

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures



Overview

This standard covers a broad range of basic competences that you need to assemble, wire and test electrical panels and components mounted in enclosures. It will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment.

The activities will include the assembly of a range of electrical components such as component panels, isolator switches, fuses and circuit breakers, contactors and relays, bases for plug-in devices, rail-mounted terminal blocks, trunking, earthing bonding, and sub-assemblies such as power supplies, card racks, and process controller units.

This will involve using a range of tools and equipment along with soldering techniques and anti-static protection techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are free from damage, correctly positioned and secured, are terminated correctly and pass the required insulation and resistance checks.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the electrical component assembly and wiring activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the assembly and wiring activities, or with the tools and equipment used, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply appropriate electrical assembly, wiring and testing procedures and techniques safely. You will understand the assembly methods and procedures used, and their application, and will know about the various components used, to the required depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when mounting electrical components in enclosures, and with using the associated tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

Specific Standard Requirements

In order to prove your ability to combine different electrical panel assembly and wiring operations, at least one of the assemblies produced must be of a significant nature, and must contain a minimum of **eight** of the components listed in scope 2 **plus six** of the activities listed in scope 5.

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

Performance criteria

You must be able to:

- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
- P2 plan the electrical assembly, wiring and testing activities before you start them
- P3 use appropriate sources to obtain the required specifications, circuit diagrams, components, assembly and test
- P4 obtain the correct tools and equipment for the assembly and test operations, and check that they are in a safe and usable condition
- P5 use the appropriate methods and techniques to assemble the components in their correct positions
- P6 secure the components ,using the specified connectors and securing devices
- P7 wire and terminate cables to the appropriate connections on the components
- P8 use appropriate test methods and equipment to check that the completed assembly is safe and meets all aspects of the specification
- P9 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
- P10 leave the work area in a safe and tidy condition on completion of the electrical assembly and testing activities

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

Knowledge and understanding

You need to know and understand:

- K1 the specific safety practices and procedures that you need to observe when assembling, wiring and testing electrical components mounted in enclosures (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)
- K2 the hazards associated with assembling, wiring and testing electrical panels (such as using sharp instruments for stripping cable insulation, use of soldering irons, carrying out insulation tests), and how they can be minimised
- K3 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
- K4 the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps, anti-static mats, special packaging and handling areas)
- K5 what constitutes a hazardous voltage and how to recognise victims of electric shock
- K6 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)
- K7 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, graphical electrical symbols, BS and ISO wiring regulations, and other documents needed for the electrical component mounting, wiring and testing activities
- K8 the basic principle of operation of the equipment/circuits being assembled and wired, and the purpose of individual components within the circuit
- K9 the assembly methods and techniques to be used when wiring electrical panels or components mounted in enclosures (such as cable stripping, soldering, crimping, securing cables using cable ties, lacing/strapping of wires)
- K10 the type of components and sub-assemblies that are used in the assembly activities (such as contactors, relays, circuit breakers/fuses, solenoids, switches, transformers, ballast chokes, terminal blocks, sub-assemblies)
- K11 preparations to be undertaken on the components and enclosure, prior to the mounting activities
- K12 how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used
- K13 how to identify any orientation requirements, values or polarity for the components used in the electrical wiring activities
- K14 methods of attaching identification markers/labels during electrical

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

- assembly activities
- K15 the different types of cabling, and their application (such as multicore cables, single core cables, single insulated, double insulated, steel wire armoured (SWA), mineral insulated (MI), screened cables)
 - K16 why electrical bonding/earthing is critical, and why it must be both mechanically and electrically secure
 - K17 the use of BS7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on electrical circuits
 - K18 how to conduct any necessary checks to ensure the accuracy and quality of the assembly produced (such as visual checks for completeness and freedom from damage to conductors or components, mechanical checks for security of components and connections, ingress protection, electrical checks for electrical continuity and earth continuity, insulation resistance and polarity checks)
 - K19 how to check that tools and equipment are free from damage or defects, are in a safe, tested, calibrated and usable condition, and are configured correctly for the intended purpose
 - K20 the problems that can occur with the wiring and testing operations, and how these can be overcome
 - K21 when to act on your own initiative and when to seek help and advice from others
 - K22 the importance of leaving the work area in a safe and clean condition on completion of the electrical assembly and wiring activities (such as returning hand tools and test equipment to the designated locations, cleaning the work area, removing and disposing of waste)

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

Additional Information

Scope/range related to performance criteria

- You must be able to:*
1. Carry out **all** of the following during the mounting of the electrical components:
 - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
 - 1.2 follow job instructions, assembly drawings and test procedures at all times
 - 1.3 ensure that the components are free from damage, foreign objects, dirt or other contamination
 - 1.4 check that the tools and test instruments are within calibration date and are in a safe, tested and usable condition
 - 1.5 prepare the electrical components and enclosures for the assembly operations
 - 1.6 use safe and approved techniques to mount the electrical components in the enclosures
 - 1.7 where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards (such as the use of grounded wrist straps and mats)
 - 1.8 return all tools and equipment to the correct location on completion of the assembly activities

