Unit 315PH: Understand cold water system installation, commissioning, service and maintenance technique

# Delivery guide

Unit information

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore cold water systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

* install and test cold water systems
* commission cold water systems
* service and maintain cold water systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

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

* What are complex cold water systems?
* What steps must you take to design a cold water system including appliances, components and accessories?
* What steps are part of commissioning appliances, components and accessories on a cold water system?
* How do you service and maintain appliances, components and accessories on a cold water system?

Learning outcomes

1. Understand the applications, advantages and limitations of appliances, components and accessories
2. Understand the appropriate industry standards and regulations
3. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken
4. Understand the appropriate testing procedures for confirming the systems’ integrity
5. Understand how to complete relevant documentation in accordance with organisational procedures
6. Understand the methods for determining the type of size of appliances, components and accessories
7. Understand how to interpret diagrams and drawings for the system to identify the planned location of the appliances, components and accessories
8. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
9. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected
10. Understand the methods and techniques for commissioning the cold water system
11. Understand the methods for determining the type of size of replacement appliances, components and accessories
12. Understand the methods and techniques for servicing and maintaining appliances, components and accessories
13. Understand the methods and techniques for replacing/repairing the appliances, components and accessories
14. Understand basic fault-finding techniques.

Suggested resources

Textbooks

* Maskrey, M. (2019) *The City & Guilds Textbook: Plumbing Book 1 for the Level 3 Apprenticeship (9189), Level 2 Technical Certificate (8202) & Level 2 Diploma (6035) (City & Guilds Textbooks).* London: Hodder Education.

ISBN 978-1-5104-1648-2

* Tanner, P. and Stephen, L. (2019) *The City & Guilds Textbook: Plumbing Book 2 for the Level 3 Apprenticeship (9189), Level 3 Advanced Technical Certificate (8202) & Level 3 Diploma (6035) (City & Guilds Textbooks).* London: Hodder Education.

ISBN 978-1-5104-1646-8

* Young, L. and Graham, M., (2000) *Water Regulations Guide*. *Water Regulations Advisory Scheme*. Stockport: WRAS.

ISBN 978-0-9539-7080-3

Websites

* [BSI | Specifications for installations inside buildings conveying water for human consumption - Operation and maintenance](https://shop.bsigroup.com/ProductDetail/?pid=000000000030200074)
* [Pegler Yorkshire | Homepage](https://www.pegleryorkshire.co.uk/)
* [Plasson | Homepage](http://www.plasson.co.uk/)
* [Toolstation | Brassware, Valves and Taps](https://www.toolstation.com/plumbing/brassware-valves-taps/c183)
* [WRAS | Homepage](https://www.wras.co.uk/)

British Standards

* BS EN 806. *Specification for installations inside buildings conveying water for human consumption* (Parts 1–5).
* BS 5422:2009. *Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C*.

Legislation

* *Building Regulations 2010 Approved Document A: Structure*. Newcastle upon Tyne: NBS.

ISBN 978-1-8594-6508-0

* *Building Regulations Approved Document G: Sanitation, Hot Water Safety and Water Efficiency*. Newcastle upon Tyne: NBS.

ISBN 978-1-8594-6600-1

* HSE | Legionnaires' disease. The control of legionella bacteria in water systems
* [GOV.UK | The Private Water Supplies (England) Regulations 2016](https://www.legislation.gov.uk/uksi/2016/618/contents/made)
* [GOV.UK | The Private Water Supplies (Wales) Regulations 2017](https://www.legislation.gov.uk/wsi/2017/1041/contents/made)
* [GOV.UK | The Water Supply (Water Fittings) Regulations 1999](https://www.legislation.gov.uk/uksi/1999/1148/contents/made)

