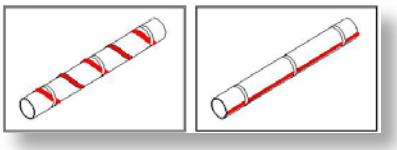
Cable Selection Options

Cable Selection Options allows the user to define for this enquiry how cable can be calculated and fitted to the piping system.



Spiral Tracing

The term "*Spiral Tracing*" refers to the method in which the heating tape is applied to the pipe.



Spiral traced **Straight traced**

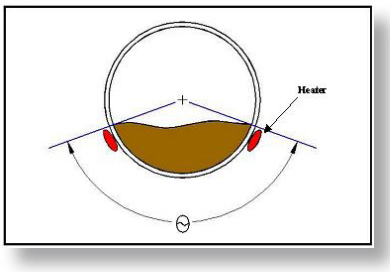
Maximum Spiral Ratio

The user can set a *Maximum Spiral Ratio*. Evolution calculates the spiral ratio required. If this exceeds the *Maximum Spiral Ratio*, then Evolution reverts to a Straight Traced method using multiple tracers.

Segment Degrees

The *Segment Degrees* option is used to assist Evolution in the cable selection process and ensure that a practical solution is reached.

Often, heater cables are applied to the lower section of the pipe to ensure that heat is concentrated in the area where the process fluid is likely to be present.

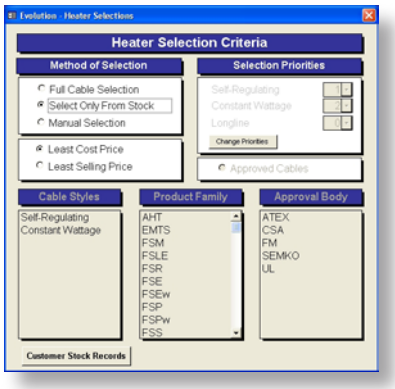


The *Segment Degrees* option dictates the area that is available for positioning the heaters. Increasing the *Segment Degrees* value will allow more heaters to be applied to the pipe. Conversely, the *Segment Degrees* value can be reduced to force Evolution to select less runs of a cable with a higher power output and a more practical installation solution.

In both the Spiral Ratio and the *Segment Degrees* option, Evolution has an inbuilt override that will not allow a heater to be positioned on a pipe too close to another heater. Irrespective of the user's selections, this override will be enforced to ensure the design is a ***"safe system that works"***.

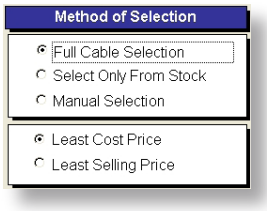
Heater Selection

The *Heater Selection* screen allows the user to restrict or influence which cables are selected. Evolution selects a cable based primarily on a *"safe system that works"* having the least cost per metre of pipe to provide the required heat output.



Method of Selection

The user can choose one of the following options:



- **Full Cable Selection** – Evolution will choose the best solution from all cables.
- **Select Only From Stock** – Evolution will choose the best solution from the cables listed in the stock records for the user.
- **Manual Selection** – The user can now specify particular product styles or families that Evolution can choose from.

The final selection of a heater is based upon cost. The user can choose to base this cost on the users cost price or the selected customers selling price.

Selection Priorities

Selection Priorities are used to enforce Heat Trace's philosophy of using a ***"safe system that works"***. This often results in selecting a self-regulating heat tracer as these are mostly inherently temperature safe. An advantage is that requiring fewer temperature controllers / heater circuits leads to a more competitive quotation.

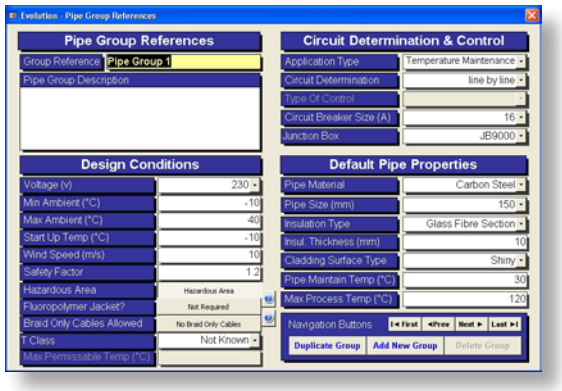
Evolution is pre-set with Parallel Self-Regulating as priority 1 and Parallel Constant Power as priority 2. Thus Evolution will select a self-regulating cable solution first. If one doesn't exist, then it will select a constant power solution before considering the cost per metre of pipe.

Approved Cables

If the heating cables must carry a specific approval, then the user selects this option to specify the *Approval Body*. Evolution will now only select cables that are approved by the selected *Approval Body*.

This option saves the user a lot of time looking through Heat Trace's extensive product approvals to determine if the cable is approved. This ensures that unapproved products are not selected.

