Unit 324HV: Understand complex hot water systems for industrial and commercial buildings

# Delivery guide

Unit information

This unit covers the knowledge and understanding of the principles for industrial and commercial complex hot water systems and their installation. Learners will gain an understanding of how to size systems and components for hot water systems and the specific requirements for the installation of unvented hot water systems in line with current Building Regulations.

Learners may be introduced to this unit by asking themselves questions such as:

* What are the typical configurations of vented and unvented hot water systems?
* What are the applicable Building Regulations for hot water systems in industrial and commercial buildings?
* How is the size of the equipment, components, and accessories determined for hot water systems?

Learning outcomes

1. Understand the layouts and operation of complex hot water systems for industrial and commercial buildings
2. Understand the requirements for installing unvented hot water systems in accordance with the relevant Building Regulations
3. Understand the methods for determining the type and size of equipment components and accessories for complex hot water systems

Suggested resources

Textbooks

* Brown, R. (2014) *BSRIA Illustrated Guide to Hot and Cold Water Services* (BG 33/2014). Berkshire: BSRIA.

ISBN 978-0-8602-2736-6

* CIBSE (2014) Guide G Public health and plumbing engineering. CIBSE. ISBN 978-1-9068-4641-1
* HSE *Legionnaires Disease. The Control of Legionella Bacteria in Water Systems. Approved Code of Practice and Guidance 2013 (L8)*. IBSN 978-0-7176-6615-7
* Oughton, D., Hodkinson, S. and Brailsford, R. M. (2015) *Faber and Kell’s Heating and Air-Conditioning of Buildings*. London: Routledge. ISBN 987-0-4155-2265-6

Websites

* [APHC | Support for Heating Contractors](https://www.aphc.co.uk/)
* [Engineering Toolbox | Homepage](http://www.engineeringtoolbox.com/)
* [GOV.UK | The Water Supply (Water Fittings) Regulations 1999](https://www.legislation.gov.uk/uksi/1999/1148/contents/made)
* [Water Regulations | Water Regulations Guide](https://www.waterregsuk.co.uk/guidance/publications/water-regulations-guide/)

British Standards

* BS EN 806:2012. *Specification for installations inside buildings conveying water for human consumption (Parts 1–5).*
* BS 8558:2015. *Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.*
* BS EN 12897:2002. *Water supply. Specification for indirectly heated unvented (closed) storage water heaters*.

Legislation

* *Building Regulations 2010 Approved Document G: Sanitation, hot water safety and water efficiency*. Newcastle upon Tyne: NBS. ISBN 978-1-8594-6600-1

