Unit 326HV: Understand complex hydronic heating and chilled water systems for industrial and commercial buildings

# Delivery guide

Unit information

This unit covers the knowledge and understanding of the installation of industrial and commercial complex hydronic heating and chilled water systems and its operating principles. Learners will gain an understanding of how to size systems and components for both hydronic heating and chilled water systems.

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

* What are the circuits and controls applicable to complex hydronic heating and chilled water systems in industrial and commercial buildings?
* What are the methods for selecting components off hydronic heating and chilled water systems?

Learning outcomes

1. Understand the operation and application of complex hydronic heating systems, controls and components
2. Understand the operation and application of complex chilled water systems, controls, and components
3. Understand the methods for selecting and determining the size of hydronic heating and chilled water systems and components

Suggested resources

Textbooks

* Bleicher, D. (2017) *BSRIA Illustrated Guide to Mechanical Building Services (BG/31/2017)*. Berkshire: BSRIA.

ISBN 978-0-8602-2758-8

* Brown, R. (2015) *BSRIA Heat Interface Units* (BG 62/2015). Berkshire: BSRIA.

ISBN 978-0-8602-2747-2

* Chadderton, D. (2012) *Building Services Engineering*. London: Taylor & Francis.

ISBN 978-0-4156-9932-7

Websites

* [BESA | TR 6: Guide to Good Practice – Site Pressure Testing of Pipework](https://www.thebesa.com/knowledge/shop/products/tr-6-guide-to-good-practice-site-pressure-testing-of-pipework/)
* [Grundfos | Homepage](http://www.grundfos.co.uk/)
* [Hamworthy | Homepage](http://www.hamworthy-heating.com/)
* [Mikrofill | Vessel Size Calculator](https://mikrofill.com/vessel-calculator)
* [Spirax Sarco | Homepage](http://www.spiraxsarco.com/)
* [Stelrad | Heat Loss Calculator](https://www.stelrad.com/advice-hub/heat-loss-programmes/)
* [Stelrad | Homepage](http://www.stelrad.co.uk/)
* [The Engineering Mindset | Homepage](http://www.engineeringmindset.com)
* [Wolseley | Heat Loss Calculator Tool](https://www.wolseley.co.uk/webapp/wcs/stores/servlet/ProductSelector?catalogId=12001&langId=44&storeId=10203&selectorType=heatloss)

Legislation

* *Building Regulations 2010 Approved Document L2A: Conservation of fuel and power in new buildings other than dwellings. 2013 edition with 2016 amendments.* Newcastle upon Tyne: NBS.