***Pipe Groups* allows the user to split the enquiry into different sections. Each section can then have different applications parameters or methods of circuit calculation.**



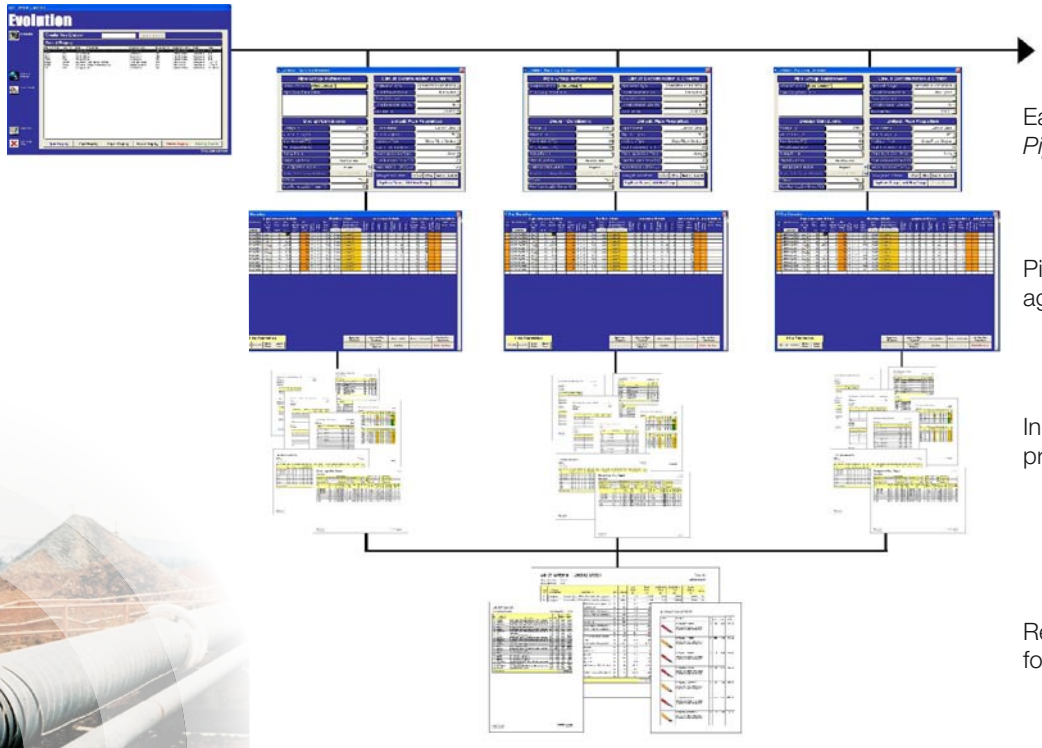
There may be various reasons for splitting an enquiry and it is at the user's discretion to split it in any way he chooses. Typical reasons for doing this are:

- The voltage to be used for calculations and product selections is set at the group level. Having more groups allows the user to have different voltages in the same enquiry.
- The enquiry may consist of both a Hazardous Area section and a Safe area section. It is good practice to separate the two areas. The enquiry may also consist of Hazardous areas with different T-Classes. A new group must be created for each T-Class as this is set at group level.
- Different applications such as Temperature Maintenance, Heat Raise and Tanks are set at group level. So if the enquiry consists of both Heat Raise and Temperature Maintenance, then a group must be created for each.
- The enquiry may specify, or the user may wish to split the quotation and bill of material into different areas of the plant. A group could be created for each area and then reports will present the data broken into these groups.
- The user may wish to provide different options for the customer. For instance, an option A using self-regulating heat tracers and an option B for constant power heat tracers. Setting up two groups named Option A and Option B will allow this to be done.

Pipe groups allows the user to do the following:

- To keep all heat tracing applications, voltages, T-class variations etc, for the same enquiry in one piece of software and under the same enquiry reference.
- To produce infinitely flexible quotations and reports.
- To analyse requirements for different parts of the enquiry or areas of the plant both separately and collectively, without any additional work.
- To manage large amounts of input data by breaking it down into groups. This will improve accuracy in the first instance and make it easier to check data input.

Pipe Groups sets Evolution above it's competition for flexibility, ease of use and efficient use of resource.



Each enquiry can have as many *Pipe Groups* as required.

Pipe Line Items are entered against a particular *Pipe Group*.

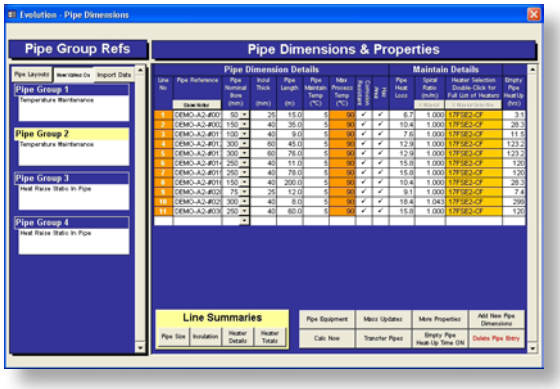
Individual reports can be produced for each *Pipe Group*.

Reports can also be produced for the overall enquiry

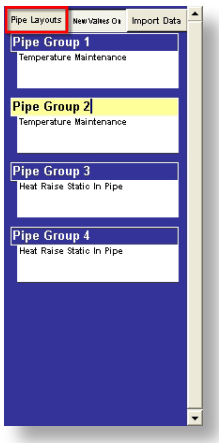
Pipe Dimensions – The Engine Room

The *Pipe Dimensions* screen is the engine room of Evolution. It is where the user enters the details of each pipe to be temperature maintained, heat raised or each tank to be heated and so on.

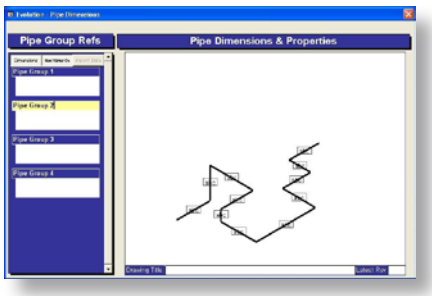
The *Pipe Groups* are listed on the left and the user can select a group to display the pipe or tank data for that group.



When a line item of pipe data is added or edited Evolution performs numerous calculations to determine the best cable solution according to the user's selections. Evolution calculates for all possible heaters and selects the most appropriate in terms of safety and cost.

