Unit 202: Electrical principles and processes for building services engineering

Outcome 2

Components used in electrical installations

Electrical components

Incoming supply

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Suppliers fuse

↓

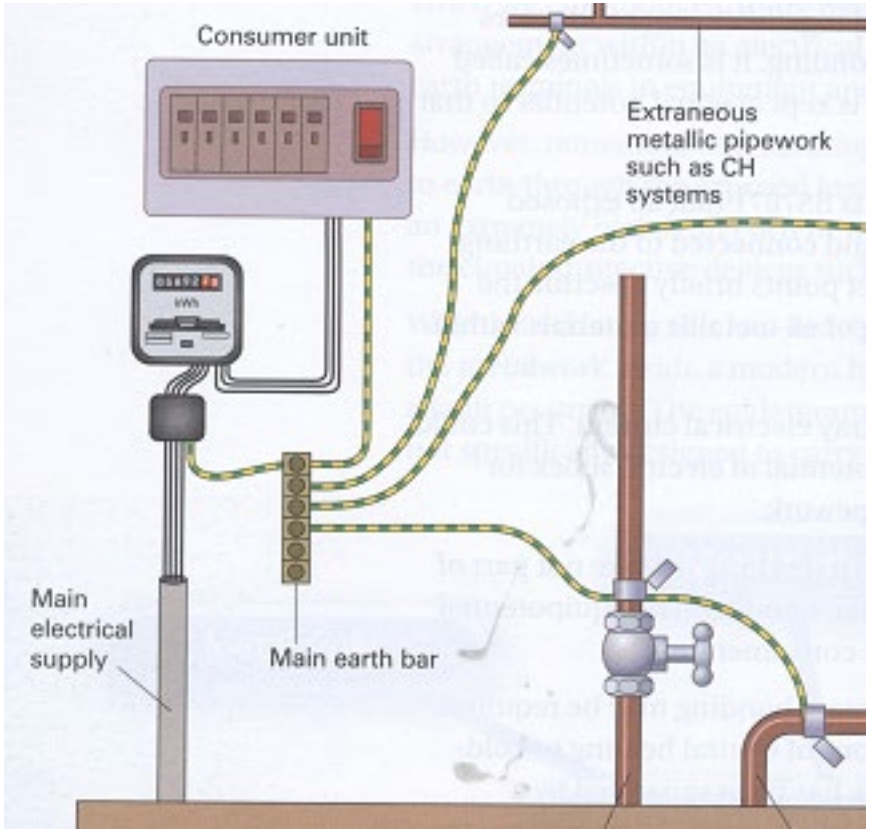
Meter

↓

Consumer unit

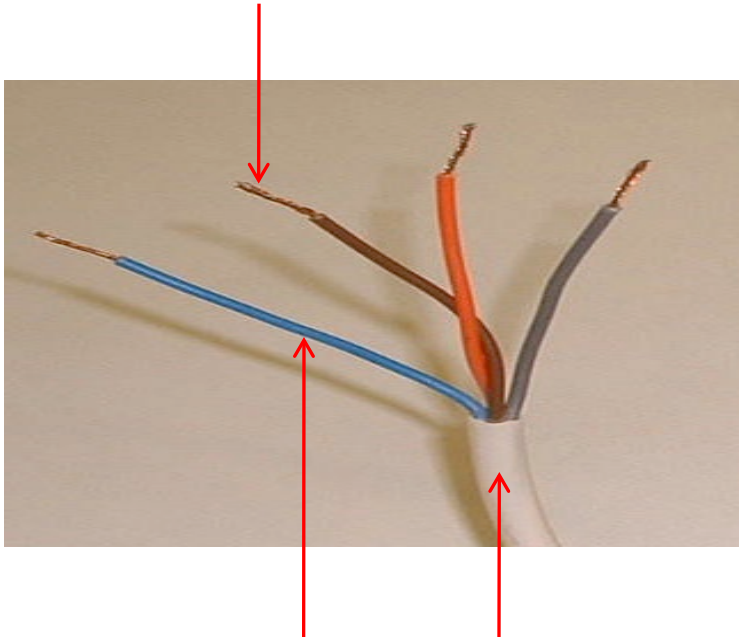
↓

Appliances/circuits



Electrical components

Conductors: copper, silver and aluminum are good conductors. These allow electricity to flow (electrons).