ISBN 978-1-8594-6745-9

| **Learning outcomes** | **Criteria** | **Delivery guidance** |
| --- | --- | --- |
| 1. Understand the operation and application of complex hydronic heating systems, controls and components | * 1. The layout and application of variable temperature constant flow circuits | * Learners to know the application of Variable Temperature (VT) circuits with regards to the processes and appliances they feed. * Learners to be shown system drawings and presentations to show typical examples of VT circuits feeding comfort control systems, such as radiator circuits. * Learners to know why the need for comfort control requires differing control methods in VT circuits, hence the need for mixing valves as opposed to diverting valves. * Learners to be able to examine the load within system layouts and highlight how flow is constant whilst its temperature varies. * Learners to be able to examine systems installed within the centre to generate discussion regarding their physical layouts. |
| * 1. The layout and application of constant temperature variable flow circuits | * Learners to know the application of Current Transformer (CT) circuits with regards to the processes and appliances they feed. * Learners to be shown system drawings and presentations to show typical examples of CT circuits feeding end products such as Fused Connection Units (FCUs), Air Handling Unit (AHUs), heat exchangers and Underfloor Heating (UFH) systems. * Learners to know why the need for constant temperature with varied flow requires differing control methods in CT circuits, hence the need for diverting valves as opposed to mixing valves. * Learners to be able to examine the load within system layouts and highlight how flow is varied whilst its temperature is constant. * Learners to be able to examine systems installed within the centre to generate discussion regarding their physical layouts. |
| * 1. The controls and components used within variable temperature and constant temperature circuits | * Learners to be able to distribute and examine a range of 3 port mixing and diverting valves for use in Low Temperature Hot Water (LTHW) systems. * Learners to be able to examine and explain the importance of control in ensuring correct connection to ports A, B and AB. * Learners to know how 3 port valves and systems are controlled by the use of: * sensors * Building Management System (BMS) * compensation control and * optimum start control. * Learners to know the importance of relative pump position in these systems and the use of pressure switches and gauges to indicate their operation. |
| * 1. The layout of primary and shunt circuits within the plant and boiler room | * Learners to be able to use systems installed within the centre to explain the layout of primary/shunt circuits. * Learners to be shown images, system schematics and presentations and to examine the options regarding low loss headers and the arrangement of components within the shunt/primary circuit including: * low loss headers * cascade systems * skids * manifolds * boiler connections * the connection of circuits to low loss headers * cold fill locations. * Learners to know about the need for headers and the use of reversed returns and cascade systems to connect to boilers, and the relationship of the cold fill pipe and pump. * Learners to be able to sketch layouts of boiler room circuits, including the connection of VT and CT circuits to low loss headers and manifolds. |
| * 1. The controls and components used within primary and shunt circuits | * Learners to be able to examine a range of controls and components and to use manufacturers’ literature and schematics to explain their use and recommended positions of controls and components such as: * pumps * pressure switches * strainers * air/dirt separators * safety valves * dosing pots. * Learners to know the position of VT/CT pumps relevant to 3 port valves and to examine why air/dirt separators work best in higher temperatures and areas of lower pressure. * Learners to be able to examine installed systems and to identify components and justify why they are positioned where they are. |
| * 1. The configuration of boiler room and plant room pipework layouts | * Learners to be able to examine a range of boiler room and plant room drawings and discuss the reasons behind their design and configurations. * Learners to understand the connections to boiler plant and the design of headers and shunt/primary circuits. * Learners to know the requirements for boiler flues and ventilation when considering their layouts. |
| 1. Understand the operation and application of complex chilled water systems, controls, and components | * 1. The layout and application of chilled water circuits | * Learners to know the application of chilled water circuits with regards to the processes and appliances they feed. * Learners to be shown system drawings and presentations to show typical examples of circuits feeding comfort control systems such as fan coil units and chilled beams. * Learners to know why the need for comfort control requires differing control methods including 2, 3 and 4 port valve arrangements. |
| * 1. The controls and components used within chilled water circuits | * Learners to be able to examine physical examples of controls and components used within chilled water systems including: * pumps * pressure switches * 3 port valves * 4 port valves * flow sensors * gauges * double regulating valves * BMS * compensation control * optimum start control. * Learners to know the capability of BMS systems in controlling space temperatures and how these systems connect to 2, 3 and 4 port valves connected to FCUs. |
| * 1. The connections methods used to connect to chillers | * Learners to know the typical connections required at chillers for a range of suitable pipework materials. * Learners to download and examine manufacturers’ literature for a range of chillers including: * air cooled * water cooled * anti-vibration mountings and * connections. * Learners to understand the need for flexible connections and the use of anti-vibration mounts and skids. * Learners to refer to BESA TR/20 (Installation and testing of pipework systems. Part two – Medium temperature hot water heating) and BESA TR/6 (Site Pressure Testing of Pipework) documents and to investigate specifications regarding chiller connections and the use of vibration reducing equipment. * Learners to visit sites to examine chillers installed in commercial buildings where possible. |
| * 1. The methods of fixing and connecting to terminal units | * Learners to use manufacturers’ literature within the classroom to examine the recommended fixing methods for terminal units such FCUs, AHUs and chilled beams. * Learners to be able to distribute a range of fixings and anchors for suspended units. * Learners to know the maximum loads of fixings and anchors and the use of tensile wires. * Learners to be given tasks to use manufacturers’ literature to investigate the recommended final connection types to terminal units and discuss the use of Ethylene Propylene Diene Monomer (EPDM) rubber and plastic connections. |
| * 1. The controls and components used within primary and shunt circuits | * Learners to be able to examine a range of controls and components and use manufacturers’ literature and schematics to explain their use and recommended positions such as: * pumps * pressure switches * strainers * air/dirt separators * cold fill connections * safety valves * dosing pots. * Learners to know the position of pumps and examine why air/dirt separators work best in higher temperatures and areas of lower pressure. * Learners to be able to examine installed systems and to identify components and justify why they are positioned where they are. |
| 1. Understand the methods for selecting and determining the size of hydronic heating and chilled water systems and components | * 1. The principles of thermal comfort within a building | * Learners to be shown presentations, psychometric charts and case studies to discuss the influences that affect comfort within a space including: * internal and external heat gains * human factors * locations * degree days. * Learners to consider what may affect thermal comfort conditions including: * air temperature * solar temperature * humidity * air speed * air change rates. |
| * 1. The methods to determine the heat loss from buildings | * Learners to be shown presentations to explain the methods of heat loss calculation including manual methods, apps and analogue calculators. * Learners to know the term ‘U Value’ and to be comfortable with its value. * Learners to be able to demonstrate the process for manual calculation of heat loss through building fabric and air movement. * Learners to be set tasks to calculate heat losses from simple spaces. * Learners to work in small groups to complete tasks before examining the conclusions as a class. |
| * 1. The principles of flow requirements through chilled water and hydronic heating pipework systems | * Learners to be given relevant charts to enable them to determine flow rates through various pipe materials at different temperatures. * Learners to be able to explain how flow rate charts are used. * Learners to discuss how these flow rates differ dependant on the pipe material and the temperature (density) of the water. * Learners to be able to explain the terms ‘laminar’ and ‘turbulent flow’ and how these impact the system performance. |
| * 1. The methods of calculating pipe sizes for heating and chilled water pipework | * Learners to be shown presentations and work packs to demonstrate the step-by-step procedures of determining pipe sizing for heating and chilled water pipework. * Learners to be able to explain how to determine basic heating and cooling loads and to demonstrate the process and formula required to establish flow rates from these cooling loads. * Learners to be set group tasks to calculate pipe sizes in given examples. |
| * 1. The methods of calculating component sizes for hydronic heating systems | * Learners to be able to explain the processes involved in calculating component sizes within heating and chilled water systems including: * pump size * expansion vessel size * boiler size * heat emitter size. * Learners to be able to use their knowledge of heat loss calculations to establish heat emitter and boiler sizes and study manufacturers’ literature and wholesaler catalogues to identify suitable equipment. * Learners to be able to use their previous knowledge of pipe sizing to help determine pump sizes. * Learners to use pump manufacturers’ information and websites to determine pumps with suitable delivery volume and head pressures. * Learners to be shown the calculations required to determine whether expansion vessels can accommodate expanded water. * Learners to be set group tasks for component sizes and to discuss conclusions as a class. |