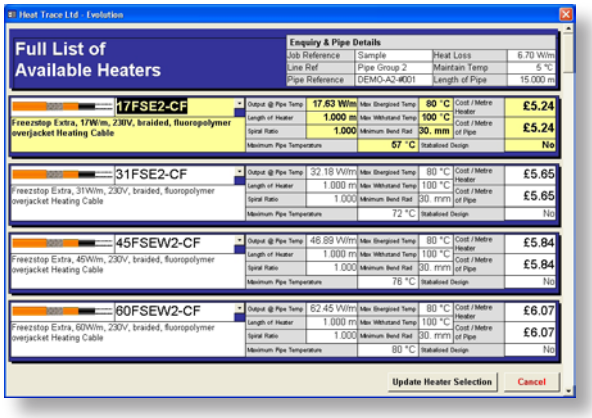


The *Pipe Groups* are listed on the left and the user can select a group to display the pipe or tank data for that group. The *Pipe Layout's* button toggles between the dimension data screen and the *Pipe Layout* screen.



Manual Heater Selection

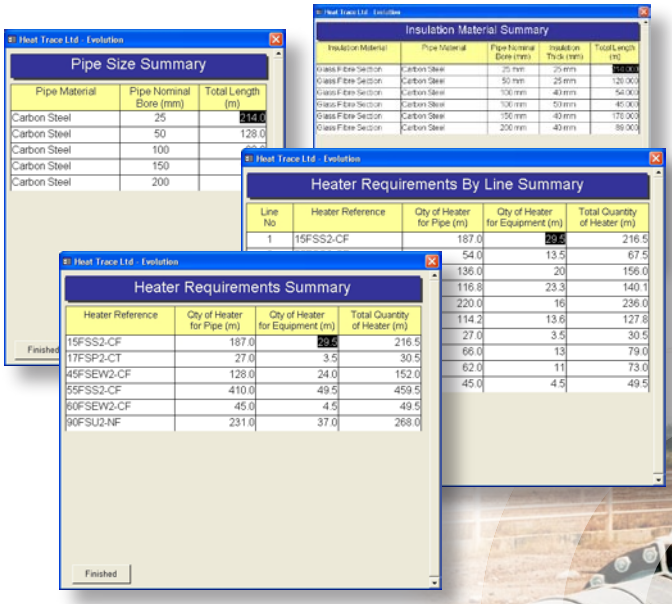
When Evolution selects the most appropriate cable, it determines, where possible, a solution for all cables selected in the Heater Selections section of the enquiry. All these solutions can be viewed by double-clicking the heater selection field. The user can override Evolution's selection and choose a different cable.



The user may wish to do this for a number of reasons. Evolution differs from other software packages in that it can be done easily. Evolution will make all the adjustments necessary, for the user's selected cable. Evolution highlights manual selections, identifying those lines that have been overridden.

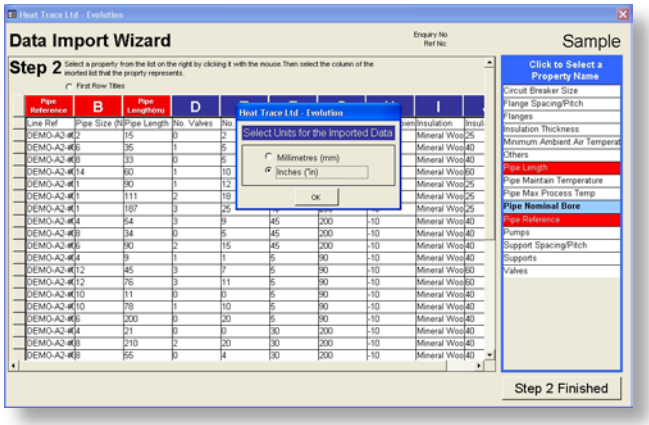
Line Summaries

A number of *Line Summaries* are available at any time by clicking the *Line Summaries*' buttons. *Line Summaries* summarise pipe size, insulation type, insulation thickness, heater selections and heater quantities.

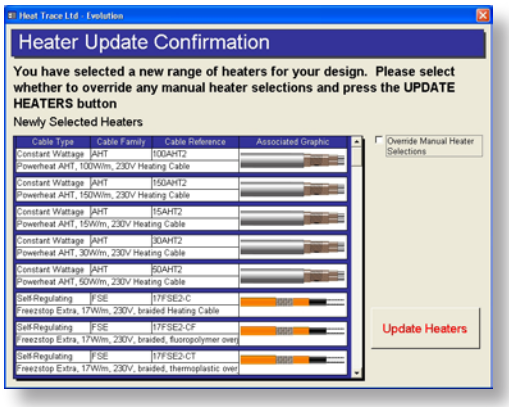


Data Import Wizard

The *Data Import Wizard* allows data to be imported directly into Evolution. Data can be imported from most Pipe Design Management Systems (PDMS). The order and format of the data is irrelevant as the *Data Import Wizard* validates and arranges the imported data for you.



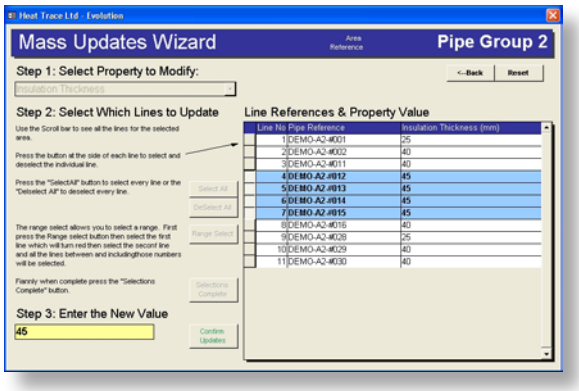
Once imported, Evolution automatically performs all calculations and product selections.



