



Skills for Employment Investment Program (SEIP)

**COMPETENCY-BASED LEARNING MATERIAL
(FACULTY GUIDE)**

FOR

**ELECTRICAL INSTALLATION AND MAINTENANCE
(CONSTRUCTION SECTOR)**

**Finance Division, Ministry of Finance
Government of the People's Republic of Bangladesh**

Table of Contents

Copyright	4
Approval Sheet	5
How to Use this Competency-based Learning Material	7
Instructions to Teaching Adult Learners	8
List of Icons	10
Modules	11
Module 1: Perform channel wiring	11
Learning Outcome 1.1 - Interpret drawings and specifications	12
Learning Outcome 1.2 - Collect tools, equipment and materials	13
Learning Outcome 1.3 - Draw the layout and set channels and cables	14
Learning Outcome 1.4 - Install boards and set all other accessories of wiring	15
Learning Outcome 1.5 - Perform circuit operation as per diagram and layout	16
Learning Outcome 1.6 - Clean the workplace	17
Module 2: Install earthing and atmospheric lightning protection system	18
Learning Outcome 2.1 - Identify the type of earthing to be used	20
Learning Outcome 2.2 - Identify the type of lightning protection system to be used	21
Learning Outcome 2.3 - Select and collect tools, equipment and materials	22
Learning Outcome 2.4 - Excavate the hole for earthing element installation	23
Learning Outcome 2.5 - Install earthing components	24
Learning Outcome 2.6 - Finish earth pit chamber for pipe earthing method	25
Learning Outcome 2.7 - Install lightning protection system	26
Learning Outcome 2.8 - Clean/maintain the work area	27
Module 3: Perform conduit wiring	28
Learning Outcome 3.1 - Collect tools, equipment and materials	29
Learning Outcome 3.2 - Install conduits and set cables	30
Learning Outcome 3.3 - Install boards and set all other accessories of wiring	31
Learning Outcome 3.4 - Test the wiring	32
Learning Outcome 3.5 - Measure the earth resistance	33
Learning Outcome 3.6 - Clean the work place	34
Module 4: Perform service connection	35
Learning Outcome 4.1 - Interpret drawings and specifications	36
Learning Outcome 4.2 - Collect tools, equipment and materials	37
Learning Outcome 4.3 - Measure the distance of service line and install cables for service connection	38
Learning Outcome 4.4 - Install energy meter and connect with main switch	39
Learning Outcome 4.5 - Clean the workplace	40
Module 5: Perform motor connection	41
Learning Outcome 5.1 - Identify and select controlling and protective devices for motor connection	42

Learning Outcome 5.2 - Collect tools, equipment and materials	43
Learning Outcome 5.3 - Install, controlling and protective devices	44
Learning Outcome 5.4 - Perform motor connection, check and test circuit	45
Learning Outcome 5.5 - Clean the workplace	46
Module 6: Install and maintain electric motor with control system	47
Learning Outcome 6.1 - Identify and select controlling devices for motors	49
Learning Outcome 6.2 - Connect starter with the motors	50
Learning Outcome 6.3 - Monitor and test conditions of motor	51
Learning Outcome 6.4 - Service motor	52
Learning Outcome 6.5 - Maintain tools, equipment, materials and workplace	53
Module 7: Perform motor rewinding and servicing	54
Learning Outcome 7.1 - Check the machine physically and dismantle it to detect the actual fault	56
Learning Outcome 7.2 - Select tools and prepare material for winding/rewinding	57
Learning Outcome 7.3 - Carry out winding/rewinding of stator rotor and armature	58
Learning Outcome 7.4 - Make connections, carry out pre-assembly tests and assembly of machine	59
Learning Outcome 7.5 - Maintain tools, equipment, materials and workplace	60
Module 8: Install and troubleshoot solar electrical system	61
Learning Outcome 8.1 - Estimate electrical load of customer	63
Learning Outcome 8.2 - Identify tools, equipment and materials	64
Learning Outcome 8.3 - Set solar panel	65
Learning Outcome 8.4 - Install solar home system and accessories	66
Learning Outcome 8.5 - Diagnose and repair faults in solar home system unit and wiring	67
Learning Outcome 8.6 – Clean and store tools and materials	68

Copyright

The Competency-based Learning Material (Faculty Guide) for Electrical Installation and Maintenance is a document, aligned to its applicable competency standard, for providing training consistent with the requirements of industry in order for individuals who graduated through the established standard via competency-based assessment to be suitably qualified for a relevant job.

This document is owned by the Finance Division of the Ministry of Finance of the People's Republic of Bangladesh, developed under the Skills for Employment Investment Program (SEIP).

Public and private institutions may use the information contained in this competency-based learning material for activities benefitting Bangladesh.

Other interested parties must obtain permission from the owner of this document for reproduction of information in any manner, in whole or in part, of this Competency-based Learning Material, in English or other language.

This document is available from:

Skills for Employment Investment Program (SEIP) Project
Finance Division
Ministry of Finance
Probashi Kallyan Bhaban (Level – 16)
71-72 Old Elephant Road
Eskaton Garden, Dhaka 1000
Telephone: +8802 551 38598-9 (PABX), +8802 551 38753-5
Facsimile: +8802 551 38752
Website: www.seip-fd.gov.bd

Approval Sheet

Identification and validation of modules and content for this occupation were made by experts within this sector. A series of consultations were held to accurately capture industry and employer needs and expectations and develop the learning material that would help to enhance the employability of the youth trained. This process started on 17 December 2017 and concluded with a validation workshop with a sectoral working group on 23 May 2018.

Experts Involved

Industry and subject-matter experts who provided their valuable inputs to develop this competency-based learning material [December 2017 - May 2018]:

Name	Organisation	Designation
Md. Rabiul Islam	Bangladesh Sugar and Food Industries	Assistant Manager (Electrical)
Eng. Dilip Kumar Sarkar	Project Builders Limited	Deputy Chief Engineer
Md. Arifuzzaman	UCEP	Instructor
Syed Bulbul Ahmed	Skills Development Institute	Instructor
Md. Hannan Sikder	Syed Sadat Ali Memorial Training Centre	Instructor
Eng. Md. Asaduzzaman	CISC	Assessment and Certification Executive
David King	British Council - SD03	Team Leader
Md. Sayedur Rahman	British Council - SD03	National Subject Matter Consultant - Construction Sector

Validation Workshop

Competency-based learning material validation workshop participants [held on 23 May 2018]:

Name	Organisation	Designation
Syed Bulbul Ahmed	Skills Development Institute	Instructor
Md. Arifuzzaman	UCEP	Instructor
Ms. Nishat Kaiser	Syed Sadat Ali Memorial Training Centre	Instructor
Eng. Dilip Kumar Sarkar	Project Builders Limited	Deputy Chief Engineer
Md. Mohin Uddin	Mohin Electrical Engineering Works	Managing Director
Ms. Aklima Akter	DAM Vocational Training Institute	Instructor
Eng. Md. Mushfiqur Rahman	BACI	Chief Coordinator

Name	Organisation	Designation
S.M. Shahjahan	BTEB	Deputy Director
Md. Abdur Razzaque	SEIP	Specialist-1 (Competency Standards)
Syed Nasir Ershad	SEIP	AEPD (Public1)
Mr. Md. Ahsan Habib	SEIP	TVET Specialist
Mr. Mohiuzzaman	SEIP	Course Specialist
David King	British Council - SD03	Team Leader
Md. Sayedur Rahman	British Council - SD03	National Subject Matter Consultant - Construction Sector

Committee Workshop

The National competency-based learning material for National Skills Certificate in Electrical Installation and Maintenance, **NTVQF Level [INSERT LEVEL]** qualification is a document developed by the Skill for Employment Investment Programme (SEIP), Finance Division, Ministry of Finance. This competency-based learning material has been developed by an industry expert group under guidance of SEIP. The competency-based learning material was approved by the SCDC [BTEB to insert date] at NTVQF Cell, BTEB.

Respectable members of the SCDC:

Electrical Installation and Maintenance - Level [INSERT LEVEL]		

How to Use this Competency-based Learning Material

Welcome to the competency-based learning material for Electrical Installation and Maintenance for use in electrical works. These modules contain training materials and activities for learners to complete in order to become competent and qualified as a skilled worker.

There are eight (8) modules that make up this course which comprises the skills, knowledge and attitudes required to become a skilled worker including:

1. Perform channel wiring
2. Install earthing and atmospheric lightning protection system
3. Perform conduit wiring
4. Perform service connection
5. Perform motor connection
6. Install and maintain electric motor with control system
7. Perform motor rewinding and servicing
8. Install and troubleshoot solar electrical system

As a trainer, you are required to guide the learners through a series of activities in order to complete each learning outcome of the module. These activities may be completed as part of structured classroom activities or they may be required to work at their own pace.

These activities will require the learners to complete associated learning and practice activities in order to gain knowledge and skills they need to achieve the learning outcomes. Refer to **Learning Activity Page of each module** to know the sequence of learning tasks and the appropriate resources to use for each task.

This page will serve as the road map towards the achievement of competence. If you read the **Information Sheets**, these will give you an understanding of the work, and why things are done the way they are. Once the learners have finished reading the Information Sheets, they are required to complete the questions in the **Self-Check Sheets**.

The self-check process follows the Information Sheets in the learning guide. Completing self-checks will help the learners know how they are progressing. To know how they fared with self-checks, they can review the **Answer Key**.

