TECHNICAL TRAINING SOLUTIONS

ELECTRICAL COURSES | INSTRUMENTATION COURSES | MECHANICAL COURSES

LEARNING BY DOING

INDUSTRIAL ELECTRICAL MAINTENANCE

COURSE 110: 10 DAYS: Max 8 Candidates

This course is designed to provide basic electrical skills to those who need to perform first-line electrical maintenance tasks – including the safe isolation, replacement and testing of a range of common electrical devices (motors, sensors, heating elements, solenoids, etc.) – in a safe and effective manner. Importantly, the format of the course is specifically designed so that, when combined with suitable on-site consolidation of training, it will assist the maintenance manager in meeting the legal requirements for employee competence in electrical work.

PARTICIPANTS

No prior electrical knowledge is assumed. The structure and content of the course is aimed at those who currently fulfil a maintenance role, for example mechanical fitters. Many companies use this course to help introduce flexibility to their workforce, as part of a multiskilling programme.

Candidates with previous electrical experience (for example instrument engineers, electronics engineers, or those that have gained the necessary knowledge of electrical principles from elsewhere can attend a shortened version of this course. An eligibility assessment is available on request.

COURSE PRESENTATION

The course has an extensive 'hands-on' practical approach, placing emphasis on safe working practice and on the development of useful, practical skills. Comprehensive course notes are provided.

COURSE OBJECTIVES

On completion of the course, participants will be able to

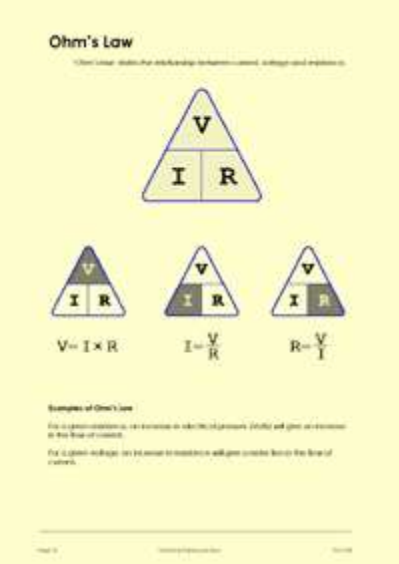
- practice safe working methods on electrical systems
- understand the relevant regulative requirements
- demonstrate an understanding of electrical principles and units
- identify a wide range of electrical equipment & devices and understand their principles of operation / connections
- understand the principles of earthing / protection and associated protective devices
- demonstrate an understanding of electrical systems, switchgear and circuit types
- diagnose basic faults and recognise their associated symptoms
- work with a range of cable types and carry out correct terminations and connections
- recognise the most common industrial motor types and understand their operation, connections and maintenance requirements
- use electrical test equipment effectively and carry out testing of a range of motors, solenoids, cables, etc. (using insulation, continuity, tong testers, etc.)
- identify motor and power circuit faults
- use circuit diagrams as an aid to maintenance
- access electrical enclosures and replace fuses, reset overloads etc
- perform electrical isolation, testing for dead, etc on a wide range of devices and circuits safely.

Successful completion of the course leads to the award of the Technical Training Solutions Certificate of Competence 110: Industrial Electrical Maintenance.

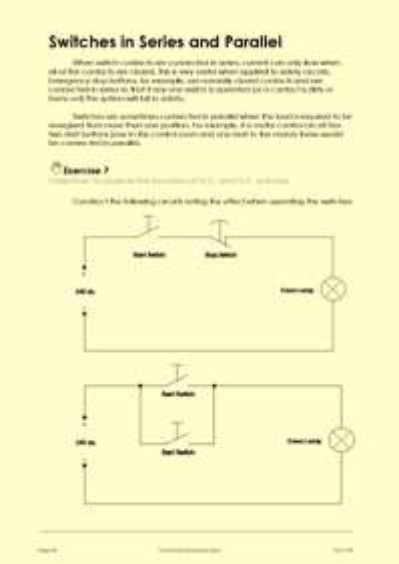
What do candidates on the Industrial Electrical Maintenance course actually do?

At the beginning of the course, candidates learn about basic electrical principles. This grounding in the fundamental concepts ensures a full understanding of the technical and safety issues in the later stages of the course.

