B&W PRODUCTIONS · CREW TRAINING · MODULE 5

Event Power for Crew

Volts, amps and watts. Single-phase and three-phase. Commando plugs, distros and generators, and how to split a 63 A supply down to the socket a speaker plugs into without tripping anything or hurting anyone. South African supply: 230 V single-phase, 400 V three-phase, 50 Hz. Crew plug in; electricians wire in.

B&W Productions · Proper Planning, Prevents Poor Performance



01 Volts, amps and watts

Three numbers describe every supply and every piece of kit. If you can turn one into the others you can plan the power for any event with a calculator. Think of electricity as water in a pipe.

VOLTS (V)	AMPS (A)	WATTS (W)
Pressure in the pipe. How hard it pushes.	Flow through the pipe. How much is moving.	Work done. Pressure × flow. What the kit label says.
SA: 230 V / 400 V	What breakers measure	W = V × A

AMPS = WATTS ÷ VOLTS · 1 000 W ÷ 230 V = 4.3 A

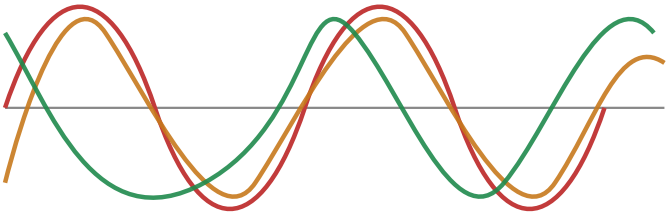
The voltage in South Africa is fixed by the supply. The watts are fixed by the kit. The only thing you ever calculate is amps, because amps are what trip breakers and melt cables.

- **Volts**: the push. 230 V between a live and neutral in South Africa (the old "220 V" figure was changed to 230 V in the national standard in the 2000s; your kit does not care). 400 V between any two lives on a three-phase supply.
- **Amps**: the flow. A 16 A breaker lets 16 A through, then trips. Everything on that circuit shares those 16 A.
- **Watts**: the work. A 1 000 W light at 230 V pulls 4.3 A. A 2 000 W tea urn pulls 8.7 A. Two urns on one 16 A circuit is already 17.4 A: trip.
- **kW and kVA**: 1 kW = 1 000 W. Generators are rated in kVA; multiply by 0.8 to get the real kW you can use (Lesson 7).

> **THE ONLY SUM YOU NEED**
>
> Amps = Watts ÷ 230. Add up the watts on a cable, divide by 230, and compare with the breaker. Stay under 80% of the breaker (12.8 A on a 16 A, 25.6 A on a 32 A, 50 A on a 63 A).

02 Single-phase and three-phase

Mains power is alternating current (AC): it swings positive and negative 50 times a second (50 Hz). A single-phase supply is one of those swings on one live wire. A three-phase supply is three swings on three live wires, each a third of a cycle behind the last. Big kit and big sites use three-phase because it carries three times the power on cables that are not three times the size.



L1 L2 L3

Each phase peaks a third of a cycle (120°) after the last. Together they never all drop to zero at once.

THE FIVE WIRES (5-PIN RED PLUG)

- **L1 · brown · live 1**
- **L2 · black · live 2**
- **L3 · grey · live 3**
- **N · blue · neutral**
- **E · green/yellow · earth**

Any live to neutral: 230 V (single-phase).
Any live to another live: 400 V.
Single-phase kit only ever sees one live + N + E.

A three-phase supply is three single-phase supplies sharing one neutral. Your sound, lights and bar fridges are all single-phase kit. The distro's job is to hand each of them one phase and keep the three phases evenly loaded.

What this means on site

- The generator and the venue's big outlet are **three-phase** (red plug, 5 pins).
- Almost everything you plug in is **single-phase** (blue Commando or ordinary 3-pin).
- Between the two sits a **distro**, which splits three-phase into single-phase outlets. That is Lesson 4.
- You never touch what is inside a plug, a distro or a board. If a lead has bare wire or a loose pin, it is out of service, tagged, and goes to an electrician.