| **Learning outcomes** | **Criteria** | **Delivery guidance** |
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| 1. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment | * 1. The working principles of cold water systems, positioning fixing, connection and operation of components | * Learners to be able to describe the working principles of cold water systems positioning fixing, connection and operation of the following components: * appliances: over the rim bidets, urinals, refrigerators, washing machines, dishwashers * taps, outlets and valves: outside taps, bib taps, bi-flow mixer taps, ceramic disc taps, spherical plug valves, float operated valves (Part 1–4) * water meters * showers: gravity, instantaneous electric, digital shower valves, bath shower mixer, pumped (single and twin impeller), mixer valve * water treatment: water softeners, water filters, water conditioners * cisterns: cold water storage cisterns, cold water feed cisterns, combined feed and expansion cisterns, WC/urinal flushing cisterns, break cisterns, sectional (1000 litre+) * boosted system components: float switch, pressure switch, accumulator/pressure vessel, booster pump sets, pressure relief valve, pressure gauge, drinking water header. * Learners to be aware of the requirements for fitting sprinkler systems in dwellings and the types of sprinkler systems used in dwellings. * Learners to understand expansion and contraction of pipework and to be able to describe the measures to take when installing pipework in different situations. |
| * 1. The layout and installation requirements for protected plastic storage cisterns | * Learners to be able to state the system layout features for protected plastic storage cisterns including: * typical cistern sizes for small dwellings * warning pipe (overflow) arrangements * inlet/outlet position * position of float operated valve * position of cistern vent * position of open vent pipe connection * requirement for a rigid close-fitting lid * service valve requirements * cistern base support requirements * insect screens. * Learners to be aware of methods to prevent stagnation in storage cisterns. * Learners to be able to state where these devices are sited, including support, drilling requirement, maintenance and access requirements, in relation to industry standards and how faults affect the safety of these systems. * Learners to be aware of the methods of linking cold water storage cisterns for use in dwellings. * Learners to understand the correct cold water pipework and cistern positioning where these are vulnerable to freezing and to know the actions to take to insulate them, including the effects of warming cold water supplies and how to avoid this using insulation techniques. |
| * 1. The operating principles of rainwater harvesting and greywater re-use | * Learners to develop their understanding of the layout of rainwater harvesting and grey water re-use water conservation systems. * Learners to be able to describe the basic operating principles of rainwater harvesting systems. * Learners to be able to identify the permitted uses of captured rainwater in properties: flushing toilets, washing cars etc. * Learners to be able to describe the purpose of components used within rainwater harvesting systems including: * anti-surcharge valve * calmed inlet * inlet filter * level sensor/float switch * module (including pump and air gap) * pump control unit * system control unit * water level gauge. * Learners to be able to describe the basic operating principles of greywater reuse systems. * Learners to be able to identify the permitted uses of grey water in properties: flushing toilets, washing cars etc. * Learners to be able to describe the purpose of components used within grey water reuse systems. |
| 1. Understand the appropriate industry standards and regulations relevant to:  * decommissioning * installing and testing * commissioning * service and maintenance of cold water systems. | * 1. The backflow risk and required methods of prevention | * Learners to be able to explain backflow risk and required methods of prevention as laid down in the Water Regulations including basic mechanical and non-mechanical methods: * air gaps: AA, AB, AD, AG, AUK1, AUK2, AUK3, DC * mechanical: BA, CA, DB, EA/EB, EC/EDHA, HUK1, HC. * Learners to be able to specify the backflow prevention requirements referring to the Water Regulations. |
| * 1. The information sources required to complete testing and commissioning | * Learners to be able to identify the information sources required to complete testing and commissioning of cold water systems including: * The Private Water Supplies Regulations 2016 * The Private Water Supplies (Wales) Regulations 2017 * The Water Supply (Water Fittings) Regulations 1999 * BS EN 806. Specifications for installations inside buildings conveying water for human consumption * Manufacturers’ technical instructions. |
| 1. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken | * 1. What may be communicated to the client through the progress of a job | * Learners to understand different ways of communicating while at work. * Learners to be aware of the information that may be communicated to the client throughout the progress of a job including: * start and finish times * changes to specifications * alternative sources whilst systems are being decommissioned * confirming the location of components * requesting valuable items are removed whilst installation work is undertaken * information regarding delivery orders/deliveries * delays to progress. * Learners to be able to explain suitable communication methods including: * verbal communication * written communication * emails * text messages. * Learners to understand company policies and procedures for communicating with different stakeholders. * Learners to be able to identify any changes to the work programme and to know how to respond to these changes. |
| * 1. The types of communication that may be required with the site management team | * Learners to be aware of the types of communication that may be required with the site management team including: * architect * quantity surveyor (QS) * buyer/estimator * surveyor * project manager/clerk of works * structural engineer * building services engineer * contracts manager * construction manager. * Learners to be able to explain suitable communication methods including: * verbal communication * written communication * emails * text messages. * Learners to be able to communicate with the site management team, for example the buyer, to confirm material requirements. |