Insulators: rubber, plastic and glass are good insulators. These protect the consumer from electric shocks.

Electrical components

Typical Cable: used to hard-wire properties; generally unseen, as it is behind walls and under floors. Ring finals, lighting and radial circuits.

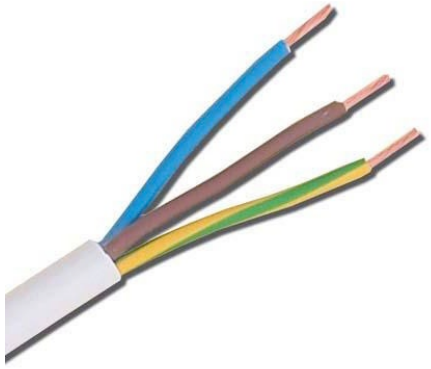
1.5mm twin and earth = lighting
2.5mm twin and earth = ring main
6mm twin and earth = smaller electric shower (7kW)
10mm twin and earth = larger electric showers (11kW)

Blue = neutral
Brown = live
Central core is earth, which needs sleeving for protection, in **green** and **yellow** (Circuit Protective Conductor CPC).

Electrical components

Typical flex: used for extension cables and leads for appliances above floor level.

Cable x	Watt	Appliance
0.5mm	700w	Lights
0.75mm	1400w	Central heating
1.0mm	2400w	Central heating
1.5mm	3600w	Kettle/immersion
2.5mm	4000w+	Commercial
4.0mm		Commercial



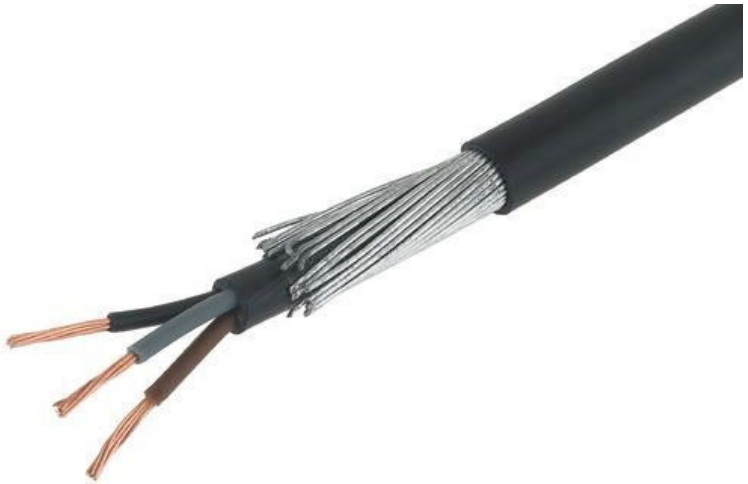
With flex, the earth is insulated. The correct selection of flex is important to prevent overheating (cross sectional area).

Electrical components

Armoured cable

This is not something that plumbers will generally come across. It is used on the incoming mains, or to supply an outhouse with power.

The metal **armour** offers additional mechanical protection where it may be vulnerable.



Electrical components

Twin and earth (CPC)

Cross section (mm)	Capacity amps	Domestic usage	Fuse amps
1.0mm	11A	Lighting	6-10
1.5mm	14A	Lighting	6-10
2.5mm	18A	Sockets	16-20
4.0mm	25A	Sockets	16-20
6.0mm	32A	Shower	30-32
10mm	43A	Cooker	45

Electrical components

If an incorrect, undersized cable is used for a circuit or an appliance this can have detrimental consequences:

- Cable can go brown
- Cable can go brittle and damage the insulation
- Cable can overheat and burn
- A fire can start.

Generally, the insulation is the first item that gets damaged – the very thing keeping people safe.

Electrical components

Heat resistant flex: used on heat producing appliances; kettles, irons and immersion heaters.

An immersion heater is usually rated at 2.5-3.0kW so the cable used would be 1.5mm butyl heat resistant flex.

