Unit 4

Describing a wiring diagram  Planning a room with a customer  Explaining safety rules

1 Warm-up

A Use the Language box and your own ideas or experience to explain the following.

- what every electrician must do before starting work on an electrical circuit
- how he/she does this
- what can happen if it is not done

**Language**

- make sure that ...
- check that ...
- disconnect ...
- lock and tag ...
- warn people that ...
- put a sign on ...
- damage ...
- overload ...
- get an electric shock
- (seriously) injure ...
- be (seriously) injured
- electrocute ...
- be electrocuted

B Use the words in the box to label the safety devices.

- blade fuse • cartridge fuse • circuit breaker • RCD

C Look at the illustrations and explain the following.

- which safety device protects people.
- which safety devices protect circuits.

D Explain in what sort of circuit you would expect to find each device.
### Using electrical wiring symbols

**A** The English terms in column C are mixed up. Match them with the symbols and German terms in columns A and B.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td><img src="lighting-schluessymbol" alt="image" /></td>
<td>Lichtanschluss</td>
<td>400 V three phase junction box</td>
<td>8</td>
<td><img src="dimmersymbol" alt="image" /></td>
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<tr>
<td>2</td>
<td><img src="ausschalter_symbol" alt="image" /></td>
<td>Ausschalter</td>
<td>Camera</td>
<td>9</td>
<td><img src="spot_melder_symbol" alt="image" /></td>
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<tr>
<td>3</td>
<td><img src="wechsel-schalter_symbol" alt="image" /></td>
<td>Wechselschalter</td>
<td>Dimmer</td>
<td>10</td>
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<td>4</td>
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<td>Serienschalter</td>
<td>Door opener</td>
<td>11</td>
<td><img src="bewegungsmelder_symbol" alt="image" /></td>
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<tr>
<td>5</td>
<td><img src="geerdete_steckdose_symbol" alt="image" /></td>
<td>geerdete Steckdose, Schutzsteckdose</td>
<td>Double (triple, fourfold) socket</td>
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<td><img src="fernsehschlussdose_symbol" alt="image" /></td>
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<td>6</td>
<td><img src="3npe_symbol" alt="image" /></td>
<td>400 V Drehstromsteckdose</td>
<td>Double switch</td>
<td>13</td>
<td><img src="tueroffner_symbol" alt="image" /></td>
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<tr>
<td>7</td>
<td><img src="doppel-dreifach-vierfach_steckdose_symbol" alt="image" /></td>
<td>Doppel-, Dreifach-, Vierfachsteckdose</td>
<td>Earthed socket outlet</td>
<td></td>
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</tr>
</tbody>
</table>

**B** Work with a partner. Describe for each other where to put electrical fittings. Use the symbols in exercise 2a and the language box to give your instructions.

**Language**
- put/draw/include a ... (e.g. socket) to the right/left of the ...
- on the top/bottom wall
- on the left-hand/right-hand wall
- in the bottom left-hand corner / top right-hand corner, etc.
- next to / between / close to

**Student A**: Turn to file 1 on page 133. **Student B**: Turn to file 10 on page 135.
A wiring diagram for a penthouse kitchen

A Can you name this kitchen equipment? Some of it will be mentioned in the dialogue.

B Listen to the dialogue and write a list of all the kitchen appliances and equipment Penny and Thomas talk about.

C Listen again and mark the sockets and other fittings needed in the kitchen on the wiring diagram. The blue symbols are for the fittings that have already been discussed and marked on the diagram.

- **TV**
- **Motion detector**
- **Lighting outlet**
- **Dimmer/dimmable light**
- **Earthed socket outlet**
- **400 V**
- **One way switch**
- **Door opener**

**Already marked on diagram**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/N/PE</td>
<td>Earthed socket outlet</td>
</tr>
<tr>
<td>3</td>
<td>Dimmer/dimmable light</td>
</tr>
<tr>
<td>4</td>
<td>TV</td>
</tr>
<tr>
<td>5</td>
<td>Motion detector</td>
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<td>6</td>
<td>400 V</td>
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<td>7</td>
<td>One way switch</td>
</tr>
<tr>
<td>8</td>
<td>Door opener</td>
</tr>
</tbody>
</table>

**Dialogues**

A: Can you name this kitchen equipment? Some of it will be mentioned in the dialogue.