| * 1. The importance of complying with company policies and procedures | * Learners to know the importance of complying with company policies and procedures and the consequences of not adhering to them, for example, not complying with company health and safety policies could result in disciplinary action. |
| * 1. The impact when materials are not delivered on time against the work programme | * Learners to know the impact when materials are not delivered on time including: * delays in completion * effect on the work programme on other trades * delays affecting other deliveries. |
| * 1. The factors which affect working time allocation to work activities | * Learners to be aware of the factors that affect working time allocation to work activities including: * material availability * labour requirements * staff experience * delivery requirements * labour availability * weather * environmental * deadlines and client requirements. |
| 1. Understand the appropriate testing procedures for confirming the systems’ integrity | * 1. The information sources required to complete testing and commissioning | * Learners to be able to identify the information sources required to complete testing and commissioning of cold water systems including: * The Private Water Supplies Regulations 2016 * The Private Water Supplies (Wales) Regulations 2017The Water Supply (Water Fittings) Regulations 1999 * BS EN 806: Specifications for installations inside buildings conveying water for human consumption * Manufacturers’ technical instructions. |
| * 1. How to fill and vent cold water systems | * Learners to know the methods of filling and venting a cold water system including: * opening the kitchen cold tap and slowly opening the mains cold water stop valve * allowing the water to flow into the kitchen sink to clear any debris that may have collected in the pipework * closing the cold tap on the kitchen sink and allowing the system to fill to full standing pressure * turning on the isolation valves to the Fixture Shutoff Valve (FOV) in the WC cisterns and allowing the cistern to fill to the water line and adjust the water level as necessary * flushing the WC and checking for leaks * filling any cisterns in the roof space and adjusting the water level at the FOV as necessary * opening any taps and terminal fittings fed from the cistern and clearing any air in the system * allowing the water to run to clear any debris. * Learners to know how to fill and vent cold water systems after a successful test in a variety of settings such as domestic and commercial buildings. * Learners to be allowed to carry out a simulation of filling and venting a system. |
| * 1. A soundness test to industry requirements on cold water systems pipework and components | * Learners to know the method of applying a soundness test using pressure testing equipment on metallic pipework systems and on plastic pipework systems. * Learners to be able to describe a soundness test to industry requirements on cold water systems pipework and components including: * visual inspection * notifying occupants * initial fill * stabilisation * testing to required pressure * checking for leaks * checking pressures after test period * completing documentation and notifying as required. * Learners to be made aware of the equipment used and the types of tests for both rigid and plastic pipework including test pressure and test durations detailed in the Water Regulations and appropriate British Standards. * Learners to be shown how to use hydraulic test equipment and to be given the opportunity to use this equipment. * Learner to be able to state the reason for a timed stabilisation period prior to carrying out a soundness test. * Learners to understand that any leaks must be rectified and retested before a test certificate is issued. |
| 1. Understand how to complete relevant documentation in accordance with organisational procedures | * 1. The range of information that would be provided on commissioning, installation and maintenance records | * Learners to be aware of the information contained on commissioning, installation and maintenance records for example: * installation date * type of system installed * name of engineer * parts maintained * pressures * flow rates * temperatures * discharge point * materials used * test information. * Learners to be provided with examples of commissioning, installation and maintenance records and to know the additional information that should be contained within a maintenance record for cold water systems. * Learners to understand how to comply with the Water Supply (Water Fittings) Regulations 1999 notification requirements. * Learners to know the procedure for notifying relevant authorities of work carried out on cold water systems. |
| * 1. The procedure for handing over to the end-user | * Learners to be able to give the appropriate advice on the safe use of a cold water system to the customer and to understand that component manufacturer’s instructions should be left and explained to the customer on handover. |
| 1. Understand the methods for determining the type of size of appliances, components and accessories in accordance with industry recognised organisational procedures | * 1. The factors which affect the selection of cold water systems for dwellings | * Learners to be aware of the factors that affect the selection of cold water systems for dwellings including: * customer needs * size of household * affordability/cost * type of property, such as building layout and features * energy efficiency * environmental impact * occupancy and purpose * appliance location * storage type/location * current legislation. |
| * 1. The information sources required to size and select cold water systems and components | * Learners to know that the following information sources are required to size and select cold water system components: * Building Regulations Approved Document G – Sanitation, hot water safety and water efficiency * The Private Water Supplies Regulations 2016 * The Private Water Supplies (Wales) Regulations 2017 * The Water Supply (Water Fittings) Regulations 1999 * BS EN 806. Specifications for installations inside buildings conveying water for human consumption * manufacturers’ technical instructions * plans and drawings * pre-determined data * specifications * industry standards. * Learners to be aware that verbal and written feedback is also required from the customer in relation to terminal fitting types and proposed locations and outlet requirements. |