This flex can be heated up to 85^0C without being damaged or going brittle.

Electrical components

An immersion heater is classified as a continuous load and, as such, should not be connected to the ring circuit, as the heater is usually 3kW (this would effectively deprive the main of half its potential capacity – 7.2kW).

It should be protected by a double pole isolator which should be fixed within 1.5m of the heater. The isolator should be 20 amp, with a flex outlet and neon indicator. With a 16 amp MCB at the consumer unit and 1.5mm butyl heat resistant cable.

It is a legal requirement to have a thermal cut-out (reset) device on the immersion .

Electrical components

Trunking

The main purposes of this are to:

- Protect flexes from damage
- Protect the customer from the flexes
- Support the flexes.

Electrical components

Conduit

The main purpose of this is to:

- Protect the flex from damage
- Protect the customer from flexes
- Support the flex.

Conduit can be surface mounted or chased into a wall and therefore hidden – be careful!

Electrical components

Voltage = V
It is the unit for electromotive force (emf): the higher the voltage the greater the force is, to cause electrons to flow along the conductor (eg 230v for domestic).

Current = I
The ampere is the unit of current, and can be defined as the unit of quantity or volume passing down a conductor (eg 3 amp fuse).

Resistance = R
The ohm is the unit of resistance, which opposes the flow of current.

Electrical components

Watts = W

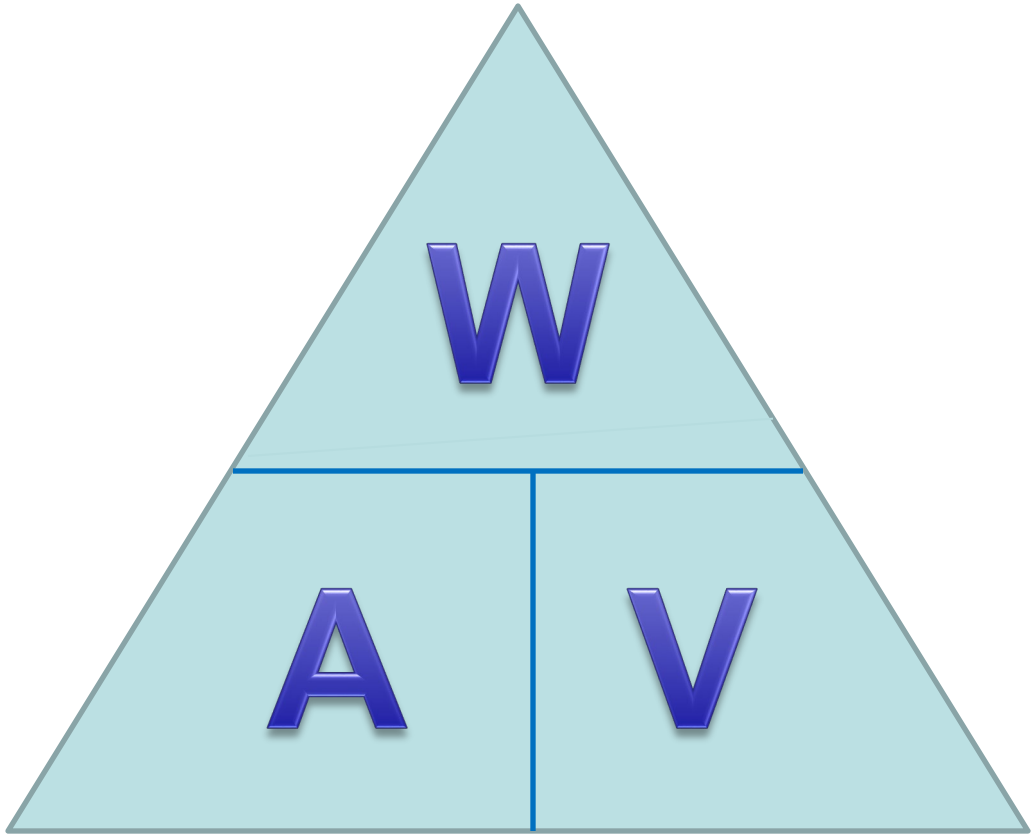
It is the unit of power for an appliance. Power is used in making an appliance work. As some power is absorbed, an appliance is never 100% efficient (eg 3kW immersion heater).