Inputting line item data manually is the single biggest drain on resource in the design process. Importing data saves all this time, and eliminates data input error.

Mass Updates Wizard

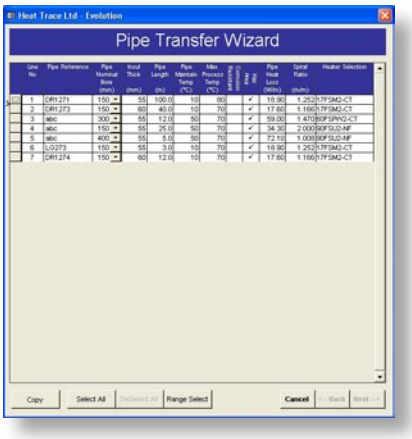
The *Mass Updates Wizard* allows the user to update many properties of their design, or pipe dimension data, in a single action.



Enquiry design parameters often change between quotation and order placement. *Mass Updates Wizard* enables these changes to be realised in just a few minutes, significantly reducing the time spent on quotations and the commitments of an essential resource.

Pipe Transfer Wizard

The *Pipe Transfer Wizard* is used to transfer pipe data from one group to another. If the user enters many lines items of data on to a single group and then subsequently decides that the quotation would be better split into a number of groups, then the *Pipe Transfer Wizard* allows this to done.



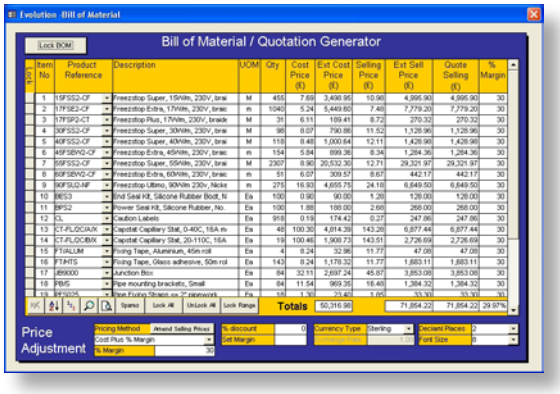
This can also work in reverse when the user has a number of groups and wishes to consolidate the pipe line item data into fewer groups.

The *Copy* button allows the pipe data to be copied instead of moved from one group to another.

Bill of Material

Evolution compiles a *Bill of Material* according to the user's product and cable selections. Evolution collates product descriptions, the user's cost prices, the customer's selling prices according to the enquiry *Selling Price Structure* and determines the margin for the products.

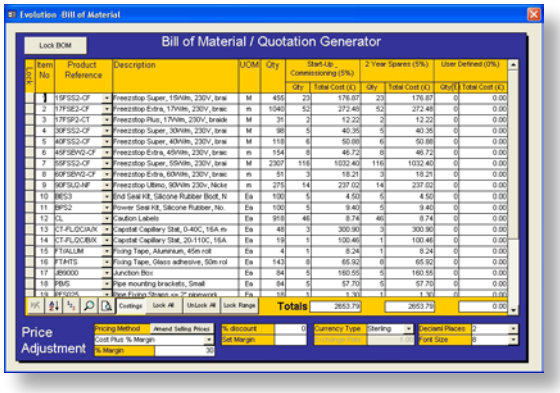
Evolution then displays the *Bill of Material* screen. This screen shows each separate product and the total quantity required for all groups. The function of this screen is for the user to adjust and check the selling prices to be applied for this enquiry.



The *Bill of Material* is the section in the enquiry where the user can view the results of the product selections made. The user is able to add additional Heat Trace Products. The products database also includes a number of miscellaneous items such as packing, shipping, engineering and documentation, which can be added to the *Bill of Material*.

Spares

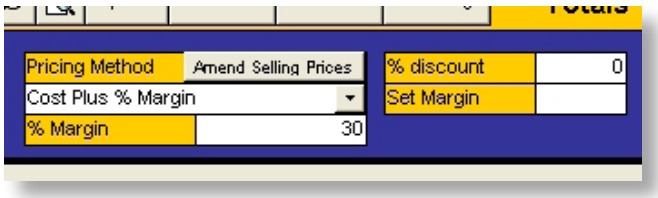
The *Bill of Material* screen has input fields for the provision of up to three types of spares. Spares can be manually added, or calculated on a percentage basis of the total quantity of the product.



Price and Margin Adjustment

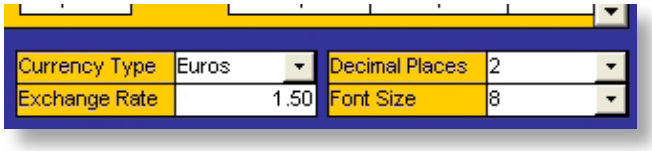
There are a number of ways in which prices and margins can be manipulated. The simplest way is to go to the price or margin that needs changing and simply type the new value. If a cost price or selling price is changed, then the margin will be recalculated automatically. If a margin is changed, then the selling price will be recalculated automatically.

The *Selling Price Structure* for the enquiry can also be viewed and amended. Amendments will cause the selling prices and margins to be recalculated.



The user can use the *Set Margin* field to set the margin of many product lines in one action. All the selling prices will then be recalculated.

