Section 2C

Illuminated Mining Cables to AS/NZS 2802

Self-Powered LED High-Visibility Reeling & Trailing Cable

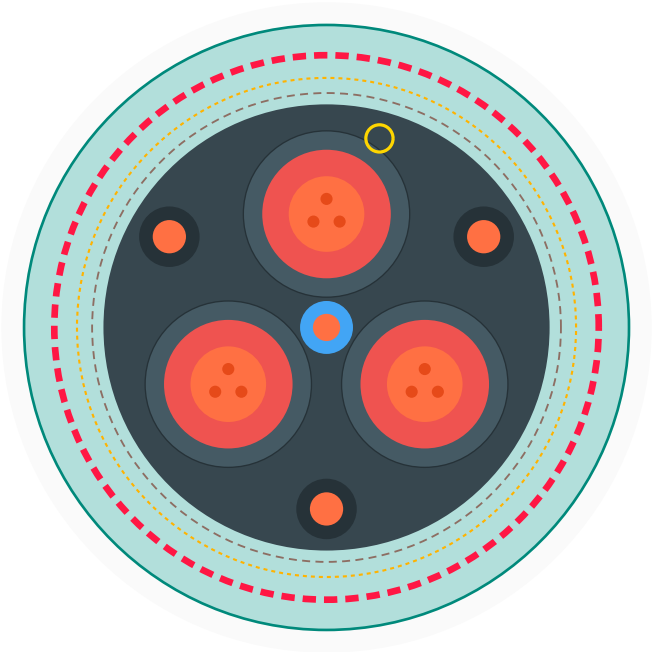
TYPE 455-LED

3.3 kV – 11 kV

SELF-POWERED LED VISIBILITY

A cable designed for slow reeling and trailing applications — stacker reclaimers, draglines, and similar mobile plant — optimised for lower weight and minimum diameter, featuring integrated self-powered LED illumination for enhanced operational visibility and personnel safety in underground and surface mining environments.

HIGHLY VISIBLE CABLE · SELF-POWERED LED · PLUG-AND-PLAY · NO INFRASTRUCTURE CHANGE · MINIMUM DIAMETER



- Translucent FR-TPU Heavy Duty Sheath
- Integrated LED Strip (Warning Red 620–630 nm)
- Aramid Stress-Relief Braid
- Open-Weave Textile Reinforcement
- Semi-Conductive PCP Filler
- Semi-Conductive Elastomer Insulation Screen
- EPR Insulation (Phase Cores)
- Tinned Copper Conductors (Class 5)
- Semi-Conductive Elastomer Covered Earths
- EPR Insulated Interstitial Pilot Core
- Induction Pickup Coil (All Variants)

Cable Construction (Inside → Out)

- **Conductors** — Annealed tinned copper, flexible Class 5 stranding per AS/NZS 1125.
- **Insulation** — EPR (Ethylene Propylene Rubber) per AS/NZS 2802, Cl. 2.4.
- **Core Screening** — Semi-conductive elastomer insulation screen over each phase core.
- **Earth Cores** — Semi-conductive elastomer covered interstitial earth conductors.
- **Pilot Core** — EPR insulated interstitial pilot conductor.
- **Filler** — Semi-conductive PCP filler.
- **Induction Pickup** — Helically wound pickup coil for EM energy harvesting (all voltage variants ≥ 3.3 kV).
- **LED Strip** — Industrial-grade flexible LED strip, warning red (620–630 nm), silicone encapsulated.
- **Stress-Relief Layer** — Aramid (Kevlar) braid surrounding LED FPC circuits.
- **Textile Reinforcement** — Open-weave textile reinforcement layer.
- **Outer Sheath** — Heavy duty translucent flame-retardant TPU/PUR (FeiChun proprietary).

Note: The Type 455-LED features a simplified, lighter construction compared to the Type 450-LED — utilising a semi-conductive elastomer insulation screen (rather than composite copper/polyester tape) and semi-conductive PCP filler. This yields a smaller overall diameter and lower weight per metre, ideally suited to long-reach stacker reclaimer and dragline tail-rope applications where cable weight is a critical design constraint.

