

Unit 63: Temporary Stage Electrical Installations

Unit code:	F/600/0173
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

This unit will enable learners to develop skills and provide temporary electrical circuits required within the performance environment. The installation will be safe and meet regulations, and give an understanding of cable sizes, safety devices and regulations.

● Unit introduction

The technical side of theatre requires a range of temporary electrical installations for shows and events which will be removed at the end of the production. The entire entertainment industry runs on temporary installation required for a specific task or event. This unit will cover the theory and practice of providing safe temporary installations.

Learners will get the chance to carry out basic electrical installation theory, including loading calculations, three-phase and single-phase power, and producing basic specifications. How to make cables, splitters and adapters and how to safely install the system will be also practised.

In this unit learners will develop the skills to plan, source and implement the temporary electrical installation typically used in entertainment venues. The intention of this unit is to allow learners to develop skills allowing them to become competent and safe. The unit addresses the current practice of buying or hiring in equipment for specific projects rather than permanently installing an electrical distribution system.

Safety will also be a key feature of the installation; looking at safety and protection devices will be part of the unit. Types of connector will be considered for mains and low voltage systems including communication equipment.

● Learning outcomes

On completion of this unit a learner should:

- 1 Be able to collate and interpret information about product ranges and specifications of equipment
- 2 Be able to carry out calculations to determine loading and phasing
- 3 Be able to install, connect and test equipment in a distribution system
- 4 Be able to construct a safe working item of circuit distribution system with protection device.

Unit content

1 Be able to collect and interpret information about product ranges and specifications of equipment

Connectors: single phase; three phase; Cam-lock (or similar types); ratings; sealing

Cables: sizes; types; ratings; protection from mechanical damage; storage

Other equipment: metering systems; indicators; isolators; housings; flight cases; 100v line audio systems

2 Be able to carry out calculations to determine loading and phasing

Electrical: voltage; current; power consumption; load; resistance; impedance

Budget: hire charges; purchase price; component costing

3 Be able to install, connect and test equipment in a distribution system

Planning: stage audio; front-of-house audio; dimmable lighting; non-dimmable lighting; backline; working light; plans; drawings; specifications

Practice: mains distribution units; 13 amp/16 amp distribution units; rack distribution units; intercom/audio distribution units

Cable systems: connectors; adapters; splitters; cable; cable protectors; steel wire armoured (SWA)

Maintenance/repair: termination; wiring techniques; tools; safety

Good practice: separation of phases; prevention of dimmer interference to audio systems; separate audio power circuits

4 Be able to construct a safe working item of circuit distribution system with protection device

Residual current devices (RCDs): ratings; sensitivity; operation; features and benefits; disadvantages

Circuit protection: Residual Current Circuit Breakers with Overcurrent protection (RCBOs); miniature circuit breakers (MCB); inrush current ratings; resistive and inductive loads

Electrical shock: avoidance; effects; first aid

Grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 collate appropriate information about product ranges and specifications [IE]	M1 present a range of information about product ranges and specifications clearly with some sense of order in terms of relevance and importance	D1 present detailed and comprehensive information about product ranges and specifications that is clearly indexed and in which there is evidence of careful selection of material
P2 carry out loading and phasing calculations with support and guidance [IE, TW]	M2 carry out loading and phasing calculations with some confidence knowing when to ask for guidance	D2 carry out a range of loading and phasing calculations with independence and confidence
P3 install, connect and test the specified range of equipment with considerable support and guidance [TW]	M3 install, connect and test the specified range of equipment with little support and guidance	D3 install, connect and test the specified range of equipment independently showing initiative, requesting safety checks when necessary
P4 construct a safe working item of circuit distribution equipment with considerable support and guidance. [TW]	M4 construct a safe working item of circuit distribution equipment with minimal support and guidance.	D4 construct a safe working item of circuit distribution equipment independently showing initiative.

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

The theatre environment requires a range of temporary installations to be provided for both sound and lighting for many shows or specific events. These installations are removed following the end of the run of shows or events. These could include temporary power distribution for exhibition stands or stalls and mains distribution for stage lighting installations for both dimmer and permanent feed circuits. Distribution should also be installed for audio systems involving clean earth paths, and the installation of intercom and talkback systems.

The systems provided should involve power distribution through consumer units, with RCD and over-current protection, and a variety of types of connector and cable to comply with regulations. Learners need to be aware of 100V line distribution systems.

Learners will normally take part in workshop sessions where the skills necessary for the unit can be taught. Formal teaching of some of the theory sessions and some support for the numerical components may be required. Wherever possible it is suggested that projects be designed to allow learners to design and build real devices that can be used.