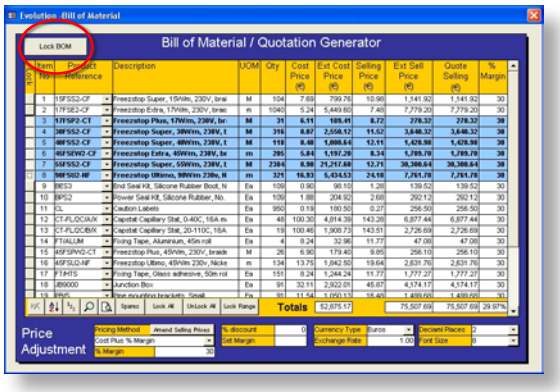
The user can use the *% Discount* field to reduce or increase the selling prices by a percentage. The selling prices and margins will be recalculated.



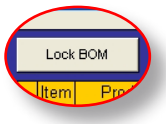
Currency and exchange rates can be set for the enquiry

Bill of Material Controls

The user can change the item number for each line of the *Bill of Material*. This allows the user to sequence the items into any order. The item numbers can then be automatically re-numbered.



Items on the *Bill of Material* can be locked so that any automatic changes, caused by applying discounts or setting margins do not affect the locked item. Locked items are highlighted.



The *Lock BOM* button locks the entire bill of material. Once locked the *Bill of Material* cannot be edited or any prices recalculated.

Locking individual items, or the entire *Bill of Material*, is particularly useful in preventing unwanted changes.

Preview Products

The *Preview Products* button uses the features of the *Product Library* to display a graphic of each of the products listed in the *Bill of Material*. With a few simple clicks, the user can navigate to view datasheets and product literature of the selected products. This further negates the need for the user to have more than just basic product knowledge.

Product Search and Select

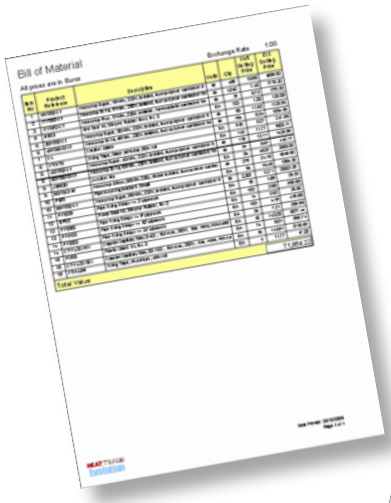
The *Product Search* button again uses the features of the *Product Library*, but this time, it allows the user to find products in the database. The product can then be automatically added to the *Bill of Material* together with appropriate pricing.

Quotations & Reports – It's all for free.

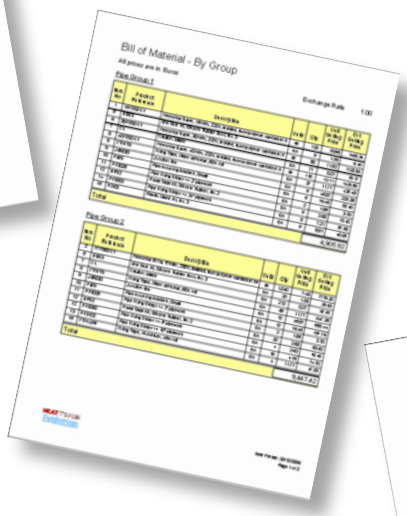
Evolution comes equipped with all the predefined reports required to satisfy everyone from the engineer and company accountant to the procurement officer and installer.

Reports are broken down into a number of categories:

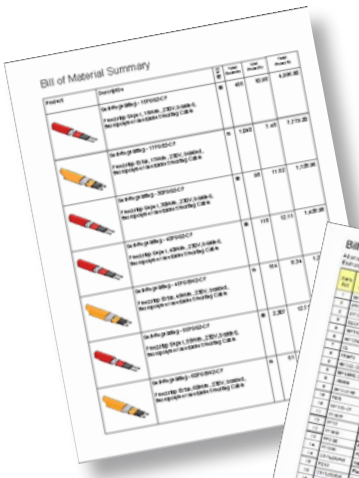
Bill of Material Reports



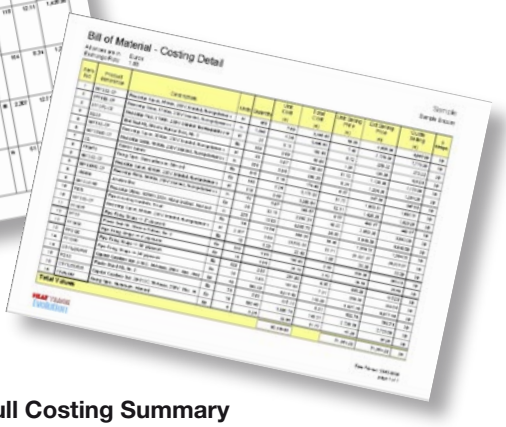
Bill of Material List
A summary of all products, quantities and quotation selling prices.



Bill of Material List by Group
Similar to the above report but this report is broken down to give an individual *Bill of Material* for each pipe group.



Bill of Material Summary
A summary of all products, quantities and quotation selling prices but this report also includes 3D illustrations of the products.



Bill of Material Full Costing Summary
A summary of all products and quantities. This report also includes all product costings, selling prices and margins.

Product Reports

Product Datasheets – Prints a copy of all datasheets for the products listed in the *Bill of Material*.

