Unit 316HV: Understand how to prepare, fabricate and install heating and ventilation systems

# Delivery guide

Unit information

This unit covers the knowledge and understanding of how to prepare and carry out the fabrication and installation of industrial and commercial pipework systems and their related components.

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

* What drawings and diagrams are required to install heating and ventilation systems?
* What are the different types of support systems and fixings used to install heating ventilation systems?
* What are the methods and techniques required to safely install heating and ventilation systems?

Learning outcomes

1. Understand how to verify that job information, site drawings and documentation is current and relevant
2. Understand how to confirm that the work area is suitable for installation work to proceed
3. Understand the types of fixings, fittings, materials, brackets and supports used within industrial and commercial pipework installation
4. Understand how to use hand and power tools specific to industrial and commercial pipework installation
5. Understand how to fit, fix, and connect the selected pipework, equipment, components, and accessories using suitable jointing methods
6. 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

Suggested resources

Textbooks

* BESA TR/20 (2003) *Technical specification for pipework installation.* London: The Building Engineering Services Association.
* McConnell, C. N. (2003) *Audel Pipefitter’s and Welder’s Pocket Manual: 3 (Audel Technical Trades Series).* Oxford: Audel.

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Websites

* [BSS | Homepage](https://www.bssindustrial.co.uk/)
* [GF Piping Systems | Homepage](http://www.gfps.com/en-gb.html)
* [Pegler | Homepage](http://www.pegleryorkshire.co.uk/)
* [The Engineering Mindset | Homepage](http://www.theengineeringmindset.com/)

British Standards

* BS EN 806:2012. *Specification for installations inside buildings conveying water for human consumption (Parts 1–5).*
* B.S 3974. *Specification for pipe supports.*

