Unit 16: Provision of Primary Services in Buildings

Delivery guidance

The four primary services of water, gas, drainage and electricity ensure that our modern domestic and commercial buildings give us a comfortable environment in which to live, work and for recreation.

In this unit, learners are given an overview of these services from the perspective of a construction professional, to gain knowledge and understanding of the complexities of the installation, operation and integration of primary services within buildings.

Though not essential, having access to a plumbing and electrical workshop would provide an ideal resource to develop an understanding of hot- and cold-water systems. The rest of the content delivery would be through academic means.

Employer engagement in the delivery of this unit is recommended though is not essential.

Approaching the unit

The focus and emphasis of this unit is for learners to develop the required skills to explain or outline the installation of gas, electricity, water and drainage to a low- rise property. They will need to be able to produce drawings in support of this, and as such, this unit has links to the Unit 7 Graphical Detailing in Construction. Cross- sections through buildings and schematic diagrams will be useful for demonstrating how a primary service is installed into a building. You will find a number of videos available online which will help considerably with the delivery of the technical elements of the unit content.

A site visit to a domestic or commercial project would also provide opportunities to investigate the services that are installed and accommodated within a structure. Where possible, site visit requirements across units should be coordinated to maximise access to information and topics for discussion.

Delivering the learning aims

Learning aim A

Learning aim A covers the water services of direct and indirect hot and cold installations. Learners need to be aware of the materials that are used for installation. Referring these to a plumbers' merchant website would be good practice. Using your centre as a resource to demonstrate the water services layouts would also prove useful. For all systems in this learning aim, you will find the internal distribution layout can be covered using diagrams and annotation with supportive text.

Having covered direct cold-water systems in topic A1, you can move on to the indirect cold-water supply, where cold-water storage tanks are used to provide a supply in support of the incoming main. The installation of the water supply tank should be demonstrated to learners. A cross- section diagram will be needed. The regulations concerning this installation should be referenced. Useful visual information on this aspect is available from tank manufacturers.

You will then move on to direct hot water systems. This is the traditional system that heated hot water and stored it in a copper cylinder. You will need to demonstrate that this type of system did not have a coil within the copper tank, but operates by displacement; thereby, the volume of water was continually replaced. Use of diagrams

and online videos will be useful here. This will need to be contrasted with functioning principles of the indirect hot water system.

There are images available (online or in textbooks) showing a cut down cylinder that would be useful to demonstrate the pipework distribution involved in such a system.

Across this Learning Aim, focus on developing learners' skills to illustrate both cold and hot water supply systems in the form of annotated line diagrams using suitable symbols and conventions. The annotation should include details of materials, jointing, dimensions, capacities and appropriate positioning.

Learning aim B

Learning aim B covers the aspects of drainage that services a property and the principles and approaches that can be taken to ensure that waste products are removed safely and without risk to health. Topic B1 covers the principles of internal drainage and the need to use sealed traps and ventilation valves. A plumbing manufacturer's website could provide details of how this can be achieved using plastic waste fittings. To investigate the above-ground drainage in more detail, you can access photographs to demonstrate single-stack and two-pipe systems to contrast the differences in both domestic and commercial applications. Obtaining the services of a building services engineer as a guest speaker would be of benefit to learners.

You will need to provide some drawn information for the delivery of below-ground drainage approaches and principles that explain how separate and combined drainage systems operate and are installed when applied to, for example, a housing development. Several manufacturers provide installation cross-sections for drainage component and run details. These are useful for learners in developing understanding of such systems.

Across this Learning Aim, focus on developing learners' skills to illustrate both cold and hot water supply systems in the form of annotated line diagrams using suitable symbols and conventions. The annotation should include details of materials, jointing, dimensions, capacities, falls and appropriate positioning.

Learning aim C

Learning aim C looks at simple electrical systems and gas installation systems for domestic applications. You will need to cover the component types commonly used in electric installations. Learners' research and product samples are a good place to start. Further online resources that demonstrate ring and radial circuits along with the consumer unit installation information, also support the delivery. These could be video and/or schematic diagrams of installations.

The topic C5 requires that learners know about ventilation, flue arrangements and the discharge of combustion products. A suitable guest speaker will be of benefit to the learners.

The illustrations and sketches showing connection of a gas service pipe including the meter box and installation of the isolation valve will be of help when delivering C6.