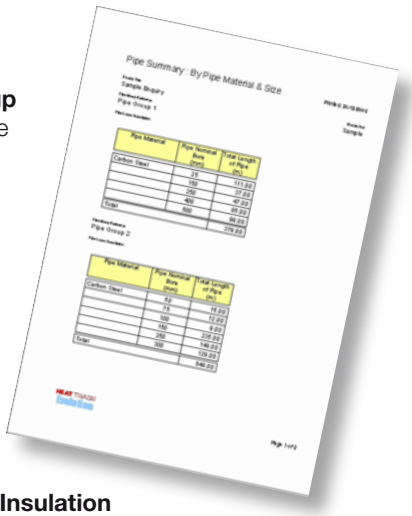
Quotation Reports

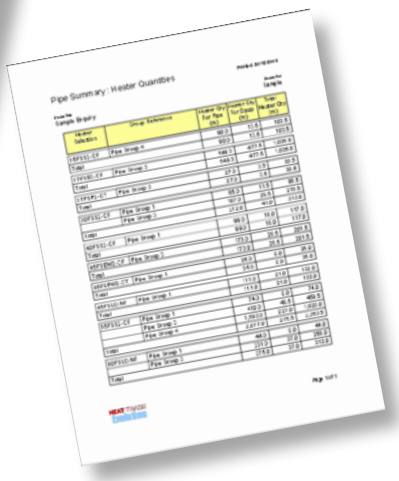
Short Quotation – A short quotation printing the cover letter and *Bill of Material* Summary.

Full Quotation – Compiles a quotation from a quotation template. Templates produced in the *Document Designer* can include text paragraphs, enquiry reports and pre-loaded Microsoft Word documents. Evolution can create a cover letter from a user defined template as a Microsoft Word document. There is an option to include datasheets, that when selected, will print a copy of all the datasheets that relate to the products in the *Bill of Material.*

Summary Reports

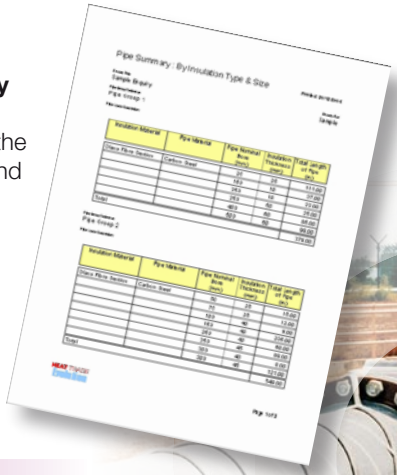
Pipe Size Summary by Group
A summary of each size of pipe and the total length of pipe for each group.





Insulation Summary by Group
A summary of thermal insulation requirements for each pipe size by group. This report can be used to determine the insulation insulation requirements of the project.

Heater Quantity Summary
A summary of the range of heating cables required for the enquiry, showing the type and quantity for each group.

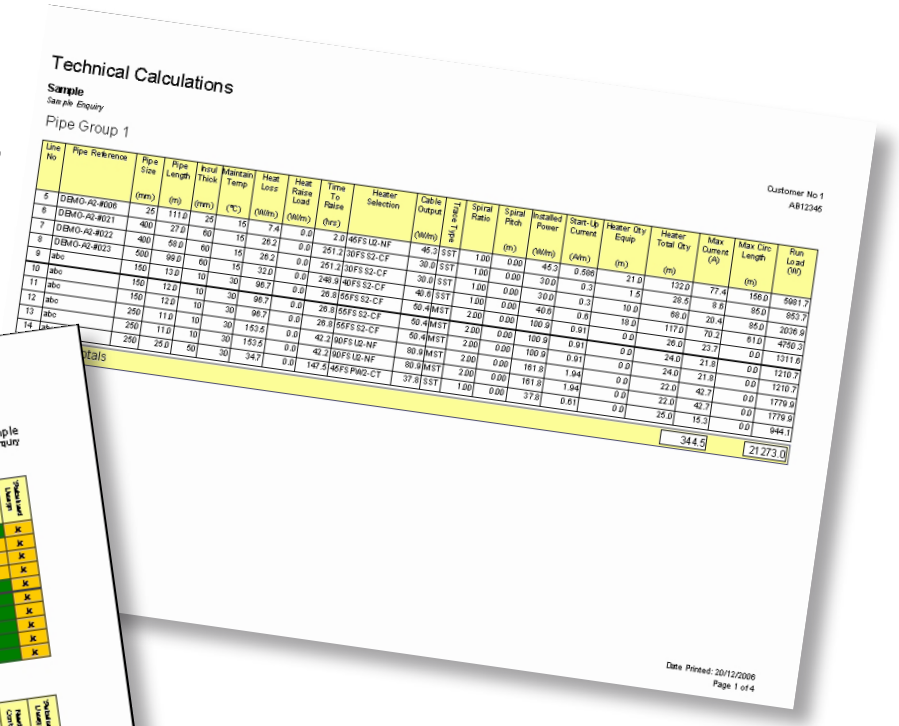


Quotations & Reports – It's all for free.

