Section 2B

Illuminated Mining Cables to AS/NZS 2802

Self-Powered LED High-Visibility Reeling & Trailing Cable

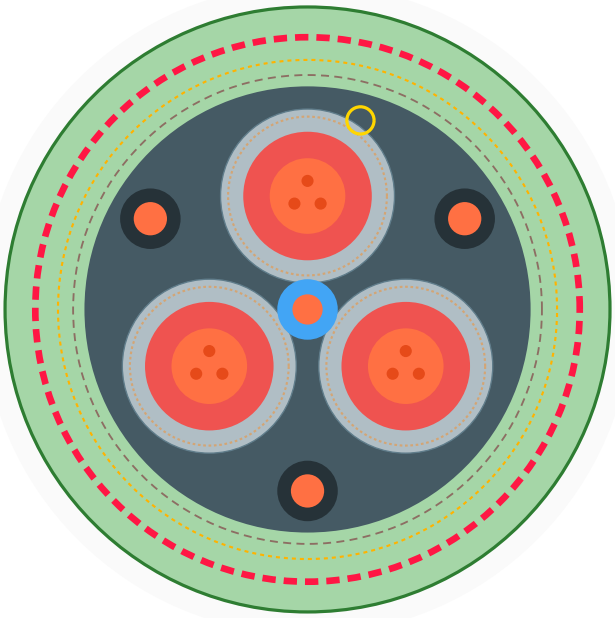
TYPE 450-LED

3.3 kV – 33 kV

SELF-POWERED LED VISIBILITY

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

HIGHLY VISIBLE CABLE · SELF-POWERED LED · PLUG-AND-PLAY · NO INFRASTRUCTURE CHANGE · UP TO 33 kV



- Translucent FR-TPU Extra Heavy Duty Sheath
- Integrated LED Strip (Warning Red 620–630 nm)
- Aramid Stress-Relief Braid
- Open-Weave Textile Reinforcement
- Elastomer Central Filler
- Composite Copper/Polyester 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** — Composite copper/polyester tape insulation screen over each phase core.
- **Earth Cores** — Semi-conductive elastomer covered interstitial earth conductors.
- **Pilot Core** — EPR insulated interstitial pilot conductor (larger cross-section than Type 441 series).
- **Filler** — Elastomer central 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** — Extra heavy duty translucent flame-retardant TPU/PUR (FeiChun proprietary).

Note: The translucent FR-TPU outer sheath replaces the conventional opaque elastomer sheath. FeiChun's proprietary TPU delivers 3–5× the abrasion resistance of conventional mining-grade rubber. The Type 450-LED retains the Type 450's optimised low-weight, minimum-diameter design philosophy whilst adding full-length LED illumination.