| **Learning outcomes** | **Criteria** | **Delivery guidance** |
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| 1. Understand how to verify that job information, site drawings and documentation is current and relevant | * 1. The documentation used within the building engineering systems installation project | * Learners to know the types and purpose of documents and systems used within the installation project which allow communication and planning throughout the project. * Learners to be able to explain the purpose of the following documents: * job specifications * work programmes * variation order * delivery notes * time sheets * policy documentation (health and safety, environmental, customer service) * manufacturer guidance * installation instructions * user instructions * quotations * estimates * invoices/statements * statutory cancellation rights * handover information * British Standards * legislation. * Learners to know the difference between legislation, guidance and British Standards. |
| * 1. The types of drawings used within the building engineering systems installation project | * Learners to be shown and be familiar with a range of drawing types used with the project including: * plan drawings * approved drawings * proposed drawings * working drawings * isometric * installation * as fitted * schematic. * Learners to be able to explain when and where each type of drawing is used and why. * Learners to be aware of the information used within the drawing such as version, revisions, titles and project. * Learners to be able to produce materials lists using this information. |
| * 1. Interpreting diagrams and drawings for the fabrication and installation of heating and ventilation systems | * Learners to know how to recognise the symbols used within drawings. * Learners to develop their use of scale by measuring and converting real-life examples onto paper. * Learners to be shown common drawing symbols relating to BES systems and pipeline drawing information and be able to ‘take off’ from drawings using the information they have gathered from it. * Learners to be able to recognise the common key terms within a drawing such as: * location of site services * planned location of the system and components * accessories and equipment * heights * datum points * scale * symbols. |
| 1. Understand how to confirm that the work area is suitable for installation work to proceed | * 1. The potential dangers to the workforce and members of the public when work is carried out | * Learners to be able to identify situations that may lead to a health and safety risk to both the workforce and others within and around the project. * Learners to know common risks and to be able to carry out a risk identification task within a controlled environment. |
| * 1. The purpose and use of risk assessments and method statements used within the building engineering systems installation project | * Learners to be able to explain the different types of risk assessments used within industry such as: * quantitative * qualitative * generic. * Learners to know the purpose and process for the use of these documents and how they are used within the project. |
| * 1. The purpose and use of the permit to work system within the building engineering systems installation project | * Learners to know why permit to work systems are used, how they are issued and controlled and the typical areas and operations on site that would require the permit system to be in place such as switch rooms, lift areas, roof tops, plant rooms, testing procedures etc. |
| * 1. The methods and procedures used to protect the customer’s property | * Learners to know the typical risks to customer’s property within a commercial environment. * Learners to know the different environments, such as commercial, industrial, retail, office spaces, accommodation etc. and how each needs to be protected against damage. * Learners to be able to recognise building fabric, which needs to be protected, such as walls, flooring and equipment through each stage of the project. |
| * 1. The methods used to check that plant, instruments, access equipment and tools are fit for purpose | * Learners to know both the physical checks and tests and the documentation and standards that are relevant to the checks for a range of equipment used on site including Risk Assessment Method Statement (RAMS) documentation and permits to work. * Learners to know the following documents and standards: * manufacturer’s literature * British Standards * specification documents * test certificates * Portable Appliance Testing (PAT) labels. * Learners to know these documents and standards for a range of equipment and plant on site such as: * pipe machinery * cutting equipment * 110V equipment * battery powered equipment * slinging equipment * chains and chain hoists * hand tools * test gauges * test pumps * ladders * scaffolds * powered access equipment. |
| 1. Understand types of fixings, fittings, materials, brackets and supports used within industrial and commercial pipework installation | * 1. The types and applications of fittings and jointing methods | * Learners to understand the types of fittings and jointing methods for pipework. * Learners to be able to identify the types of fittings available for the types of pipe material. * Learners to be able to explain the advantages and disadvantages for each type as well as the equipment required and the processes involved in making the joint. * Learners to know fitting types and jointing methods to including: * malleable iron * screwed and socketed * flanged * crimped * collar * grooved * welded fittings * copper * end feed * internal solder ring * compression * brazed * brass * Acrylonitrile Butadiene Styrene (ABS) * solvent weld * Medium-Density Polyethylene (MDPE) fusion weld * copper phosphorus/hard soldering. |
| * 1. The types and applications of pipework material | * Learners to be aware of the types of pipe material available for use in industry and their applications and limitations such as: * pressure * strength * fluid being carried * expansion and contraction * reaction with other metals * reaction to ultraviolet (UV) light. * Learners to be aware of the following pipe materials and their relevance to the applications and limitations for each: * Low Carbon Steel (LCS) (heavy/medium) * carbon steel * stainless steel * galvanised steel * copper * plastics (ABS, PB, PE, PVC). |