B: Listen to the dialogue and write a list of all the kitchen appliances and equipment Penny and Thomas talk about.

C: Listen again and mark the sockets and other fittings needed in the kitchen on the wiring diagram. The blue symbols are for the fittings that have already been discussed and marked on the diagram.
Practice: conditional 2

Thomas Keller is talking to Trevor Bell about the wiring in the kitchen. Use the conditional 2 grammar table to complete the dialogue with the correct verb forms.

Trevor How much ...\(^1\) (it/cost) if we ...\(^2\) (install) an EIB system later?
Thomas If you ...\(^3\) (do) that, it ...\(^4\) (be) a lot more expensive, Mr Bell. And remember that you'll have greater security with EIB. If you ...\(^5\) (not have) an EIB system, you ...\(^6\) (need) to switch off all the lights separately every night.
Trevor I see what you mean. Life ...\(^7\) (be) a lot easier if we ...\(^8\) (have) an EIB system now. If a burglar ...\(^9\) (break) in, what ...\(^10\) (happen)?
Thomas If a burglar ...\(^11\) (stand) near a motion detector in the building, it ...\(^12\) (send) a signal to the police station or security company and if they ...\(^13\) (receive) a signal, they ...\(^14\) (come) immediately.

What would happen if ... ?

A Describe the following chain reaction using if-sentences.

If Thomas used the wrong cable, the installation would melt. → If the insulation melted, it would trip the circuit breaker. → If it tripped ...

B Now make more sentences with these words.

Thomas / use / the wrong cable → the insulation / melt → it / trip / the circuit breaker → the circuit breaker / switch off / the circuit → the lights and sockets / not work → Penny and Trevor / be / annoyed → they / call / the company → Thomas / get / into trouble.
Read the text below, then complete the statements.

1. If five times the nominal current flows through a circuit …
2. The two different types of metal in a bimetallic strip …
3. The bimetallic strip breaks the circuit because …
4. A solenoid is …
5. A solenoid reacts more quickly …
6. To complete the circuit again you …

CIRCUIT BREAKERS

A circuit breaker breaks the circuit (trips) if the current flowing through it rises to an unacceptable level. This is usually between three and five times the current the circuit breaker is designed to take (nominal current).

Modern circuit breakers have a solenoid, a bimetallic strip or both.

Thermal-magnetic circuit breaker

In a thermal circuit breaker a bimetallic strip is made of two different types of metal which expand at different rates when heated. At room temperature the two strips of metal are both straight. If, however, a stronger current flows through them, heat is produced and the two metal strips start to expand. As one of them expands more than the other, it trips the electrical contact and breaks the circuit.

In the circuit breaker shown in Figure 3 there is a bimetallic strip on the right (3) and a solenoid in the centre (2). A solenoid is an electromagnetic switch. This combination has the advantage that a sudden large current surge will trip the solenoid, which reacts quickly (e.g. in 20 milliseconds), and a smaller long-term overload will trip the bimetallic strip, which reacts more slowly but to a lower current. The circuit can be completed again by pushing the switch (1) up by hand.

Figure 1: Thermal-magnetic circuit breaker

Working with words

Match a–e with 1–5. The expressions are all in the text.

1. break
2. produce
3. bend
4. trip
5. push up

a. the solenoid
b. the switch
c. the strip
d. heat
e. the circuit
A Complete the text below with words from the diagram (figure 4).

RESIDUAL CURRENT DEVICE (RCD)

In figure 4 the ... current of 16 amps travels to the load in the left-hand part of the circuit and the ... current of 15 amps returns from it. As there is a ... current of 1 amp, the RCD switches off the circuit.

In a circuit without a fault, the current enters the phase ... on its way to the load and returns to the ... through the neutral coil. A magnetic ... is produced in both coils. However, as the coils are identical but wound in opposite directions, they cancel each other out because one is ... and the other ...

In the case of a fault, some current is lost to ... and the ... current returning to the supply is less than the ... current to the load. The ... flux in the neutral coil is therefore less than in the phase coil. This difference is picked up by a ... coil, which is connected to a ... This disconnects the main ... and switches off the circuit.