Candidates learn in a practical way about ohm's law, series and parallel circuits etc, seeing at first hand what the relationships are between voltage, current and resistance. The following are some example of the course notes for this part of the course, describing ohm's law, series and parallel circuits and solenoids, relays and contactors:



Page 12 of Part 1 of the electrical maintenance training course notes, describing ohm's law



Page 20 of Part 1 of the electrical maintenance training course notes, describing series and parallel circuits

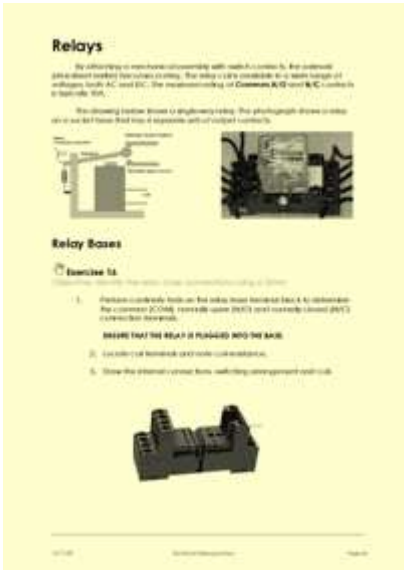
Page 26 of Part 1 of the electrical maintenance training course notes, describing solenoids and relays

We ensure that this part of the course is kept interesting and relevant to the objectives of the course by avoiding any unnecessary theory and introducing some commonly-used industrial components, whilst using multimeters to make measurements, exploring the basic electrical principles as they go. To achieve this we have constructed exercise boards with industrial switches, sensors, relays, contactors etc so that they can build circuits, make measurements using digital multimeters, gain familiarity with the components and learn about the principles in a structured, interesting and enjoyable way.

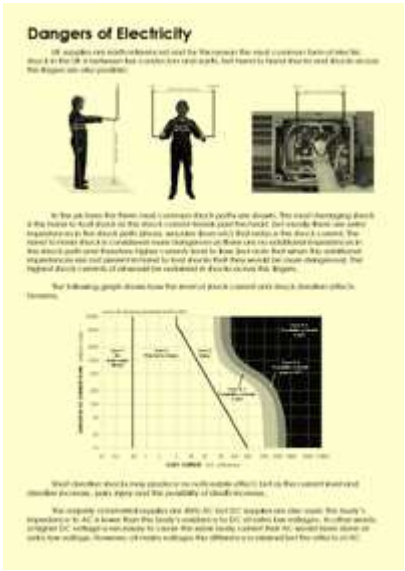
Our custom-designed basic circuits rig allows candidates to build basic electrical circuits and learn about electrical principles whilst familiarising themselves with the basic electrical components in week 1 of the electrical maintenance skills training course

In the early days of the electrical maintenance skills course candidates also study the common industrial electrical components that they are likely to encounter - proximity detectors, relays, thermocouples, Pt100s and others. More complex circuits incorporating these components are constructed on the basic circuits board shown above. They also have an in-depth briefing of the effects of electric shock - a key issue on this course, as we need to be confident that they are aware of the potential dangers. The following are example pages from this part of the course notes for the electrical maintenance skills course, describing proximity detectors, relays and the effects of electric shock:

Page 39 of part 1 of the electrical maintenance training course notes, describing proximity detectors



Page 43 of part 1 of the electrical maintenance training course notes, describing relays

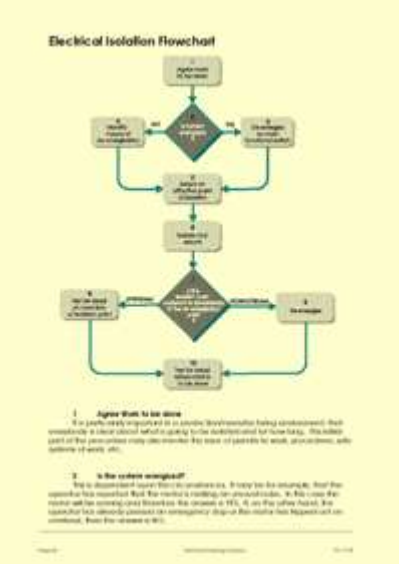


Page 50 of part 1 of the electrical maintenance training course notes, describing the effects of electric shock

In the next part of the electrical maintenance skills course the candidates build on the fundamentals by learning about electrical dangers and protection methods; the principles of earthing, how the effects of electric shock are reduced, fuses, circuit breakers, RCDs and other related issues. They also learn about the Electricity at Work (EAW) Regulations and how these might affect their future work - exploring issues like live-working, competency, etc. The following are example pages from this part of the course notes for the electrical maintenance skills course, describing the various types of fuses available, how insulation resistance testers should be used and how electrical systems should be isolated (getting the candidates to think through the various stages necessary):