03 Plugs and sockets you will meet



SA 16 A, 3 round pins, 230 V



CEE 16 A blue, 3-pin, 230 V



CEE 32 A blue, 3-pin, 230 V



CEE 32 A red, 5-pin, 400 V



CEE 63 A red, 5-pin, 400 V

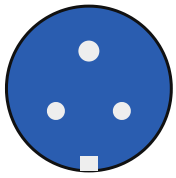


powerCON, 230 V kit link

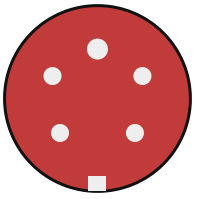
Colour tells you the voltage, pin count tells you the phases, size tells you the amps. If it does not fit, it is not allowed to fit.

South African event power uses two families: the ordinary 3-pin round plug for the last metre, and the industrial CEE "Commando" plugs for everything upstream. Colour tells you the voltage. Size tells you the current. Pin count tells you single or three-phase. You can only plug a connector into its own matching socket, which is the point: the system protects you from the common mistakes.

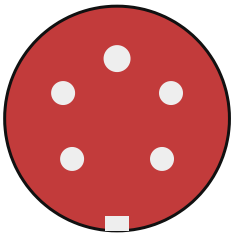
CONNECTOR	COLOUR	PINS	RATING	MAX POWER AT 80%	WHERE YOU SEE IT
SA 3-pin round (SANS 164-1) and the newer ZA plug (164-2)	white/black	3	16 A	2.9 kW	The last extension lead to a speaker, light bar, laptop, urn
16 A Commando	blue	3	16 A	2.9 kW	Distro outlets, lighting bars, powered speakers with a Commando inlet
32 A Commando single-phase	blue	3	32 A	5.9 kW	Feeding a single-phase distro, a catering line, a big LED wall processor
32 A Commando three-phase	red	5	32 A per phase	17.7 kW	Feeding a 32 A distro from the 63 A distro
63 A Commando three-phase	red	5	63 A per phase	34.8 kW	Generator outlet, venue main outlet, into the 63 A distro
125 A Commando three-phase	red	5	125 A per phase	69 kW	Big stages, LED walls, festival mains. Electrician territory.



16 A · BLUE · 3 PIN
230 V single-phase



32 A · RED · 5 PIN
400 V three-phase



63 A · RED · 5 PIN · BIGGER

Blue means 230 V. Red means 400 V. A 32 A plug does not fit a 63 A socket, so "it fits" means "it is allowed". Never force, adapt or file a plug.

ADAPTORS

A 16 A Commando to 3-pin adaptor is fine. A "3-pin to 32 A" adaptor is a death trap: it lets a 3-pin lead carry 32 A, which it cannot. If an adaptor goes from a small plug to a bigger socket, it is wrong.