| **Learning outcomes** | **Criteria** | **Delivery guidance** |
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| 1. Understand the layouts and operation of complex hot water systems for industrial and commercial buildings | * 1. The types and configurations of vented hot water systems | * Learners to know the principles behind the open vented hot water storage system. * Learners to be able to use system layout drawings to discuss the role of the open vent pipe and the cold feed and expansion pipe. * Learners to be able to use images and physical examples to identify the connections to calorifiers and cylinder. * Learners to be shown examples of vented instantaneous heaters and their associated vented taps to help them understand how these units are still classed as vented. * Learners to know the difference between direct and indirect storage systems. * Learners to know the layouts of these systems, including unvented systems, indirect centralised systems that incorporate plate heat exchangers, localised and instantaneous heaters and storage calorifiers and the requirement for circuits. * Learners to be shown the difference between this and the indirect types using examples of gas fired direct storage heaters and electric vented storage heaters. * Learners to be shown the difference between centralised and localised hot water, using systems within the centre. * Learners to be shown presentations and to inspect physical examples of systems and hot water generators and discuss: * centralised systems * open vented hot water systems * localised systems * instantaneous vented heaters * indirect storage systems (including water jacketed tube heaters) * direct storage systems * electrically heated * gas or oil fired * bulk storage heaters (combination tank). |
| * 1. The types and configurations of unvented hot water systems | * Learners to understand vented systems and to be able to identify the roles of each vital system part (open vent, cold feed and expansion pipe, cistern etc.). * Learners to look at an unvented system layout and consider what roles have now been removed by the omission of cistern, open vent pipe etc. * Learners to know the vital parts of an unvented system. * Learners to be shown images, presentations and physical examples of unvented hot water systems and to be able to identify the vital system layouts and positions of connections, safety and functional controls. * Learners to be shown examples of expansion vessels used within potable systems and their positions within the unvented system. * Learners to know the reasons for the positioning of balanced cold water connections and the use of backflow protection devices within the system. * Learners to be familiar with the following: * unvented point of use heaters * localised * centralised * indirect storage systems * combination boilers * internal expansion cylinders. |
| * 1. The types and configurations of solar thermal hot water systems | * Learners to know the basic arrangement of solar thermal hot water systems and the main components such as collectors, pump unit and storage vessel. * Learners to know the different types of collectors, including flat and evacuated tube types, and how to use manufacturers’ literature and videos. * Learners to be shown singe and twin coil storage vessels and cylinders and to know the methods for controlling the temperature within the vessel. * Learners to know the need for temperature and pressure relief valves and to understand the use of glycol within the sealed circuit. |
| * 1. The pipework layout features of complex hot water systems for industrial and commercial buildings | * Learners to know about hot water systems within Instrumentation and Control (I&C) buildings. * Learners to know how the following hot water system terms interlink to provide an efficient and suitable system: * direct and indirect * vented and unvented * direct and indirect * cylinders * calorifiers * solar thermal * thermal stores * combination boilers * secondary circulation * location and type of pump * automated timing devices * methods of balancing systems * control systems including Building Management System (BMS). * Learners to be shown presentations, physical systems and system drawings to explain how larger more complex systems operate and how pipework should be installed in a specific manner, including the use of secondary circulation in more detail and the position of the secondary pump. * Learners to be able to sketch more complex system arrangements and to be comfortable with central hot water system layouts. * Learners to be able to investigate options for multi-storey buildings and to know whether up feed or down feed systems are more suitable or whether localised systems fed via boosted cold water supplies are a better option. |
| 1. Understand the requirements for installing unvented hot water systems in accordance with the relevant Building Regulations | * 1. The documents which should be followed when installing, repairing or maintaining unvented hot water systems | * Learners to refer to the following documents: * Building Regulations 2010 Approved Document G: Sanitation, hot water safety and water efficiency * Building Regulations Parts L and M * Gas Safety (Installation and Use) Regulations 1998 * The Water Supply (Water Fittings) Regulations 1999 * manufacturers’ instructions. * Learners to use reference documents to investigate the requirements of more complex hot water systems within this unit. * Learners to be given exercises asking them to find certain pieces of information within these documents or to use these documents throughout the unit as the information is delivered. |
| * 1. The recommended design temperatures for hot water systems | * Learners to be able to state the recommended design temperatures within hot water systems and to identify where this information is located using relevant documents within the unit. * Learners to be set tasks to use documentation to confirm temperatures of given scenarios. These temperatures include the following at a range of building types including health care facilities: * storage temperatures * distribution temperatures * secondary circulation temperatures and temperatures at outlets including wash hand basins (WHBs) * showers and baths. |
| * 1. The types and operation of safety controls used within Unvented Hot Water systems | * Learners to be shown presentations and physical system examples of the operation of Unvented Hot Water (UVHW) safety controls. * Learners to be able to explain the difference between safety and functional controls and to be comfortable with the three-stage safety controls and their relevant operating temperatures. * Learners to be able to look at physical components to discuss their operation and how they are designed to interrupt the heat source. * Learners to know how these are interlinked with the heat source whether it be fuel (gas, oil, Liquefied Petroleum Gas (LPG)), Low Temperature Hot Water (LPHW) (automatic valves) or direct electric. * Learners to know that ECO types should be manually re-settable only and that automatic resetting types are not to be used. |