| * 1. The recommended design temperatures within cold water systems | * Learners to be aware that when selecting, positioning and designing cold water systems and components, the required design temperatures should also be considered. * Learners to know that Water Regulations state that water supplying a tap should not be warmed above 25°C. * Learners to know that pipework should be positioned to prevent undue warming. * Learners to know that, when installing pipework, the hot should run above the cold on horizontal pipe runs. * Learners to know that condensation on pipework must be considered and can be minimised by insulating the pipework (BS 5422). * Learners to know that all cold water storage cisterns should be insulated to minimise undue warming and the risk of freezing. * Learners to know that cold water storage and distribution should not exceed 20°C. |
| * 1. How to calculate cold water system requirements used in dwellings | * Learners to be provided with system requirements and different sources of information to calculate system components including: * capacity of a cold water storage cistern * sizes of pipework using demand units suitable to meet the system design * types and sizes of outlets * the required head pressure and mass flow rate of booster pumps * the capacity of an expansion vessel based on system volume. * Learners to be able to determine how to make the required selection of components after the completion of calculations. |
| * 1. How to select cold water components in accordance with calculations from predetermined data | * Learners to be provided with system requirements and different sources of information to select system components using pre-determined data: * cold water storage cistern * pipework including pipe sizes * accumulator * booster pumps * the capacity of an expansion vessel based on system volume. * Learners to determine how to make the required selection of components. |
| 1. Understand how to interpret diagrams and drawings for the cold water system to identify the planned location of the appliances, components and accessories | * 1. Interpret information to complete a detailed materials list. | * Learners to be aware of how to interpret information from a range of sources including diagrams and drawings to complete a detailed material list. * Material lists should include quantities, colours/grades/sizes of: * pipework * consumables * fittings * components * fixings. * Learners to be aware that, when ordering from a plumber’s merchant, product codes should also be included. * Learners to be shown how to prepare a quotation from design information and calculations and understand the method of presenting and producing a tender. * Learners to be introduced to the use of scale drawings and to understand the formula to determine full-scale measurements from the drawings and to develop this understanding and look at the contents of drawings, plans and specifications. |
| * 1. Present calculations and information in a suitable format for quotation and tender | * Learners to know the process of using specifications when carrying out design calculations. * Learners to be aware of the methods to complete and present calculations and information in various formats including: * scale drawings to show the customer the proposed final installation * technology and bespoke computer programmes, 3D drawings and artist impressions to show what the installation will look like when completed * spreadsheets to present design calculations; functions can also be added to automatically calculate data * Word documents and spreadsheets to produce quotes, material lists and write job specifications to supplement drawings. * Learners to be given the opportunity to present calculations using a range of formats and to prepare line drawings to present design calculations. * Learners to know how to prepare a quotation from design information and calculations and to understand the method of presenting and producing a tender. |
| 1. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:  * the plumbing and heating system’s design * the working environment * manufacturers’ instructions | * 1. How to install cold water systems | * Learners to know the procedures to follow to install the following components, appliances and accessories in compliance with the manufacturer instructions, industry requirements and current regulations and standards: * booster sets * showers * plastic and copper pipework. * Learners to be aware of how to connect cold water pipework to components using plastic and copper pipework. * Learners to be given the opportunity to install cold water systems in a realistic working environment. |
| 1. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected in accordance with:  * the plumbing and heating system’s design * the working environment * organisational procedures | * 1. A visual inspection of a cold water system to confirm that it is ready to be soundness tested | * Learners to know the reasons for a visual inspection prior to charging a system with water and what is required on a visual inspection and looking for the correct appliances, components and accessories. * Learners to know the visual checks required to a cold water system before it is filled. * Learners to know the procedure for inspecting pipework supports and how to check the back or underside of soldered fittings in awkward positions on cold water systems. * Learners to be able to explain the steps taken during a visual inspection to confirm the cold water system is ready to be soundness tested including: * checking that all joints have been made correctly * checking that all pipework is secure * checking the installation conforms to the regulations * checking any open ends of pipes have been fitted with cap ends * checking any cisterns are supported * checking service valves have been fitted correctly * checking drain off valves have been closed off * checking tap and tank connections are fully tightened * checking the inside of any cisterns installed to ensure that they are free of debris. * Learners to understand the procedure to follow if they identify installation faults on cold water systems whilst carrying out a visual inspection. * Learners to be aware that any problems, such as insufficient clipping of pipes and missing or incorrectly installed service valves, should be rectified before testing begins. |
| 1. Understand the methods and techniques for commissioning the cold water system in accordance with:  * the plumbing and heating system’s design * the working environment * organisational procedures | * 1. The flushing requirements including the use of system additives for new and existing cold water systems | * Learners to be informed of the requirements for flushing a cold water system before putting to work and following soundness testing. * Learners to be aware of the flushing requirements including the use of system additives for new and existing cold water systems as detailed in the Water Regulations. These include: * flushing requirements: cold, disinfection * system additives: neutralisers, cleanser, water softener (salt). * Learners to know the procedures for dealing with suspected infestations of micro-biological contamination in cold water systems. |