2C.1 TYPE 455-LED — Dimensional & Electrical Data

Type	Part No.	Voltage	Cond. Size mm^2	Cond. Dia. mm	Pilot Cond. Size mm^2	Pilot Dia. mm	LED Power Method	Sheath Thk. mm	Cable O.D. mm	Wt. kg/ 100 m
455-LED.3	MCO-455L.3-025	3.3kV	25	13.6	8.48	6.6	Induction	4.9	46.5	313
	MCO-455L.3-035	3.3kV	35	14.8	8.48	6.6	Induction	5.2	50.2	378
	MCO-455L.3-050	3.3kV	50	16.8	12.51	7.4	Induction	5.6	56.0	465
	MCO-455L.3-070	3.3kV	70	18.4	19.04	8.5	Induction	6.1	61.0	605
	MCO-455L.3-095	3.3kV	95	20.2	24.68	9.3	Induction	6.5	66.2	713
	MCO-455L.3-120	3.3kV	120	21.8	29.62	10.3	Induction	6.8	70.5	864
	MCO-455L.3-150	3.3kV	150	23.5	39.15	11.4	Induction	6.9	75.0	1037
455-LED.6	MCO-455L.6-025	6.6kV	25	15.2	8.48	6.6	Induction	5.4	51.5	348
	MCO-455L.6-035	6.6kV	35	16.4	8.48	7.0	Induction	5.7	55.2	421
	MCO-455L.6-050	6.6kV	50	18.0	12.51	7.8	Induction	6.0	59.8	508
	MCO-455L.6-070	6.6kV	70	19.6	19.04	8.9	Induction	6.4	64.8	648
	MCO-455L.6-095	6.6kV	95	21.4	24.68	9.7	Induction	6.7	69.5	749
	MCO-455L.6-120	6.6kV	120	23.0	29.62	10.7	Induction	6.9	73.5	908
	MCO-455L.6-150	6.6kV	150	24.7	39.49	11.8	Induction	7.0	77.8	1075
455-LED.11	MCO-455L.11-025	11kV	25	19.2	8.48	7.8	Induction	6.5	63.8	497
	MCO-455L.11-035	11kV	35	20.4	8.48	7.8	Induction	6.7	67.0	557
	MCO-455L.11-050	11kV	50	22.0	12.51	8.6	Induction	6.8	71.0	643
	MCO-455L.11-070	11kV	70	23.6	19.04	9.7	Induction	6.9	75.2	789
	MCO-455L.11-095	11kV	95	25.4	24.68	10.5	Induction	7.1	80.0	897
	MCO-455L.11-120	11kV	120	27.0	29.62	11.5	Induction	7.2	84.5	1070
	MCO-455L.11-150	11kV	150	28.7	39.49	12.6	Induction	7.3	89.0	1242

Dimensions and weights are nominal ± manufacturing tolerances. Cable O.D. includes LED strip, aramid braid, and FPC surge-protection circuits. Weights approx. 8–12 % greater than standard Type 455 equivalents. All variants use electromagnetic induction energy harvesting as the Type 455 series operates exclusively at ≥ 3.3 kV. The Type 455-LED offers a smaller diameter and lower weight than the equivalent Type 450-LED at each voltage and conductor size.

TYPE 455-LED | Illuminated Mining Cables to AS/NZS 2802:2000

2C.2 Self-Powered LED Illumination Technology

The TYPE 455-LED incorporates a self-powered LED illumination system requiring **no external DC power supply, no modifications to existing gate end boxes, and no additional switchgear**. Disconnect the legacy cable, connect the 455-LED, energise — the cable glows. Because the entire Type 455 range operates at 3.3 kV and above, all variants employ **electromagnetic induction energy harvesting** exclusively.

Electromagnetic Induction Energy Harvesting

In 3.3 kV, 6.6 kV and 11 kV systems the alternating current in the phase conductors generates a powerful alternating magnetic field. The Type 455's semi-conductive elastomer insulation screen provides an electrically transparent window for magnetic flux coupling, enabling highly efficient energy harvesting:

- **Pickup Coil Integration:** During cable stranding a purpose-designed induction pickup wire is helically wound in the interstices between the screened phase cores, within the semi-conductive PCP filler layer. This wire functions as the secondary winding of a micro current transformer whose primary is the phase conductor.
- **Operating Principle:** Load current produces alternating magnetic flux; the pickup coil generates an EMF per Faraday's law ($E = -N \cdot d\Phi/dt$). Harvested energy is rectified and regulated to stable 12 V / 24 V DC for the LED strip.
- **Galvanic Isolation:** Zero direct galvanic connection between the illumination circuit and any conductor rated above 50 V. Inherent isolation satisfies intrinsic-safety principles per AS/NZS 60079.11 without additional barriers.
- **Screen Compatibility:** Unlike the Type 450's composite copper/polyester screen (which partially attenuates the magnetic field), the Type 455's non-metallic semi-conductive elastomer screen is magnetically transparent. This allows the induction pickup to achieve higher coupling efficiency at any given load current — particularly advantageous for partial-load and light-duty reeling scenarios.

2C.3 Integrated Overvoltage & Surge Protection

Stacker reclaimers, draglines, and similar plant generate severe transient conditions during motor starting, slewing, and fault events. FeiChun's multi-layer "micro substation" protects the LED illumination circuit:

Layer	Component	Function & Operating Principle
1	**Magnetic Saturation**	Pickup coil geometry enters magnetic saturation beyond design threshold — physically capping energy transfer at the source.
2	**TVS Diodes**	Micro transient voltage suppressors clamp surge spikes in picoseconds, diverting excess energy to earth.
3	**Zener / LDO**	Precision regulation locks LED rail to 12 V or 24 V DC. Eliminates flicker and prevents LED degradation.
4	**PTC Resettable Fuses**	Polymer PTC devices self-heat to high-impedance state under overcurrent. Auto-reset when fault clears — no replacement required.