Technical Reports

Technical Calculations

A detailed technical report showing circuit information such as in-rush current, run current, duty and heater requirements for each pipe line item of the enquiry split into pipe groups


Technical Calculations

Sample

Sample Enquiry

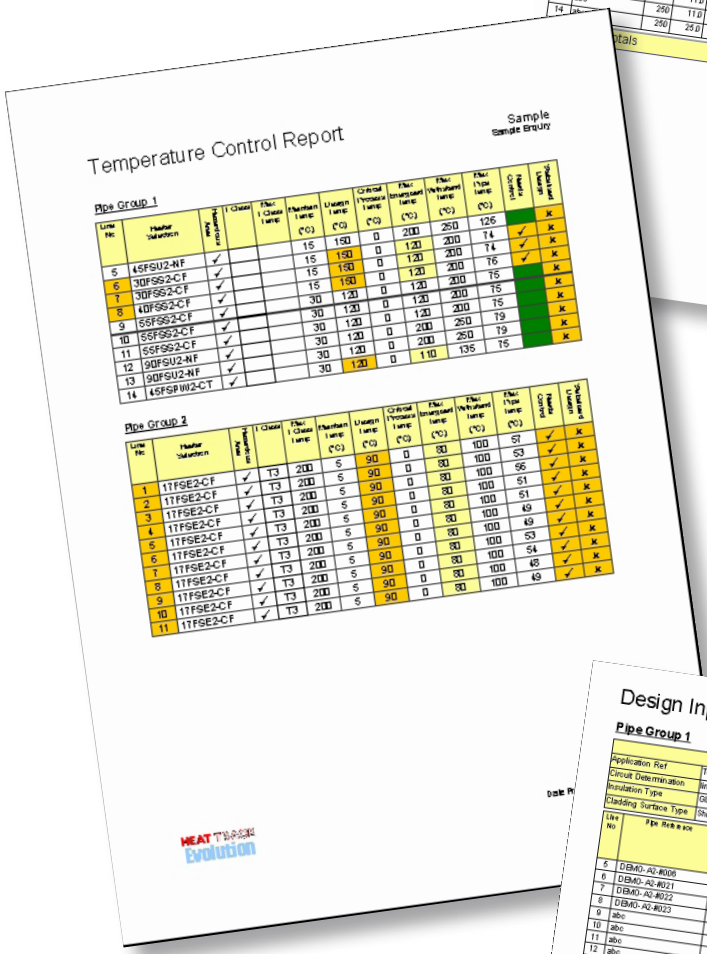
Pipe Group 1

Customer No 1

AB12346

Date Printed: 20/12/2006

Page 1 of 4


Temperature Control Report

Sample

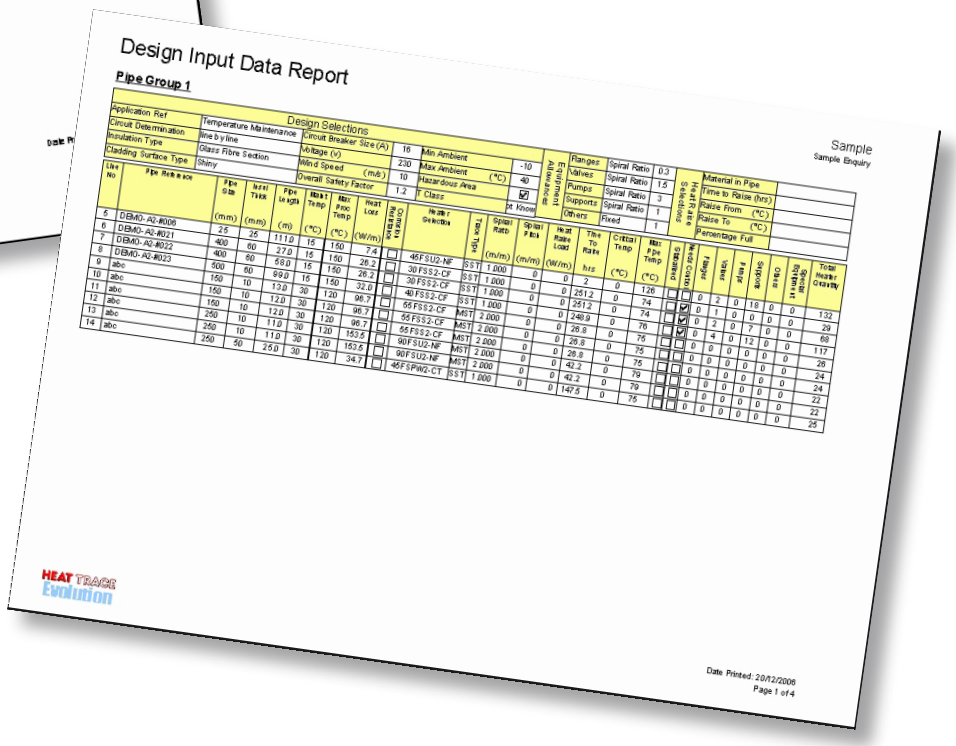
Sample Enquiry

Pipe Group 1

Pipe Group 2

Temperature Control

On this report all pipe line items are expressed in terms of temperature and temperature control requirements. It can be seen at a glance which lines stabilise at a safe temperature and those lines requiring to be controlled to ensure temperature safety.


Design Input Data Report

Pipe Group 1

Sample

Sample Enquiry

Date Printed: 20/12/2006

Page 1 of 4

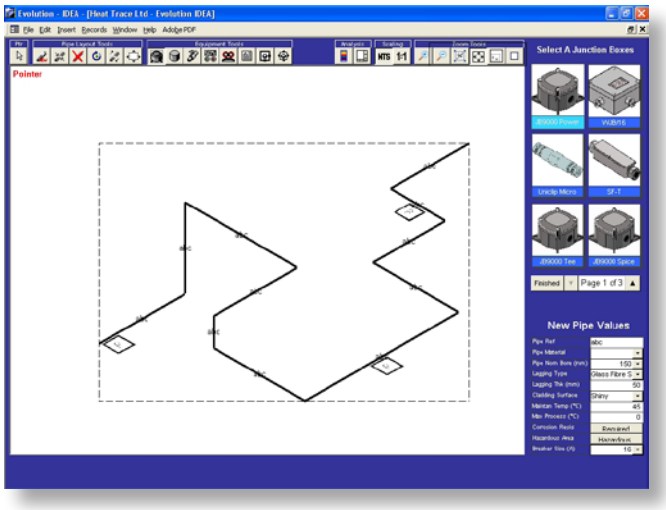
Design Input Data

A detailed report of each pipe line item showing what has been inputted into the design of the system. The report shows all general pipe properties but also pipe line equipment details and the heater allowances used. This report can be used to clearly state what has been included for in the quotation and also to verify user inputs.