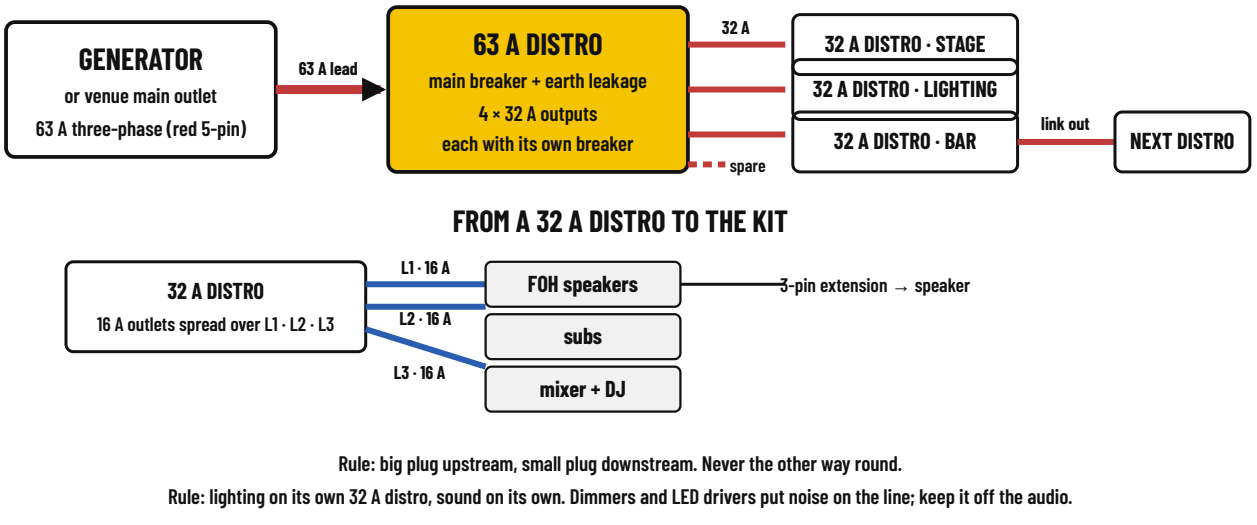
In the B&W kit: 63 A and 32 A five-core trailing leads, 16 A blue Commando extensions, and standard 3-pin extension leads for the last metre.

04 The distro chain



A 63 A distro: red 5-pin in, blue 32 A outlets out, each behind its own breaker. Crew plug in here. Anything that gets wired in is the electrician's.

A distro (distribution box) takes one big supply in and gives you several smaller, protected supplies out. Every outlet has its own breaker, so one overloaded speaker trips one outlet, not the whole event. On site, the chain always runs big to small.



Generator → 63 A distro → 32 A distros → 16 A outlets → kit. Each step down has a breaker. The 32 A distros have a link-out so you can daisy-chain to the next one across the site, but every box you add on a chain shares the same 32 A.

In the B&W kit: 63 A three-phase distros with four 32 A outputs, and 32 A distros with an in and a link-out that chain to the next distro.

Setting up the chain

1. Every breaker on every distro **off**. Earth leakage units reset.
2. Run the 63 A lead from the generator (or venue outlet) to the 63 A distro. Lay it where nobody walks or drives; ramp it where they must.
3. Run 32 A leads from the 63 A distro to each 32 A distro. One per area: stage, lighting, bar, catering. Keep the leads short; long runs lose voltage.
4. Run 16 A Commando or 3-pin extensions from the 32 A distros to the kit. One lead per speaker stack where you can. No daisy-chained extension leads on sound.
5. Walk the whole chain once with nothing on. Check every plug is fully home and every lead is off the ground where it crosses water.
6. Power up from the source outwards: generator → 63 A main → 63 A outputs → each 32 A distro main → its outlets → kit, one area at a time. Listen for the earth leakage. If it trips, the fault is on whatever you just switched on.

> **THE LINK-OUT IS NOT FREE POWER**
> A 32 A distro's link-out passes the same 32 A on to the next box. Three distros on one chain still share 32 A total. Chain for distance, not for capacity.

05 Load and phase balance



Generator away from the guests, exhaust pointing downwind, extinguisher next to it. Warm up with nothing plugged in; shut down the same way.

Two sums before every event: does each cable stay under 80% of its breaker, and are the three phases carrying roughly the same load? An unbalanced three-phase supply trips one phase early while the other two sit idle, and it makes a generator run badly.

TRY IT: LOAD THE DISTRO

ITEM	WATTS EACH	QTY
Powered top (12")	500	
Powered sub	800	
Mixer + DJ + laptops	300	
LED PAR can	150	
Moving head	350	
Slush machine	800	
Tea urn / kettle	2000	
Bar fridge	300	

Heaters here total 2800 W (12,2 A). Put them on their own phase and outlets; a 16 A outlet carries one urn and not much else.

