

Unvented Hot Water Storage Systems

CDA Information Sheet 51, 1990

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December 1990

Acknowledgements

Copper Development Association wishes to acknowledge the assistance given by IMI Range Ltd in the preparation of this Information Sheet.

Copper Development Association

Copper Development Association is a non-trading organisation sponsored by the copper producers and fabricators to encourage the use of copper and copper alloys and to promote their correct and efficient application. Its services, which include the provision of technical advice and information, are available to those interested in the utilisation of copper in all its aspects. The Association also provides a link between research and user industries and maintains close contact with other copper development associations throughout the world.

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Unvented Hot Water Storage Systems



Introduction

Copper cylinders have been used to store hot water in British homes for more than 90 years.

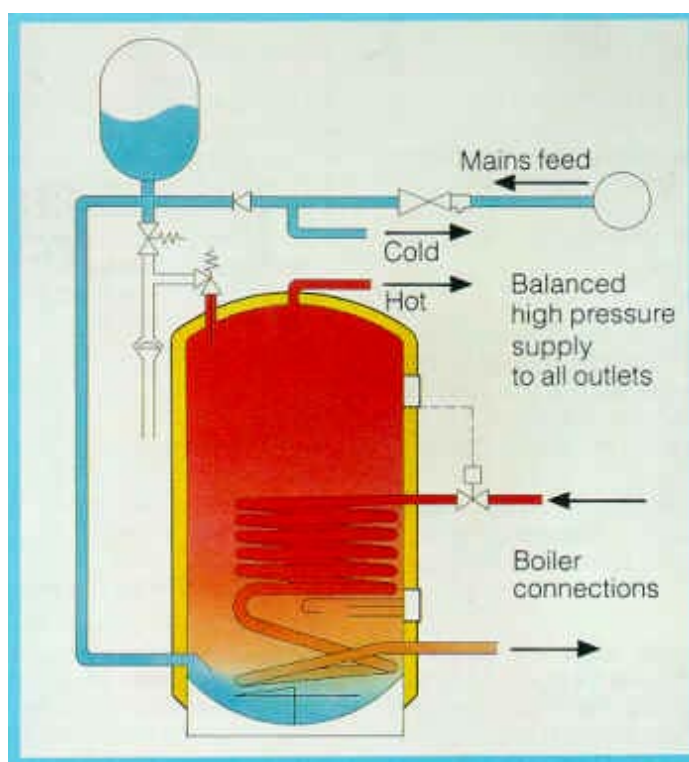
The advantages of copper as a material in hot water systems are unrivalled and have been proven many times over. Its resistance to corrosion and heat transfer capability are properties which make copper a natural and ideal metal used universally throughout British plumbing practice. Indeed, there are currently over 20 million copper hot water systems installed in the UK.

An emerging demand is now being seen for unvented hot water storage cylinders and the same properties that have made copper synonymous with domestic hot water in Great Britain apply equally in unvented packages.

The traditional British domestic hot water supply system, in which water is heated and stored for use, is based on cold water feed from a storage cistern to a heated cylinder that is vented to the atmosphere. The flow rate and pressure of the hot water discharged from the hot water outlets is then dependent on the height of the storage cistern above the outlets.

The desire to remove cisterns from the roof space means increasing difficulties in meeting consumer demands for modern designs of high performance hot water systems and in particular the growing market for showers, from traditional open vented systems.

Unvented domestic hot water systems can, however, meet these expectations by utilising regulated cold water supplied directly from the mains to the heated storage cylinder. Included with the cylinder is a package of safety devices and controls to regulate temperature and pressures within the system. This type of system can provide flow rates in excess of 25 litres/min thus meeting BS6700 specification for design flow rates of 18 litres/min whilst retaining the facility for simultaneous draw-off from other hot water outlets.



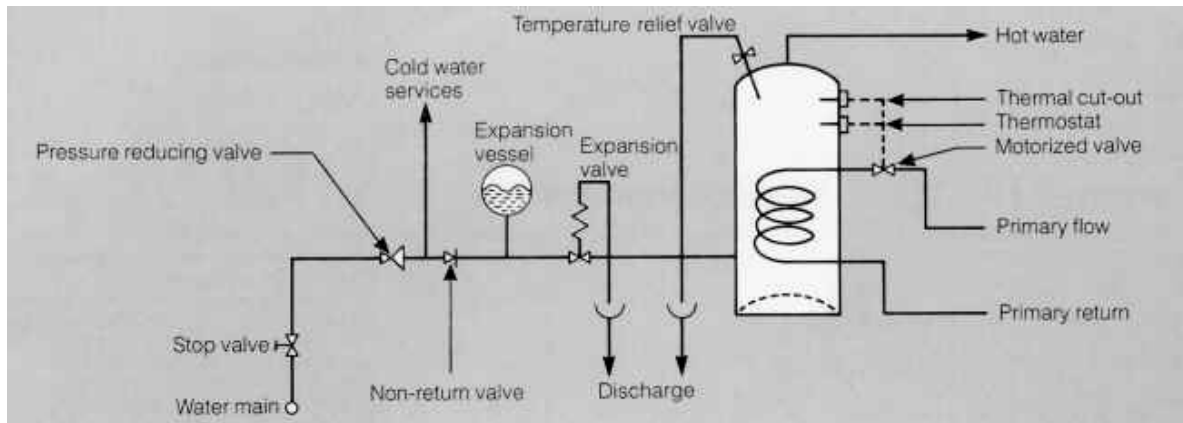
Copper Storage Cylinder

The shell is constructed from copper sheet to BS EN 1653. The thickness of the sheet for the cylinder will depend on the diameter of the cylinder body and the expansion relief valve setting. (Typically thicknesses up to 1.5 mm for cylinders of 450 mm diameter and expansion relief valve setting 3.5 bar). Each cylinder is tested to a minimum of 1.5 times the working pressure.