The learners are required to complete all activities as directed in the **Job Sheet**. This is where they will apply their newly acquired knowledge while developing new skills. When working, high emphasis should be laid on safety requirements. The learners should be encouraged to raise relevant queries or ask the facilitator for assistance as required.

When the learners have completed all the tasks required in the learning guide, an assessment event will be scheduled to evaluate if they have achieved competency of the specified learning outcomes and are ready for the next task.

Introduction to Teaching Adult Learners

Since you will be dealing with adult learners, it is important to understand the basic principles of adult learning and methodologies. Adults learn best through associations, experiences and application. A few facts to consider while teaching adult learners:

Discussion: Adult learning is best managed through mutual dialogue and discussion. Discussion needs to be encouraged and used in the classroom to maximise learning.

Associations: Adults have experiences which can be related to any learning objectives to create associations which enhance conceptual comprehension. Associations can be used to create user interest and gain attention. Adults learn new attitudes or skills best in relation to previous life experiences.



This strategy also ensures knowledge retention.

Create an environment conducive to learning and sharing: Make people feel comfortable talking to you and each other. They should feel at ease asking questions, sharing views even if they are not very sure of the efficacy of their suggestions or views.

Physical surroundings: Temperature, light, space and furniture should be optimal. There should be no distractions.

Inculcate respect: Encourage learners' contributions and experiences. People are more encouraged to learn and share when their experiences are acknowledged - new information builds easily on past knowledge and experience.

Reward and recognition: Acknowledging the efforts of people, even small attempts, can reap great benefits. Learners like to receive praise and positive encouragement, which motivates them to deliver their best.

Learners also like to be reassured that they are correctly recalling or using information they have absorbed in the classroom.

Structured teaching: Learners study faster when information or skills are presented in a structured way:

- Concepts to be taught in small, bite sized portions for easy assimilation
- Put forth the easiest ideas or skills first and then gradually build on them
- Bring in the important ideas first
- Reinforce key ideas at regular intervals
- Reinforce high order concepts at regular intervals

Move learner from generic to specific flow of information: Introduce the generic concepts first and then move to specific more complex information to ease understanding and comprehension.

Application of concepts/ideas taught: Help students put into practice the concepts taught in the class through exercises and work-based projects. Application ensures knowledge retention and skill building.

Relevance building: Build up relevance of the concepts being taught in class by relating them to day-to-day life and workplace experiences.

Learners should know to use and apply what they have learned in the classroom as they learn faster when they recognise that what they are learning will be useful in the future.

Sharing: Encourage learners to learn from each other and solve problems collectively. This makes learning easier and improves team spirit and the interpersonal skills of the learners.

Participation: Involve learners in the class - adults favour to be *active participants* in learning rather than passive receivers of knowledge. People learn faster when they actively process information, solve problems and practice skills.

Motivate: Inspire the class so that teaching does not become a one-way process of knowledge download. Learners will learn faster when they feel an inner urge to learn and be an active participant in the class.

Create a learning environment in which the learners feel free and able to shed their inhibitions and develop receptivity towards new ideas and concepts.

Students will have different motivation levels - some will be more eager to learn than others as each learner is different from the other and therefore need to be treated differently.

And remember - adapt your communication style to suit the needs of the audience.

Communicate effectively: Communicate in a manner that is understood by the class. The language and sentence structuring should be clear and succinct.

Technical concepts should be explained in a manner that de-mystifies the concept - make things simple and easy to understand.

Avoid using *too much* technical jargon - if it is part of the curriculum, ensure the class is first made familiar with the words or jargon used.

Assessments: Conduct skill and knowledge checks regularly:















- Reinforce high order concepts at regular intervals.
- Conduct formative and summative assessments.
- Strengthen areas which appear to be weak.

Regular feedback:

- Provide regular feedback to learners
- Help them identify their strengths and areas of improvement
- Feedback should always be constructive
- Timely and specific feedback is easier to accept and act on



List of Icons

Icon Name	Icon
Module content	
Learning outcomes	
Performance criteria	
Contents	
Assessment criteria	
Resources required	
Information sheet	
Self-check Quiz	
Answer key	
Activity	
Video reference	
Learner job sheet	
Assessment plan	
Review of competency	

Module 1: Perform channel wiring

Module Descriptor:	This module covers the skills, knowledge and attitudes to perform channel wiring. This specifically includes interpreting drawings and specifications, collecting tools, equipment and materials, drawing the layout and setting channels and cables, installing boards and setting all other accessories of wiring, performing circuit operation as per diagram and layout and cleaning the workplace.	
Nominal Duration:	35 hours	
Learning Outcomes:	1.1.	Interpret drawings and specifications
	1.2.	Collect tools, equipment and materials
	1.3.	Draw the layout and set channels and cables
	1.4.	Install boards and set all other accessories of wiring
	1.5.	Perform circuit operation as per diagram and layout
	1.6.	Clean the workplace
Performance Criteria:	1.1.	Electrical drawings are collected and interpreted.
	1.2.	Sign and symbols are identified.
	1.3.	Terms and abbreviations are identified.
	1.4.	Specifications are interpreted.
	1.5.	Tools, equipment and materials are collected and checked for usability.
	1.6.	PPE is collected and used as per requirements.
	1.7.	Wiring layout is drawn according to supplied drawing.
	1.8.	Rowel plug points are located, drilled and inserted as per requirements.
	1.9.	Bottom part of the channel is installed and screwed.
	1.10.	Cables with ECC are laid on the bottom part of the channel.
	1.11.	Boards are collected and fitted as per wiring diagram.
	1.12.	Switches, sockets, fan regulator are fitted on the board and connected to the circuits.
	1.13.	Ceiling rose and different types of holders are fitted on the board and connected to the circuit.
	1.14.	MCB and MCCB are connected and fitted on the board.
	1.15.	Circuit materials are placed on the board and other accessories are connected and fitted.
	1.16.	The bottom part of the channel is covered with upper part of the channel.
	1.17.	Tools and equipment are cleaned and stored as per standard practice.
	1.18.	Waste materials are disposed of and workplace is cleaned in accordance with standard procedure.



Learning Outcome 1.1 – Interpret Drawings and Specifications

Contents:	<ul style="list-style-type: none"> ▪ Electrical plans/drawings ▪ Sign and symbols ▪ Terms and abbreviations ▪ Specifications 		
Resources Required:	<ul style="list-style-type: none"> ▪ Electrical plans/drawings ▪ Sign and symbols related to construction and electrical works ▪ Terms and abbreviations ▪ Specification sheets 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.1	<ul style="list-style-type: none"> ▪ Information Sheet 1.1.1 ▪ Self-Check Quiz 1.1.1 ▪ Answer Key 1.1.1 http://en.wikipedia.org/wiki/Electrical wiring	8 11 35
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Drawings are collected and interpreted ▪ Sign and symbols are identified ▪ Terms and abbreviations are identified ▪ Specifications are interpreted 		



Learning Outcome 1.2 – Collect Tools, Equipment and Materials

Contents:	<ul style="list-style-type: none"> ▪ List of hand tools and their uses/functions ▪ List of power tools and their uses/functions ▪ List of equipment ▪ List of electrical materials and their uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Hand tools: adjustable wrench, wire stripper, mallet, c-clamp, chisels: (a) wooden (b) cold, drill bits, files: (a) flat (b) round (c) half round, hacksaw, hammers: (a) ball peen (b) claw, hand drill, measuring tape, pliers: (a) combination pliers (b) cutting pliers (c) diagonal cutting pliers (d) long nose pliers, punches, screwdrivers: (a) star (b) flat (c) connecting, try square, neon tester, wire cutters, S.W.G., set squares, electrician knife, ladder ▪ Power tools: electric drill machine, grinders, soldering iron ▪ Equipment: multi meter/AVO meter, earth tester, digital weight machine ▪ Materials: Channel (1/2", 3/4", 1", 1.25", 1.5" PVC), GI wire, elbow, bend, PVC circular box, rowel plug, saddle, screw, cable lugs, cable tie, thread ball, insulating clip, flexible conduit, plastic forma, electric soldering lead, plastic tape, cable (PVC, VIR) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.2	<ul style="list-style-type: none"> ▪ Information Sheet 1.2.1 ▪ Information Sheet : 1.2.2 ▪ Self-Check Quiz 1.2.1 ▪ Self-Check Quiz 1.2.2 ▪ Answer Key 1.2.1 ▪ Answer Key 1.2.2 <p>https://www.thespruce.com › Home Repair › Electrical Repair › Electrical Repair Tools</p>	<p>13</p> <p>15</p> <p>15</p> <p>18</p> <p>35</p> <p>35</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools, equipment and materials are collected ▪ Tools, equipment and materials are checked for usability 		



Learning Outcome 1.3 – Draw the Layout and Set Channels and Cables

Contents:	<ul style="list-style-type: none"> ▪ List of PPE and their uses ▪ Layout and set channels and cables 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: channels, wire, elbows, bends, PVC circular box, plugs, saddles, screws, cables, cable lugs, cable ties, thread ball, insulating clips, flexible conduit, plastic forma, electric soldering lead 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.3	<ul style="list-style-type: none"> ▪ Information Sheet 1.3.1 ▪ Information Sheet 1.3.2 ▪ Job Sheet 1 ▪ Self-Check Quiz 1.3.1 ▪ Self-Check Quiz 1.3.2 ▪ Answer Key 1.3.1 ▪ Answer Key 1.3.2 	<p>19</p> <p>21</p> <p>23</p> <p>21</p> <p>24</p> <p>35</p> <p>35</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ PPE is collected and used ▪ Wiring layout is drawn according to supplied drawing ▪ Rowel plug points are located, drilled and inserted as per procedure ▪ Bottom part of the channels are installed and screwed ▪ Cables with ECC are laid on the bottom part of the channel 		