LOAD	AMPS AT 230 V	FITS 16 A (80%)?	FITS 32 A PER PHASE?
1 000 W	4.3	Yes	Yes
3 000 W	13.0	No (12.8 max)	Yes
6 000 W	26.1	No	Yes, as one phase (25.6 max) only if split
18 000 W	78.3	No	Yes, 26 A per phase when balanced

Worked example: 2 tops, 2 subs, mixer, 8 PARs, 4 moving heads, slush, urn, 2 fridges = 9 300 W = 40.4 A total = 13.5 A per phase on a 32 A distro. Fine, as long as it is actually spread over three phases and the urn is not sharing a 16 A outlet with the subs.

How to balance

- A 32 A distro's 16 A outlets are already split across L1, L2 and L3 (the label on each outlet, or the layout, tells you which). Spread your heavy items across all three.
- Put the heaters (urns, slush machines, heat lamps) on their own outlets and their own phase. They are the biggest single loads at a corporate event.
- Sound on one phase, lighting on another, catering on the third is a good default for a small event with one 32 A distro.
- Write it down. A taped label on each outlet ("L2 · subs") saves the next person guessing.

06 Breakers, earth leakage and leads

Everything between the source and the kit exists to break the circuit before a person or a cable gets hurt. Learn what each device does so you know what it means when one trips.

MCB (BREAKER)

Trips on **too much current**: an overload or a dead short. If it trips, you have too much plugged in or a damaged lead. Unplug, find it, reset once. If it trips again, stop and call it in.

EARTH LEAKAGE (RCD/ELU)

Trips when current **leaks to earth**, which is usually through a person or water. 30 mA in milliseconds. Nuisance trips come from wet leads, cracked plugs, and a long chain of LED fixtures each leaking a little. It is never bypassed. Ever.

MAIN BREAKER

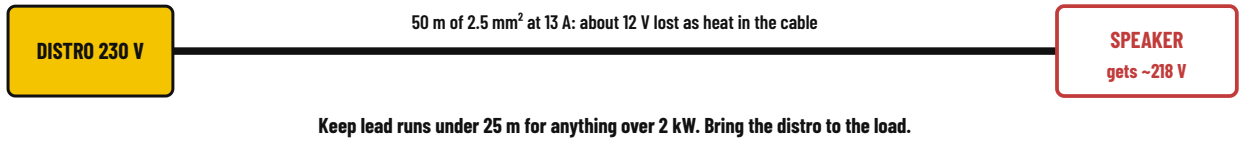
The big switch on the distro. Off before you plug in, on last. It is also your emergency stop for that whole area.

CABLE RATING

A lead is rated for the plug on its end, if it is the right cable. 2.5 mm^2 for 16 A, 6 mm^2 for 32 A, 16 mm^2 for 63 A. A thin "household" extension on a 16 A Commando is a fire.

Extension leads: the three rules

1. **Unroll cable drums fully.** A coiled drum carrying load is a heater. The rating on the drum halves when it is wound.
2. **One lead, one job.** No lead into a lead into a multiplug. Every join is a weak point, a trip hazard and a place water gets in.
3. **Short runs for big loads.** Voltage drops along a cable. 50 m of 2.5 mm^2 lead feeding a 3 kW load loses enough voltage that amplifiers clip early and heaters run cold. Move the distro closer instead of running the lead longer.



Keep lead runs under 25 m for anything over 2 kW. Bring the distro to the load.

Volt drop is invisible until an amp starts clipping or a breaker trips "for no reason". The fix is a shorter lead or a thicker one, never a bigger breaker.

07 Generators

When there is no mains, or the venue's supply is too small, the generator is your power station. Treat it as the most important piece of kit on site: if it stops, everything stops.

In the B&W kit: a 32 kVA three-phase diesel generator with a 63 A five-pin outlet.

