Episode Book

EPISODE #5897

Why You Can't Buy an IEC 60309 Power Strip

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SYNOPSIS

Daniel terminated his first IEC 60309 connector — the blue 16A industrial plug known as commando, pin and sleeve, or CeeForm — and it worked. But two questions remain: what cable actually belongs on a 16A connector feeding a device that would run fine on a lamp cord, and why can't you buy a bench strip or PDU with these outlets? The cable answer is counterintuitive: you size the cable to the connector, not the appliance, because the circuit is defined by the plug and its breaker, not by whatever you happen to plug in. The market answer is stranger — the multi-outlet product Daniel went looking for doesn't appear to exist, and the reason is baked into what IEC 60309 was designed to do.

TRANSCRIPT



Corn

Alright. I have been thinking about a plug for two days, and I need to say that out loud before we start.



Herman

Which plug?



Corn

Daniel wired his first IEC 60309 connector. The blue one, two hundred and thirty volts, sixteen amps. He called it the nuclear option when he described it to an electrician friend, and the friend did not laugh, which tells you something.



Herman

Fair.



Corn

And it worked. He terminated it, plugged the thing in, and it ran. But two things are still bothering him. First, his air blower barely draws anything, and he wants to know what cable actually belongs on a sixteen amp connector feeding a device that would probably run off a lamp cord. Second, he wants a few of these outlets in his workshop, went looking for some off-the-shelf strip or PDU to make the job smaller, and found nothing. His words were that his search was basically in vain.



Herman

That's the real question, actually. The cable spec is arithmetic. The market gap is interesting.



Corn

So let's do the arithmetic first, and then get to the interesting part.



Herman

Right. And to answer either one we have to be clear about what this connector actually is, because Daniel is describing it as a plug and it is not really a plug in the domestic sense. IEC 60309 is the international standard for industrial plugs, sockets and couplers. Formerly IEC 309, and before that CEE 17. In the UK you'll hear commando. In North America, pin and sleeve. In the entertainment industry, CeeForm.



Corn

Three names for the same blue thing.



Herman

And one standard underneath all of them. The blue version specifically is P plus N plus E, single phase, two hundred to two hundred and fifty volts, sixteen amps, and the keying position is six h.



Corn

Six h.



Herman

The earth pin sits in one of twelve clock positions. Six h is the position that means two hundred to two hundred and fifty volts. Red is three eighty to four eighty. Yellow is a hundred to a hundred and thirty. Violet is twenty to twenty-five, which almost nobody sees. Black is five hundred to a thousand. The clock position is what makes it safe. A blue plug physically cannot enter a red socket. The pins won't line up.



Corn

So the colour coding isn't decoration, it's the mechanism.



Herman

The keying is the mechanism. The colour is a label for the keying. And that is why Daniel's electrician friend didn't laugh at the nuclear option crack. The whole system is built so that for each type of plug only one matching socket exists, and a dangerous mis-connection is impossible. It's not a beefier version of what he had before. It's a system whose entire point is that it will not connect to anything else.



Corn

Which, if you're tired of flaky connections on wired tools, is oddly appealing.



Herman

That's exactly the audience for it. And this is the connector that has almost completely replaced national domestic plugs on European campsites and marinas, precisely because it's pan-European and it's inherently IP44 safe. So the same blue plug that runs a caravan hookup runs a bench grinder.



Corn

Alright. Now the cable.



Herman

And this is the part Daniel already noticed by hand before he asked us about it, which I like. He said you have to expose more copper because the terminals are deeper. He's right, and the reason is physical.



Corn

Deeper how much?



Herman

The sixteen amp connector uses five millimetre line and neutral pins and a seven millimetre earth pin, and each of them is thirty-seven millimetres long. Compare that to a domestic plug, where you've got flat brass pins that are maybe seventeen millimetres and a few tenths of a millimetre thick. The thirty-two amp version steps up again, six and eight millimetre pins at forty-five millimetres.



Corn

Thirty-seven millimetres of pin. That's not a connection, that's a commitment.



Herman

And the male plug has a circular shroud around those pins that fits into a matching recess on the socket, plus an alignment key that mates with a slot. That shroud is why the housing is bulky. It's why the terminals sit recessed behind it. You're not poking a wire at a screw you can see from above, you're reaching into a tube.



Corn

And the strain relief.



Herman

The strain relief is built for a substantial round cable, because that's what gets used in a workshop. The standard industrial flexible cable is H07RN-F. Harmonised rubber, rated four fifty seven fifty, class five flexible stranded copper, EPR insulation, PCP sheath. Oil resistant, flame retardant to the 60332-1-2 test. It's specified for medium to severe mechanical stress. That last part is the whole reason the connector exists.