| * 1. The types of fixings and consumables used in the installation of industrial and commercial pipework | * Learners to know the types of surfaces in which fixings may be required. These types of building fabric will help determine the type of fixing required. * Learners to be shown and know a range of fixing types including: * wall plugs * anchor bolts * toggle bolt * wedge type anchors * concrete screws * cartridge fired fixings * chemical fixings * plasterboard fixings. * Learners to be aware of and shown the types of: * screws * bolts * nuts * rod * washers required for the types of fixings to be made into. * Learners to know the advantages and disadvantages of these fixings and consumables and their limitations, applications and use. |
| * 1. The types of brackets, hangers and accessories for use in industrial and commercial pipework installation | * Learners to have a good knowledge of the range of brackets, hangers, supports and accessories used in the industrial and commercial Building Services Engineering (BES) industry. * Learners to know the use of channel bracket systems and the types of fittings and accessories used within it. * Learners to be shown a range of brackets that can be fixed to this and the use of rod to make brackets for this type of system. * Learners to know which brackets and clips are suitable for pipe material types and to be aware of the requirements to allow for expansion and contraction as well as protect against corrosion. * Learners to be shown a wide range of brackets, hangers and accessories including: * malleable iron clips * rubber lined * split band clips * roller and chair * U bolt * phenolic blocks * plastic clips * brass clips * channel strut * anti-vibration mounts * channel nuts * L brackets * power arms * wire hangers * beam clamps * lightweight channel systems. |
| * 1. The basic elements of a building and its structure | * Learners to be able to identify the important elements that make up a building and its structure including: * substructure * foundations * superstructure * vapour barrier * damp-proof membranes (DPM). * Learners to identify the various building elements of a range of building types including traditional Welsh construction methods and stone building methods. * Learners to know how to make fixings into a range of materials and fix brackets to carry a range of pipework materials. |
| 1. Understand how to use hand and power tools specific to industrial and commercial pipework installation | * 1. The operation of common hand tools | * Learners to be able to state the safe and efficient use and operation of a range of common hand tools. * Learners to be given practical demonstrations of their use and to be allowed time to practice the use of these tools. * Learners to know the safety aspects of individual tool use in full before they are allowed time to use them. * Common tools include: * pipe wrench * hacksaw * pipe cutters * rod cutter * bending tools for copper pipes * hand stocks * chain tools * screwdrivers * files * Allen keys * pliers * chisels * flange bars * rivet guns * hammers * water level * boat level. |
| * 1. The operation of common power tools | * Learners to be able to state the safe and efficient use and operation of a range of common power tools. * Learners to be given practical demonstrations of their use and to be allowed time to practice the use of these tools. * Learners to know the safety aspects of individual tool use in full before they are allowed time to use them. * Common power tools include: * drills * reciprocating saw * pipe threading machine * grooving tools * crimping tools * grinding tools * chop saw * impact driver. |
| * 1. The use of different drill bits for a range of materials | * Learners to know the different types of drill bits for use on a range of material types. * Learners to be shown examples of these drill bits and the safety precautions to be adhered to during their use. * Materials include: * brick * blockwork * concrete * stone materials * wood and timber * plasterboard * metalwork. * Learners to know drill bit types such as: * high speed steel * masonry * Slotted Drive System (SDS) * hole saws * diamond drilling bits * flat wood bits * auger bits. |
| * 1. The maintenance checks and inspections required for hand and power tools | * Learners to be aware of the checks and inspections that should be made to hand and power tools as part of routine maintenance and regularly before and after use. This should be in line with: * manufacturer’s literature * British Standards * specification documents * test certificates * PAT labels. * Learners to know these points for the range of hand and power tools covered. |
| * 1. The training requirements and prohibitions for persons operating and maintaining power tools | * Learners to know the requirements for maintaining power tools and where to find information to guide them on this. * Learners to be aware of manufacturer’s instructions. * Learners to know the limitations to their authority regarding what they can and cannot do to tools and equipment without the correct training. * Learners to know the types of training that are common in the workplace for the tools and power tools discussed. |
| 1. Understand how to fit, fix, and connect the selected pipework, equipment, components, and accessories using suitable jointing methods | * 1. The procedures used to bend and set a range of pipework materials | * Learners to know the procedures and equipment needed to form a range of bend types within pipework of differing material. Bends should include 30, 90 and 45 degree bends, passovers and offsets. * The methods should include: * heat bends * hydraulic bending * manual bending * spring bending. * And include the following materials: * LCS * copper. * Learners to know the geometry of bends and the maths involved in calculating bends. |