The testing phase of the construction work may become the focus of the safety components of the unit. The tutor or other competent person must supervise the testing phase to ensure safety standards are upheld.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment

Introduction to the unit and structure of the programme of learning.

Introduction to electrical installation planning: Tutor

- health and safety
- electrical safety
- class 1 and class 2 and earthing requirements
- loading
- regulations
- cable/connector types.

Topic and suggested assignments/activities and/assessment

Assignment 1: Collate Information about Product Ranges – P1, M1, D1

Learners:

- create a portfolio of reference material covering
 - ◊ connectors
 - ◊ cables
 - ◊ identify equipment to be used and where it would be used
 - ◊ research sizes/dimensions of equipment to be housed
 - ◊ identify housing options
 - ◊ identify interconnect requirements
 - ◊ servicing potential.

Assignment 2: Design a Distribution System to be Implemented for a Specific Project – P2, M2, D2

Learners:

- identify loading requirements
- identify environment it is to be used in and its implications
- identify local power sources
- design distribution system
- calculate loading
- discuss safety devices/protection
- cost plan.

Assignment 3: Carry out Installation Planned in Assignment 2 – P3, M3, D3, P4, M4, D4

Learners:

- carry out installation
- make leads/cables
- make panels as required
- carry out safety checks
- use the distribution system in performance.

Review unit and assignments.

Feedback from assignment.

Assessment

Evidence for this unit can be generated through practical projects that demonstrate competence by test and actual usage. In addition, some research skills are required during the information collection stage. Learners will also have assessment of their paper-based skills through the documentation, planning and presentation phases.

This unit requires each learner to install a distribution system, taking account of the listed unit content. Tutors must ensure that a suitable occasion is chosen for each learner to carry out this task. The task may be a team effort but the size of the team should be no more than three learners and their individual contribution must be identifiable.

There are four elements to the assessment of work for this unit:

- producing an indexed reference portfolio of electrical and associated equipment
- demonstration of basic power calculations
- installation and connection of equipment
- construction of safe working distribution equipment.

Each element can be documented in a number of ways to produce sufficient and reliable evidence for assessment purposes. Evidence of background research material should include manufacturer and product range research undertaken along with a presented report either written, spoken or using ICT. The differences and uses of each type of equipment should be identified, and explained, with some technical notation. This should include as a minimum Ingress Protection (IP) ratings and loading

Learners should maintain a working log/diary for the practical elements of this unit and should also have supporting evidence in the form of photographic, video and observation records. A permanent record of learners' achievements can best be made with photographic or video evidence of the effects or processes achieved in practical work. Written evidence from the learners would also be valid but it would be difficult to detail adequately the actual processes they used and, whilst acceptable as evidence, the production of this written evidence would be very time consuming.

Witness evidence from suitably qualified individuals in a professional environment would also be acceptable subject to internal and external verification processes. Witness testimony or assessment should be undertaken and a record placed as evidence in learners' portfolios

Please note that it is not acceptable for learners to direct a member of staff or another learner in the installing, testing and connecting processes. Individual learners being assessed must carry out the mechanical process on their own. The term 'direction' used in this unit is the industry standard method of instructing another individual to carry out a remote task either directly or via a communications system.

Learning outcome 1 requires learners to develop a portfolio of information about product ranges and specifications.

At pass level, learners will list a range of types of distribution equipment, cabling and associated equipment. They should show a basic understanding of the types of distribution system and manufacturers' product ranges. Research evidence will be presented along with any letters, emails or documented phone calls to manufacturers. Research can include catalogues and internet prints but the relevant information should be highlighted or annotated and then used and explained.

At merit level, learners will describe equipment in more detail, evidence should look at published data, sizes, and comparisons made between manufacturer and product ranges. Control equipment should be discussed highlighting differences and making comparisons. At merit level the information should be presented, analysed to a degree and basic conclusions made as to which product range and type learners would choose and why.

At distinction level, learners will describe in detail a large range of equipment, analysing advanced technical details including:

- *connectors*: single phase, three phase, Cam-lock (or similar types), ratings, sealing
- *cables*: sizes, types, ratings, protection from mechanical damage, storage
- *other equipment*: metering systems, indicators, isolators, housings, flight cases, 100v line audio systems.

Learning outcome 2 requires learners to carry out loading and phasing calculations. This will be from a given project or simulation.

At pass level, learners will be able to calculate loading on a single phase distribution system, with help and guidance.