Learning Outcome 1.4 – Install Boards and Set All Other Accessories of Wiring

Contents:	<ul style="list-style-type: none"> ▪ Boards and their uses ▪ Uses of switches, sockets, fan regulator and ballast ▪ Ceiling rose and different types of holders ▪ MCB and MCCB: rewirable fuse, cartridge fuse, glass fuse, HRC fuse, single pole MCB, double pole MCB, MCCB, earth leakage circuit breaker (ELCB) 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: boards, switches, sockets, fan regulator, ceiling rose, holders, MCB and MCCB 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.4	<ul style="list-style-type: none"> ▪ Information Sheet 1.4.1 ▪ Self-Check Quiz 1.4.1 ▪ Answer Key 1.4.1 	<p>26</p> <p>28</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Boards are collected and fitted as per wiring diagram ▪ Switches, sockets, fan regulator and ballast are fitted on the board with screw ▪ Switches, sockets and fan regulator are connected to the circuits ▪ Ceiling rose and different types of holders are fitted on the board ▪ Those fixtures are connected to the circuit ▪ MCB and MCCB are connected and fitted on the board 		



Learning Outcome 1.5 – Perform Circuit Operation as Per Diagram and Layout

Contents:	<ul style="list-style-type: none"> ▪ Cables and their uses ▪ Circuits and accessories 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: electrical channel/mould, cables 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.5	<ul style="list-style-type: none"> ▪ Information Sheet 1.5.1 ▪ Self-Check Quiz 1.5.1 ▪ Answer Key 1.5.1 	<p>29</p> <p>31</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Bottom parts of the channels are placed and set according to drawing on the board ▪ Cables are drawn through the bottom part of the channels ▪ Circuit materials required for the specified circuit are placed on the board ▪ Other accessories are connected and fitted ▪ The bottom parts of the channels are covered with upper part of the channel 		



Learning Outcome 1.6 – Clean the Workplace

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 <p>https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning</p>	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		

Module 2: Install earthing and atmospheric lighting protection system

Module Descriptor:	This module covers the knowledge, skills and attitudes to installing earthing and atmospheric lighting protection system. It specifically includes identifying the type of earthing to be used, identifying the type of lightning protection system to be used, selecting and collecting tools, equipment and materials, excavating the hole for earthing element installation, installing earthing components, finishing earth pit chamber for pipe earthing method, installing lightning protection system and cleaning/maintaining the work area.	
Nominal Duration:	20 hours	
Learning Outcomes:	2.1.	Identify the type of earthing to be used
	2.2.	Identify the type of lightning protection system to be used
	2.3.	Select and collect tools, equipment and materials
	2.4.	Excavate the hole for earthing element installation
	2.5.	Install earthing components
	2.6.	Finish earth pit chamber for pipe earthing method
	2.7.	Install lightning protection system
	2.8.	Clean/maintain the work area
Performance Criteria:	2.1.	Types and method of earthing is identified in accordance to electrical plan/design.
	2.2.	Types and sizes of earthing materials are identified in accordance to electrical plan/design.
	2.3.	Types of lightning protection system is identified in accordance to electrical plan/design.
	2.4.	Types and sizes of lightning protection system materials are identified in accordance to electrical plan/design.
	2.5.	Tools, equipment and materials are collected and checked for usability.
	2.6.	Earthing materials are collected and checked for conformance in accordance to specification.
	2.7.	Lightning protection materials are collected and checked for conformance in accordance to specification.
	2.8.	PPE is collected and used in accordance to OHS requirements.
	2.9.	Hole is dug following with safety requirements.
	2.10.	Hole is shaped and sized in accordance to electrical plan/design specification.
	2.11.	Earthing element is fitted in the bottom of the excavated hole following standard earthing procedure.
	2.12.	Earth lead is connected to the earth element tightly and brought up the meter board through the conduit.
	2.13.	Powdered charcoal and salt are laid around the earthing element in accordance to workplace procedure.
	2.14.	A proper sized and length of GI pipe is fitted from top of the earth element to the bottom of the earth pit chamber.

	2.15.	Rest of the excavated hole is filled with earth.
	2.16.	Earth pit chamber is constructed with brick chips, cement and sand mixture in accordance with standard/specification.
	2.17.	Pit chamber cover is made and fitted/installed in accordance with electrical plan/design.
	2.18.	Check earth resistance in accordance with electrical plan/specification.
	2.19.	Lightning rod is installed at specified location and earth down conductor is connected as per diagram.
	2.20.	Performance of lightning protection system (LPS) is tested as per standard procedure.
	2.21.	Tools and equipment are cleaned and stored as per standard practice.
	2.22.	Waste materials are disposed and workplace is cleaned in accordance with standard procedure.



Learning Outcome 2.1 – Prepare Machines and Work Area for Safe Operation

Contents:	<ul style="list-style-type: none"> ▪ Machines used for aluminium fabrication works ▪ Uses of tools and personal protective equipment (PPE) 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): hard hat (helmet), safety eye glass, face shield, face mask, respirator, hand gloves, apron (vest), safety shoes, ear plug, safety belt ▪ Tools: measuring tape, steel rule, tri-square, marking pen/pencil, hacksaw, wrenches, tin snip, drill bits, plastic hammer, combination plier, spirit level, plumb bob, screwdrivers, sealant gun, rivet gun, string lines, scribe, glass cutter (diamond tip), glass file set, glass holder, centre punch ▪ Equipment: pneumatic circular saw, band saw, aluminium profile cutting machine, mitering jig, deburring machine, work benches, drill press, bending machine, portable grinder 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.1	<ul style="list-style-type: none"> ▪ Information Sheet 2.1.1 ▪ Information Sheet 2.1.2 ▪ Self-Check Quiz 2.1.1 ▪ Self-Check Quiz 2.1.2 ▪ Answer Key 2.1.1 ▪ Answer Key 2.1.2 <p>https://en.wikipedia.org/wiki/Earthing_system</p>	<p>39</p> <p>43</p> <p>42</p> <p>44</p> <p>59</p> <p>59</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Machines used for aluminium fabrication works are prepared and checked for operating condition ▪ Tools and personal protective equipment (PPE) are gathered and check for usability ▪ Work area is cleaned and prepared for safe cutting operation 		



Learning Outcome 2.2 – Identify the Type of Lightning Protection System to be Used

Contents:	<ul style="list-style-type: none"> ▪ Types of lightning protection system ▪ Lightning protection system materials 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: adjustable wrench, wire stripper, mallet, C-clamp, chisels: (a) wooden (b) cold, drill bits, files: (a) flat (b) round (c) half round, hacksaw, hammers: (a) ball peen (b) claw, hand drill, measuring tape, pliers: (a) combination pliers (b) cutting pliers (c) diagonal cutting pliers (d) long nose pliers, punches, screwdrivers: (a) star (b) flat (c) connecting, try square, neon tester, wire cutters, S.W.G., set squares, electrician knife, ladder ▪ Equipment: electric drill machine, soldering iron, multimeter, earth tester, megger tester ▪ Materials: continuity conductor/cable, earth lead, lightning rod (spike arrester), earth down conductor (arrester), bolts and nuts 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.2	<ul style="list-style-type: none"> ▪ Information Sheet 2.2.1 ▪ Self-Check Quiz 2.2.1 ▪ Answer Key 2.2.1 https://www.ingesco.com/en/noticias/lightning-protection-system-installation	45 46 59
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Types of lightning protection system is identified in accordance to electrical plan/design ▪ Types and sizes of lightning protection system materials are identified in accordance to electrical plan/design 		



Learning Outcome 2.3 – Select and Collect Tools, Equipment and Materials

Contents:	<ul style="list-style-type: none"> ▪ List of hand tools and their uses/functions ▪ List of power tools and their uses/functions ▪ List of equipment and their uses/functions ▪ List of earthing materials and their uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: adjustable wrench, wire stripper, mallet, C-clamp, chisels: (a) wooden (b) cold, drill bits, files: (a) flat (b) round (c) half round, hacksaw, hammers: (a) ball peen (b) claw, hand drill, measuring tape, pliers: (a) combination pliers (b) cutting pliers (c) diagonal cutting pliers (d) long nose pliers, punches, screwdrivers: (a) star (b) flat (c) connecting, try square, neon tester, wire cutters, S.W.G., set squares, electrician knife, ladder ▪ Equipment: electric drill machine, grinder, soldering iron, multimeter, earth tester, megger tester, digital weight machine ▪ Materials: continuity conductor/cable, earthing lead, earth electrode/plate, connector, G.I. pipe/conduit, bolts and nuts, powdered charcoal and salt 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.3	<ul style="list-style-type: none"> ▪ Information Sheet 2.3.1 	47
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools, equipment and materials are checked for usability ▪ PPE is collected and used ▪ Drawings are collected and interpreted 		