Summary of unit

Learning aim	Key content areas	Assessment approach
A Examine the practices associated with the provision of hot- and cold-water systems	**A1** Direct cold-water systems **A2** Indirect cold-water systems **A3** Direct hot-water systems **A4** Indirect hot-water systems	Learners will be given construction drawings of a domestic building and associated external areas. They will be required to provide a report that includes details of an appropriate direct and indirect hot- and cold-water system
B Examine the principles and approaches associated with the provision of above- and below-ground drainage systems	**B1** Above-ground drainage principles **B2** Above-ground drainage approaches **B3** Below-ground drainage principles **B4** Below-ground drainage approaches	
C Understand the principles and practices associated with the provision of simple, single-phase electrical systems and domestic has systems	**C1** Electrical principles **C2** Electrical components **C3** Ring final circuits **C4** Radial circuits **C5** Gas installation principles **C6** Gas installations	Learners will be given construction drawings of a domestic building. They will be required to provide a report that includes details of an appropriate layout of single-phase electrical systems to buildings, and the internal layouts of ring final circuits and radial circuits, including line drawings, materials and components

Assessment guidance

A maximum number of two summative assignments is recommended for this unit, with assignment 1 covering both learning aims A and B.

You should provide adequate details within the brief such as construction drawings and concept design which learners could develop into line drawings for schematics and annotations. The same set of drawings could be used for both assignments.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 16: Provision of Primary Services in Buildings

Introduction

The technology covered within this unit is evolving, with many variations and options to consumers and developers opening up, such as renewable energy systems to heat hot water. This presents opportunities to inspire and engage learners with relevant and meaningful examples of new approaches to the provision of services. They will need to demonstrate an awareness of the many variations and hybrid systems that now exist and are currently installed in homes.

This is a technical unit that requires access to current specifications and distribution details. These can be sourced from industry, especially a building services engineer, a plumbing contractor or a heating engineering contractor. The use of component manufacturers' websites can also provide information and installation details of their component inclusion within full systems.

Learning aim A

Learning Aim A1 covers direct cold-water systems. Learners need to describe the route, components, depth and installation from the service authorities' mains into the building. A tutor-led discussion based upon relevant drawings or illustrations could be used to demonstrate the service entries into a building from the mains. Such materials should cover the entire route up to the meter or isolation valves.

Learners could then be directed to any local regulations that are aimed at ensuring a safe supply of drinking water.

Following this, learners could conduct small group work to examine various scenarios to establish when a direct cold-water system is or is not appropriate. They could feed back their analysis in a class discussion.

A physical site visit to observe the installation of a direct cold-water system would be of great value. The visit could be recorded for future delivery to a cohort.

Locating a video online of an installation for class viewing would be useful. You could follow this with a Q and A session that will help highlight key points for learners.

Once you have covered the initial service pipe installation up to the isolation valve, the layout of the system can be delivered with the support of materials such as:

- schematic diagrams of typical installations
- use of manufacturers' data for pipework diagrams
- use of a plumbing merchant's components catalogue
- contrasting the use of copper pipework to plastic.

Learning Aim A2 covers the indirect installation for a cold-water supply. You could initiate class discussion and gauge prior knowledge, asking learners what the main contrasts are between the direct and indirect cold-water systems that need to be considered. You could then go on to examine schematic diagrams of a layout for a cold-water storage cistern.

- You could use diagrams of the cold-water storage cistern, including insulation, dimensions, ball cock valve, position of overflow and exit pipework and the cover with a vent pipe**.**
- Learning Aim A3 moves on to the direct hot-water system. Here you could make

reference to the advances in technology, which mean this traditional system is not currently installed, but one which learners may come across in older buildings. Again, schematic diagrams are the best method of explaining how the system works.

- An ideal and holistic way of covering hot- and cold-water service installations would be to view a house that has the installations but are not yet complete. This would provide a hands-on approach to see the whole system installed for hot and cold water, how it is routed through a house, connections, fittings, fixtures, tanks and boilers.
- Learning Aim A4 contrasts against topic A3 in the indirect method of hot-water heating. You will need to demonstrate this using a cut-away image of a hot-water cylinder that shows the coil heat exchanger. Introduce learners to the materials used, and their dimensions and capacities which they can then apply when annotating line diagrams.

Learning aim B

Learning Aim B1 examines the drainage that is above and below ground level. You could introduce the drainage principles to be covered, ideally by visiting a site where learners could view an above-ground drainage installation where a site manager could give learners guidance on access and maintenance of such a drainage system.

Back in the classroom, you could then introduce learners to details of falls and sizes of pipework. Learners should also be provided with schematic diagrams that show a typical distribution network for above-ground drainage.

For Learning Aims B2 & B3, a paired activity could follow, taking the information from the above, asking learners to design a simple drainage system above and below ground for a bathroom installation on the first floor, and a kitchen on the ground floor. This would combine sub- and superstructure drainage and offer team working which simulates what may happen in a design office.

Learners will benefit from getting hands-on with some of the components available to reinforce understanding of the drainage principles. For example, you could demonstrate the functionality of a trap seal using a plastic component.

You should task learners to research drainage supplier's websites for above-ground plastic pipework installation products for a given system requirement. This could be a single-stack system for foul water drainage. Ventilation to drainage also needs to be covered, and a series of fittings can facilitate this, such as one-way air admittance valves fitted to soil stacks.

