Unit 320HV: Understand chilled water systems for industrial and commercial buildings

# Delivery guide

Unit information

This unit covers the knowledge and understanding of the principles for chilled water systems and related components. Learners will gain an understanding of the system layouts, circuits, components and controls used within the system. Within this unit learners will know the basic principles behind the cooling of the water through the refrigerant cycle and learners will gain knowledge of chillers, heat absorption equipment, cooling towers, simple air conditioning systems which use heat pumps and also the regulations, guidance and standards available to assist the learner to install these system components.

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

* How do chilled water systems work?
* What are the different types of chillers used?
* What are the different types of controls and accessories used in chilled water systems in industrial and commercial buildings?
* What are the industry standards and regulations that apply to chilled water systems in industrial and commercial buildings?

Learning outcomes

1. Understand the operation, applications, advantages, and limitations of chilled water systems
2. Understand the applications, advantages and limitations of chilled water system components, controls, and accessories in relation to the working environment
3. Understand the types and applications of terminal units and appliances used within chilled water systems
4. Understand the appropriate industry standards and regulations relevant to the installation of chilled water systems

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

* 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

* [Airedale | Homepage](https://www.airedale.com/)
* [Daikin | Homepage](http://www.daikin.co.uk/)
* [Danfoss | Homepage](https://www.danfoss.com/en/)
* [HSE | Control of legionella bacteria in water systems](https://www.hse.gov.uk/pubns/books/ck02.htm)
* [Legislation.gov.uk | The Water Supply (Water Fittings) Regulations 1999](https://www.legislation.gov.uk/uksi/1999/1148/contents/made)
* [The Engineering Mindset | Homepage](http://www.theengineeringmindset.com/)

British Standards

* BS EN 378-3:2016+A1:2020. *Refrigerating systems and heat pumps. Safety and environmental requirements – Installation site and personal protection.*
* BS EN 14511:2018. *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors (Parts 1–4).*
* BS EN 303-5:2012. *Heating boilers – Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW. Terminology, requirements, testing and marking.*
* BS EN 806. *Specifications for installations inside buildings conveying water for human consumption.*

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

* *Building Regulations 2010 Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings. 2010 edition (incorporating 2010, 2011, 2013 and 2016 amendments).* Newcastle upon Tyne: NBS.