Learning Outcome 2.4 – Excavate the Hole for Earthing Element Installation

Contents:	<ul style="list-style-type: none"> ▪ List of PPE and their uses ▪ Tools and equipment used for digging hole in wall, floor/roof and earth 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: shovel, trowel, spading fork, drain spade, pick, auger, wheelbarrow 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.4	<ul style="list-style-type: none"> ▪ Information Sheet 2.4.1 https://www.wikihow.com/Dig-Post-Holes 	48
Assessment Criteria:	<ul style="list-style-type: none"> ▪ PPE is collected and used in accordance to OHS requirements ▪ Hole is dug following with safety requirements ▪ Hole is shaped and sized in accordance to electrical plan/design specification 		



Learning Outcome 2.5 – Install Earthing Components

Contents:	<ul style="list-style-type: none"> ▪ Earthing element and earthing lead ▪ Powdered charcoal and salt ▪ GI pipe, bolts and nuts 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: rods, tape, terminals, bars, conductors, electrodes 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.5	<ul style="list-style-type: none"> ▪ Information Sheet 2.5.1 <p>www.swaonline.co.uk/earthing-components-accessories</p> <p>www.electrical-installation.org/enwiki/Earthing_connections</p>	50
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Earthing element is fitted in the bottom of the excavated hole following standard earthing procedure ▪ Earth lead is connected to the earth element tightly and brought up the meter board through the conduit ▪ Powdered charcoal and salt are laid around the earthing element in accordance to workplace procedure ▪ A proper sized and length of GI pipe is fitted from top of the earth element to the bottom of the earth pit chamber ▪ Rest of the excavated hole is filled with earth 		



Learning Outcome 2.6 – Finish Earth Pit Chamber for Pipe Earthing Method

Contents:	<ul style="list-style-type: none"> ▪ Earth pit chamber ▪ Pit chamber cover 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: shovel, trowel, spading fork, drain spade, pick, auger, wheelbarrow ▪ Equipment: multimeter, earth tester, electrical plans/drawings ▪ Materials: water, brick chips, sand, cement, GI sheet 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.6	<ul style="list-style-type: none"> ▪ Information Sheet 2.6.1 https://www.indiamart.com › Electric Fittings & Components › Earth Pit	52
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Earth pit chamber is constructed with brick chips, cements sand and water mixture in accordance with standard/specification ▪ Pit chamber cover is made with G.I sheet in accordance with electrical plan/design ▪ Pit cover is fitted/installed on the pit chamber ▪ Check earth resistance in accordance with electrical plan/specification 		



Learning Outcome 2.7 – Install Lightning Protection System

Contents:	<ul style="list-style-type: none"> ▪ Uses of lightning rod ▪ Earth down conductor 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape, plumb bob ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: channels, wire, elbows, bends, PVC circular box, plugs, saddles, screws, cables, cable lugs, cable ties, thread ball, insulating clips, flexible conduit, conductors, plastic forma, electric soldering lead, protective tubing, lightning protection system 		
Learning Activities:	Activity	Resource	Student Guide Page
	2.7	<ul style="list-style-type: none"> ▪ Information Sheet 2.7.1 ▪ Job Sheet 2 https://www.ingesco.com/en/noticias/lightning-protection-system-installation	54 56
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Lightning rod is installed at specified location ▪ Earth down conductor is connected as per diagram ▪ Performance of lightning protection system (LPS) is tested as per standard 		



Learning Outcome 2.8 – Clean/Maintain the Work Area

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		

Module 3: Perform conduit wiring

Module Descriptor:	This module covers the skills, knowledge and attitudes to perform conduit wiring. It specifically includes collecting tools, equipment and materials, installing conduits and setting of cables, installing boards and other accessories of wiring, testing the wiring, measuring the earth resistance and cleaning the workplace.	
Nominal Duration:	35 hours	
Learning Outcomes:	3.1.	Collect tools, equipment and materials
	3.2.	Install conduit and set cables
	3.3.	Install boards and set all other accessories of wiring
	3.4.	Test the wiring
	3.5.	Measure the earth resistance
	3.6.	Clean the workplace
Performance Criteria:	3.1.	Tools, equipment and materials are collected and checked for usability.
	3.2.	PPE is collected and used as per requirements.
	3.3.	Drawings are collected and interpreted.
	3.4.	Layout is drawn on the wall as per drawing.
	3.5.	Wall is cut and grooved.
	3.6.	Collected conduits are cut and set.
	3.7.	Conduits are installed on the wall and clamped.
	3.8.	Fish wires are measured, cut and inserted.
	3.9.	Cables are collected, cut, tied with fish wire and insert into the conduit.
	3.10.	Boards are collected and fitted as per wiring diagram.
	3.11.	Switches, sockets, fan regulator and ballast are fitted on the board and connected to the circuits.
	3.12.	Ceiling rose and different types of holders are fitted on the board and connected to the circuit.
	3.13.	MCB and MCCB are connected and fitted on the board.
	3.14.	Polarity of wiring is checked by megger and justified each of the switches, fuses and circuit breakers.
	3.15.	The main switches and circuit breakers are disconnected and all loads are connected and checked the continuity each of the switches and circuit breakers.
	3.16.	Continuity is tested and insulation resistance is measured.
	3.17.	The earth terminals are connected as per appropriate measurement and position.
	3.18.	Tools and equipment are cleaned and stored as per standard practice.
	3.19.	Waste materials are disposed and workplace is cleaned in accordance with standard procedure.



Learning Outcome 3.1 – Collect Tools, Equipment and Materials

Contents:	<ul style="list-style-type: none"> ▪ List of hand tools and their uses/functions ▪ List of power tools and their uses/functions ▪ List of equipment and their uses/functions ▪ List of electrical materials and their uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: conduit (1/2", 3/4", 1", 1.25", 1.5" PVC), GI wire, elbow, bend, PVC circular box, rowel plug, saddle, screw, cable lugs, cable tie, thread ball, insulating clip, flexible conduit, plastic forma, electric soldering lead, plastic tape, cable (PVC, VIR) 		
Learning Activities:	Activity	Resource	Student Guide Page
	3.1	<ul style="list-style-type: none"> ▪ Information Sheet 3.1.1 ▪ Information Sheet 3.1.2 ▪ Information Sheet 3.1.3 <p>https://www.ecmag.com/section/your-business/tools-most-used-electricians</p> <p>https://www.kele.com/electrical-wiring-materials.aspx</p>	<p>61</p> <p>62</p> <p>62</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools, equipment and materials are checked for usability ▪ PPE is collected and used ▪ Drawings are collected and interpreted 		



Learning Outcome 3.2 – Install Conduits and Set Cables

Contents:	<ul style="list-style-type: none"> ▪ Layout and wall cutting ▪ Conduit cutting and setting ▪ Fish wire and cables inserting 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: conduits and setting cables, clamps, fish wire 		
Learning Activities:	Activity	Resource	Student Guide Page
	3.2	<ul style="list-style-type: none"> ▪ Information Sheet 3.2.1 ▪ Job Sheet 3 ▪ Self-Check Quiz 3.2.1 ▪ Answer Key 3.2.1 <p>https://www.wikihow.com/Install-Electrical-Conduits</p>	64 65 66 80
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Layout is drawn on the wall as per drawing ▪ Wall is cut and grooved ▪ Collected conduits are cut and set ▪ Conduits are installed on the wall and clamped ▪ Fish wires are measured and cut ▪ Fish wire is inserted ▪ Collected cables are cut ▪ Cables are tied with fish wire and insert into the conduit 		



Learning Outcome 3.3 – Install Boards and Set all other Accessories of Wiring

Contents:	<ul style="list-style-type: none"> ▪ Boards and their uses ▪ Switches, sockets, fan regulator and ballast ▪ Ceiling rose and different types of holders ▪ MCB and MCCB 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: boards, setting accessories, rewire able fuse, cartridge fuse, glass fuse, HRC fuse, single pole MCB, double pole MCB, MCCB, earth leakage circuit breaker (ELCB), sockets, fan regulator, ceiling rose, holders, MCB, MCCB 		
Learning Activities:	Activity	Resource	Student Guide Page
	3.3	<ul style="list-style-type: none"> ▪ Information Sheet 3.3.1 ▪ Self-Check Quiz 3.3.1 ▪ Answer Key 3.3.1 <p>https://wazipoint.blogspot.com/2015/08/electrical-distribution-board-db-wiring.html</p>	<p>70</p> <p>70</p> <p>80</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Boards are collected and fitted as per wiring diagram ▪ Switches, sockets, fan regulator and ballast are fitted on the board with screw ▪ Switches, sockets and fan regulator are connected to the circuits ▪ Ceiling rose and different types of holders are fitted on the board ▪ Those fixtures are connected to the circuit ▪ MCB and MCCB are connected and fitted on the board 		



Learning Outcome 3.4 – Test the Wiring

Contents:	<ul style="list-style-type: none"> ▪ Testing of the wiring ▪ Polarity of wiring ▪ Continuity of wiring ▪ Insulation resistance 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: boards, switches, sockets, fan regulator, ceiling rose, holders, MCB, MCCB 		
Learning Activities:	Activity	Resource	Student Guide Page
	3.4	<ul style="list-style-type: none"> ▪ Information Sheet 3.4.1 ▪ Self-Check Quiz 3.4.1 ▪ Answer Key 3.4.1 <p>https://www.familyhandyman.com/electrical/how-to-use...electrical-testers/view-all/</p> <p>https://www.familyhandyman.com › Electrical</p>	<p>72</p> <p>74</p> <p>80</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Polarity of wiring is checked by megger as per procedure ▪ Polarity is justified and checked each of the switches, fuses and circuit breakers ▪ The main switches and circuit breakers are disconnected ▪ All loads are connected and checked the continuity each of the switches and circuit breakers ▪ By observing the zero positions of the megger continuity is tested and insulation resistance is measured 		