Corn

What's the outer diameter on the two point five?



Herman

H07RN-F 3G2.5 tops out at fourteen millimetres overall diameter. Domestic flat twin and earth is eight to ten. So the gland is sized for something roughly half again as thick as what Daniel's used to stripping.



Corn

So his hands already told him what the spec sheet says.



Herman

His hands told him the terminals are deep and the gland is big. The spec sheet tells him which cable. And for H07RN-F, single phase AC, the current capacity is straightforward. One square millimetre carries ten amps. One point five carries sixteen. Two point five carries twenty-five.



Corn

So on a sixteen amp connector, one point five is the floor.



Herman

Two point five gives you headroom, and I would take the headroom, for reasons we'll get to.



Corn

Now here's where his question gets sharp, because his air blower is not a sixteen amp device. It's nowhere near it.



Herman

It isn't. And that's the counterintuitive part, and it's the part that trips people up, and honestly it's the bit that trips people up in exactly the direction you'd hope. Daniel is assuming he should size the cable to the appliance. You size the cable to the connector.



Corn

Say that again, because that's the whole episode.



Herman

The circuit is defined by the connector and the protective device, not by what you happen to plug into it. If the connector is rated sixteen amps and the breaker behind it is a sixteen amp breaker, then the cable has to be able to carry sixteen amps safely, because that is the current the circuit is permitted to deliver if something goes wrong. The appliance is not a limiter. A stalled air blower is not a sixteen amp load, but a damaged one, or a shorted one, absolutely can pull that.



Corn

So you're not sizing for the blower. You're sizing for the worst case the plug will ever see.



Herman

Which is the entire logic of industrial wiring. It's the opposite of domestic practice, where the appliance dictates the flex. Your kettle comes with a flex rated for the kettle because the kettle is the only thing that flex will ever feed. A commando plug is a general purpose connection. It doesn't know what's coming.



Corn

And there's a thermal piece to this too. The cable isn't just a hose, it's got to shed heat.



Herman

It does, and that's where the de-rating comes in. The current ratings assume a reference ambient. Run that cable at forty degrees and the one point five drops to about eighty-two percent of sixteen. At forty-five degrees, seventy-one percent. A workshop in a bad summer, or a cable coiled on a reel, or a cable run through insulation, and your one point five is no longer a sixteen amp cable.



Corn

And voltage drop.



Herman

One point five is thirty-two millivolts per amp per metre. Two point five is nineteen. On a short bench lead, irrelevant. On a twenty metre run out to a machine at the back of a garage, it starts to matter, especially on a motor, because motors are unhappy about undervoltage.



Corn

And bending radius?



Herman

Fixed installation, four times the overall diameter. Flexed, six times. On a fourteen millimetre cable, that's eighty-four millimetres minimum bend. Which is worth knowing before you decide to coil it tightly around a hook.



Corn

So if Daniel's ordering cable, what's the answer in one line.



Herman

H07RN-F, three core, one point five minimum, two point five if he wants to stop thinking about it. Which for a blower is comical, and which is exactly right.



Corn

Two point five rubber cable on a device that moves air.



Herman

It's over-engineered on purpose. The over-engineering is the feature. You're buying the ability to plug anything into that lead later without re-terminating it, and you're buying a cable that can survive being dragged across a workshop floor, which is what actually kills cables, not current.



Corn

Right. Because the failure mode on a bench lead isn't the copper cooking. It's the sheath getting chewed.



Herman

It's always the sheath. That's why H07RN-F is specified for mechanical stress and not just current. The rubber outer sheath takes abrasion, oil, water, sunlight, and it stays flexible in cold. PVC goes stiff and cracks. That's the difference you're paying for.



Corn

Herman, quick one. You said his Dremel might be one of the tools he terminates. Is there anything different about a tool that's already got a moulded plug on it?



Herman

Mostly psychological, but it matters. Once you cut the moulded plug off, you've taken on the responsibility for that termination forever. And the tool's own flex is often thinner than what the connector wants, so you're either re-cabling the whole tool or you're putting a small cable into a big gland, and that's the thing you don't want to do.



Corn

Why not?



Herman

Because a gland that's sized for fourteen millimetres, with an eight millimetre cable inside it, doesn't grip. And a cable that isn't gripped gets its conductors loaded at the terminals every time someone yanks it. That's how you get a loose line conductor inside a plug that still looks fine from the outside.



Corn

Noted.



Herman

So the cable spec answers the first question, cleanly. The second one is where the story gets stranger.



Corn

The market gap.



