TRACE HEATING OF HOT WATER SYSTEMS

Infrequent use of Hot Water Taps and Showers within a hot water distribution system means that water will sit within pipework in a no-flow situation.

There are several ways in which to counteract or decrease these heat losses.

- Insulating the pipework.
- Local Systems (Instant Water Heaters)
- Installing a Re-Circulating Hot Water System
- Installing a Single Feed Hot Water System with Trace Heating

Insulation

The use of insulation is required on all systems as insulating distribution pipework can improve the efficiency of the hot water system by around 70% (Stephen and Mason, 1987) this data is based on a domestic system, so for larger commercial buildings the potential heat losses that the pipework would experience are unacceptable.

Instant Hot Water Heaters

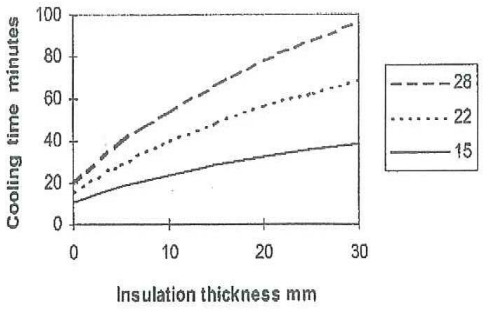
Instantaneous or demand hot water heating systems rely on a water heater installed at the point of exit form the hot water system which individually heats the water demanded by the adjacent tap. A benefit that is seen with this type of system is that there is no requirement for the ‘flow and return’ type system to maintain the water temperature. (NAHB Research Centre Inc, 2002). However there are potential capital cost savings compared to these local systems which require heaters at every outlet by using a centralised system (Day, Ratcliffe and Shepherd, 2008).

Re-Circulating Hot Water System

The system is designed to pump a continuous flow of hot water around a ‘flow and return’ circuit which is fed by a storage tank. Over the ’flow and return’ length the temperature of the final leg of the return pipe must not fall below the specified water temperature, which should not be less than 50ºC (HSE Legionnaires’ Disease 2004 Code of Practice). This requires water to be heated to 60-65ºC when exiting the boiler so that it does not drop below 50ºC on return.

The ‘flow and return’ system does not however maintain the water temperature within the pipes which serve the individual taps, known as ‘droppers’ or ‘dead legs’. These lengths will fall in temperature. To meet HSE requirements, water from ‘dead legs’ must reach 50ºC within 1 minute of discharge commencing.

ESH Trace Heating Ltd, Unit 10, Hortonwood 33, Telford, Shropshire TF1 7EX
Telephone: (01952) 604033 Fax: (01952) 608122
E-mail: enquiries@eshltd.com Web site: www.eshltd.com
Registered in England N. 4809053

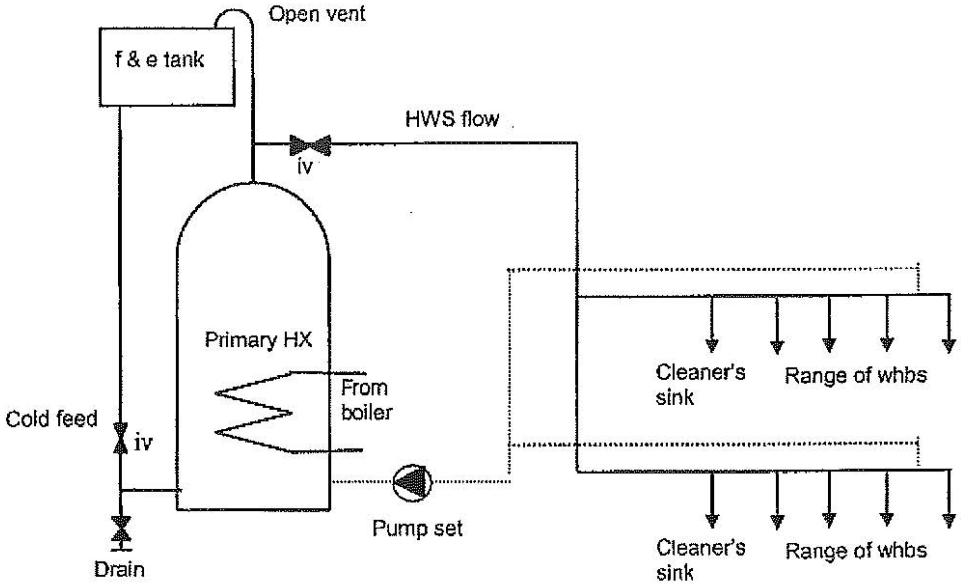


Effect of insulation on cooling rate.
(Day, Ratcliffe and Shepherd 2008).

