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Vocational training

Principles of electrical engineering

Part 1: Electrical engineering



Textbook

Dr.-Ing. Paul Christiani GmbH & Co. KG
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Vocational training –

Principles of electrical engineering

Section: Textbook

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Preface

All practical work requires theoretical background knowledge. This statement applies in principle to all activities, and in particular to electrical engineering work.

The textbook provides this background knowledge where it is necessary for the implementation of the practical exercises.

Of course, the trainers decide on the scope and time at which the textbook will be used.

However, it is a good idea for trainees to use the textbook for familiarisation before planning and implementation of the individual exercises. Trainees can demonstrate any knowledge gained in this way in a technical discussion, for example.

Work with the textbook is supported with slides that are available digitally in MOLA¹⁾.

In addition to slides specified in the trainer guidelines, which make direct reference to the individual exercises, all photos and drawings of the textbook area also available digitally. This supports trainers and trainees with possible presentations, for example.

¹⁾ MOLA: My Own Learning App

Finally, we ask that male and female readers alike feel included in the use of the plural forms of "trainer" and "trainee". We are of the opinion that this gender-neutral form is less tedious for the reader than reading "he/she" on every page of the book. Therefore, we have chosen not to use this double designation and ask you to take this reader-friendly decision into account.

Contents

1	Electrical installation tools	7
2	Single core non-sheathed cables, insulated cables and cables	15
2.1	Stripping cables	23
2.2	Stripping electrical conductors.....	26
2.3	Wire end ferrules and cable lugs	27
2.4	Bending eyelets	31
3	Clamping connections	33
3.1	Screw terminals	39
4	Laying cables	41
4.1	Classification of the clamps and bending radii	43
4.2	Conduit installation	45
5	Cable entry into equipment.....	49
6	Duct wiring with single-core non-sheathed cable.....	55
7	Round wire bundles	56
8	Connection plan	57
9	Cable laying systems	57
10	Current rating of cables	61
11	Overcurrent protection devices	63
11.1	Safety fuses	63
11.2	Circuit breakers.....	69
12	Definitions	73
13	Important network systems.....	75
14	Faults in electrical systems.....	77
15	Equipment reference indicator	79
16	Earthing pin plug connections	83
16.1	Production of extension cables	89
16.2	Perilex plug connection	91
16.3	Collar-type plug connection	91

17	Evidence of electrical safety	95
18	Electrical installation circuits	99
18.1	Electrical engineering circuit diagrams	101
18.2	Guidelines for wiring of junction boxes	104
18.3	ON/OFF switch	105
18.4	Series circuit	106
18.5	Two-way circuit.....	107
18.6	Cross-connect circuit.....	109
18.7	Impulse circuit.....	110
18.8	Staircase time switch	114
19	Lamps	115
19.1	Fluorescent lamps.....	117
19.2	Halogen lamps.....	121
19.3	LED lamps.....	124
19.4	Dimmers.....	133
20	Small transformers.....	137
20.1	Bell door opener system	141
21	Electromagnetic switches	145
21.1	Relays	145
21.2	Contactors.....	147
21.3	Contactor circuit with one control point.....	150
22	Motor protection	155
22.1	Motor protection relay	155
22.2	Switching a three-phase motor from two points	157
22.3	Motor circuit breaker	158
23	Illustration of circuit diagrams	163
24	Symbols and circuit symbols	171
25	Distributor.....	181
26	Residual current device (RCD)	185

Electrical installation tools

7

1 Electrical installation tools

Proper tooling is a requirement for safe and professional work. *Care and maintenance* of the tools is particularly important. *Organised* and *user-friendly* tool storage (e.g. in tool bags) not only reduces the risk of accidents but is also a requirement for efficient work.

• Side-cutting pliers

Side-cutting pliers are used to trim thin, solid and fine-stranded cables. Hand protection insulation is advisable.



1 Side-cutting pliers

Due to the *lever effect*, it is also possible to cut through wires with a larger cross-section, if the wire is positioned as close as possible to the joint of the side-cutting pliers. Side-cutting pliers are available in different sizes. In electrical engineering, lengths of 145 mm to 150 mm are advisable.

• Combination pliers

Combination pliers are a *multifunctional tool*.

For example, they can be used to grip and to cut wires. They have a *side cutting edge* like side-cutting pliers, but also *jaws* like flat nose pliers and a pipe wrench, to grip and hold screw heads, for example.

Combination pliers can also be used to *notch* or *cut off* thin *steel wires*. When used for electrical work, *hand protection insulation* is indispensable. Example of *cutting performance*: Maximum wire cross-section for aluminium/copper: 16 mm².