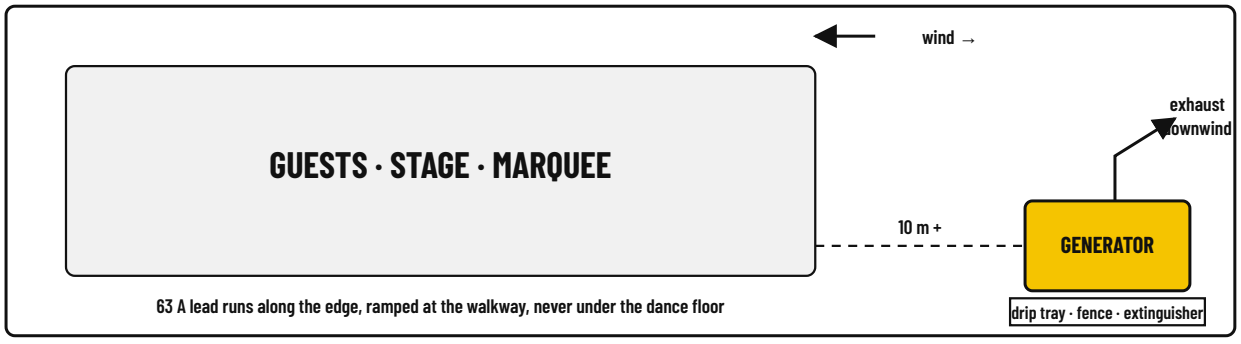
kVA, kW and headroom

- Generators are rated in **kVA**. Multiply by 0.8 to get usable **kW**: a 32 kVA set gives about 25 kW. A 20 kVA set gives 16 kW.
- Never run a generator flat out. Plan for **70% load**: 32 kVA → about 18 kW of kit. 20 kVA → about 11 kW.
- Motors and amplifiers pull a surge when they start. Switch kit on in stages, biggest first, with a few seconds between.
- Too little load is also bad for a diesel. Under 30% load for hours glazes the engine. If the event is tiny, hire a smaller set.

GENERATOR	USABLE (KW)	PLAN FOR (70%)	ROUGH DIESEL USE AT THAT LOAD	WHAT IT RUNS
20 kVA	16	11 kW	~3 to 4 L/h	Small PA, 16 LED pars, a bar, one urn
32 kVA	25	18 kW	~5 to 6 L/h	Full small-event rig: PA with subs, lighting, catering, slush, fridges
60 kVA	48	34 kW	~9 to 11 L/h	Stage with moving heads, LED wall, catering kitchen

Fuel figures are planning estimates. Check the set's own plate and fill before every event; an 8-hour corporate day on a 32 kVA set is roughly 40 to 50 litres.

Placing the generator



Far enough that guests do not hear it or breathe it, close enough that the 63 A lead stays short. Level ground, a drip tray, a fire extinguisher, and nobody parks against it.

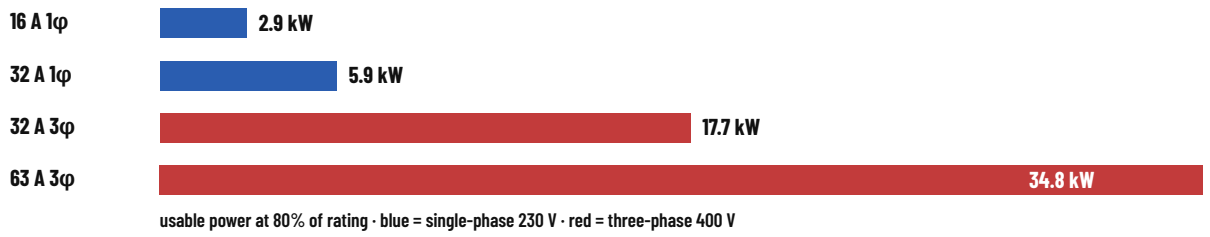
Start-up and shutdown

1. Fuel, oil and coolant checked. Earth spike connected (the hire company or electrician does this; you confirm it is there).
2. Main output breaker **off**. Start the engine. Let it run 3 to 5 minutes with no load.
3. Main breaker on. Then the 63 A distro, then each 32 A distro, then kit, one area at a time.
4. Shutdown in reverse: kit off, distros off, main breaker off, let the engine run 2 to 3 minutes unloaded, then stop it. Never stop a diesel under load.
5. Refuel only with the engine off and cool. Log the hours.