Joules = J

It is the unit of electrical energy. As this is so small it is not generally used; today it would be measured in the kilowatt hour (kWh), which is how electricity bills are measured.

Electrical components

The relationship between **watts** – **amps** – **volts**



Try and work out the following…

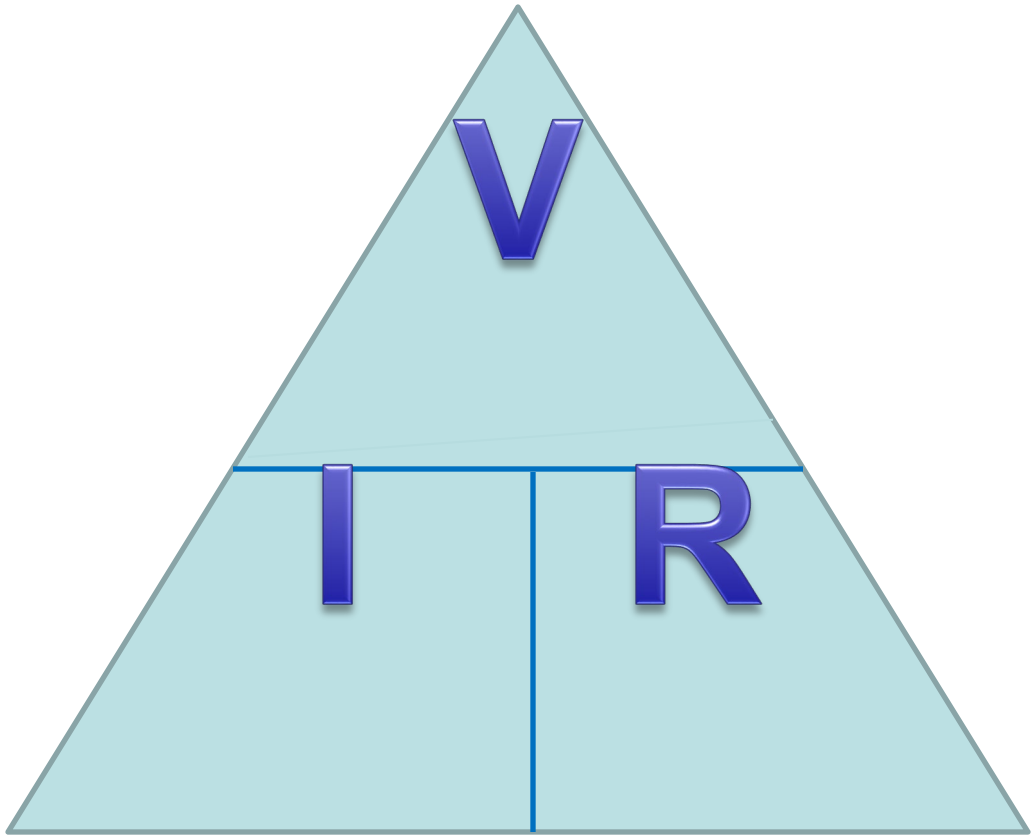
1. If an appliance needs 3kW in a domestic property, what is the fuse size?
   13amp

2. In a domestic property, an appliance has a fuse size of 3amp. What is the maximum power rating of the appliance?
   690w or 0.69kW

3. An appliance has a 5amp fuse and needs 1.25kW of power. What is the voltage required?
   230v

Electrical components

Ohm's Law, which shows the relationship between:
VOLTAGE – CURRENT – RESISTANCE



Try and work out the following…

1. What would be the resistance of a domestic appliance if the fuse size was 3 amp?
   76.7 ohms

2. What is the fuse size for a domestic appliance which has 1,200 ohms resistance?
   0.19 amp

3. If an appliance has a fuse rated at 13 amp, and the resistance is 31 ohms, what would the voltage be?
   400v

Electrical components

Domestic 3 pin plug

- Modern appliances come with a moulded plug for safety, which offers access to the fuse
- Re-wireable plugs are also available with cartridge fuses
- Maximum fuse size is 13 amp.