Page 62 of the electrical maintenance training course notes, describing the various types of fuses available

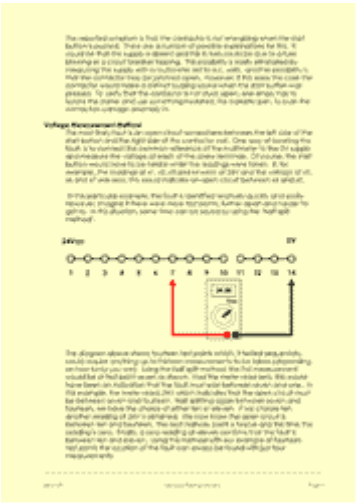
Page 70 of the electrical maintenance training course notes, describing insulation and continuity testing



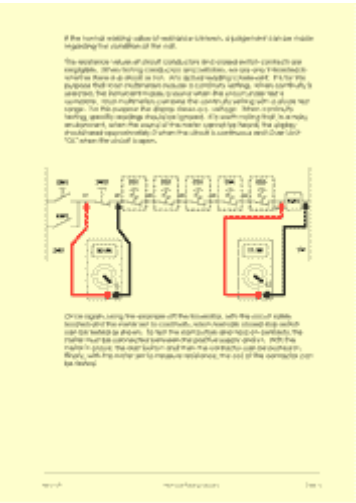
Page 76 of the electrical maintenance training course notes, describing isolation procedures

We explore the skills of fault finding by discussing the most common fault conditions e.g. Open Circuit, Short Circuit and Insulation Breakdown. The candidates are provided with course notes that explain how these faults can be found in real industrial electrical systems.

Page 80 of the course notes for the electrical fault finding part of the course



Page 85 of the course notes for the electrical fault finding part of the course

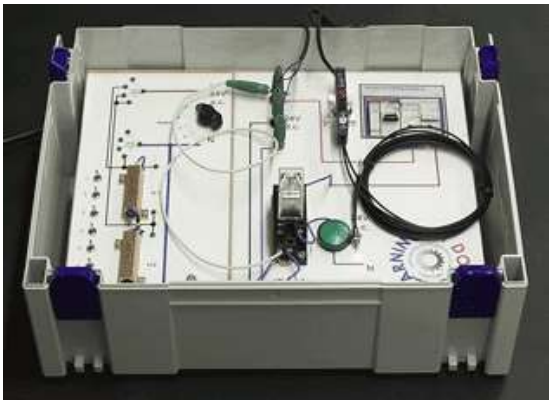


Page 91 of the course notes for the electrical fault finding part of the course

The candidates are then given fault simulation rigs and test equipment. The simulation rigs present the candidates with industrial sensors, relays and switches that provide a baffling array of faults and symptoms. In some cases the candidates may not immediately be aware of any faults as the equipment appears to be working correctly.

However, by using logical fault finding methods and the equipment provided, candidates are able to successfully diagnose faults that impact upon safety as well as functionality alone. This builds confidence and enables the candidate to suggest the necessary actions to effect a suitable repair.

The simulated faults range from welded switch contacts and burnt out relay coils to faulty proximity sensors. All testing is carried out in complete safety because the fault rigs (which have both control and load circuits) operate from 24v dc and 24v ac.



The fault finding simulation rig used by candidates on the electrical maintenance training course

We teach the candidates the right way to prepare and terminate cables into plugs and sockets and how to use professional crimp tools to crimp conductors properly.

Candidates also learn why and how insulation and continuity testers are used, for which we have developed simulation units so that once they are able to use the testers properly to check cables, accessories and current-using equipment, they then apply their skills to finding open circuits, short circuits and insulation breakdowns within specially constructed test circuits. This allows them to gain some basic electrical fault finding skills, developing their skills and understanding of the fundamentals further.

We also explain the effects of overload, short circuit and earth faults in electrical systems, showing how the various protective devices like fuses, circuit breakers and RCDs operate. We have a specially-constructed training rig for this also, so that candidates can explore these important issues.