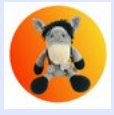
Herman

Daniel went looking for industrial plug PDUs and industrial plug strips. What he found was the beefy weatherproof single outlets he already had, and nothing else. And I want to confirm that for him, because it's a real finding and not a search failure.



Corn

You looked.



Herman

There is no consumer-grade or workshop-grade IEC 60309 multi-outlet strip or bench PDU that I can find. The category does not appear to exist. What exists instead is three things, and none of them is what he wants.



Corn

Go.



Herman

One, single weatherproof outlets, which is what he found. Two, construction-site power splitters. Those are the industrial answer to distribution, and they run the other way round. A red three-phase inlet at sixteen, thirty-two or sixty-three amps, feeding groups of single-phase outputs, each with its own circuit breaker, so you can balance loads across phases on a site or at a festival. That's a distribution board in a plastic box. It's not a bench strip.



Corn

And three?



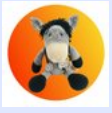
Herman

Three, rack-mount PDUs in data centres, which do have IEC 60309 inputs, and every single one of them outputs IEC 60320, the little C13 and C19 connectors. There's a Schroff strip with a sixteen amp commando input and eighteen C13 outlets. There's a Panduit unit with twenty-four C13 and twelve C19. Tripp Lite does three-phase switched PDUs with a sixty-three amp red input. Those are all server rack products.



Corn

So the plug goes in one end, and the power comes out the far end in a completely different connector shape.



Herman

The industrial plug is used as the input because it's the reliable mains connection, and then everything downstream is data-centre connectors, because that's what servers use. Nobody is making the thing in the middle where all the outlets are also commando.



Corn

Why not?



Herman

Because the standard was never designed for that. IEC 60309 is a fixed-installation standard. The entire ecosystem assumes that if you need more than one outlet, you hard-wire a distribution board and install sockets. The plug is for the appliance end. The socket is for the wall. There is no assumption anywhere in that system that you'd want a row of them on a bench and plug a strip into a wall.



Corn

And that's the answer to his question. Not "nobody has got round to it". The design intent doesn't include it.



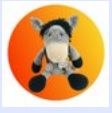
Herman

That's the honest version. And it's why he was right to notice it and slightly wrong to expect a product. He's looking for a consumer category inside an industrial standard, and the industrial world solved that problem forty years ago with a distribution board.



Corn

Which is more work, not less. He was hoping the market had done the work for him.



Herman

It hasn't. So what people actually do, and this is the practical answer, is individual surface-mounting socket enclosures on a dedicated radial circuit. You buy the surface-mounting version, which comes as one unit, back box and socket face together. You mount it at working height, a metre to a metre and a half. You anchor it properly, because a loose socket that gets yanked by a heavy cable will pull away from the wall, and a fourteen millimetre cable is not gentle when someone trips over it.



Corn

So the elegant solution he was hoping for is the inelegant solution done carefully.



Herman

It's a row of individual sockets on a dedicated circuit. That's it. That's the workshop answer.



Corn

What's the circuit?



Herman

A radial. Two point five square millimetre twin and earth on a sixteen amp circuit gets you roughly twenty-five metres. Go longer than that and you step up to four square millimetre to stay inside voltage drop limits. Radial, not ring, and that's worth a note because ring finals are a British and Irish peculiarity that the rest of the world finds baffling.



Corn

What's the sizing rule on a radial?



Herman

A twenty amp radial on two point five serves up to about fifty square metres. A thirty-two amp radial on four millimetres serves up to seventy-five. And radials are standard for commercial and industrial socket outlets anyway, and increasingly preferred over ring finals because there's no broken-ring failure hiding inside a wall where nobody can see it.



Corn

Which is a nice fit with the whole spirit of the connector.



Herman

It is. Radial is to ring what commando is to a domestic plug. Fewer sneaky pitfalls.



Corn

Termination details. What's actually inside the box?



Herman

Strip the outer sheath and leave eighty to a hundred millimetres inside the enclosure. Strip each conductor to terminal depth, about eight millimetres for screw terminals. Brown to line, blue to neutral, green and yellow to earth. And the protection is a sixteen amp, thirty milliamp RCBO in a spare way, because thirty milliamp additional protection is mandatory for socket outlets rated thirty-two amps and below, with no risk-assessment exception in a dwelling.



Corn

And the electrician question, because Daniel explicitly said he assumed this was a job for one and wanted to know why.



Herman

He's right, and the interesting part is why he's right. The socket termination is not hard. Stripping three cores and putting them in terminals is a beginner task. The reason it's a job for an electrician is the other end.



Corn

The consumer unit.