| * 1. The types and operation of functional controls used within unvented hot water systems | * Learners to be able to use a range of physical examples within the classroom and workshop to explain how the functional controls within a UVHW system operate. * Learners to be able to use expansion vessels with open sides to show how water is accommodated during expansion. * Learners to open up strainers to discover how they catch debris within the system. * Learners to look at installed systems to investigate pressure reducing valves including multifunction type valves that incorporate a range of functions. * Learners to be set tasks to install components within systems or to be able to identify and explain the purpose of components that are already in position including: * line strainer * pressure relief valve * check valves * expansion vessel/integral vessel * tundish * composite valves. * Learners to know the difference between expansion relief valves and temperature/pressure relief valves. * Learners to be able to explain the circumstances that lead to expansion relief valves operating. |
| * 1. Methods of preventing water exceeding 100°C | * Learners to know about functional and safety controls. * Learners to be able to identify the requirements to prevent hot water exceeding 100°C and to refer to Building Regulations 2010 Approved Document G3: Hot water supply and systems. * Learners to be able to explain how the safety controls interlock the relevant heat sources in a range of systems using a number of fuel sources such as natural gas, oil, LPG, LPHW and electricity. * Learners to know what temperatures these interlocks operate at and the three stages of safety controls for the thermostat, ECO and temperature and pressure relief valve. |
| * 1. The methods of ensuring balanced pressures within unvented hot water system | * Learners to be able to use system drawings to identify and explain the importance of balanced hot and cold water pressures. * Learners to understand the implications of unbalanced pressures on the hot and cold water systems. * Learners to be able to look at physical systems and trace pipework to show where cold water connections are most suited and to discuss their positions relevant to non-return valves and pressure reducing valves. |
| * 1. The installation and positioning requirements for safety discharge pipework | * Learners to use relevant documentation to investigate the suitable options of safety discharge pipework. * Learners to know the difference between D1 and D2 pipework, materials, dimensions and visibility. * Learners to be shown examples of tundishes and pipework arrangements. * Learners to be set exercises and to use tables for discharge pipe sizing to identify sizes and routes for discharge pipework. * Learners to know the distances required between components, the suitable angles and termination requirements. * Learners to be given the opportunity to install pipework where facilities allow and to inspect installed systems and note any installations which do not meet the requirements of the Building Regulations. |
| * 1. The specific commissioning requirements for unvented hot water systems | * Learners to be shown presentations and practical demonstrations to explain the step-by-step processes involved during the commissioning stage of unvented hot water systems including: * visual checks * temperature adjustment * flow rates * pressures * safety devices. * Learners to be set tasks to carry out commissioning checks under supervision. |
| * 1. The cause and rectification methods of common faults related to unvented hot water systems | * Learners to be able to discuss potential faults within unvented hot water systems and the consequences of those faults including: * expansion relief valve discharging * temperature relief valve discharging * low pressure * no heat. * Learners to be able to use pre-designed practical training rigs to demonstrate these faults. * Learners to be set tasks to identify faults in a range of circumstances and discuss the options for rectification. |
| * 1. The requirements for competence and limitations to authority when carrying out work on unvented hot water systems | * Learners to be able to use Building Regulations and British Standards to explain the legal requirement for competency when carrying out work on unvented hot water systems. * Learners to know the process involved in becoming an approved operative (applicable for domestic installations only; not industrial commercial). |
| 1. Understand the methods for determining the type and size of equipment components and accessories for complex hot water systems | * 1. The factors to be taken into account when designing complex hot water systems | * Learners to understand the role of the designer when considering hot water systems for I&C buildings. * Learners to be able to list factors that may be taken into consideration by the designer and discuss these as a group. This should include: * daily consumption * maximum average flow rates required * availability of mains supply * variances and surges in pressure * environmental considerations. * Learners to use presentations and manufacturers’ guidance to explain how these factors may vary and what may influence them. |
| * 1. The methods used to calculate the size of hot water discharge pipework and components | * Learners to be familiar with relevant documentation used in the calculation of discharge pipework. * Learners to refer to the Building Regulations to determine suitable pipe sizes of both D1 and D2 pipework. * Learners to be set tasks in small groups to determine pipe sizes for a range of examples before discussing the outcomes as a group. * Learners to know about relevant applications and websites that may assist in this process as an alternative to using standard tables. |
| * 1. The methods used to calculate the requirements of hot water systems and components | * Learners to know about a range of applications and computer programmes that assist the engineer in calculating the pipe sizes, capacity and output of: * water heaters * calorifiers * pipework * cisterns * associated components. * Learners to know how the following assist in the calculation of pipe sizes for hot water systems: * Building Regulations 2010 Approved Document G3: Hot water supply and systems * BS EN 806:2012Specification for installations inside buildings conveying water for human consumption (Parts 1–5) * The Water Supply (Water Fittings) Regulations 1999 and * Manufacturers’ literature. * Learners to be shown presentations to guide them through the process and to work in small teams to calculate water heater outputs and cistern storage capacity requirements. * Learners to be able to use manufacturers’ guidance to select water heater and calorifier types. * Learners to be given guidance on how to specify equipment on behalf of a client by visiting manufacturers where possible. |