Figure 2: How an RCD works

B Study the diagram and text and then say whether the following statements are true or false. Correct the false statements.

1. The residual current is the difference between the phase and neutral currents.
2. The phase coil and the neutral coil are wound in the same direction.
3. The current from the supply first produces a negative magnetic flux, then a positive one.
4. There is no physical difference between the phase coil and the neutral coil.
5. The test button is connected to the solenoid.
6. The sensing coil is wound around the neutral coil.
7. The sensing coil triggers the test button.
Ein Kollege hat den folgenden Text auf einer englischen Internetseite gefunden. Da er nicht ausreichend Englisch spricht, jedoch vergleichen will, ob die beschriebenen Sicherheitsstandards ähnlich wie in Deutschland sind, bittet er Sie, die wesentlichen Aussagen des Textes für ihn auf Deutsch zusammenzufassen.

In an electrical circuit the current from the power station flows along the **hot wire** (phase – *black, brown or grey conductor*) through the **load** (e.g. a light) and then along the **neutral wire** (blue conductor) back to the power source. The load in the circuit acts as a **resistance** and stops an uncontrolled amount of current (a **surge**) from flowing along the hot wire directly back to the source.

If there is a fault in the circuit, e.g. if the brown and blue conductors touch because the insulation has melted (short-circuit), a massive amount of current suddenly flows through the circuit because there is almost no resistance in the circuit. This is a very dangerous situation because the extra energy takes the form of heat and can cause a fire.

For this reason a modern house wiring system includes safety devices to switch off the electricity supply if there is a surge in current.

There are basically two types of safety device in a modern home – **circuit breakers** to protect the circuit and **residual current devices** (RCDs) to protect people. A circuit breaker reacts if too much current flows through a circuit, whereas an RCD reacts if there is current leakage, e.g. in the case of a ground fault.

In a modern house or flat there will normally be 10 – 20 circuit breakers and 1 or 2 RCDs, e.g. in the electrical circuit of a bathroom. Whereas a 16-amp circuit breaker will trip within 0.4 seconds if the current rises to 5 times the nominal value (e.g. $5 \times 16 \text{ A} = 80 \text{ A}$), an RCD will trip within 0.2 seconds if there is a fault current of only 30 mA.

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**B**  **Read the text again and answer the questions.**

1. What would happen if there was a short circuit in an electrical circuit without a safety device?
2. Which device in the circuit would react first to a fault current of 40 mA – a circuit breaker or an RCD?
3. Explain what would happen if someone in a bathroom without an RCD but with a circuit breaker in the circuit got an electric shock while under the shower or in the bath. Also explain what wouldn’t happen.
Safety at work

A Hartvig Pekkala is a Finnish trainee electrician on work placement in Germany at Ritter Installation in Dortmund. When Hartvig and Thomas Keller are in the workshop, Hartvig sees a notice on the five safety rules. He asks Thomas to help him understand them. Complete their dialogue with German words from the notice.

Hartvig I’m not quite sure if I’ve understood this, Thomas. Does ‘freischalten’ mean ‘switch off’?

Thomas Yes, that’s right, but it means more than that. It means you must disconnect an electrical circuit or a piece of equipment before you work on it.

Hartvig Oh, I see. And what about ‘…’? Has that got something to do with ‘safety’?

Thomas Yes, but here it means ‘protect’ – protect the circuit against being turned on again.

Hartvig OK, I get it. Now what does ‘…’ mean?

Thomas It means ‘make certain’. We have to make sure the circuit isn’t live. In German we say ‘make certain it’s free of electricity’. It’s best to test it with a multimeter to make sure it’s not connected to the mains.

Hartvig I’m sorry to bother you but there’s just one more thing. Could you explain ‘…’?

Thomas Certainly. It means ‘earth and short-circuit’. Hartvig I won’t even try the last one but I think ‘…’ has got something to do with ‘neighbours’, hasn’t it?

Thomas No, you’ve got the wrong end of the stick there, Hartvig. It means ‘cover up or fence off nearby live components’.

Hartvig OK, I’ve made a note of that.