Herman

Adding a new circuit is notifiable work, and the piece that bites is that you're working live above the main switch, in a metal enclosure, at the point where the supply enters the building. That is where the experience matters, and that is where the obligation sits.



Corn

So the answer isn't "the socket is hard". The answer is "the socket is easy and the circuit is not".



Herman

That's the whole thing. If you've got a spare way and a qualified person to fill it, the socket end is something you could do yourself. The circuit is not.



Corn

There's something pleasing about that. The fancy industrial plug is the easy part and the boring grey box in the hall is where the danger lives.



Herman

Nobody is ever scared of the right thing. That's true of way more than wiring.



Corn

So to lay it out. Daniel's cable is H07RN-F, one point five or two point five, sized to the connector and not the blower. His outlets are individual surface-mount sockets on a radial, because the strip he was looking for doesn't exist and won't, because the standard was designed for the wall and not the bench.



Herman

That's the shape of it.



Corn

And the honest answer to "why can't I buy this" is "because the industry that invented it never wanted it".



Herman

Which is a better answer than a supply chain problem. It's a philosophy problem.



Corn

Let me give you the misconception and then we'll wrap. The one people walk in with.



Herman

Go on.



Corn

The one I'd guess most people hold is that the cable should be sized to the device. Because that's what every domestic appliance teaches you. And it's backwards here.



Herman

It's backwards because the plug isn't the last link in a chain, it's a standardised interface. You size for what the interface is rated for, not for what's currently hanging off it. Sixteen amp connector, sixteen amp cable, regardless of the blower.



Corn

So the blower draws two hundred watts and the cable could carry sixteen amps, and the gap between those two numbers is the safety margin, not a mistake.



Herman

It's the safety margin. And the same gap is what lets him unplug the blower and plug in something that actually needs it, ten years from now, without touching the cable again.



Corn

The plug has come out of the desk.



Hilbert

The gland is the thing that'll get him. Not the terminals.



Herman

Go on, Hilbert.



Hilbert

The problem isn't the copper-to-terminal connection at all. Anyone can strip eight millimetres and tighten a screw. It's the strain relief, because that's a mechanical interface and it'll punish the wrong cable. A gland sized for a fourteen millimetre cable with an eight millimetre rubber flex in it will not bite. The cable slips. And the first time someone yanks the lead, it pulls at the terminals, and within a month you've got a loose neutral in a plug that looks perfectly fine from the outside.



Corn

So the safety argument and the mechanical argument point the same direction.



Hilbert

The safety argument is the paperwork. The gland is the thing that'll actually do the damage. I've seen it chew a mains flex that was perfectly fine electrically. Right size for the tool. It got chewed in six weeks because the rubber was too thin for the grip. Cable had to be replaced end to end, and no inspector would ever have caught it, because from the outside nothing was wrong. I had exactly that on a one eighty watt bench grinder once, with two point five on it. Overkill. But the two point five is what the gland wanted, so the two point five is what it got.



Herman

Two point five on a hundred and eighty watt grinder.



Hilbert

The grinder's gone. Somebody offered me money for it, so it went. The lead stayed. It's coiled on a hook on the left side of the bench, and it's plugged into a socket that's connected to a circuit breaker somebody else put in.



Corn

The lead outlived the tool.



Hilbert

The lead outlives the tool. That's usually the case, if you terminate it properly.



Herman

Which is the whole episode, honestly.



Hilbert

It is.



Corn

There's your landing. The blower is temporary. The cable is the thing that stays, and the connector is the thing that makes the cable worth keeping. That's why he sizes for the plug. Not because the blower needs it, but because the blower is going to get replaced and the lead isn't.



Herman

It might be a while before anyone sells him a strip to plug it into.



Corn

Yeah. The gap's still there. Somebody could fill it. But the standard has been fixed since CEE 17, and the whole industry that uses it has decided it wants a board on a wall and not a strip on a bench.



Herman

I don't think it changes unless workshops change shape. If enough people start hanging serious tools off commando sockets, someone may make it. But for now the answer is a few surface-mounts and an electrician.



Corn

Which is an odd thing to say about a plug described as the nuclear option. The connection is overkill and the installation is domestic.



Herman

The strongest part is the part you can't buy. That's funny.



Corn

It is. Thanks as ever to Hilbert Flumingtop, our producer. If you enjoyed this one, try episode thirty-eight twenty-one, The Blue Plug That Runs the World; episode two, Local STT For AMD GPU Owners; and episode fifty-seven fifty-six, The Blue Plug That Out-Engineers Your House. This has been My Weird Prompts.



Herman

Send us your own prompt on Telegram at t dot me slash MWP listener bot. We'll be back soon.



Corn

See you tomorrow.

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