2B.1 TYPE 450-LED — Dimensional & Electrical Data

Type	Part No.	Voltage	Cond. Size mm²	Cond. Dia. mm	Screen Area mm²	Dia. Over Screen mm	Pilot Size mm²	LED Power Method	Sheath Thk. mm	Cable O.D. mm	Wt. kg/ 100 m
450-LED.3	MCO-450L.3-025	3.3kV	25	13.6	8.3	15.6	8.48	Induction	5.2	52.5	358
	MCO-450L.3-035	3.3kV	35	14.8	9.0	16.8	8.48	Induction	5.5	56.0	418
	MCO-450L.3-050	3.3kV	50	16.8	10.0	18.71	12.51	Induction	6.0	61.8	520
	MCO-450L.3-070	3.3kV	70	18.4	14.7	20.97	19.04	Induction	6.4	68.2	678
	MCO-450L.3-095	3.3kV	95	20.2	15.6	22.8	24.68	Induction	6.7	73.5	782
	MCO-450L.3-120	3.3kV	120	21.8	17.0	24.39	29.62	Induction	6.8	77.5	942
	MCO-450L.3-150	3.3kV	150	23.5	18.1	26.06	39.49	Induction	7.0	82.0	1133
450-LED.6	MCO-450L.6-025	6.6kV	25	15.2	9.2	17.2	8.48	Induction	5.6	52.5	405
	MCO-450L.6-035	6.6kV	35	16.4	9.8	18.4	8.48	Induction	5.9	55.8	470
	MCO-450L.6-050	6.6kV	50	18.0	10.2	19.91	12.51	Induction	6.3	60.0	562
	MCO-450L.6-070	6.6kV	70	19.6	15.6	22.17	19.04	Induction	6.7	66.0	725
	MCO-450L.6-095	6.6kV	95	21.4	16.3	24.0	24.68	Induction	6.8	70.0	828
	MCO-450L.6-120	6.6kV	120	23.0	17.8	25.59	29.62	Induction	6.9	73.8	970
	MCO-450L.6-150	6.6kV	150	24.7	18.1	27.26	39.49	Induction	7.0	77.5	1140
450-LED.11	MCO-450L.11-025	11kV	25	19.2	15.1	21.8	8.48	Induction	6.7	65.0	573
	MCO-450L.11-035	11kV	35	20.4	16.0	23.0	8.48	Induction	6.8	68.0	640
	MCO-450L.11-050	11kV	50	22.0	17.0	24.51	12.51	Induction	6.9	71.5	732
	MCO-450L.11-070	11kV	70	23.6	18.1	26.17	19.04	Induction	7.0	75.5	880
	MCO-450L.11-095	11kV	95	25.4	19.3	28.0	24.68	Induction	7.1	79.5	988
	MCO-450L.11-120	11kV	120	27.0	19.4	29.59	29.62	Induction	7.3	83.5	1145
	MCO-450L.11-150	11kV	150	28.7	27.3	31.26	39.49	Induction	7.4	87.5	1347
450-LED.22	MCO-450L.22-035	22kV	35	25.6	18.1	28.2	8.48	Induction	7.2	80.0	855
	MCO-450L.22-050	22kV	50	27.2	19.2	29.71	12.51	Induction	7.3	83.5	957
	MCO-450L.22-070	22kV	70	28.8	27.7	31.97	19.04	Induction	7.4	88.8	1141
	MCO-450L.22-095	22kV	95	30.6	28.4	33.8	24.68	Induction	7.6	93.2	1263
	MCO-450L.22-120	22kV	120	32.2	28.7	35.39	29.62	Induction	7.7	96.8	1432
	MCO-450L.22-150	22kV	150	33.9	29.0	37.06	39.49	Induction	7.8	100.8	1622
450-LED.33	MCO-450L.33-050	33kV	50	33.0	29.0	36.11	12.51	Induction	7.8	98.8	1291
	MCO-450L.33-070	33kV	70	34.6	29.2	37.77	19.04	Induction	7.9	107.5	1469

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 450 equivalents. All variants use electromagnetic induction energy harvesting as the Type 450 series operates exclusively at ≥ 3.3 kV.

2B.2 Self-Powered LED Illumination Technology

The TYPE 450-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 450-LED, energise — the cable glows. Because the entire Type 450 range operates at 3.3 kV and above, all variants employ **electromagnetic induction energy harvesting** exclusively — no solid-state shunt circuitry is required.

Electromagnetic Induction Energy Harvesting

In 3.3 kV through 33 kV systems the alternating current in the phase conductors generates a powerful alternating magnetic field. At the higher voltage ratings of the Type 450 series (22 kV and 33 kV), the available energy is significantly greater, enabling robust LED illumination even under partial-load conditions:

- **Pickup Coil Integration:** During cable stranding a purpose-designed induction pickup wire is helically wound in the interstices between the screened phase cores, adjacent to the composite copper/polyester insulation screen. This wire functions as the secondary winding of a micro current transformer whose primary is the phase conductor itself.
- **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. This inherent isolation satisfies intrinsic-safety principles per AS/NZS 60079.11 without additional barriers.
- **High-Voltage Optimisation (22 kV / 33 kV):** At elevated system voltages, the composite copper/polyester insulation screen of the Type 450 construction provides an additional electromagnetic shielding reference plane. FeiChun's coil geometry is specifically tuned to harvest energy efficiently from the stronger fields present in these higher-voltage systems, whilst the pickup coil remains magnetically decoupled from the screen grounding path.

2B.3 Integrated Overvoltage & Surge Protection

Heavy mobile plant — draglines, excavators, bucket-wheel reclaimers — subjects trailing cables to extreme transient conditions. Motor inrush currents of 5–10× rated value and fault currents during short-circuit events cause rapid flux changes that induce destructive voltage spikes in the LED supply circuit. FeiChun addresses this with a multi-layer "micro substation" integrated within the cable:

Layer	Component	Function & Operating Principle
1	**Magnetic Saturation**	Pickup coil geometry and core material engineered to enter magnetic saturation when primary current exceeds design threshold. Induced voltage ceases to rise proportionally — physically capping energy transfer at the source.
2	**TVS Diodes**	Micro transient voltage suppressors in parallel across the LED rail. Conduct in picoseconds, clamping voltage to a safe level and diverting surge energy to earth.
3	**Zener / LDO**	Precision voltage regulation locks the LED rail to exactly 12 V or 24 V DC. Absorbs residual fluctuations, eliminating flicker and preventing LED degradation.
4	**PTC Resettable Fuses**	Polymer PTC devices in series. Under sustained overcurrent, self-heat into high-impedance state (open circuit). Automatically reset when fault clears — no internal fuse replacement possible or required.