The above-ground drainage approaches of single stack-systems and two-pipe systems are covered next. Again, diagrammatic images are the best method of demonstrating the drainage installation. Many plastic drainage pipe manufacturers provide full-storey height details for an above-ground drainage system, and this should detail all of the components, branches and connections used for a single- stack system.

Learning Aim B4 introduces the principles of below-ground drainage, where you will deliver information about depth of drainage, falls, pipe sizes, access points, manholes and inspection chambers.

Finally, you will move on to deliver the approaches to below-ground drainage installations – namely separate and combined systems. Ideas for activities to deliver this would be:

- After initial tutor presentation on the separate and combined systems, you could ask learners to design a drainage system around a footprint drawing by annotating their plan onto an existing layout.
- You could invite a guest speaker to illustrate the local drainage systems that operate in your area.
- A guest speaker from a design or architect's practice could demonstrate drainage designs

for housing projects. This would need to focus on the preparation of questions by learners that are assessment specific. You would need to direct these against the unit's content.

Learning aim C

When delivering on both gas and electric services, you will need to demonstrate; the service entry into the building, accommodating the service within the ground, meter installation and the isolation of the service.

Learning aim C1 covers the health and safety features associated with mains electrical supply. You could begin by holding up a smartphone charger and asking learners a sequence of questions to draw out the safety features, such as:

- How does this plug protect you from shock?
- What about the switch on the wall?
- What about the fuse board?
- Anything to do with different colours of insulation to wires?
- What is a RCD and a MCB?

For learning aim C2, learners can start to investigate the electrical components. This can be delivered through reference to suppliers and manufacturer websites. You could split the class, giving groups a specific focus for their research. From this activity, comprehensive notes could be gathered from across the groups and made available to all of the class.

It would be useful to obtain sample products from manufacturers for learners to examine, combined, if possible, with a demonstration by a technical sales representative whom the learners can engage with.

Examination of the components within your centre could be carried out, with small groups conducting an audit of a specific area to capture volume and variety of components used.

The electrical meter set-up is best shown by an online video that can demonstrate the enhanced functionality of the new smart meters.

With learning aim C3, schematic diagrams are a good method of demonstrating the ring final circuits (including live and neutral conductors, fuses and circuit breakers), along with the rules for spur sockets and socket outlets. Using coloured schematic diagrams will illustrate the three colours used in modern wiring.

Again, a schematic diagram can be used to illustrate the loop in method of wiring lighting circuits for learning aim C4. For high-power appliances, the level of protection needs to be examined for ratings on the circuit (e.g. 45 amps). This can be done by examination of the installation of a cooker point for a domestic property and the rules and regulations associated with such supply.

You will need to cover the combustion, ventilation and flue arrangements of gas installations. You could use an online video of a boiler installation, from which learners could produce a summary report.

The principles of a gas installation can be delivered using details of the service pipe entry up to the meter box, installation of the meter, gas isolation valve and the governor, and finally, the meter.

Finding a cross-section through the external wall to demonstrate the meter box and supply pipe installation demonstrating the range of meter boxes that are available for different locations.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- *Unit 1: Construction Technology*
- *Unit 2: Construction Design*
- *Unit 7: Graphical Detailing*
- *Unit 14: Low Temperature Hot Water Systems in Building Services Engineering*
- *Unit 15: Measurement Techniques in Construction*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Internationals in Construction and the Built Environment. Check the Pearson website at http://qualifications.pearson.com/endorsed-resources for more information as titles achieve endorsement.

Textbooks

Hall F and Greeno R, *Building Services Handbook* (9th Edition), Routledge, 2017 ISBN 9781138244351 – A comprehensive guide on building services, updated in line with recent regulations and technologies

Linsley T, *Basic Electrical Installation Work 2365 Edition* (8th Edition), Routledge, 2015 ISBN 9781138848849 – Includes end of chapter revision questions for learners

Treloar R, *Plumbing* (4th Edition), Wiley-Blackwell, 2011 ISBN 9781405189590 – Accessible guide to plumbing, heating and gas installations

Journal

Building Surveying Journal (RICS Journals) – this is the journal for building surveyors and has a lot of useful articles on defects and dealing with them

Videos

YouTube:
Domestic Electricity Demonstration Part 4 - Ring Main, Radial Circuits, Fuses and Amps - Domestic electricity ring main installation
HOW TO: Install an Underground Drainage System with FloPlast | Professional Building Supplies - Flopast drainage system video demonstrating below-ground drainage installation in plastic
Worcester Bosch Greenstar i Boiler Installation - Installation of a boiler
How to install Hep2O Pipe Runs and tee junctions - Plumbing plastic pipework installation
See how we'll install your smart meter into your home - Installation of a smart meter

Websites

Visit the Chartered Institution of Building Services Engineers website. This is a professional body for building services engineers and offers resources, standards and professional development routes.

Search igl Installing Your Supply Pipe in Thames Waters' Area for more information on water supply pipe installation

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.