| * 1. The requirements for sleeving and fire stopping pipework and the clipping and clearance distances for pipework systems | * Learners to know why fire stopping and sleeving is important in the prevention of fire spreading. * Learners to know how pipework should be installed through structures to prevent damage and the spread of fire and smoke. * Learners to be familiar with a range of intumescent collars, the methods for sleeving pipework through walls and how sleeves should be fixed and sealed. * Learners to know the clearances for a range of pipework system types, including wet services and gas pipework. * Learners to be able to identify the dimensions required for clearance from other services, from fabric, the floor and what the different clipping distance recommendations for pipework types, contents and its orientation. * Learners to know why different materials have different set centres. |
| * 1. The installation methods to accommodate for linear expansion in pipework | * Learners to know the methods to accommodate expansion in pipework. * Learners to know the calculation needs to determine the potential expansion and the term ‘cold draw’. * Learners to be shown a range of mechanical devices used to accommodate this including: * expansion loops * expansion bellows * use of natural bends * expansion brackets * hangers and sliders. |
| * 1. The methods to improve installation efficiency | * Learners to know the installation practices that would help to contribute to efficient installation practices. This criteria does not particularly focus on system designs and appliance efficiency but more the methods to reduce carbon footprint during the installation procedure and reduce costs and time during the project. This also includes materials and workmanship, which contributes to a more efficient, greener and cost affective project. * Methods to include: * pre-fabrication * site set-up * modular installation * housekeeping * storage * types and properties of pipework insulation * waste disposal. |
| * 1. The approved standards relevant to fittings and materials | * Learners to know the approved standards relevant to fittings and materials with the class. * Learners to be able to state the relevant British and E.U. Standards and other approved standards for a range such as: * pipe materials * threads * installation of pipework * identification of pipework. |
| * 1. The types and applications of valves and specialist fittings within industrial and commercial pipework installations | * Learners to know the types of valves and specialist fittings used within industry. * Learners to be able to state where these components should be fitted within the system and why they are located there. * Learners to know a range of valves and specialist fittings including: * valves * gate, globe, lever, double regulating, stop tap, service, butterfly, pressure reducing, pressure relief, temperature relief, thermostatic radiator, lock shield * differential pressure, drain, float operated, solenoid, two/three/four port * specialist fittings: gauges, air vents, actuator, expansion vessel, expansion * loop, expansion bellow, strainers, air dirt separators, commissioning points, sight glass * dosing pots. * Learners to be shown examples of the operation and location of valves and specialist fittings within a system. |
| * 1. Types of measurements and checks for pipework installations | * Learners to be aware of the static, visual, dynamic and pressure tests carried out on pipework systems. * Learners to know the stages in which these checks are carried out within the installation. * Learners to be able to identify common issues as part of a visual inspection and to ensure that open ends, valve positions, brackets, clearances, levels and dimensions etc are correct. * Learners to know the types of hydraulic and pneumatic tests and the pressures and processes involved in both for metallic and plastic pipework system. * Learners to be shown these procedures in controlled environments. |
| 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. Methods of communication used within the project to share information between other trades, the client, and peers | * Learners to understand the types, stages and importance of site communication as well as being able to communicate clearly themselves. * Learners to know the general methods used on site to relay information including: * Building Information Modelling (BIM) * site meetings * email * written letter * phone calls * text messages * remote working * use of IT based systems. * Learners to develop their communication skills using role play scenarios. |
| * 1. The purpose and use of variation orders | * Learners to understand the purpose of variation orders (VOs) and when they are raised. * Learners to know how VOs effect the end price of the job and to be able to give examples of where a VO may be needed as part of a change to the project or addition to it. * Learners to be shown examples of variation orders as used on site. |
| * 1. Producing work programmes to ensure a project can follow a critical path | * Learners to be shown examples of work plans and programmes for a real project and to discuss the stages of the project, which are critical to enable the project to complete on time. * Learners to use role plays and be given scenarios to develop work programmes in the classroom as part of a group task. |
| * 1. Producing risk assessments for a range of planned tasks | * Learners to be able to produce a risk assessment for a given scenario or task using the information provided by the tutor. * Learners to know how the calculations are made and how risks are reduced when it is deemed too hazardous to carry out a task. * Learners to know that these assessments are to be reviewed regularly as the tasks may change. |
| * 1. How to produce method statements for a planned task | * Learners to know where a method statement is used and to be given examples of real method statements from site. * Learners to be shown how to complete a method statement for given scenarios or procedures and to be given an opportunity to produce these either individually or as part of a group. |