Manufacturing Implementation

- **FPC Construction:** All surge-protection components (TVS, LDO, PTC, Zener) are surface-mounted on polyimide (PI) flexible circuit board. The FPC bends freely with the cable and withstands dynamic bending radii encountered during slow reeling.
- **Epoxy / Silicone Potting (IP68+):** Every micro circuit is fully encapsulated in high-elasticity epoxy or silicone before extrusion — providing 100 % moisture/dust ingress protection and a shock-absorbing cushion surviving repeated crushing loads.
- **Aramid Stress-Isolation Braid:** Woven Kevlar sheath surrounds the LED strip and FPC driver circuits. Under cable tension or torsion during reel-in/reel-out, the aramid absorbs all mechanical stress; the copper-foil LED circuits experience zero strain.

2B.4 Translucent Extra Heavy Duty FR-TPU Outer Sheath

The standard Type 450 employs an extra heavy duty opaque elastomer outer sheath for maximum mechanical protection. The TYPE 450-LED replaces this with FeiChun's proprietary **extra heavy duty translucent FR-TPU/PUR** compound — engineered to match or exceed the mechanical toughness of the original whilst transmitting LED illumination along the full cable length.

- **High Light Transmittance** — The FR-TPU permits clear, uniform transmission of 620–630 nm warning-red LED output through the full extra-heavy-duty sheath wall, producing a continuous bright glow visible from all angles.
- **Flame Retardancy** — Meets AS/NZS 1802 Cl. 13.2 and AS/NZS 2802 Cl. 2.12 flame-propagation requirements. Halogen-free FR additives; self-extinguishing with no toxic/corrosive fumes.
- **Abrasion Resistance** — 3–5× conventional elastomer per AS/NZS 2802 Cl. 2.10 (Taber). Designed for severe service on dragline tail-ropes, excavator cable festoons, and wharf crane reels.
- **Tear Propagation Resistance** — Exceptional notch and tear resistance; damage from broken rock or steel edges does not propagate under repeated flexing.
- **UV & Ozone Resistance** — Resists UV degradation and ozone cracking for surface dragline and open-cut excavator applications.
- **Chemical Resistance** — Resistant to hydraulic fluids, diesel, cutting oils, and mine water. No appreciable swelling or softening under prolonged exposure.

2B.5 Australian & International Standards Compliance

The TYPE 450-LED is a derivative design based on the AS/NZS 2802:2000 Type 450 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 restricts energy below ignition thresholds.
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 composite screen per rated voltage classes up to 33 kV.
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).

2B.6 Key Advantages & Operational Benefits

1 Enhanced Visibility for Slow-Reeling Plant

Continuous red glow delineates cable paths across dragline tail-rope spreads, excavator bench areas, and wharf crane aprons. 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 450. Disconnect old cable → connect 450-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 Optimised Weight & Diameter

The Type 450-LED retains the Type 450's lower-weight, minimum-diameter design philosophy. LED illumination adds only 8–12 % to cable weight — a negligible penalty for the dramatic safety improvement.

5 33 kV Capability

The only illuminated mining cable available at 22 kV and 33 kV voltage ratings, enabling LED visibility on the largest draglines and long-distance trailing applications.

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 450 construction. All electrical ratings, earth continuity, pilot-circuit monitoring and insulation-resistance specifications maintained. No derogation from the base standard.

FEICHUN SPECIAL CABLES

Website www.feichuncables.com
Technical Enquiries Tech@feichuncables.com Mining Division mining@feichuncables.com
WhatsApp +86 138 5608 5607 & +86 138 5512 3218
Email ziyu.huang@feichuncables.com & zihao.yang@feichuncables.com

This document is the property of FeiChun Special Cables and is issued for information purposes only. Specifications are subject to change without notice. All cables are manufactured under ISO 9001:2015 quality management systems. For project-specific engineering support, contact the Mining Division.

FEICHUN SPECIAL CABLES

Website Address www.reelingcable.com www.feichuncables.com
Whatsapp Account + 86 13855123218
Email Address Zihao.yang@feichuncables.com & Ziyu.huang@feichuncables.com