Unit 304E: Understand how to install enclosures for electrical cables, conductors and wiring systems

# Delivery guide

Unit information

This unit covers the knowledge and understanding for the installation of enclosures for electrical cables, conductors and wiring systems internally and externally for electrical systems. Learners will gain the key knowledge and understanding of electrical systems and circuits and their requirements.

The learner must be able to comply with the procedures and methods for installing enclosures for electrical cables, conductors and wiring systems 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 will know the different types of enclosures for electrical cables, conductors and wiring systems, their limitations, applications and the techniques for the positioning, fitting, fixing and connection of the enclosures, their components and accessories.

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

* What types of circuits supply electrical loads?
* What is meant by earthing?
* What are the different types of wiring systems used?

Guidance: within this unit, learners will know the main relating requirements of the *IET On-Site Guide*.

Learning outcomes

1. Understand the operation, applications, advantages and limitations of different electrical systems
2. Understand the appropriate industry standards, regulations and requirements relevant to installing enclosures
3. Understand the applications, advantages and limitations of types of enclosures

Suggested resources

Textbooks

* *IET On-Site Guide (BS 7671:2018) (Electrical Regulations)*. 7th edition. London: Institution of Engineering and Technology.

ISBN 978-1-7856-1442-2

* Tanner, P. (2018) *The City & Guilds Textbook: Book 2 Electrical Installations for the Level 3 Apprenticeship (5357), Level 3 Advanced Technical Diploma (8202) & Level 3 Diploma (2365)*. London: Hodder Education. ISBN 978-1-5104-3225-3

Websites

* [Electrical Apprentice | Homepage](https://electricalapprentice.co.uk/)
* [Electrical Apprentice | Overview of cable management systems](https://electricalapprentice.co.uk/an-overview-of-cable-management-systems/)
* [Expert Electrical | Metal & Plastic Enclosures](https://www.expertelectrical.co.uk/metal-plastic-enclosures)
* [YouTube | John Ward – Lighting Circuits Part 1](https://www.youtube.com/watch?v=dnpV781c6Sw)
* [YouTube | John Ward – Lighting Circuits Part 2 – Wiring Multiple Switches, 2 way and Intermediates](https://www.youtube.com/watch?v=LPJ_nE1JAqg)
* [YouTube | John Ward – Earthing & Bonding Part 1: Earthing](https://www.youtube.com/watch?v=odnUIWyC0oU)
* [YouTube | John Ward – Earthing & Bonding Part 2: Main Protective Equipotential Bonding](https://www.youtube.com/watch?v=a5JOTA-mJ4A)
* [YouTube | John Ward – Earthing & Bonding Part 3: Supplementary Protective Equipotential Bonding](https://www.youtube.com/watch?v=CVxBettQpPU)
* [YouTube | John Ward – Surge Protection Devices Part 1](https://www.youtube.com/watch?v=DWBFHjE5zK0)
* [YouTube | John Ward – Surge Protection Devices Part 2](https://www.youtube.com/watch?v=-ehw6uZOOfw)

British Standards

* BS 7671:2018+A1:2020. *Requirements for Electrical Installations. IET Wiring Regulations.*
* BS 1363-4:2016+A1:2018. *13 A plugs, socket-outlets, adaptors and connection units. Specification for 13 A fused connection units switched and unswitched*.

Legislation

* [HSE | Construction – The Construction (Design and Management) Regulations 2015](https://www.hse.gov.uk/construction/cdm/2015/index.htm)
* [HSE | Managing risks and risk assessment at work](https://www.hse.gov.uk/simple-health-safety/risk/steps-needed-to-manage-risk.htm)
* [HSE | Risk at Work – Personal protective equipment (PPE)](file:///C:\Users\floan\Desktop\Mum's%20Work\Qualification%20Wales\Electrotech\HSE%20|%20Risk%20at%20Work%20–%20Personal%20protective%20equipment%20(PPE))
* [HSE | The Electricity at Work Regulations 1989](https://www.hse.gov.uk/pubns/books/hsr25.htm)
* [HSE | The Electricity Safety, Quality and Continuity Regulations 2002](https://www.legislation.gov.uk/uksi/2002/2665/contents/made)
* [HSE | Health and safety video resources](https://www.hse.gov.uk/resources/videos.htm)
* [HSE | Work at height – Types of access equipment](https://www.hse.gov.uk/work-at-height/types-of-equipment.htm)