B Nach ihrem Gespräch über Sicherheit hält Thomas es für ratsam, Hartvig eine kurze Zusammenfassung der fünf Sicherheitsregeln auf Englisch zu geben. Schreiben Sie die Zusammenfassung mit Hilfe der Ausdrücke auf S. 36 und in der „Language“-Box.

5 Sicherheitsregeln
Vor Beginn der Arbeiten
- Freischalten
- Gegen Wiedereinschalten sichern
- Spannungsfreiheit feststellen
- Erden und kurzschließen
- Benachbarte, unter Spannung stehende Teile abdecken oder abschranken

<table>
<thead>
<tr>
<th>Language</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>a multimeter reading</td>
<td>to disconnect</td>
</tr>
<tr>
<td>an electrical circuit</td>
<td>to lock and tag</td>
</tr>
<tr>
<td>electrical components</td>
<td>to short-circuit</td>
</tr>
<tr>
<td>electrical equipment</td>
<td>to switch off</td>
</tr>
<tr>
<td>live (e.g. a live conductor)</td>
<td>to tell your workmates</td>
</tr>
<tr>
<td>mustn’t (darf nicht)</td>
<td>to test</td>
</tr>
<tr>
<td>to be careful not to (e.g. touch a live conductor)</td>
<td>to touch one conductor against another</td>
</tr>
<tr>
<td></td>
<td>to turn back on again</td>
</tr>
</tbody>
</table>
Produktion


Erklären Sie Ihrem Kollegen auf Englisch, wie Sie unter Beachtung der fünf Sicherheitsregeln vorgehen, um die beschädigte Anschlussdose zu ersetzen und was Sie dem Hausbesitzer raten, als Nächstes zu tun. Beschreiben Sie Ihre Vorgehensweise Schritt für Schritt jeweils mit kurzer Begründung.

Produktion

Ihre nächste Aufgabe besteht darin, einen Elektroherd anzuschließen. In der Wohnung Ihres Kunden finden Sie einen alten E-Herd, der wie im Bild dargestellt noch angeschlossen ist.

How dangerous is an electric shock?

Electricity can kill: most deaths result from a current entering the body and passing through the chest or the head. In all cases, the voltage (V) is less important than the strength of the current (A – amperage) and the duration (how long it flows through the body).

An electric shock of 1 mA isn’t dangerous or painful to most people. You may feel a slight ‘tingle’, if anything. A 5 mA shock is unpleasant, but not usually dangerous.

With slightly higher currents, there is a danger that your muscles will ‘freeze’ and you won’t be able to let go of the electricity source. This reaction greatly increases the duration of the shock and happens somewhere between 6 mA and 30 mA. Most adults can still let go at 15 mA AC (or 70 mA DC), and this value is known as the ‘let go’ or ‘freezing’ current. Higher currents than this are extremely painful and may cause death.

Currents of 1–4 amps disturb the rhythm of your heartbeat, causing ventricular fibrillation (uncoordinated heart function). Nerve damage is also likely. A shock of this strength may even stop your heart (cardiac arrest) and cause death.

A current of over 10 amps causes serious internal and external burns and will almost certainly cause death by cardiac arrest.

### Understanding a technical text

Read the safety information above, then copy and complete the table.

<table>
<thead>
<tr>
<th>Strength of AC current</th>
<th>Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1 mA</td>
<td>k</td>
</tr>
<tr>
<td>2 5 mA</td>
<td></td>
</tr>
<tr>
<td>3 6–30 mA</td>
<td></td>
</tr>
<tr>
<td>4 50–150 mA</td>
<td></td>
</tr>
<tr>
<td>5 1.0–4 A</td>
<td></td>
</tr>
<tr>
<td>6 &gt;10 A</td>
<td></td>
</tr>
</tbody>
</table>

- **a** cardiac arrest possible
- **b** cardiac arrest likely
- **c** death likely
- **d** death possible
- **e** extreme pain
- **f** freezing of muscles
- **g** mild pain
- **h** strong pain
- **i** nerve damage
- **j** severe burns
- **k** tingling
- **l** ventricular fibrillation

### First aid

Explain what you should do if a colleague receives an electric shock.

**Example:** *Disconnect electricity source.*