Insulation slows down the heat loss rate but the water will still eventually fall below an acceptable temperature. Users will run the tap until sufficiently hot water is obtained, wasting significant amounts of lukewarm water. The graph above shows the heat loss rate for various normal pipe sizes and various thicknesses of insulation for the time taken for the water temperature, initially at 65ºC, to fall to 50ºC (when the ambient temperature is 20ºC).

Un-insulated 15mm pipes require only about 10 minutes for the water to cool down whereas adding commonly used 10mm thick DIY insulation extends this to about 24minutes. Yet increasing the thickness to 15mm would only slow down the process by a few minutes.

Estimating the quantity of energy (and water) wasted in this way is very difficult as it depends on the frequency of use, amount of water which needs to be run off (dead leg), and the behaviour of the occupants. A simple model suggests a cost of about £30/year for a domestic system. So total losses are about £43 (for an insulated system) in total annual costs of around £100. in other words, even a well-insulated system is only about 55-60% efficient (Day, Ratcliffe and Shepherd 2008).



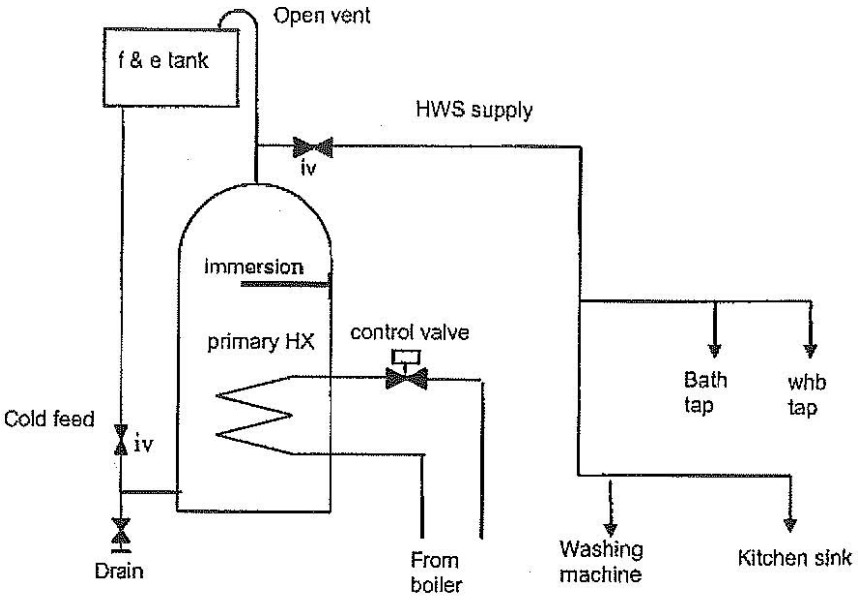
Non-domestic HWS storage installation with return circuit.
(Day, Ratcliffe and Shepherd 2008).

ESH Trace Heating Ltd, Unit 10, Hortonwood 33, Telford, Shropshire TF1 7EX
Telephone: (01952) 604033 Fax: (01952) 608122
E-mail: enquiries@eshltd.com Web site: www.eshltd.com

Trace Heated (ESH) Single Feed Hot Water System

Day, Ratcliffe and Shepherd (2008) state that a trace heated system is probably preferable to a circulatory system.

Installing a single feed hot water system which is then trace heated instantly removes the need for 'return' pipe work as needed by the 'flow and return' system. The system is designed to maintain the temperature within the pipework rather than pumping cooler water back to the boiler then re-heating to the required temperature.