Learning Outcome 3.5 – Measure the Earth Resistance

Contents:	<ul style="list-style-type: none"> Measurement of earth resistance 		
Resources Required:	<ul style="list-style-type: none"> Workplace (simulated or actual) Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron Equipment: earth resistance tester 		
Learning Activities:	Activity	Resource	Student Guide Page
	3.5	<ul style="list-style-type: none"> Information Sheet 3.5.1 Self-Check Quiz 3.5.1 Answer Key 3.5.1 https://testguy.net/content/233-4-Important-Methods-of-Ground-Resistance-Testing	75 78 80
Assessment Criteria:	<ul style="list-style-type: none"> The earth terminals are connected as per the appropriate measurements and positions By observing the positions of the pointer of the megger earth resistance is measured 		



Learning Outcome 3.6 – Clean the Workplace

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 <p>https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning</p>	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		

Module 4: Perform a service connection

Module Descriptor:	This module covers the skills, knowledge and attitudes to perform a service connection. It specifically includes installing interpreting drawings and specifications, collecting tools, equipment and materials, measuring the distance of service line and installing cables for service connection, installing energy meter and connecting with main switch and cleaning the workplace.	
Nominal Duration:	20 hours	
Learning Outcomes:	4.1.	Interpret drawings and specifications
	4.2.	Collect tools, equipment and materials
	4.3.	Measure the distance of service line and install cables for service connection
	4.4.	Install energy meter and connect with main switch
	4.5.	Clean the workplace
Performance Criteria:	4.1.	Drawing are collected and interpreted.
	4.2.	Sign and symbols are identified.
	4.3.	Terms and abbreviations are identified.
	4.4.	Specifications are interpreted.
	4.5.	Tools, equipment and materials are collected and checked for usability.
	4.6.	PPE is collected and used as per requirements.
	4.7.	Distance between distribution pole and meter are checked and measured.
	4.8.	Distance between main switch and meter are checked and measured.
	4.9.	Size of cables are selected as per load.
	4.10.	Quality cables are selected and collected for service connection.
	4.11.	Collected cables are cut and set.
	4.12.	Cables are held on and clamped properly with distribution pole.
	4.13.	Cables are joined and connected with the pole and energy meter.
	4.14.	Energy meter is collected and set on the board.
	4.15.	Energy meter is connected with service line.
	4.16.	Cables are measured and sized.
	4.17.	Cables are laid into the conduit.
	4.18.	Connection between energy meter and main switches are performed.
	4.19.	Tools and equipment are cleaned and stored as per standard practice.
	4.20.	Waste materials are disposed and workplace is cleaned in accordance with standard procedure.



Learning Outcome 4.1 – Interpret Drawings and Specifications

Contents:	<ul style="list-style-type: none"> ▪ Electrical plans/drawings ▪ Sign and symbols ▪ Terms and abbreviations ▪ Specifications 		
Resources Required:	<ul style="list-style-type: none"> ▪ Electrical plans/drawings ▪ Sign and symbols related to construction and electrical works ▪ Terms and abbreviations ▪ Specification sheets 		
Learning Activities:	Activity	Resource	Student Guide Page
	4.1	<ul style="list-style-type: none"> ▪ Information Sheet 4.1.1 ▪ http://en.wikipedia.org/wiki/Electrical_wiring 	80
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Drawings are collected and interpreted ▪ Sign and symbols are identified ▪ Terms and abbreviations are identified ▪ Specifications are interpreted 		



Learning Outcome 4.2 – Collect Tools, Equipment and Materials

Contents:	<ul style="list-style-type: none"> ▪ List of hand tools and their uses/functions ▪ List of power tools and their uses/functions ▪ List of equipment and their uses/functions ▪ List of materials and their uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: GI wire, connector, distribution board, energy meter, main switch, cables, guy instructor, clamps, tie, hook 		
Learning Activities:	Activity	Resource	Student Guide Page
	4.2	<ul style="list-style-type: none"> ▪ Information Sheet 4.2.1 ▪ Information Sheet 4.2.2 https://quizlet.com/.../tools-and-materials-used-in-electrical-installation-and-maintenan...	81 82
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Usability of tools and equipment are checked and verified ▪ Materials are collected 		



Learning Outcome 4.3 – Measure the Distance of Service Line and Install Cables for Service Connection

Contents:	<ul style="list-style-type: none"> ▪ List of PPE and their uses ▪ Size and quality of cables ▪ Cutting and setting of cables ▪ Clamping of cables ▪ Cable joints and connections with pole and meter 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: electrical cables, clamps 		
Learning Activities:	Activity	Resource	Student Guide Page
	4.3	<ul style="list-style-type: none"> ▪ Information Sheet 4.3.1 ▪ Information Sheet 4.3.2 ▪ Self-Check Quiz 4.3.2 ▪ Answer Key 4.3.2 <p>https://www.fpl.com/partner/pdf/electric-service-standards-meter-connections.pdf</p> <p>https://www.quora.com/What-are-the-different-types-of-wire-joints</p>	<p>84</p> <p>84</p> <p>86</p> <p>91</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ PPE is collected and used ▪ Distance between distribution pole and meter are checked and measured ▪ Distance between main switch and meter are checked and measured ▪ Size of cables are selected as per load ▪ Quality cables are selected and collected for service connection ▪ Collected cables are cut and set ▪ Cables are held on and clamped properly with distribution pole ▪ Cables are joined and connected with the pole and energy meter 		



Learning Outcome 4.4 – Install Energy Meter and Connect with Main Switch

Contents:	<ul style="list-style-type: none"> ▪ Setting of energy meter ▪ Connection of energy meter 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, energy meters, electrical plans/drawings ▪ Materials: energy meter, main switch, cables 		
Learning Activities:	Activity	Resource	Student Guide Page
	4.4	<ul style="list-style-type: none"> ▪ Information Sheet 4.4.1 ▪ Self-Check Quiz 4.4.1 ▪ Answer Key 4.4.1 https://www.youtube.com/watch?v=7gdQoImH8QU	87 89 91
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Energy meter is collected and set on the board ▪ Energy meter is connected with service line ▪ Cables are measured and sized ▪ Cables are laid into the conduit ▪ Connection between energy meter and main switches are performed 		



Learning Outcome 4.5 – Clean the Workplace

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		

Module 5: Perform motor connection

Module Descriptor:	This module covers the skills, knowledge and attitudes to perform motor connection. It specifically includes identifying and selecting controlling and protective devices for motor connection, collecting tools, equipment and materials, Installing, controlling and protective devices, performing motor connection, checking and testing circuit and cleaning the workplace.	
Nominal Duration:	30 hours	
Learning Outcomes:	5.1.	Identify and select controlling and protective devices for motor connection
	5.2.	Collect tools, equipment and materials
	5.3.	Install, controlling and protective devices
	5.4.	Perform motor connection, check and test circuit
	5.5.	Clean the workplace
Performance Criteria:	5.1.	Manuals and documents of controlling and protective devices are collected.
	5.2.	Drawings and symbols of controlling and protective devices are sorted.
	5.3.	Types of controlling and protective devices are listed.
	5.4.	Tools, equipment and materials are identified, collected and checked for usability.
	5.5.	PPE is collected and used as per requirements.
	5.6.	Controlling and protective devices are selected and collected according to the need of the operations.
	5.7.	Controlling and protective devices are installed according to the layout plan.
	5.8.	Controlling and protective devices are set and connected to the motor.
	5.9.	Direct on-line starter is collected and its diagram interpreted.
	5.10.	Direct on-line starter is connected with the motor.
	5.11.	Star-delta starter is collected and its diagram interpreted.
	5.12.	Star-delta starter is connected with the motor.
	5.13.	Auto- transformer starter is collected and its diagram interpreted.
	5.14.	Auto-transformer starter is connected with motor.
	5.15.	All the connections of each starter are checked and justified.
	5.16.	Connection between motor and starter is checked and tested.
	5.17.	Tools and equipment are cleaned and stored as per standard practice.
	5.18.	Waste materials are disposed and workplace is cleaned in accordance with standard procedure.