08 63 A vs 32 A vs 16 A: what goes where

The number on the plug is the most current that cable and socket may carry. Here is the same rule from the other direction: how much kit each supply can feed, and which supply each job needs.

SUPPLY	MAX AT 80%	FEEDS	TYPICAL JOB
16 A single-phase	2.9 kW	One speaker stack, or 10 LED pars, or one urn	The last lead to a piece of kit
32 A single-phase	5.9 kW	A small PA with subs, or a catering line	One area from a single-phase source
32 A three-phase	17.7 kW	A whole small event: PA, lights, bar, catering	One 32 A distro per area of the site
63 A three-phase	34.8 kW	Four 32 A distros, or a stage with moving heads and an LED wall	The main feed from generator or venue



Three-phase triples what a plug of the same amp rating can feed. That is why the site feed is red and the kit feed is blue.

VENUE POWER CHECK, BEFORE YOU QUOTE

Ask the venue: "What is the biggest outlet near the stage and is it three-phase?" A 16 A wall socket runs a speech system. A 32 A single-phase runs a small party. Anything with subs, moving heads and catering wants a 32 A three-phase or a generator.

09 Safety, and where crew stop

Event power kills people every year, almost always through water, damaged leads or someone opening something they should not. The rules are short because they have to be followed every time.

> **THE LINE**
> Crew plug in. Crew never wire in. Tails, distribution boards, generator earth spikes, anything with a screwdriver: a registered electrician does it and signs for it. If a plug, lead or distro is damaged, it is tagged "OUT OF SERVICE" and goes back to the warehouse.

Every event

- Visual check of every lead as you run it: cuts, crushed sections, bent pins, loose cable glands. Damaged means tagged and out.
- All plugs fully home. A half-inserted Commando plug arcs and melts.
- Leads off wet ground. Crossings ramped or flown. Nothing under a vehicle route.
- Distros off the floor on a stand or case, lids closed, out of the rain, never inside a tent wall where a guest leans.
- Water and power do not meet: no distro near the bar sink, the ice bath or the sprinkler. Outdoor gear is rated IP44 or better, or it is under cover.
- Know where the main breaker and the generator stop button are. Everyone on crew knows. Tell the venue manager.
- Earplugs, gloves for hot lamps, no jewellery on hands when handling leads.

Fast fault-finding

SYMPTOM	CHECK FIRST	THEN
Earth leakage trips at switch-on	Which outlet did you just switch on? Unplug it, reset, try the rest	Wet plug or lead on that outlet; swap the lead, then the kit
MCB trips when the music gets loud	Too many amps on one 16 A outlet	Move the subs to their own outlet on another phase
Trips at 15:00 when catering starts	Urns and heaters added to a loaded phase	Catering on its own 32 A distro
Speakers clip early, lights dim when the urn boils	Volt drop on a long lead or an overloaded generator	Shorter lead, distro closer, check generator load %
Hum in the sound	Sound and lighting sharing a phase or a distro	Separate distros; ground-lift the DI
Generator hunting or stalling	Load too high, or switched on all at once	Shed load, restart in stages, check fuel
Plug warm to touch	Loose pin, not fully home, or a lead rated too small	Switch off, swap the lead, tag the warm one

Before you leave the warehouse

- Count: 63 A leads, 32 A leads, 16 A extensions, 3-pin extensions, distros, ramps, gaffer, earth spike and hammer (generator jobs), tags and marker
- Test every distro: main on, earth leakage test button, every outlet live
- Generator: fuel full, hours logged, extinguisher and drip tray on the truck
- Spares: one of every lead type

10 Check what you learnt

Ten questions. Circle one answer for each. The answer key is on the last page. Pass mark: 8 out of 10.