| **Learning outcomes** | **Criteria** | **Delivery guidance** |
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| 1. Understand the operation, applications, advantages and limitations of different electrical systems | * 1. The types and requirements of typical circuits | * Learners to understand the types and requirements of typical circuits, including: * lighting circuits * ring final socket circuits * standard radial final socket circuits * standard circuit arrangements for loads and equipment * components of lighting and power circuits. * Learners to understand the requirement for the division of an installation into circuits (see BS 7671:2018+A1:2020, section 314). * Learners to understand the polarity requirements for circuits as described in 9.3.1 (c) of the *IET On-Site Guide*. * Learners to know the circuit diagrams for one-way, two-way and intermediate, including the conversion method. * Learners to know the joint box method and loop in method of wiring and the block, circuit and wiring diagrams of circuits. * Learners to know the different components that can be used in lighting circuits, including transformers. * Learners to know about overcurrent protection and different switches including: * ways * gangs * grid switches * dimmer switches * back boxes. * Learners to know about lighting outlets and lamps including LEDs, SELV transformers, joint boxes and RB4 and related components. * Learners to know the requirements of standard ring final socket circuits and circuits for supplying sockets and connection units and fused connection units (switched and unswitched) to BS 1363-4:2016+A1:2018 (including USB sockets). * Learners to know the requirements of standard radial final socket circuits and circuits for supplying sockets and connection units and fused connection units (switched and unswitched) to BS 1363-4:2016+A1:2018. * Learners to know the conventional common domestic circuits such as cooker circuits, shower circuits, immersion heater circuits. * Learners to be given the opportunity to participate in practical workshop activities for constructing circuits from diagrams including: * one-way, two-way and intermediate lighting circuits * connecting to standard consumer units and their overcurrent protective devices * SELV lighting * LED lighting * radial and ring final circuits * other domestic circuits. * Learners to understand the general requirements of isolation and switching (see *IET On-Site Guide*, Appendix J and BS 7671:2018+A1:2020, Ch 46). |
| * 1. Earthing systems and earthing and protective conductors | * Learners to understand earthing systems, earthing and protective conductors by being shown videos covering earthing and bonding, such as the John Ward YouTube channel – Earthing and bonding Parts 1, 2 and 3. * Learners to be given the opportunity to participate in practical workshop activities such as connecting main protective bonding conductors to simulated main earth terminals, and simulated water and gas pipes. * Learners to produce diagrams showing the full earth fault loop impedance paths for TN-S, TN-C-S and TT earthing systems. * Learners to understand the purpose of earthing and protective conductors when used for protection. * Learners to recognise the components which provide automatic disconnection of supply (ADS), including exposed and extraneous conductive parts, and to understand the earth fault loop impedance paths of the different earthing systems (see Tanner, *Book 2*, Ch 6). * Learners to understand the general requirements for the installation of main protective bonding (see Tanner, *Book 2*, Ch 3 and the *IET On-Site Guide*, section 4). |
| * 1. Devices used for safety and protection in electrical systems | * Learners to understand the devices used for safety and protection in electrical systems (see Tanner, *Book 2*, Ch 2 and BS 7671:2018+A1:2020, Chs 42 and 44), such as: * fuses * circuit breakers * residual-current devices (RCDs) * residual-current circuit breakers (RCCBs) * surge protective devices (SPDs) * arc-fault detection devices (AFDDs). * Learners to be shown videos covering these protection devices, such as the John Ward YouTube channel – Surge protection devices Parts 1 and 2. * Learners to understand the terms ‘overcurrent’ and ‘overcurrent protection’ as described in the *IET On-Site Guide*, section 3.2, and what causes an overcurrent. |
| 1. Understand the appropriate industry standards, regulations and requirements relevant to installing enclosures | * 1. Industry standards and regulations | * Learners to have an understanding of industry standards and regulations including the Electricity at Work Regulations 1989, Electrical Safety, Quality and Continuity Regulations (ESQCR) 2002 and The Construction (Design and Management) Regulations 2015. * Learners to understand the requirements of the *IET On-Site Guide* with respect to industry standards and regulations. * Learners to refer to the (informative) Appendix 2 of BS 7671:2018+A1:2020. |
| * 1. How to produce a risk assessment and method statement for the work to be carried out | * Learners to produce a risk assessment relating to their practical workshop safety using the 5-step approach recommended by the Health and Safety Executive (HSE). * Learners to prepare a method statement for the steps required to conduct a safe isolation of a main switch within a consumer unit. * Learners to follow good practice, to see an example of a completed risk assessment and to follow the procedure relating to work to be carried out (see Tanner, *Book 2*, Ch 7). * Learners to follow good practice for the procedure for completing a method statement for the work to be carried out (see Tanner, *Book 2*, Ch 7). |