 2. Mount electrical components on panels or into enclosures, to include **twelve** of the following items:
 - 2.1 enclosure partitions
 - 2.2 bases for plug-in devices
 - 2.3 soft starters
 - 2.4 component mounting plates
 - 2.5 switches (push button, toggle)
 - 2.6 variable speed drives
 - 2.7 component marking
 - 2.8 capacitors
 - 2.9 limit switches
 - 2.10 trunking
 - 2.11 resistors
 - 2.12 sensors

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

- 2.13 conduit
 - 2.14 rectifiers
 - 2.15 programmable controllers
 - 2.16 contactors
 - 2.17 timers
 - 2.18 plugs/sockets
 - 2.19 overload and other relays
 - 2.20 power supplies
 - 2.21 grommets/grommet strip
 - 2.22 transformers/chokes
 - 2.23 circuit boards
 - 2.24 lighting fixtures
 - 2.25 circuit breakers/fuses
 - 2.26 thermistors/thermocouples
 - 2.27 batteries
 - 2.28 panel meters (voltage, current)
 - 2.29 indicators (lamps, LEDs)
 - 2.30 connector rails
 - 2.31 terminal blocks/junction boxes
 - 2.32 thermostats
 - 2.33 solenoids
 - 2.34 safety interlocks
 - 2.35 busbars
 - 2.36 isolators
 - 2.37 other specific components
3. Carry out **eight** of the following activities during the mounting of the electrical components:
- 3.1 setting working clearance
 - 3.2 aligning components
 - 3.3 applying sealants/adhesives
 - 3.4 drilling
 - 3.5 torque setting fasteners
 - 3.6 clamping
 - 3.7 filing
 - 3.8 earth bonding
 - 3.9 crimping
 - 3.10 riveting
 - 3.11 securing using mechanical fasteners/threaded devices
 - 3.12 component marking
 - 3.13 sawing/cutting
 - 3.14 making screw connections
 - 3.15 forming
 - 3.16 punching

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

- 3.17 measuring
- 4. Wire up electrical components on panels or in enclosures, using **two** of the following cable/wire types:
 - 4.1 single core cable
 - 4.2 mineral insulated cable
 - 4.3 twisted pair/ribbon cable
 - 4.4 multicore cable
 - 4.5 screened cable
 - 4.6 braided copper
 - 4.7 laminated copper
 - 4.8 fibre-optic
 - 4.9 data/communication cable
 - 4.10 other specialist cable
- 5. Use **ten** of the following methods and techniques (and the appropriate tools) during the wiring activities:
 - 5.1 cable forming/bending
 - 5.2 making screwed connections
 - 5.3 cable supporting/tying
 - 5.4 soldering (where appropriate)
 - 5.5 cable/wire clamping
 - 5.6 cable routeing
 - 5.7 cable protection (such as sleeving, grommets)
 - 5.8 connecting pre-formed looms
 - 5.9 cable/wire crimping
 - 5.10 wire marking/colour coding
 - 5.11 insulation stripping
- 6. Carry out quality checks, to include **all** of the following:
 - 6.1 positional accuracy of all components
 - 6.2 correct termination of all wires to components
 - 6.3 correct orientation
 - 6.4 completeness
 - 6.5 correct alignment
 - 6.6 ensuring enclosure is free of debris (such as cable offcuts/insulation, enclosure/trunking breakouts)
 - 6.7 component security
 - 6.8 security of all terminations
 - 6.9 ensuring freedom from damagePlus **all** of the following electrical checks:
 - 6.10 continuity of cable/wiring connections (such as battery and lamp checks)
 - 6.11 polarity

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

- 6.12 protective conductor resistance values
 - 6.13 earth continuity
 - 6.14 insulation resistance
7. Assemble electrical components on panels or in enclosures, in accordance with **one** or more of the following
- 7.1 BS7671/IET wiring regulations
 - 7.2 other BS or ISO standards and procedures
 - 7.3 company standards and procedures

SEMPEO2-35 - SQA Unit Code FP3H 04

Assembling, wiring and testing electrical panels/components mounted in enclosures

Developed by SEMTA

Version number 2

Date approved December 2011

Indicative review date December 2016

Validity Current

Status Original

Originating organisation SEMTA

Original URN 35

Relevant occupations Engineering and manufacturing technologies; Engineering;

Suite Performing Engineering Operations Suite 2

Key words engineering, engineering operations, assembling, wiring, testing, electrical panels, components, enclosures, manufacturing, soldering