At merit level, learners will be able to calculate loading on single and three phase distribution systems with minimal help and show an understanding of cable and connector sizes required.

At distinction level, learners should be able to independently carry out loading and phasing calculations with confidence giving alternative connectors, and cabling options for the distribution system.

Learning outcome 3 requires learners to install, connect and test the specified equipment.

At pass level, learners will be able to wire and connect the distribution system with help and guidance and check it functions at a basic level.

At merit level, learners will be able to wire, and connect the distribution system with minimal guidance and identifying checks when required, and ensuring it functions as designed.

At distinction level, learners will be able to wire, and connect the distribution system with no guidance, solving problems and identifying checks when required and carrying out fault finding tasks, and identifying hazards.

Learning outcome 4 requires learners to understand safety protection devices on electrical circuits. Learners will construct a basic distribution system, calculating loading and showing knowledge of protection devices including fuses, RCDs, RCBOs and MCBs.

At pass level, learners will construct a working item of circuit distribution system, with considerable guidance, showing a basic knowledge of protective devices used.

At merit level, learners will construct a working item of circuit distribution system, with minimal guidance, showing a working knowledge of protective devices used, and calculating fuse and breaker ratings.

At distinction level, learners will construct a working item of circuit distribution system, independently, showing a good knowledge of protective devices used, and calculating fuse and breaker ratings, working safely showing attention to detail and good installation techniques. The installation will be neat and safe.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	Collate Information about Product Ranges	Learners, in role of electrician, have to research types of enclosure, connector and cables and build a portfolio of reference material to use throughout this unit.	Portfolio of reference material containing: <ul style="list-style-type: none"> • types and specifications of connectors • cables • equipment lists, including where and when it would be used • dimensions of equipment to be housed and enclosure options • interconnect requirements • servicing options within design.
P2, M2, D2	Design a Distribution System for a Specific Project	Learners, in role of electrician, carry out loading calculations for specific project and come up with a design of a solution to the task specified.	Project portfolio containing: <ul style="list-style-type: none"> • loading requirements of the project • environment it is to be used in an implications for the design • local power sources and constraints • distribution system design • loading of the designed system • safety devices/protection requirements.
P3, M3, D3, P4, M4, D4	Carry out the Planned Installation	Learners, in role of electrician, will construct the distribution system designed in Assignment 2, installing, connecting and testing the system constructing it safely.	Finished distribution system. Test results. Observation. Video. Photo. Diary.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Performing and Production Arts sector suite. This unit has particular links with the following unit titles in the BTEC Performing and Production Arts suite:

Level 1	Level 2	Level 3
Exploring Technical Support for Stage Performance	Crewing for Stage Performance	Stage Technical Maintenance
		Technical Stage Operations
		Stage Lighting Operations
		Stage Sound Operations.

This unit also has links with the following National Occupational Standards:

Technical Theatre

- CPD1 – Improving your skills
- CPD2a – TP Keeping up to date with technical and production developments in the live arts
- CPD4a – Contributing to technical production work for performance
- HSI – Working safely
- TP8.2a – Setting up, focusing lighting and checking control systems and accessories
- TP8.4 – Setting up and checking sound equipment
- TPI6a – Preparing and assembling rigging and de-rigging
- MTPI – Using tools and equipment for construction or maintenance.

Essential resources

This unit requires learners to construct examples of electrical distribution equipment cable systems, connectors, distribution boxes, etc. These may be for actual usage or can be a set of components that are returned to stock after assessment. At least one functioning power outlet: IEC309, CEE17 and BS4343 types must be available, as these are, at the time of writing, the current industry standard for connection of temporary cable systems. Sufficient tools, test and safety equipment must be available.

Employer engagement and vocational contexts

Health and safety legislation prevents learners aged under 16 from carrying out work for this unit in the workplace. Work for the unit needs to be carried out in the centre, either in a workshop setting or in a performance space.

Indicative reading for learners

Textbooks

Linsley T – *Basic Electrical Installation Work* (Newnes, 2008) ISBN 9780750687515

Scaddan B – *PAT – Portable Appliance Testing: In-service Inspection and Testing of Electrical Equipment* (Newnes, 2008) ISBN 9780750687362

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	researching equipment ranges
Team workers	installing the system carrying out loading and phasing calculations
Effective participators	installing the system.

● Functional Skills – Level 2

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	carrying out loading and phasing calculations
Identify the situation or problem and the mathematical methods needed to tackle it	working out design of enclosure
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	working out system design
Draw conclusions and provide mathematical justifications	presenting options for final design
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching components
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	presenting ideas.