The following are examples of the fault finding training rigs (where candidates diagnose faults in the control and load circuits of industrial electrical circuits), the tools that the candidates use on the electrical maintenance skills course for terminating cables, the training rig used for exploring the effects of short circuits, overloads and earth faults, the rig used for the cable termination exercise, one of the insulation resistance testers used and examples of some of the leads that candidates build on the course:

The fault finding test board used on the electrical maintenance training course

We provide the candidates with all the necessary tools during the electrical maintenance training course

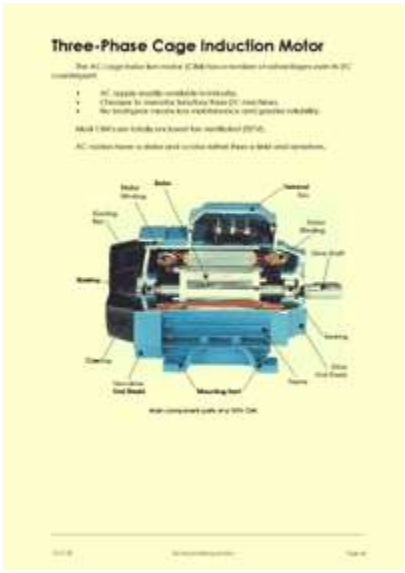
The electrical fault board used on the electrical maintenance training course - this is used to explain what happens when short circuits, earth faults and overloads occur

This is the cable termination rig used on the electrical maintenance training course

We use professional insulation resistance / continuity testers on the electrical maintenance training course

Examples of some of the leads that candidates construct on the electrical maintenance training course

We then teach the candidates about three-phase motors: how they work, identification features, terminal configuration, testing, etc, whilst using their knowledge of voltage, current and resistance to understand the principles of induction.



Page 5 of part 2 of the electrical maintenance training course notes, describing the key features of cage induction motors

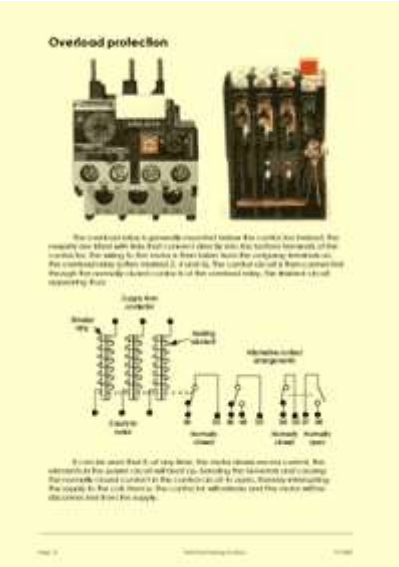
Page 9 of part 2 of the electrical maintenance training course notes, describing the information found on the nameplates of industrial motors

Page 13 of part 2 of the electrical maintenance training course notes, describing the configuration of the terminals of a delta-linked motor

Next we explain the various standards of symbols used on industrial circuit diagrams and look at the function of the most common components found in control panels - contactors, overload relays, etc. The following are example pages from this part of the electrical maintenance skills course, describing electrical symbols, contactors and overload relays:

Page 17 of part 2 of the course notes for the electrical maintenance training course, describing the various electrical symbols used on drawings for a range of common Standards

Page 20 of part 2 of the course notes for the electrical maintenance training course, describing how contactors are used



Page 23 of part 2 of the course notes for the electrical maintenance training course, describing how overload relays are used

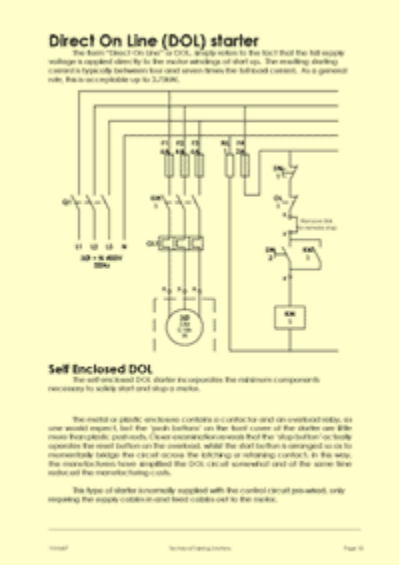
We then introduce industrial control panels with DIN-rail mounted components like circuit breakers, fuses, contactors, overload relays, timers, switches and lamps. The candidates build some basic industrial electrical circuits - for example from simple DOL to star/delta motor starters - giving them the experience of recognising each of the components, their markings and terminal identifications, the differences between the load and control circuits etc, in an engaging way that they really enjoy. The following are the three-phase 40V motors we use, the empty control panel (before candidates have assembled their circuits) and the components that they use to build the circuits:

This is one of the specially-wound 40 volt three-phase motors used on the electrical maintenance training course