Electrical components

Domestic 3 pin plug

- When the cable enters the plug, make sure the insulation is fully inside the plug clamp. If the cable looks brown or is burnt at the point of entry to the plug, this may be the result of a loose wire inside the plug
- A loose wire in a plug can also cause an appliance to work intermittently
- Always tighten the screw-down terminals sufficiently.

Electrical components

Plug socket

These accept the domestic 3 pin plug. Any one socket can take up to 3kW, but not on a continuous load.

- Flush mounted
- Surface mounted
- Switched
- Un-switched
- Single socket
- Double socket

Electrical components

Single or one gang countersunk or flush mounted box

Single or one gang surface mounted back box, or pattress box

Double or two socket countersunk or flush mounted box

Double or two socket countersunk dry wall/plasterboard box

Electrical components

Switches

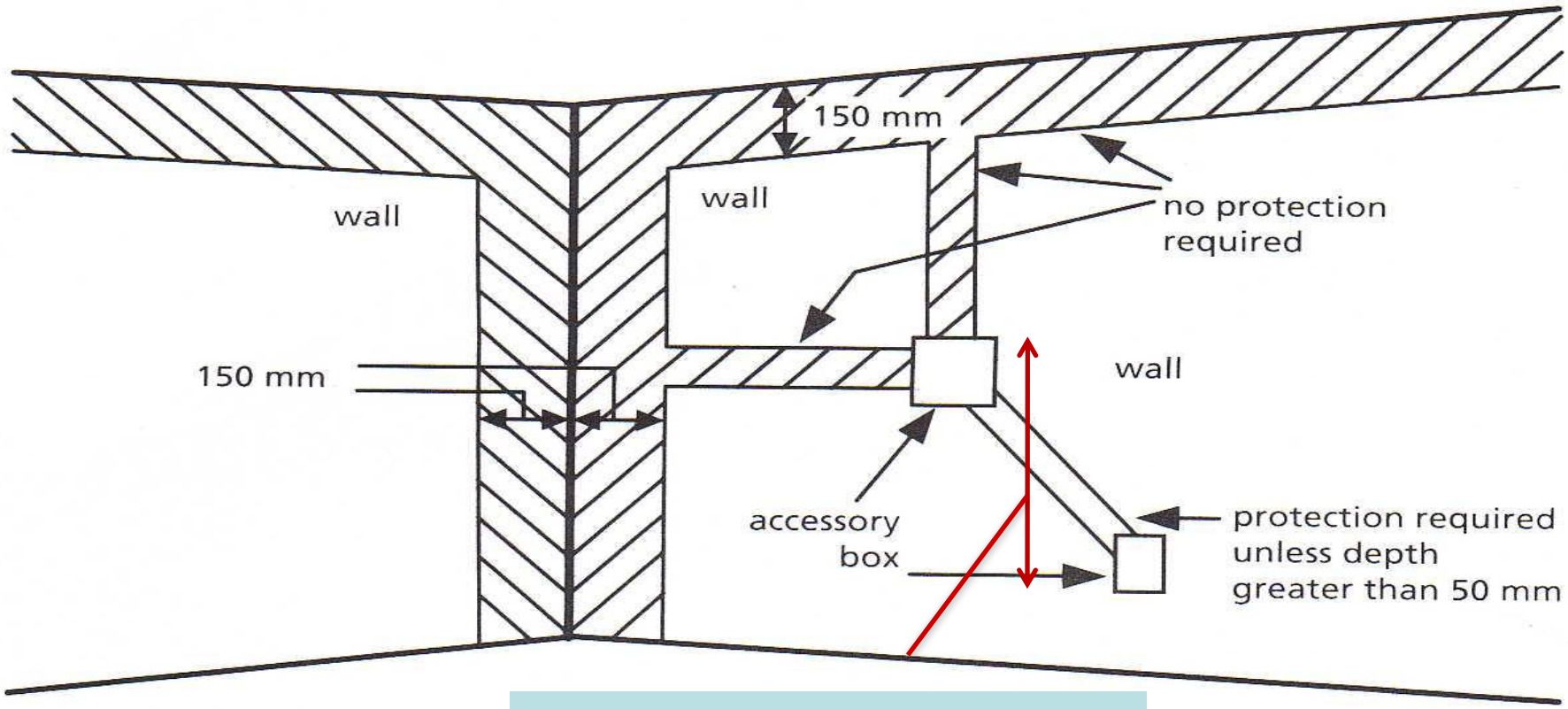
Two way switch: allows the live to be switched off in two different places (eg upstairs and downstairs).