Learning Outcome 5.1 – Identify and Select Controlling and Protective Devices for Motor Connection

Contents:	<ul style="list-style-type: none"> ▪ Manuals and documents ▪ Drawings and symbols ▪ Symbols 		
Resources Required:	<ul style="list-style-type: none"> ▪ Manuals and documents related to controlling and protective devices ▪ Electrical plans/drawings ▪ Sign and symbols related to construction and electrical works ▪ Controlling and protective devices 		
Learning Activities:	Activity	Resource	Student Guide Page
	5.1	<ul style="list-style-type: none"> ▪ Information Sheet 5.1.1 ▪ Information Sheet 5.1.2 ▪ Self-Check Quiz 5.1.1 ▪ Self-Check Quiz 5.1.2 ▪ Answer Key 5.1.1 ▪ Answer Key 5.1.2 <p>http://www.businessdictionary.com/definition/technical-manual.html</p> <p>https://en.wikipedia.org/wiki/Motor_controller</p>	<p>93</p> <p>95</p> <p>95</p> <p>99</p> <p>112</p> <p>112</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Manuals and documents of controlling and protective devices are collected ▪ Drawings and symbols of controlling and protective devices are sorted ▪ Types of controlling and protective devices are listed 		



Learning Outcome 5.2 – Collect Tools, Equipment and Materials

Contents:	<ul style="list-style-type: none"> ▪ List of hand tools and their uses/functions ▪ List of power tools and their uses/functions ▪ List of equipment and their uses/functions ▪ List of materials and their uses ▪ List of PPE and their uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, nail gun, soldering iron, megger, multimeter, ammeter, volt meter, tachometer, wattmeter, electrical plans/drawings ▪ Materials: GI wire, connector, distribution board, motor, main switch, starter, cables, conduit, saddle, rowel plug, wooden screw, insulating tape 		
Learning Activities:	Activity	Resource	Student Guide Page
	5.2	<ul style="list-style-type: none"> ▪ Information Sheet 5.2.1 ▪ Information Sheet 5.2.2 ▪ Information Sheet 5.2.3 	100 101 101
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools, equipment and materials are identified and collected ▪ Tools, Equipment and Materials are checked for usability ▪ PPE is collected and used 		



Learning Outcome 5.3 – Install Controlling and Protective Devices

Contents:	<ul style="list-style-type: none"> ▪ Types of controlling devices ▪ Protective devices 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: switches, direct online starter, MCCB, ELCB, change over switches, main switches, circuit breaker, relays, magnetic starter, auto starter, star-delta starter 		
Learning Activities:	Activity	Resource	Student Guide Page
	5.3	<ul style="list-style-type: none"> ▪ Information Sheet 5.3.1 ▪ Information Sheet 5.3.2 ▪ Self-Check Quiz 5.3.1 ▪ Self-Check Quiz 5.3.2 ▪ Answer Key 5.3.1 ▪ Answer Key 5.3.2 <p>https://www.schneider-electric.hu/...and.../asg-4-motor-starting-and-protection.pdf</p>	102 104 104 104 112 112
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Controlling and protective devices are selected and collected according to the need of the operations ▪ Controlling and protective devices are installed according to the layout plan ▪ Controlling and protective devices are set and connected to the motor 		



Learning Outcome 5.4 – Perform Motor Connection, Check and Test Circuit

Contents:	<ul style="list-style-type: none"> ▪ Types of starter with their uses ▪ Check and test circuit 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, energy meter, electrical plans/drawings ▪ Materials: main switch, cables, starter 		
Learning Activities:	Activity	Resource	Student Guide Page
	5.4	<ul style="list-style-type: none"> ▪ Information Sheet 5.4.1 ▪ Job Sheet 4 ▪ Self-Check Quiz 5.4.1 ▪ Answer Key 5.4.1 <p>https://www.testandmeasurementtips.com › New Articles</p>	<p>107</p> <p>109</p> <p>110</p> <p>112</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Direct on-line starter is collected and its diagram interpreted ▪ Direct on-line starter is connected with the motor ▪ Star-delta starter is collected and its diagram interpreted ▪ Star-delta starter is connected with the motor ▪ Auto- transformer starter is collected and its diagram interpreted ▪ Auto-transformer starter is connected with motor ▪ All the connections of each starter are checked and justified ▪ Connection between motor and starter is checked and tested 		



Learning Outcome 5.5 – Clean the Workplace

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		

Module 6: Install and maintain electric motor with control system

Module Descriptor:	This module covers the skills, knowledge and attitudes to perform installing and maintaining electric motor with control system. It specifically includes identifying and selecting controlling devices for motors, connecting starter with the motors, monitoring and testing conditions of motor, servicing motors and maintaining tools, equipment, materials and workplace.	
Nominal Duration:	40 hours	
Learning Outcomes:	6.1.	Identify and select controlling devices for motors
	6.2.	Connect starter with the motors
	6.3.	Monitor and test conditions of
	6.4.	Service motors
	6.5.	Maintain tools, equipment, materials and workplace
Performance Criteria:	6.1.	Manuals and documents of motors with controlling devices are collected.
	6.2.	Drawings and symbols of controlling devices are sorted.
	6.3.	Tools, equipment and materials are identified, collected and checked for usability.
	6.4.	PPE is collected and used as per requirements.
	6.5.	Necessary controlling devices for motor are selected and collected.
	6.6.	Starter is collected, its diagram is interpreted and connected with the motors.
	6.7.	Wire up control and power circuits as per job requirement.
	6.8.	Test and commission the motors as per job requirement.
	6.9.	Mechanical defects are checked visually in accordance with standard practices.
	6.10.	Electrical defects of motors are checked such as loose or burned electrical connections.
	6.11.	Motors are tested by using specified instruments.
	6.12.	Motors are tested under running conditions for detecting faults.
	6.13.	Work order for maintenance is obtained from concern section according to established procedure.
	6.14.	Motor mains is disconnected before inspection and testing in accordance with standard procedure.
	6.15.	Motor is dismantled for replacing bearings and greasing, repairing windings, varnishing, heating or any other tests if required as per standard procedures following safety precautions.
	6.16.	Service parts of the motor are cleaned by using specified cleaning agent and tools in accordance with manufacturer's specification.
	6.17.	Check winding insulation of motors with megger/insulation resistance tester if necessary in accordance with standards.

	6.18.	Motors are assembled according to the manufacturer's specification.
	6.19.	No load and load test are conducted and noted down results in accordance with specification.
	6.20.	Tools and equipment are cleaned and stored as per standard practice.
	6.21.	Waste materials are disposed and workplace is cleaned in accordance with standard procedure.



Learning Outcome 6.1 – Identify and Select Controlling Devices for Motors

Contents:	<ul style="list-style-type: none"> ▪ Manuals and documents ▪ List of hand tools and their uses/functions ▪ List of power tools and their uses/functions ▪ List of materials and their uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Manuals and documents ▪ Drawings and symbols ▪ Tools, equipment and materials (as required) ▪ Controlling devices for motor 		
Learning Activities:	Activity	Resource	Student Guide Page
	6.1	<ul style="list-style-type: none"> ▪ Information Sheet 6.1.1 ▪ Information Sheet 6.1.2 ▪ Information Sheet 6.1.3 <p> https://en.wikipedia.org/wiki/Motor_controller www.electrical-online.com/electrical-tools-and-equipment/ </p>	<p>114</p> <p>115</p> <p>115</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Manuals and documents of motors with controlling devices are collected ▪ Drawings and symbols of controlling devices are sorted ▪ Tools, Equipment and materials are collected for required job ▪ Necessary controlling devices for motor are selected and collected 		



Learning Outcome 6.2 – Connect Starter with the Motors

Contents:	<ul style="list-style-type: none"> ▪ List of PPE and their uses ▪ Types of starter uses 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: starter and motor for connection 		
Learning Activities:	Activity	Resource	Student Guide Page
	6.2	<ul style="list-style-type: none"> ▪ Information Sheet 6.2.1 ▪ Information Sheet 6.2.2 ▪ Self-Check Quiz 6.2.2 ▪ Answer Key 6.2.2 <p>https://en.wikipedia.org/wiki/Motor_starter</p> <p>https://www.elprocus.com/motor-starter/</p>	<p>116</p> <p>117</p> <p>119</p> <p>130</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ PPE is collected and used ▪ Starter is collected, and its diagram is interpreted ▪ Wire up control and power circuits as per job requirement ▪ Starter is connected with the motors ▪ Test and commission the motors as per job requirement 		



Learning Outcome 6.3 – Monitor and Test Conditions of Motor

Contents:	<ul style="list-style-type: none"> ▪ Mechanical defects: tight bearings, bent shape, vibration, humming sound, misalignment ▪ Faults: tripping of protective devices, difficulty in starting, low rpm, high vibration, unusual noises, excessive heat 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, electrical plans/drawings ▪ Materials: motor 		
Learning Activities:	Activity	Resource	Student Guide Page
	6.3	<ul style="list-style-type: none"> ▪ Information Sheet 6.3.1 ▪ Self-Check Quiz 6.3.1 ▪ Answer Key 6.3.1 <p>https://irispower.com/asset/motor-monitoring/</p> <p>https://www.engineerlive.com/content/common-causes-electric-motor-failure</p>	<p>120</p> <p>124</p> <p>130</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Mechanical defects are checked visually in accordance with standard practices ▪ Electrical defects of motors are checked such as loose or burned electrical connections ▪ Motors are tested by using specified instruments ▪ Motors are tested under running conditions for detecting faults 		



Learning Outcome 6.4 – Service Motors

Contents:	<ul style="list-style-type: none"> ▪ Cleaning of motor service parts ▪ Assembling of motor ▪ No load and load test of motor 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: pressure cleaner, electrical plans/drawings ▪ Materials: cleaning agents/materials required for servicing 		
Learning Activities:	Activity	Resource	Student Guide Page
	6.4	<ul style="list-style-type: none"> ▪ Information Sheet 6.4.1 ▪ Self-Check Quiz 6.4.1 ▪ Answer Key 6.4.1 https://www.amazon.com/Electric-Motor-Maintenance-Troubleshooting.../007176395...	126 127 130
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Work order for maintenance is obtained from concern personnel according to established procedure ▪ Motor mains is disconnected before inspection and testing in accordance with standard procedure ▪ Motor is dismantled for replacing bearings and greasing, repairing windings, varnishing, heating or any other tests if required as per standard procedures following safety precautions ▪ Service parts of the motor are cleaned by using specified cleaning agent and tools in accordance with manufacturer's specification ▪ Check winding insulation of motors with megger/insulation resistance tester if necessary in accordance with standards ▪ Motors are assembled according to the manufacturer's specification ▪ No load and load test are conducted and noted down results in accordance with specification 		