2 Combination pliers

Side-cutting pliers should sit comfortably in your hand. The tool must not slip during use.

Tools must be visually checked for damage before each use.

■ Identification of safety tools

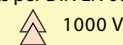
Pictograms and voltage information

As per DIN VDE 0680



1000 V

As per DIN EN 60900



1000 V

Safety tools enable increased contact protection.

8

Electrical installation tools

• **Lever end cutting pliers**

Suitable for *cutting* steel wires and stronger copper wires. *High cutting force* due to special lever support. Screws and nails can be cut easily.



3 Lever end cutting pliers

• **Flat nose pliers**

These have two roughened flat jaws for *gripping* objects or for *bending* wires.



4 Flat nose pliers

• **Round nose pliers**

Suitable for *bending eyelets* in single-core copper conductors.



5 Round nose pliers

The jaws of the flat nose pliers are rough.

They can transfer a greater holding force than long-nose pliers.

With round-nose pliers, both jaws are slightly truncated and cone-shaped. They have a round cross-section over their entire length.

Round-nose pliers are also called *eyelet pliers*.

Electrical installation tools

9

• Long nose pliers

As with flat nose pliers, long nose pliers have *roughened flat jaws* for *gripping* objects.

The pointed shape means the tool can be used to *reach into* small openings.

Often, long nose pliers are equipped with a *cutting edge* on the side near the joint, which can be used like side-cutting pliers.



6 Long-nose pliers

• Wire stripper

Used to *strip* insulation from cable conductors.

First, the *setting screw* is used to set approximately the diameter of the wire to be stripped. Then a *test cut* is made.

Only the insulation must be cut, never the copper conductor. The correct *setting* can be *fixed* with a *counter-nut*.



Work with wire strippers requires great care: Solid conductors must never be notched, and the cross-section of thin conductors must not be reduced.



7 Mechanical wire stripper

• Automatic wire stripper

For small cross-sections (0.08 to 6 mm²), the *automatic wire stripper* can be used without adjustment. Damage to the conductor insulation is prevented by adapting the gripping jaw contact pressure to the conductor cross-section.

The longer the nose of the pliers, the less pressing force can be used at the tips.

■ Disadvantages of mechanical wire strippers

Damage to the conductor if adjusted incorrectly.

Physical effort for removal.

In some circumstances, several attempts may be required.

10

Electrical installation tools

■ **Automatic wire stripper**

It is not necessary to manually adjust the cable cross-section. The lengths of the insulation to be removed can be adjusted.

■ **Caution!**

Wire stripping tools should only be used for the purpose described in the operating manual.

Only work on de-energised conductors!

The use of cable stripping knives (Fig. 9) is certainly less common now.

There are easier and safer ways of preparing cables.

Yet electricians must still be able to handle cable stripping knives safely. They almost always carry this tool with them.

After the stripping process, the gripping jaws automatically open and prevent individual wires from being *spliced* in *flexible conductors*. An *adjustable end stop* allows you to set the desired stripping length.



8 Automatic wire stripper

• **Cable stripping knife**

Cable stripping knives can be used to *prepare electrical cables*. They can be used to *strip* and *remove insulation* from cables.

The use of cable stripping knives can easily lead to injuries. Always guide the blade away from your body.

Due to the risk of accident, a *system tool* is generally used instead of a cable stripping knife.



Blades must not be carried open in your work clothing. After use, they should be placed back in the tool bag.



9 Cable stripping knife

• **Wire stripping tool**

This tool consists of a handle with an internal blade, as well as a cable holder and a setting screw (Fig. 10 top).

A test cut is used to adjust the tool to the respective cable sheath thickness.

Electrical installation tools

11

The non-metallic-sheathed cable is clamped in and the tool rotated around the cable. The tool is then pulled forward (towards the end of the cable) and the sheath can be removed easily.



10 Wire stripping tool



Caution is required during stripping. The conductor insulation under the sheath must not be damaged.

• Wire end ferrule crimping tool

This tool is used to fit wire end ferrules, which can be used when connecting fine-stranded and superfine-stranded conductors.

Ensure that the correct cross-section is selected when using the simple version of the tool.



11 Wire end ferrule crimping tool

This is a solderless connection.

Such connections must be gas-tight.

I.e. the conductor and connector are crimped together in such a way that there are no intermediate spaces. This can prevent oxidation. This is known as crimping.

■ Sheath cutters and wire stripping tools

have the advantage of an adjustable cutting depth, unlike the cable stripping knife.

Damage to the conductor insulation is therefore less likely.