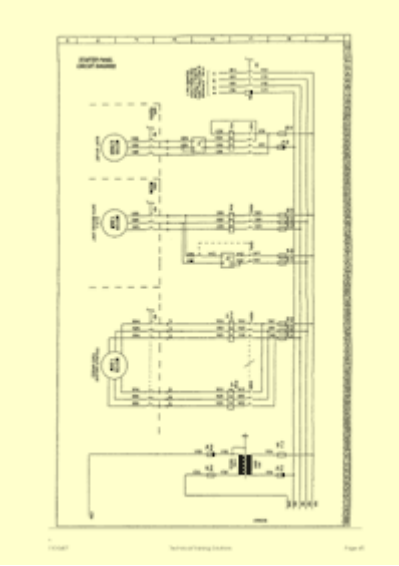
We have designed a special training rig so that the candidates actually build the circuits that we give them, using real industrial components, following the circuit diagrams provided in the electrical maintenance training course

Candidates are provided with a range of industrial circuit breakers, contactors, timers and overload relays with which to build the circuits that we give them on the electrical maintenance training course

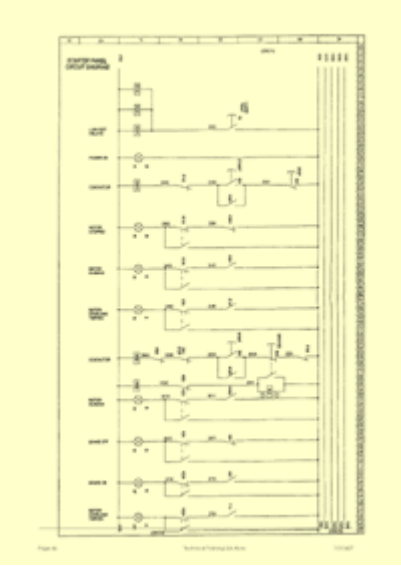
Reading circuit diagrams and translating them to real components is a key objective of the course. The best method for learning about this is to engage the candidates in an enjoyable way and therefore we provide the candidates with (amongst others) the following example circuits which they build into the panels shown above:



Page 41 of part 2 of the course notes for the electrical maintenance training course, describing how DOL starters work - candidates build this circuit in the panels shown above



Page 45 of part 2 of the course notes for the electrical maintenance training course, describing star/delta starters - candidates build this circuit in the panels shown above



Page 46 of part 2 of the course notes, describing a complex control circuit diagram - candidates build this circuit in the panels shown above

The candidates can then (before connecting these circuits to our custom-manufactured 3-phase 40 Volt motors) inspect and test their prepared units, ensuring that the circuits have been interpreted correctly. We have developed a three phase 40-volt ac supply to power these systems so that all this can be done safely. The following are examples of our 40 volt three-phase supply units, one of the control panels assembled and ready for the candidates to wire up, and our testing for dead instruments:

One of the control panels, ready for wiring by the candidates on the electrical maintenance training course

This is our specially-designed three-phase 40 Volt ac supply: It generates its output from a single-phase mains supply, so that we can provide the course without needing a three-phase supply

Candidates use professional voltage testers and proving units on the electrical maintenance training course

The above units can then be powered-up to check for their correct functionality. Any faults need to be rectified and candidates gain valuable experience of fault finding in real industrial control panels during this exercise.

Once the systems are working correctly we can then explore various scenarios in which candidates work out how a safe isolation should be performed on their systems. We can simulate a variety of scenarios, including situations in which the system has local and remote start/stop and local and remote isolators. Candidates give their written explanation (a method statement of work) for how they intend to do this and once they have written it correctly we ask them to perform it for real on the systems that they constructed earlier.

The above exercise is one of the focal points of the course as it brings together not only the candidate's ability to perform an electrical isolation but also their use of voltage testers, recognition of the various components, an understanding of the system etc.

We then replace some of the components in the candidates' functional systems with faulty components like burned out contactors, faulty overload relays, incorrect contactor coil voltages, faulty auxiliary contacts etc. Candidates then fault find the systems to diagnose the faults.

To be absolutely sure that the candidates have understood the key teaching points of the course we then administer a multiple choice assessment paper.

Part of the assessment paper for the Industrial Electrical Maintenance course

If you would like to see some of the equipment used on the industrial electrical maintenance course for yourself, then please call us to arrange a visit to our offices in Kent. Alternatively, we can visit you anywhere in the British Isles.

CONTACT US

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