ISBN 978-1-8594-6746-6

| **Learning outcomes** | **Criteria** | **Delivery guidance** |
| --- | --- | --- |
| 1. Understand the operation, applications, advantages and limitations of chilled water systems | * 1. The working principles of chilled water systems | * Learners to consider how heat can be removed from a building in summer and to understand the principles of how heat can be absorbed into cold surfaces. * Learners to be shown images, presentations and system drawings to deliver the basic system layouts and pipe arrangements relevant to chilled water heat rejection systems including: * heat rejection systems * sealed circuits * air cooled systems * water cooled systems * primary circuits * secondary circuits. * Learners to know how the systems are arranged and the configuration of the two pipe systems, primary circuits and secondary circuits in a similar manner to heating system layouts and that chilled water systems are sealed circuits. * Learners to know the differences between air cooled and water-cooled systems and how the heat is rejected either by fans or via a cooling tower. * Learners to be shown diagrams of condenser circuits to highlight these important points. |
| * 1. The application of chilled water systems relevant to building layout and use | * Learners to know how different chilled water systems are best suited to a range of different buildings and building uses including: * commercial * industrial * agricultural * horticultural * leisure and entertainment * residential medical and care facilities * public services establishments and * pre-1919 traditional/historic buildings. * Learners to know that the terminal units used in chilled water systems have a large impact on the selection of suitable systems for building types. * Learners to know how heat can be absorbed from building fabric as well as the air and how different terminal units apply this practice. * Learners to consider a range of scenarios to help them consider suitable system types. * Learners to be shown images of cooling towers, chillers and condensers so that they can see how some buildings may not have space or structural strength to allow for their installation. |
| * 1. The operating temperatures of chilled water systems | * Learners to be able to state typical chilled water circuit temperatures and how these are affected by changing loads. * Learners to be shown videos and manufacturer’s literature to support discussions. |
| * 1. The advantages and limitations of various chilled water system types | * Learners to know the advantages and limitations of system layouts and incorporate this into discussions around building use and type. * Learners to be given scenarios or system layouts relevant to building and load types to discuss in small groups and then feedback. |
| * 1. The methods to protect, insulate and identify chilled water system pipework | * Learners to be able to list reasons why chilled water system pipework may become damaged. * Learners to know why pipework is positioned in certain positions and to be able to identify areas of issue within installations that could lead to damage or corrosion. * Learners to discuss and suggest ways in which it could be protected such as: * painting * galvanising * water treatment * insulation types * pipe bandings * wrapping pipework * BS 1710:2014. Specification for identification of pipelines and services. * Learners to be shown videos of water treatment processes and manufacturer’s literature to know the benefits of inhibitors and glycol additives. * Learners to be told about the benefits of inhibitors and glycol additives by visiting water treatment companies where possible. * Learners to be able to explain the purpose of dosing pots and dirt/air separators. * Learners to be able to recognise the colour bandings for the systems as well as the letters used to identify chilled water in close proximity to other services. |
| * 1. The installation requirements specific to chilled water system pipework within the building | * Learners to be able to use reference material such as BESA TR/20 Installation and testing of: Part Six: Chilled water to explain the specific installation requirements for chilled water systems. * Learners to be shown presentations and physical resources to show how pipework is installed to prevent condensation. * Learners to know how bracketry is installed using vapour barriers and phenolic blocks. * Learners to be given tasks using the specification material to research specific points such as: * pipework types * clipping and bracketry * phenolic blocks * routes and positions and typical sizes * vapour barriers * anti-vibration mountings. * Learners to know about the mounting and fixing of terminal units and how any vibration they produce is isolated from the system pipework. |
| * 1. Types of chillers installed within chilled water systems | * Learners to be shown videos, presentations and manufacturer’s literature to explain the basic principles of chillers including: * air cooled chillers * water cooled chillers * absorption chillers. * Learners to be shown images of how water circuits are connected and to be aware of their physical differences. * Learners to know the difference between air and water types and the basic principles of the refrigerant cycle, which underpins their operation and type. |
| * 1. The basic principles of the refrigerant cycle | * Learners be aware of the basic principles of the refrigerant cycle. * Learners to be shown images and presentations to explain: * vapour compression cycle * compressor * condenser * evaporator * expansion valve. * Learners to be able to draw a basic cycle, including the four main components, so that they can appreciate how heat is claimed from chilled water distribution circuits via the evaporator and then transferred via the condenser to either water or air. |
| * 1. The principles of cooling towers used in conjunction with water cooled chillers | * Learners to know how heat is transferred into condenser water circuits and then moved via pumps to cooling towers. * Learners to be shown images to explain how water is moved within the cooling tower and heat removed via a fan. * Learners to be aware of the major legionella risk attached to cooling towers and how water treatment and maintenance is essential. |
| * 1. The operating principles of heat pump technology for cooling systems | * Learners to research manufacturer information and online content to determine how to differentiate between chilled water systems used for heat rejection and refrigerant systems such as: * air source heat pumps * ground source heat pumps. * Learners to know how the principle of components within a chiller (those essential to the refrigerant cycle) are also used within air source and ground source heat pumps to remove heat from buildings. |