The seams in the cylinder are jointed by brazing, butt welding or for small cylinders with a diameter less than 250 mm soft soldering (circumferential seams only), using those filler alloys specified in BS1845, BS290:Part 3 and BS EN 29453 respectively and recommended in BS 7206.

Each cylinder is protected from corrosion by an aluminium rod which will, in aggressive waters, corrode preferentially. This protection device and the inherent corrosion resistance of copper ensures long life and durability.

A layer of insulation is applied externally to retain the heat within the cylinder. This insulation is usually polyurethane foam which maintains a heat loss not exceeding 1W per litre of capacity, as specified in BS1566:Part 1.



Unvented system indirectly heated

Means of Water Heating

The means of heating the water in the storage cylinder may be either a) direct, which entails one or more immersion heaters in the cylinder, or b) indirect, in which case the contents of the storage cylinder are heated by a primary heater of the copper coil heat exchanger type.

In both cases the heat source is subject to thermostatic control. Should the thermostat fail the energy input to the storage cylinder, either from an immersion heater or a copper coil heat exchanger, will be interrupted by an energy cut-out.

Pipework and Fittings

As the pressure in the unvented system is usually greater than the vented system, it may be possible to use copper tube to BS EN 1057 with smaller diameters than traditionally used to achieve the same or an increased water flow rate. However, it may be necessary to use larger diameter pipes from the mains supply to the dwelling to ensure that an adequate flow rate supply to the system is attained.

Connections to the cylinder should be made from copper, gunmetal or dezincification resistant brass. These connections are for use with copper and copper alloy fittings complying with BS EN 1254: Part 1 and Part 2.

To comply with the Water Byelaws it is necessary to include a non-return valve between the system and the cold water supply. This non-return valve will prevent backflow of heated water into the mains supply and crossflow into the domestic cold water supply.

Energy Control

Water for domestic purposes is required to be below 100°C and the requirements of Section G3 of the Building Regulations specify that there must be adequate precautions to prevent the water temperatures from exceeding 100°C.

These safety devices consist of a thermostat on the cylinder, a thermal cut-out operating on the energy input to the system and a temperature relief valve.

It is very important that all the temperature sensing devices fitted to the storage cylinder remain below the water level. The hot water draw-off is therefore situated at the top of the cylinder.

Supply Pressure Control

The water pressure in the mains supply varies over a period of time and it is necessary to control the pressure of the water entering the unvented hot water storage system. A pressure regulating valve is fitted on the domestic supply pipe, to enable the system to be supplied at a constant pressure. This may be fitted either before or after cold water draw-offs depending upon application in order to achieve balanced hot and cold water pressures.

Accommodation of Expansion

Because Water Byelaws do not permit expansion to waste, it is accommodated by the inclusion of an expansion vessel. As an additional safety measure an expansion relief valve is fitted to limit the pressure within the system should the vessel fail. The vessel and the relief valve are fitted in the cold feed to the storage cylinder, keeping them away from unnecessary contact with hot water and potential problems due to the formation of scale.

Advantages of the Copper Unvented System

The advantages of the copper unvented system are:

- Balanced hot and cold water pressures.
- Improved shower performance.
- Less pipework and no storage cistern.
- Reduced risk of frost damage to system.
- Saving on installation time and costs.
- High resistance to corrosion.
- Excellent heat transfer capability.
- Allows the use of a wider range of modern tap fittings and showers.
- High efficiency insulation.
- Flexibility of vessel siting and hence system design.

Approvals

To ensure compliance with Building Regulations, it is important that unvented systems over 15 litre capacity have British Board of Agrément approval.

Alternative Mains Pressure Systems

Alternative copper storage vessels have been developed to provide mains pressure hot water when lower flow rates are acceptable whilst still complying with BS 6700 Code of Practice. These utilise high performance copper heat exchangers operating within thermal stores.

Standards

BS EN 1254 Copper and copper alloys – Plumbing fittings

Part 1 Fittings with ends for capillary soldering or capillary brazing to copper tubes.

Part 2 Fittings with compression ends for use with copper tubes.

BS 1566 Copper indirect cylinders for domestic purposes.

Part 1 Specification for double feed indirect cylinders.

Part 2 Specification for single feed indirect cylinders.

BS EN 1653 Plate, sheet and circles for boilers, pressure vessels and hot water storage units.

BS 1845 Specification for filler metals for brazing.

BS 2901 Specification for filler rods and wires for gas shielded arc-welding.

Part 3 Copper and copper alloys.

BS 6700 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.

BS 7206 Specification for unvented hot water storage units and packages.

BS EN 29453 Soft solder alloys – Chemical compositions and forms.

References

Department of the Environment and The Welsh Office. The Building Regulations.

Department of the Environment, Scottish Development Department and Welsh Office.

Model Water Byelaws.

British Board of Agrément. The assessment of unvented hot water storage systems and the approval and surveillance of installers. MOAT No. 38.

Picture acknowledgements

Unvented system indirectly heated Courtesy: The British Standards Institution.

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