Single Feed HWS storage installation.
(Day, Ratcliffe and Shepherd 2008).

The utilisation of this type of system allows the full length of the pipework to be maintained at the required temperature and therefore the water is at the required temperature at the point of exit which stops wastage of 'cold' or 'lukewarm' water within the 'dead leg' of a 'flow and return' system.

The heating of the entire length of the pipework also protects the installation from Legionnaires' Disease which are common and can be found naturally in low numbers in water sources such as lakes, rivers and reservoirs. Maintain temperatures exceeding 50ºC are required where the discharge would not otherwise reach 50ºC In 1 minute. It is normal practice to install the Trace Heating to within 1-1.5m from the Thermostatic Mixing Valve (TMV) (HSE Legionnaires' Disease 2004).

The two industry standards for trace heating cable are 55ºC and 65ºC. The 55ºC cable will ensure a constant temperature above 50ºC so that Legionnaires' Disease can not grow whereas the 65ºC cable can raise the pipe temperature to above 60ºC which will kill any present Legionnaires' Bacteria (HSE Legionnaires' Disease 2004).

ESH Trace Heating Ltd, Unit 10, Hortonwood 33, Telford, Shropshire TF1 7EX
Telephone: (01952) 604033 Fax: (01952) 608122
E-mail: enquiries@eshltd.com Web site: www.eshltd.com

System Costs

Estimating the energy and water wastage, as with the re-circulation system, is difficult as it is also very much dependant on the frequency of use, but obviously does not suffer from water wastage and loss of temperature.

The use of **Insulated Trace Heating improves the system efficiency to 75%** and effectively doubles the volume of useful hot water available (Stephen and Mason 1987).

As with any heating system it is more economical to maintain a temperature than it is to continually re-heat a material.

If a heat traced system is permanently energised to maintain the temperature at 55ºC based on a electricity cost of 12p/kWh (peak demand), and heat trace loading of 9 watts per metre of pipe, then the maximum annual trace heating cost would be 847p per metre of pipe. The boiler may not require to be operational at night or weekends.

A re-circulatory system with insulated pipework would require a boiler exit temperature 65ºC to ensure a minimum temperature of 50ºc for return to the boiler. Re-circulated water would require re-heating to 65ºc and night time/weekend boiler shutdown would require reheating of water from even lower temperatures.

Heat loss from a re-circulatory system would be twice that of a trace heated system (double length of pipework) plus the cost of reheating water. Running costs would be dependant upon the rate of water circulation but with losses and reheating, would certainly exceed those of a trace heated system.

Summary

Trace heated systems simple to install and are very reliable, with relatively low maintenance requirements, are efficient in reducing the need for water re-heating, eliminate return pipe work and pump.

Capital costs are reduced, water is saved by eliminating ‘dead leg’ waste and system efficiency is increased.

Please refer to ESH Trace Heating specification sheets listed below for technical details (all pages are available on our website www.eshltd.com within the hot water products section).

F1021	Heating Tapes Parallel Self Limiting
F1068	Self Limiting Schematic
F1024-1	Type H2O WAT Heating Tape
F1302	ESRS FBT H2OWAT TERMINATION INSTRUCTIONS

This information is by no means detailed, but hopefully will give some information concerning some of the differences between re-circulatory and trace heated hot water systems.

For further information, please contact ESH Trace Heating Ltd.

Acknowledgements:-
A.R. Day, M.S. Ratcliffe and K.J. Shepherd. (2008). Heating Systems, Plant and Control (pages 227-246). www3.interscience.wiley.com.
NAHB Research Centre Inc (2002). Domestic Hot Water System modelling for the design of energy efficient systems.
F.R. Stephen and C. Mason. (1987) Trace Heating of Domestic Hot water Pipework. The Electricity Council Research Centre.

ESH Trace Heating Ltd, Unit 10, Hortonwood 33, Telford, Shropshire TF1 7EX
Telephone: (01952) 604033 Fax: (01952) 608122
E-mail: enquiries@eshltd.com Web site: www.eshltd.com