| 1. Understand the applications, advantages and limitations of chilled water system components, controls and accessories in relation to the working environment | * 1. The basic operating principles and positions of components, controls and accessories used within chilled water systems | * Learners to be shown site drawings, schematics and presentations and to be able to explain where a range of components and accessories fit within the system. * Learners to be able to state the principles of each and describe the effect of these components within a system. * Learners to be shown physical examples of systems installed within the centre and to be given components to examine and discuss including: * two port valves * three port valves * four port valves * heat exchangers * buffer vessels, pumps * strainers * commissioning stations * commissioning valves * anti-vibration mountings * Building Management Systems (BMS). * Learners to be able to state the need for buffer vessels. * Learners to be given examples of 2, 3 and 4 port valves and to be able to explain how these relate to the system. * Learners to be able to label and complete incomplete drawings to add these components and take breakout sessions within the workshop or centre facilities to identify physical components where available. |
| * 1. The advantages and limitations of components, controls and accessories used within chilled water systems | * Learners to examine 2, 3 and 4 port valves and to know about their individual advantages and limitations. * Learners to know about the components and accessories listed and how they are limited to their particular role. * Learners to know not to mistake anti-vibration bellows for expansion devices and to be able to explain why each are used. * Learners to know the different types of valves and discuss their advantages and limitations such as: * gate valves * quarter turn lever valves * butterfly valves * single and double regulating valves * pressure regulating control valves. |
| * 1. The basic operating principles of circulating pumps for chilled water systems | * Learners to know the purpose of the range of circulating pumps within an industrial and chilled water systems and the type and position of each. * Learners to know the effect of a pump on the system flow and how pressures are affected by positive and negative sides of the pump. * Learners to be shown examples of actual pumps and their construction including: * centrifugal pumps * direct driven pump * belt driven pump. * Learners to be shown diagrams to explain how a neutral point is created and how this effects the system pressure. * Learners to be able to look at system schematics to identify where the range of pumps are positioned including: * shunt pump * variable temperature pump * constant temperature pump * primary pump. |
| * 1. The installation methods and positioning of circulating pumps within chilled water systems | * Learners to know how pumps should be orientated dependant on manufacturer’s instructions and how pumps should pump upwards as opposed to downwards to prevent air locking. * Learners to be shown examples of anti-vibration mountings and connections and connections for differential pressure switches. * Learners to be able to draw basic system layouts and to identify within how pressure is affected within the system. |
| 1. Understand the types and applications of terminal units and appliances used within chilled water systems | * 1. The types of terminal units and appliances used in chilled water systems | * Learners to be shown presentations, physical examples and manufacturer’s literature to be able to describe the types, limitations, differences and operating principles of: * fan coil units * chilled beams * chilled ceilings * air handling units. * Learners to know the basic layout of air handling units and the components within them with examples in the centre where available. |
| * 1. The advantages and limitations of various terminal units and appliance types relevant to building type and use | * Learners to be able to describe how active chilled beams differ from non-active types and the advantages offered by both relevant to the building. * Learners to be shown videos and physical examples to examine physical size and shape to generate discussion regards positioning and installation. * Learners to be shown images of installed terminal units to generate discussion regarding aesthetics of units, such as chilled beams and ceilings. * Learners to be aware of the different temperatures of chilled water required by the various terminal units, such as chilled beams to prevent excess condensation at the unit. |
| * 1. The specific installation and connection requirements for terminal units and appliances used within chilled water systems | * Learners to be able to describe the connection process for newly installed terminal units such as the flexible connections and control valves. * Learners to know the types of flexible connectors that are suitable at chilled water temperatures. * Learners to know the purpose and principles behind drip trays for condensation and how condense pipework should be connected at units and at condensate pumps including: * pipework material types * flexible connections * drip trays * condenser connections * two/three/four port valves * actuators and * motorised valves. |
| 1. Understand the appropriate industry standards and regulations relevant to the installation of chilled water systems | * 1. Current regulations and standards relevant to chilled water systems | * Learners to be familiar with all legislation, British Standards and regulations specific to the installation of chilled water systems where possible, however some of this content will be discussed throughout the unit in relevant criteria. * Learners to know the legal stance of each document and to know the difference between British Standards and legislation. * Learners to be familiar with a range of relevant documentation including: * The Water Supply (Water Fittings) Regulations 1999 * The Building Regulations 2010 Approved Document L2A – Conservation of fuel and power in new buildings other than dwellings * The Building Regulations 2010 Approved Document L2B – Conservation of fuel and power in existing buildings other than dwellings * BESA TR/20 Installation and testing of: Part Six: Chilled water * manufacturer’s instructions. * Learners to be able to know the main points within each of these documents and to be aware of how each is used and the information that can be gathered from each. * Learners to be introduced to these documents first and to be told how to use them when discussing the individual content of the criteria as relevant. |