Learning Outcome 6.5 – Maintain Tools, Equipment, Materials and Workplace

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		

Module 7: Perform motor rewinding and servicing

Module Descriptor:	This module covers the skills, knowledge and attitudes to perform motor rewinding and servicing. It specifically includes checking the machine physically and dismantle it to detect the actual fault, selecting tools and prepare material for winding/rewinding, carrying out winding/rewinding of stator, rotor and armature, making connections, carrying out pre-assembly tests and assembling of machine, carrying out final test and recording the test result.	
Nominal Duration:	55 hours	
Learning Outcomes:	7.1.	Check the machine physically and dismantle it to detect the actual fault
	7.2.	Select tools and prepare material for winding/rewinding
	7.3.	Carry out winding/rewinding of stator rotor and armature
	7.4.	Make connections, carry out pre-assembly tests and assembly of machine
	7.5.	Carry out final test and record the test result
Performance Criteria:	7.1.	Check the machine physically and dismantle it to detect the actual fault.
	7.2.	Visual and manual inspection is carried out to detect the mechanical damage/defects.
	7.3.	Burnt winding is checked by smelling.
	7.4.	The machine is dismantled as per standard procedure and manufacturer instructions.
	7.5.	Winding data is collected and winding diagram is prepared.
	7.6.	Winding is checked with specified measuring instrument to detect the fault.
	7.7.	Bearing, carbon brushes, rockers, slip rings are checked visually and tested by specified instrument.
	7.8.	Specified tools, materials and equipment are selected and used for winding work.
	7.9.	Winding wire of required gauge, insulation and binding material are prepared.
	7.10.	Formers are prepared and coil is formed on former according to winding data.
	7.11.	Stator/rotor and armature are cleaned by using specified tools.
	7.12.	Insulation material is inserted into slots.
	7.13.	Formed coil is insulated, bind and inserted into slot.
	7.14.	Winding resistance and insulation level is checked by specified test instrument.
	7.15.	Coil ends are terminated and insulated.
	7.16.	Winding continuity is checked.
	7.17.	Dry running is carried out, performance is checked.

	7.18.	Insulating varnish is applied to winding and baked it up to specified temperature in baking oven.
	7.19.	Assembly of stator, rotor and other parts are assembled.
	7.20.	Rotor free movement is checked.
	7.21.	No load/load/locked rotor tests are performed.
	7.22.	Rotor static and dynamic balancing are carried out.
	7.23.	Test result are documented in the relevant recorded sheet.
	7.24.	Tools, equipment and materials are cleaned and stored as per workplace standard.



Learning Outcome 7.1 – Check the Machine Physically and Dismantle it to Detect the Actual Fault

Contents:	<ul style="list-style-type: none"> ▪ Types of machine: Single phase AC motor, DC motor, 3-Phase AC motor ▪ Types of measuring instrument: ammeters, voltmeters, ohmmeter, wattmeter, megger, clamp-on-AVO meter, AC and DC power supply unit ▪ Associated accessories: bearing, carbon brushes, rockers, slip rings 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Equipment: single phase AC motor, DC motor, 3-Phase AC motor, ammeters, voltmeters, ohmmeter, wattmeter, megger, clamp-on-AVO meter, AC and DC power supply unit ▪ Materials: bearings, carbon brushes, rockers, slip rings 		
Learning Activities:	Activity	Resource	Student Guide Page
	7.1	<ul style="list-style-type: none"> ▪ Information Sheet 7.1.1 ▪ Information Sheet 7.1.2 ▪ Self-Check Quiz 7.1.1 ▪ Self-Check Quiz 7.1.2 ▪ Answer Key 7.1.1 ▪ Answer Key 7.1.2 <p>https://www.precision-elec.com/difference-between-ac-and-dc-motors/</p> <p>https://www.slideshare.net/Pramodalathur/basic-electrical-measuring-instruments</p>	134 135 135 137 152 152
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Check the machine physically and dismantle it to detect the actual fault ▪ Visual and manual inspection is carried out to detect the mechanical damage/defects ▪ Burnt winding is checked by smelling ▪ The machine is dismantled as per standard procedure and manufacturer instructions ▪ Winding data is collected and winding diagram is prepared ▪ Winding is checked with specified measuring instrument to detect the fault ▪ Associated accessories faults are checked as per manufacturer data and noted down ▪ Bearing, carbon brushes, rockers, slip rings are checked visually and tested by specified instrument ▪ Fault is detected and noted down for proper repair 		



Learning Outcome 7.2 – Select Tools and Prepare Material for Winding/Rewinding

Contents:	<ul style="list-style-type: none"> ▪ List of tools and their uses/functions ▪ List of equipment and their uses ▪ List of materials 		
Resources Required:	<ul style="list-style-type: none"> ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: continuity tester, bearing puller, electric oven, manual coil winder, electric motor winding, winding head cutter, winding puller. ▪ Equipment: electric oven, manual rewinding machine, power driven rewinding machine, winding head cutter, winding puller, electric hand drill machine with bits, AC & DC power supply unit, single phase AC motor, DC motor, three phase AC motor, universal motor ▪ Materials: super enamel wires, insulating plastic film, PVC tape, laminates, insulating paper, ceramic fibre, flexible cables, slot insulation paper, binding thread, varnish, thinner, grease, bearings, solder, resin, winding string 		
Learning Activities:	Activity	Resource	Student Guide Page
	7.2	<ul style="list-style-type: none"> ▪ Information Sheet 7.2.1 ▪ Information Sheet 7.2.2 ▪ Self-Check Quiz 7.2.1 ▪ Self-Check Quiz 7.2.2 ▪ Answer Key 7.2.1 ▪ Answer Key 7.2.2 	139 140 140 142 152 152
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Technical information and winding data are collected, and winding diagram is prepared as per winding data ▪ Specified tools, materials and equipment are selected for winding work ▪ Winding wire of required gauge, insulation and binding material are prepared ▪ Formers are prepared according to winding data ▪ Coil is formed on former as per collect winding data 		



Learning Outcome 7.3 – Carry Out Winding/Rewinding of Stator Rotor and Armature

Contents:	<ul style="list-style-type: none"> ▪ Stator/rotor and armature ▪ Insulation material ▪ Formed coil 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: stator, rotor and armature, insulation materials and formed coil 		
Learning Activities:	Activity	Resource	Student Guide Page
	7.3	<ul style="list-style-type: none"> ▪ Information Sheet 7.3.1 ▪ Self-Check Quiz 7.3.1 ▪ Answer Key 7.3.1 https://www.wikihow.com/Rewind-an-Electric-Motor	143 145 152
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Stator/rotor and armature are cleaned by using specified tools ▪ Insulation material is inserted into slots ▪ Formed coil is inserted into slots as per standard ▪ Rotor is cleaned and checked ▪ Servicing and repaired works is carried out as necessary ▪ Formed coil is insulated, banded and inserted into slot 		



Learning Outcome 7.4 – Make Connections, Carry Out Pre-Assembly Tests and Assembly of Machine

Contents:	<ul style="list-style-type: none"> ▪ Pre-assembly tests ▪ Winding continuity ▪ Dry running ▪ Insulating varnish 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: motor with all parts and accessories 		
Learning Activities:	Activity	Resource	Student Guide Page
	7.4	<ul style="list-style-type: none"> ▪ Information Sheet 7.4.1 ▪ Self-Check Quiz 7.4.1 ▪ Answer Key 7.4.1 www.pcbheaven.com/userpages/check_the_windings_of_a_3phase_ac_motor/	147 148 152
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Winding resistance and insulation level is checked by specified test instrument ▪ Coil ends are terminated and insulated ▪ Winding continuity is checked ▪ Dry running is carried out, performance is checked and remedial action has taken if necessary ▪ Insulating varnish is applied to winding and baked it up to recommended temperature in baking oven ▪ Assembly of stator, rotor and other parts are assembled 		



Learning Outcome 7.5 – Carry Out Final Test and Record the Test Result

Contents:	<ul style="list-style-type: none"> ▪ Final test ▪ Test result recording ▪ Meaning, importance and necessity of cleaning tools/instruments and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Storage of tools, equipment and materials used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: reporting forms for test result, cleaning agents/materials required for servicing 		
Learning Activities:	Activity	Resource	Student Guide Page
	7.5	<ul style="list-style-type: none"> ▪ Information Sheet 7.5.1 ▪ Information Sheet 7.5.2 ▪ Self-Check Quiz 7.5.1 ▪ Answer Key 7.5.1 <p>https://www.wikihow.com/Check-an-Electric-Motor</p> <p>https://www.electrical4u.com/no-load-test-of-induction-motor/</p>	<p>150</p> <p>151</p> <p>151</p> <p>153</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Rotor free movement is checked ▪ No load/load/locked rotor tests are performed ▪ Rotor static and dynamic balancing are carried out ▪ Test result are documented in the relevant recorded sheet ▪ Test reports are prepared ▪ Machine performance is demonstrated ▪ Tools, equipment and materials are cleaned and stored as per workplace standard 		