| * 1. How to verify that job information and documentation is current and relevant and that the plant, instruments, access equipment and tools are fit for purpose | * Learners to verify that job information and documentation is current and relevant and that all plant, instruments and access equipment (especially ladders) and tools are not damaged and are fit for purpose by: – following manufacturers’ instructions – referring to information from the Health and Safety Executive (HSE) – following guidance from Tanner, *Book 2*, Ch 7. * Learners to be shown the organisation’s documentation for reporting unsafe equipment. * Learners to understand the procedures for ensuring job information and documentation is current and relevant (see Tanner, *Book 2*, Ch 4). |
| * 1. The applications, advantages and limitations of types of personal protective equipment | * Learners to understand the advantages and limitations of types of personal protective equipment (PPE). * Leaners to be shown videos from the HSE regarding personal safety (see Suggested resources). * Learners to know where to download PPE reference material (see Suggested resources). * Learners to understand the Personal Protective Equipment at Work Regulations 1992, as described in Tanner, *Book 2*, Ch 7. * Learners to understand that an effective risk assessment makes PPE a last resort and that its limitations are fully explained on the HSE website. |
| 1. Understand the applications, advantages, and limitations of types of enclosures | * 1. The applications, advantages, and limitations of types of enclosures | * Learners to understand the applications, advantages and limitations of types of enclosure. * Learners to know where to download pictures and explanations of different types of enclosure (see Expert Electrical website in Suggested resources), such as: * plastic enclosures * junction boxes * stainless-steel enclosures * galvanised adaptable boxes * dust-tight enclosures * water-resistant enclosures. * Learners to understand PVC and metallic conduit systems as described in the *IET On-Site Guide*, Appendix E. * Learners to appreciate the differences, advantages and limitations of different types of containment systems used within electrical installations, such as: * cable tray * cable basket * ladder systems lighting track * ducting * modular wiring systems * busbar lighting systems * busbar lighting track. * Learners to know where to download pictures and explanations of their use (see Electrical Apprentice website in suggested resources). |
| * 1. The industry-recognised methods for determining the type and size of enclosures | * Learners to understand the industry-recognised methods for determining the types of enclosures, with reference to BS 7671:2018+A1:2020, Regulation 416.2.1 (barriers and enclosures). * Learners to recognise industry-standard enclosure sizes and the methods for determining them. * Learners to be shown examples and manufacturer’s data sheets. |
| * 1. How to interpret diagrams and drawings to locate site services and identify the planned location of the enclosures and equipment | * Learners to understand how to interpret types of diagrams and drawings, to know how to locate site services and to be able to identify planned locations for enclosures and equipment. * Learners to be shown examples of plans and layout drawings of installations and to know how to interpret their measurements. * Learners to be shown examples of site plans and as-fitted drawings and to know how to interpret their measurements. * Learners to understand the ratios used in drawings and conversion from site drawings to ascertain material etc. * Learners to understand the graphical symbols used in diagrams and drawings, including: * switches – one-way, two-way, intermediate and pull * lighting points – incandescent, fluorescent, wall-mounted * socket outlets – switched and unswitched * fused connection units and switched fused connection units * consumer control units * cooker control units * integrated meters (kWH meters) * fuses and circuit breakers. |
| * 1. The methods and techniques for fitting, fixing and connecting the selected enclosures and their components and accessories in accordance with: * the electrical system's design * manufacturers' instructions | * Learners to understand methods and techniques for fitting, fixing and connecting accessories, enclosures and their components, with respect to the system design and manufacturer’s instructions. * Learners to understand that different surfaces need different fixing methods and techniques for mounting accessories. * Learners to be shown examples of such fixings for different surfaces, such as fixings used for wood, plasterboard, concrete, steel, dry walling, cavity walls. * Learners to understand that system design must be followed for fixtures and fittings of accessories and cannot be selected randomly. * Learners to understand that manufacturer’s instructions must be followed where specific fixings and techniques are utilised. * Learners to understand connection methods and techniques used for the selected accessories and enclosures. |