The Bigger Picture – Much more than calculations and product selections

Intuitive **D**rawing **E**xchange **A**pplication (**IDEA**)

Evolution has its own *Intuitive Isometric Drawing Package* **IDEA**. The user can draw isometric pipe layout systems on screen, simply using a mouse. It is not necessary to have any knowledge of CAD systems. **IDEA** operates more like a computerised sketchpad.



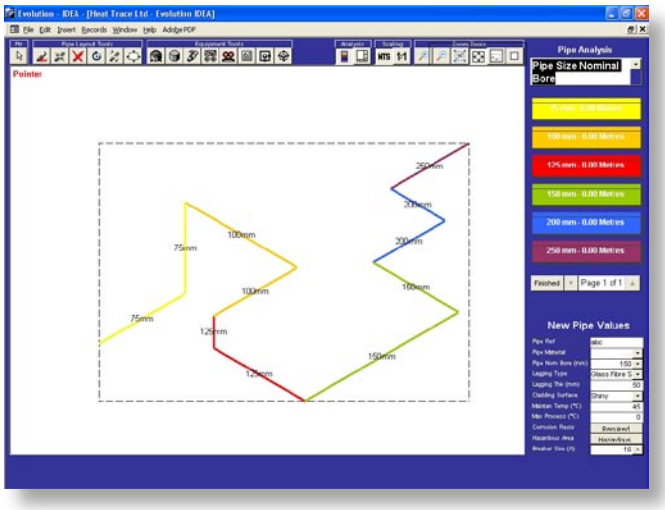
The main principle is that when the user draws a line on the sketchpad it knows it's a piece of pipe with all properties such as size, insulation type and thickness, length and temperatures. As soon as the user clicks to complete drawing a line **IDEA** writes the pipe data into the pipe dimensions list of the enquiry, automatically calculates heat loss, heat raise loads, selects the most appropriate heat tracer and determines stabilised design and temperature control requirements. Although the sketchpad is currently only viewed in 2 dimensions, **IDEA** builds a 3 dimensional understanding of the piping system.

Using simple tools and wizards, it is possible to add equipment such as pumps and valves, position junction boxes, determine circuits and add temperature control and monitoring equipment.

Evolution can now compile an isometric drawing as if produced on a CAD system, and produce a calculated *Bill of Material*. The drawings can then be converted to a file format compatible with CAD systems such as AutoCAD.

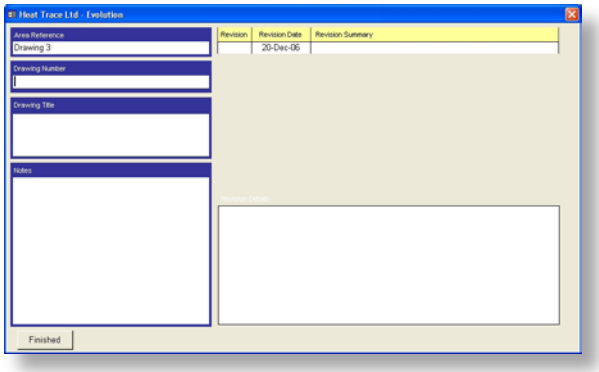
The interface between the drawing and all other functions of Evolution are seamless and the user can move between the drawing and the pipe dimensions screen, making changes in either.

IDEA can also be used to analyse the heat tracing system to view any temperature control issues or to select the best position for a thermostat.



It is obvious that with Evolution's **IDEA**, there are enormous savings in expensive CAD resource. Drawings, calculations, designs, reports and quotations happen simultaneously. Simply draw the pipe layout and the job is done.

IDEA has a built in drawing management screen to control revisions and amendments



With **IDEA** Evolution really is the Complete Heat Tracing Design Software.

Engineering Support

When working with Evolution, Help and Support is never far away. Enquiry data entered can be e-mailed to Heat Trace or any other user with a copy of Evolution. They can then import the enquiry directly into their Evolution and work with the enquiry.

It may be that, for certain enquiries, additional support from Heat Trace is required to confirm the design or to offer alternative solutions to generate a more competitive quotation. Simply E-mail the enquiry to Heat Trace and within seconds we can be reviewing the enquiry data. Once reviewed it can be E-mailed back to the user to update the design.

Web Site Help and Support

Heat Trace's web site has a special section for registered users. The section contains information relating to latest updates, the latest software user's guide, tutorials, FAQ's and news on the latest developments.

Heat Trace EVOLVING to meet the demands of the Future.

Heat Trace is committed to continue to develop and improve it's Evolution software, ensuring that it continues to stay ahead of the competition.

Further developments include:

- Application wizards for specific heat tracing applications.
- Enhanced reporting to allow the user to develop custom reports.
- Drawing / Document Control application.
- Project scheduling and planning application with gant chart creation.
- Addition of commercial and residential heat tracing applications.
- Multi-Lingual versions of Evolution.
- Multi-Media presentations for termination and Installation of Heat Trace products.

The **Heat Tracing Authority™**

Notes

Notes

A Guide to Industrial Electric Heat Tracing

HEAT TRACE™
SETTING THE STANDARDS LEADING THE WAY

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