One way switch: allows the live to be switched off in one place (eg for a single room).

- Flush mounted
- Surface mounted
- Single gang
- Multi gang

Electrical components

Switch and socket positioning



Height is between
450mm and 1,200mm

Electrical components

Fused spurs

- Flush mounted
- Surface mounted
- Switched
- Un-switched
- Luminated

Used to connect an appliance to the ring final, giving a point of isolation.

Electrical components

Double or triple pole isolator is used on a boiler connection after the fused spur for the system.

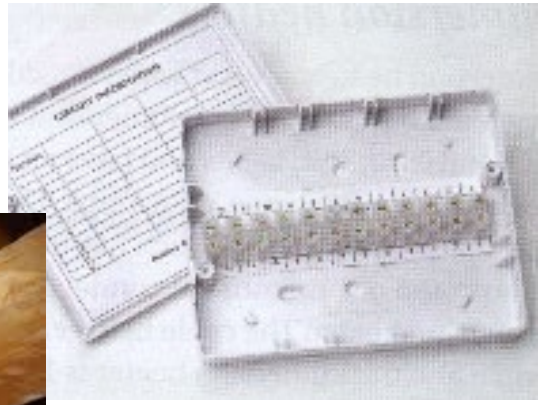
It is also required for an electric shower or immersion, but needs a neon light if remote (triple for boiler with overrun).

Electrical components

Junction box

This is used for flex connections in wiring circuits. No conductor must be visible.

On central heating systems a large junction box is used called a wiring centre.

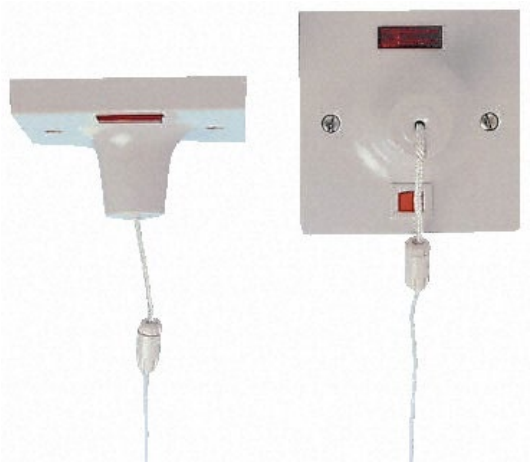


Electrical components

Pull cords

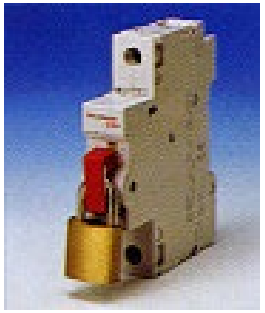
These are used in danger zones to switch off appliances, so wet fingers do not touch electrical switches.

- Lights in a bathroom – single pole isolator
- Isolator for electric shower – double pole isolator (these
- must be luminated and have a manual indicator).



Electrical components

Isolators



These need to be able to be locked off and labelled.

- Main consumer unit isolator
- Each MCB
  fused spur

The on-off switches on an appliance are **not** isolators!

Electrical components

Isolators

If some major electrical fault is found, the circuit, or even the main isolator, may have to be locked off until an electrician can rectify the situation.

Electrical components

Electrical timers

The most common electrical timer a plumber will come across is a central heating programmer. These can be digital or mechanical. Another timer is the new programmable room thermostat.

SmartScreen.co.uk
Dedicated online support

Electrical components