| * 1. The operational checks required during commissioning | * Learners to be able to describe the operational checks required during commissioning of cold water systems including: * temperature * flow rate * pressures * operation of controls. * Learners to be provided with the opportunity to undertake the commissioning procedure and to carry out operational checks, including: * how to take and record flow rates and pressure readings from cold water discharge points * how to check the correct operation of controls. |
| * 1. The commissioning procedures for cold water systems | * Learners to be aware of the commissioning procedure for cold water systems including: * visual inspection * fill and vent * soundness test * flush * operational checks * commissioning documentation * handover procedure. * Learners to know the commissioning procedure that must be followed in line with the Water Supply (Water Fittings) Regulations 1999 and industry guidance. |
| * 1. The actions that must be taken when commissioning reveals defects | * Learners to be able to identify the actions that must be taken when inspection and testing reveals defects in cold water systems including: * dealing with systems that do not meet correct installation requirements * remedial work associated with defective pipe work bracketing * remedial work associated with leakage from pipe work systems. * Learners to be provided with practical examples and asked to come up with solutions to rectify the defects. |
| 1. Understand the methods for determining the type of size of replacement appliances, components and accessories in accordance with industry recognised organisational procedures | | * Learners to understand the methods for determining the type of size of replacement components and accessories using design data, pre-installed systems, and manufacturer information. * Learners to be provided with examples and asked to determine the type of size of replacement components and accessories. * Learners to know how to calculate the sizes of appliances, components and accessories for new installations on existing and replacement systems. |
| 1. Understand the methods and techniques for servicing and maintaining appliances, components and accessories in accordance with:  * the plumbing and heating system’s design * the working environment * manufacturers’ instructions | * 1. How to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components | * Learners to be able to explain the use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of cold water system components. |
| * 1. The routine checks required on cold water system components and pipework as part of a periodic maintenance programme | * Learners to know how to how to carry out routine checks on cold water system components as part of a periodic maintenance programme: * visual inspection of pipework for leakage, adequate support and insulation * signs of wear: taps, valves passing water * effective operation of terminal fittings * effective operation of float operated valves * effective operation of valves * condition of cold water storage cisterns * strainer/filter inspection and cleaning * pump operation * float and pressure switch operation * pressure relief valves * conformity to regulations. * Learners to be given the opportunity to carry out routine maintenance procedures. |
| * 1. The requirements for Legionella and bacterial-growth control measures | * Learners to have an overview of the Legionella and bacterial growth control measures and the procedures for dealing with suspected infestations of micro-biological contamination in cold water systems. * Learners to be introduced toApproved Code of Practice (ACOP) L8: – The Control of Legionella Bacteria in Water Systems HSE documentation. |
| 1. Understand the methods and techniques for replacing/repairing the appliances, components and accessories in accordance with:  * the plumbing and heating system’s design * the working environment * manufacturers’ instructions | | * Learners to know how to apply knowledge developed on decommissioning systems and working on systems safely, how to carry out commissioning and testing procedures and how these can be used while replacing/repairing the appliances, components and accessories. * Learners to understand the methods and techniques for replacing/repairing the components and accessories in cold water systems. * Learners to be given the opportunity to replace/replace components on cold water systems. |
| 1. Understand basic fault-finding techniques | * 1. The repair and rectification procedures to deal with a range of faults | * Learners to know the fault diagnosis and rectification procedure as follows: * diagnose * notify client * safely isolate * decommission * rectify * re-commission * handover. |
| * 1. The methods of obtaining information on system faults | * Learners to know the types of instruments and measuring devices used in fault diagnosis techniques, the method of checking system components for correct operation and the methods of repairing faults in cold water system components. * Learners to be aware of how information on system faults can be obtained: * the customer (end-user): they will be able to give you an overview of the fault, what is happening, when it happens * carrying out a visual inspection can identify faults on the system * service history: information relating to the system/component faults may be detailed on a maintenance record with remedial actions to be completed * manufacturer instructions contain a maintenance section which will detail common system/component faults. This section may include a flow chart detailing symptoms and checks/repairs * manufacturer technical instructions will detail replacement part numbers. * Learners to know that faults to discuss and rectify include: * incorrect pressures * accumulator expansion vessel failure * blockages * system debris * pump failure * control failure * pressure relief valve * incorrect support to system pipework and storage cisterns * excessive noise in pipework systems * cistern failure * leakage from below ground cold water service pipework * leakage or ineffective operation of terminal fittings, float operated valves, stop and service valves. |