Manufacturing Implementation

- **FPC Construction:** All surge-protection components surface-mounted on polyimide (PI) flexible circuit board. Bends freely with the cable through all reeling cycles.
- **Epoxy / Silicone Potting (IP68+):** Full encapsulation in high-elasticity epoxy or silicone — 100 % moisture/dust protection and shock absorption under crushing loads.
- **Aramid Stress-Isolation Braid:** Woven Kevlar sheath absorbs all mechanical stress during reel-in/reel-out; copper-foil LED circuits experience zero strain.

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2C.4 Translucent Heavy Duty FR-TPU Outer Sheath

The standard Type 455 uses a heavy duty opaque elastomer sheath. The TYPE 455-LED replaces this with FeiChun's proprietary **heavy duty translucent FR-TPU/PUR** — engineered to match or exceed the mechanical performance of the original whilst transmitting LED illumination.

- **High Light Transmittance** — Clear, uniform transmission of 620–630 nm warning-red LED output. Continuous bright glow visible from all angles.
- **Flame Retardancy** — Meets AS/NZS 1802 Cl. 13.2 and AS/NZS 2802 Cl. 2.12. Halogen-free FR additives; self-extinguishing, no toxic/corrosive fumes.
- **Abrasion Resistance** — 3–5× conventional elastomer per AS/NZS 2802 Cl. 2.10 (Taber). Resists cutting from broken rock and conveyor structures.
- **Tear Propagation Resistance** — Exceptional notch and tear resistance; damage does not propagate under repeated flexing.
- **UV & Ozone Resistance** — Suitable for surface stacker reclaimer and open-cut dragline applications.
- **Chemical Resistance** — Resistant to hydraulic fluids, diesel, cutting oils, and mine water.

2C.5 Australian & International Standards Compliance

The TYPE 455-LED is a derivative design based on the AS/NZS 2802:2000 Type 455 construction. All applicable clauses of the base standard are maintained:

Standard	Title / Scope	Applicability
AS/NZS 2802:2000	Electric cables — Trailing and reeling — For mining and general use	Primary construction standard. All electrical, mechanical and dimensional requirements maintained.
AS/NZS 1802:2003	Electric cables — Reeling and trailing — For underground coal mining	Underground coal-specific: flame propagation, earth monitoring, pilot circuit integrity.
AS/NZS 60079.11	Explosive atmospheres — Intrinsic safety 'i'	LED circuit designed to Ex ia IIC Ga/Gb energy limits. Galvanically isolated induction supply.
AS/NZS 3808:2000	Electrical equipment for coal mines — Intrinsic safety	LED circuit meets Group I (methane) IS requirements.
AS/NZS 62208	Empty enclosures — Low-voltage switchgear	Compatibility with existing gate end boxes and coupler hardware.
IEC 60502-1/2	Power cables with extruded insulation	EPR insulation system and semi-conductive screen per rated voltage classes.
AS/NZS 1125	Conductors in insulated electric cables	Conductor material, stranding class, resistivity.
IEC 60079.0	Explosive atmospheres — General requirements	General construction practices for hazardous zones.
EN 50575 (CPR)	Construction Products Regulation — Cables	FR-TPU tested to B2ca-s1,d0,a1 (optional for export).

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2C.6 Key Advantages & Operational Benefits

1 Enhanced Visibility for Slow-Reeling Plant

Continuous red glow delineates cable paths across stacker reclaimer bench runs, dragline tail-rope spreads, and similar areas. Operators and ground personnel can visually trace energised cable routes without portable lighting — critical during night shifts, dust storms, and low-visibility conditions.

2 Plug-and-Play Deployment

No additional DC supplies, no gate end box modifications, no new coupler pins. Direct drop-in replacement for standard Type 455. Disconnect old cable → connect 455-LED → restore power → illumination begins immediately.

3 Intrinsically Safe Cold Light Source

LED strips generate negligible heat. Galvanic isolation via electromagnetic induction ensures the illumination circuit cannot ignite methane or coal dust atmospheres — satisfying AS/NZS 3808 and AS/NZS 60079.11.

4 Lightest Illuminated Mining Cable

The Type 455-LED's simplified semi-conductive screen and PCP filler construction delivers the smallest diameter and lowest weight of any LED-illuminated mining cable in the FeiChun range — ideal where cable mass directly affects machine performance (boom tip loads, reel torque, tail-rope drag).

5 Superior Induction Coupling Efficiency

The non-metallic semi-conductive elastomer screen is magnetically transparent, enabling higher pickup coil coupling efficiency than copper-taped constructions. Reliable LED illumination even at partial load and light-duty reeling.

6 Maintenance-Free Illumination Circuit

PTC resettable fuses, TVS diodes and magnetic-saturation design provide autonomous surge protection. Designed for the full mechanical life of the cable with zero maintenance.

7 Energisation Status Indication

LED glow provides immediate visual confirmation that the cable is live — a significant safety advantage during isolation and lock-out / tag-out (LOTO) procedures.

8 Full Regulatory Compliance

Derivative of the proven AS/NZS 2802 Type 455 construction. All electrical ratings, earth continuity, pilot-circuit monitoring and insulation-resistance specifications maintained. No derogation from the base standard.

FEICHUN SPECIAL CABLES

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