Module 8: Install and troubleshoot solar electrical system

Module Descriptor:	This module covers the skills, knowledge and attitudes to install and troubleshooting of solar electrical system. It specifically includes estimating electrical load of customer, identifying tools, equipment and materials, setting solar panel, installing solar home system and accessories, diagnosing and repairing faults in solar home system unit and wiring and cleaning and storing the tools and materials.	
Nominal Duration:	40 hours	
Learning Outcomes:	8.1.	Estimate electrical load of customer
	8.2.	Identify tools, equipment and materials
	8.3.	Set solar panel
	8.4.	Install solar home system and accessories
	8.5.	Diagnose and repair faults in solar home system unit and wiring
	8.6.	Clean and store the tools and materials
Performance Criteria:	8.1.	Customer required electrical load are estimated.
	8.2.	Layout drawing of selected work plan is prepared.
	8.3.	Capacity of panel, battery, inverter, charge controller and other accessories are selected.
	8.4.	Following the layout plan required quantity and size of cable, wire and other installation materials are estimated.
	8.5.	Information on cost of equipment, accessories and materials are collected.
	8.6.	Cost of equipment, accessories and materials are estimated.
	8.7.	Installation charges are estimated.
	8.8.	Tools, installation materials and components and accessories are collected.
	8.9.	Personal protective equipment (PPE) is used while working.
	8.10.	Frames are constructed as per panel size.
	8.11.	Appropriate place with maximum sunlight exposure for panel setting is located.
	8.12.	Setting of panels within frame is demonstrated between 23 to 30 degrees.
	8.13.	Solar home system and accessories are installed as per layout plan.
	8.14.	Channel or conduit wiring is performed, switches and sockets are fixed as per layout diagram.
	8.15.	Connections with all related components are performed.
	8.16.	Testing of solar electrical system for operation is performed.
	8.17.	Physical faults in inverter, charger, charge controller, panel, battery and wiring system are checked.
	8.18.	Operational faults in the inverter and charge controller are checked by testing instrument.

	8.19.	Panel is tested for appropriate functioning.
	8.20.	Battery is checked by meter for appropriate voltage and water is added if needed.
	8.21.	Electrolyte of battery is checked by hydrometer.
	8.22.	Electrical connections are checked and loose connections are repaired throughout the wiring.
	8.23.	Charge controller and inverter are tested.
	8.24.	Burn components and inactive or faulty components are replaced.
	8.25.	Tools, equipment and materials are cleaned and stored as per workplace standard.



Learning Outcome 8.1 – Estimate Electrical Load of Customer

Contents:	<ul style="list-style-type: none"> ▪ Electrical load ▪ Other accessories ▪ Equipment, accessories and materials 		
Resources Required:	<ul style="list-style-type: none"> ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: light fixtures, ceiling fans, television, refrigerator, water pump, computer, switch board, switch, sockets, MCB, cables, wires, solar panel, charge controller, battery, inverter, switch and sockets, conduit, fixing materials 		
Learning Activities:	Activity	Resource	Student Guide Page
	8.1	<ul style="list-style-type: none"> ▪ Information Sheet 8.1.1 ▪ Self-Check Quiz 8.1.1 ▪ Answer Key 8.1.1 <p>https://www.slideshare.net/.../preliminary-electrical-load-calculation-course-share</p> <p>https://www.shopyourway.com/questions/1000700</p>	<p>157</p> <p>158</p> <p>173</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Customer required electrical load are estimated ▪ Layout drawing of selected work plan is prepared ▪ Capacity of panel, battery, inverter, charge controller and other accessories are selected as per guidance ▪ Following the layout plan required quantity and size of cable, wire, and, other installation materials are estimated ▪ Information on cost of equipment, accessories and materials collected from suppliers/manufacturers ▪ Cost of equipment accessories and materials are estimated ▪ Installation charges are estimated 		



Learning Outcome 8.2 – Identify Tools, Equipment and Materials

Contents:	<ul style="list-style-type: none"> • List of tools and their uses • Installation materials ▪ Solar electrical system components: panel, inverter, charge controller, battery ▪ Solar electrical system accessories: light fixtures, switches, sockets, junction boxes 		
Resources Required:	<ul style="list-style-type: none"> ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: inverter, charge controller, battery, junction boxes ▪ Materials: cables, channels, screws, rowel plugs, clips, nails, plastic board, conduits, plastic connectors, cable ties, panel, , light fixtures, switches, sockets 		
Learning Activities:	Activity	Resource	Student Guide Page
	8.2	<ul style="list-style-type: none"> ▪ Information Sheet 8.2.1 ▪ Information Sheet 8.2.2 <p>https://www.ecmag.com/section/your-business/tools-most-used-electricians</p> <p>https://www.scribd.com/document/97899235/Electrical-Supplies-and-Materials</p>	159 160
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools are selected and collected ▪ Installation materials, and, solar electrical system components and accessories are collected ▪ Battery is collected and tested 		



Learning Outcome 8.3 – Set Solar Panel

Contents:	<ul style="list-style-type: none"> ▪ List of PPE and their uses ▪ Setting of solar panels 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings 		
Learning Activities:	Activity	Resource	Student Guide Page
	8.3	<ul style="list-style-type: none"> ▪ Information Sheet 8.3.1 ▪ Information Sheet 8.3.2 ▪ Job Sheet 5 ▪ Self-Check Quiz 8.3.2 ▪ Answer Key 8.3.2 https://en.wikipedia.org/wiki/Solar_panel	161 162 163 164 173
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Personal protective equipment (PPE) is used while working ▪ Special rope, safety belts, and ladder are used for working on the roof ▪ Frames are constructed as per panel size ▪ Appropriate place with maximum sunlight exposure for panel setting is located ▪ Setting of panels within frame is demonstrated between 23 to 30 degrees 		



Learning Outcome 8.4 – Install Solar Home System and Accessories

Contents:	<ul style="list-style-type: none"> ▪ Installation of solar home system with accessories ▪ Testing of solar electrical system 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: drill, ladder, grinder, soldering iron, multimeter, earth tester, electrical plans/drawings ▪ Materials: solar home system 		
Learning Activities:	Activity	Resource	Student Guide Page
	8.4	<ul style="list-style-type: none"> ▪ Information Sheet 8.4.1 ▪ Self-Check Quiz: 8.4.1 ▪ Answer Key 8.4.1 https://www.wikihow.com/Set-Up-a-Small-Solar-(Photovoltaic)-Power-Generator	165 167 173
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Solar home system and accessories are installed as per layout plan ▪ Channel or conduit wiring is performed as per layout diagram ▪ Switches and sockets on board are fixed ▪ Connections with all related components are performed ▪ Testing of solar electrical system for operation is performed 		



Learning Outcome 8.5 – Diagnose and Repair Faults in Solar Home System Unit and Wiring

Contents:	<ul style="list-style-type: none"> ▪ Physical faults ▪ Operational faults ▪ Testing instrument ▪ Electrical connections ▪ Repair faults in solar home system unit and wiring 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools: wrench, wire stripper, bolt cutter, hammer, clamp, chisel, files, hacksaw, hand drill, measuring tape, pliers, punch, screwdrivers, try square, set square, knife, plastic tape ▪ Equipment: testing, electrical plans/drawings 		
Learning Activities:	Activity	Resource	Student Guide Page
	8.4	<ul style="list-style-type: none"> ▪ Information Sheet 8.5.1 ▪ Information Sheet 8.5.2 ▪ Self-Check Quiz 8.5.1 ▪ Self-Check Quiz 8.5.2 ▪ Answer Key 8.5.1 ▪ Answer Key 8.5.2 	169 169 169 171 173 173
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Physical faults in the inverter, charger, charge controller, panel, battery, and wiring system are checked visually ▪ Operational faults in the inverter and charge controller are checked by testing instrument ▪ Panel is tested for appropriate functioning ▪ Battery is checked by meter for appropriate voltage ▪ Electrolyte of battery is checked by hydrometer ▪ Electrical connections are checked throughout the wiring ▪ Charge controller and inverter are tested ▪ Burn components are replaced ▪ Inactive and faulty components are replaced ▪ Battery water is added if required ▪ Loose connections are repaired throughout the wiring 		



Learning Outcome 8.6 – Clean and Store the Tools and Materials

Contents:	<ul style="list-style-type: none"> ▪ Importance and necessity of cleaning tools, equipment and workplace ▪ Methods of cleaning, tools and equipment required for cleaning ▪ Display and/or storing of tools and equipment used 		
Resources Required:	<ul style="list-style-type: none"> ▪ Workplace (simulated or actual) ▪ Personal protective equipment (PPE): gloves, dust mask, safety shoes, hard hat, belt/body harness, goggles, working clothes, apron ▪ Tools and equipment: brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags ▪ Materials: water, detergents, abrasives, bleaches and lubricants (oil, grease and powder) 		
Learning Activities:	Activity	Resource	Student Guide Page
	1.6	<ul style="list-style-type: none"> ▪ Information Sheet 1.6.1 ▪ Self-Check Quiz 1.6.1 ▪ Answer Key 1.6.1 https://www.worksafe.qld.gov.au/injury-prevention-safety/workplace.../cleaning	<p>32</p> <p>34</p> <p>36</p>
Assessment Criteria:	<ul style="list-style-type: none"> ▪ Tools and equipment are prepared for cleaning ▪ Tools and equipment are stored as per standard ▪ Waste materials are disposed as per workplace standard 		