1. A 2 000 W tea urn on a 230 V supply draws roughly how many amps?

- ○ **A** 2 A
- ○ **B** 4.3 A
- ○ **C** 8.7 A
- ○ **D** 17 A

2. What is the voltage between any two live wires on a South African three-phase supply?

- ○ **A** 110 V
- ○ **B** 230 V
- ○ **C** 400 V
- ○ **D** 690 V

3. A red five-pin Commando plug tells you the supply is…

- ○ **A** 230 V single-phase
- ○ **B** 400 V three-phase
- ○ **C** 12 V DC
- ○ **D** Low voltage lighting

4. Which adaptor is never allowed?

- ○ **A** 16 A Commando to 3-pin
- ○ **B** 3-pin to 16 A Commando socket (small plug, bigger socket)
- ○ **C** 63 A to 32 A distro feed
- ○ **D** Any of them, if the electrician says so

5. **Three 32 A distros are daisy-chained through their link-outs. How much current do they share in total?**

- ○ **A** 32 A
- ○ **B** 64 A
- ○ **C** 96 A
- ○ **D** It depends on the breakers

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6. **Correct power-up order on site?**

- ○ **A** Kit on, then distros, then generator
- ○ **B** Everything at once from the main breaker
- ○ **C** Generator → 63 A distro → 32 A distros → kit, one area at a time
- ○ **D** 32 A distros first so you can test them

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7. **A 32 kVA generator should be planned to run about how much kit?**

- ○ **A** 32 kW
- ○ **B** 25 kW
- ○ **C** 18 kW
- ○ **D** 10 kW

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8. **The earth leakage unit trips the moment you switch on the bar distro. First move?**

- ○ **A** Bypass the earth leakage so the bar can open
- ○ **B** Switch that distro off, unplug its outlets, reset, and add them back one at a time
- ○ **C** Reset it and ignore it if it holds
- ○ **D** Move the bar onto the stage distro

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9. **Why must a cable drum be fully unrolled before it carries a load?**

- ○ **A** So it reaches further
- ○ **B** A coiled drum heats up; its rating halves when wound
- ○ **C** So the plug sits straight
- ○ **D** It doesn't matter for short events

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10. **A plug on a lead feels warm. What do you do?**

- ○ **A** Nothing, a bit of warmth is normal
- ○ **B** Wrap it in tape
- ○ **C** Switch off, swap the lead, tag the warm one out of service
- ○ **D** Push it in harder

Answer key

1. **C**. Amps = watts ÷ volts. 2 000 ÷ 230 = 8.7 A. Two urns on one 16 A outlet is already over the limit.
2. **C**. Live to neutral is 230 V. Live to live is 400 V. All your kit is 230 V single-phase; only the distro deals with 400 V.
3. **B**. Red = 400 V three-phase, five pins (L1 L2 L3 N E). Blue = 230 V single-phase, three pins.
4. **B**. An adaptor from a small plug to a bigger socket lets a thin lead carry more current than it can. The plug system is designed to stop this; don't defeat it.
5. **A**. The link-out passes the same 32 A along. Chain for distance, not capacity.
6. **C**. Source outwards, one area at a time. Then if the earth leakage trips you know which thing caused it.
7. **C**. 32 kVA × 0.8 = 25 kW usable, and you plan for 70% of that: about 18 kW. Never run a generator flat out.
8. **B**. The fault is on whatever you just switched on. Isolate it outlet by outlet. The earth leakage is never bypassed.
9. **B**. Current in a coiled cable makes heat that can't escape. Drums have a lower rating wound than unwound for this reason.
10. **C**. Warm means a loose pin, a half-inserted plug or an undersized lead. Swap it and tag it. Crew don't open plugs; electricians do.

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