

Section 2D

Illuminated Mining Cables to AS/NZS 2802:2000

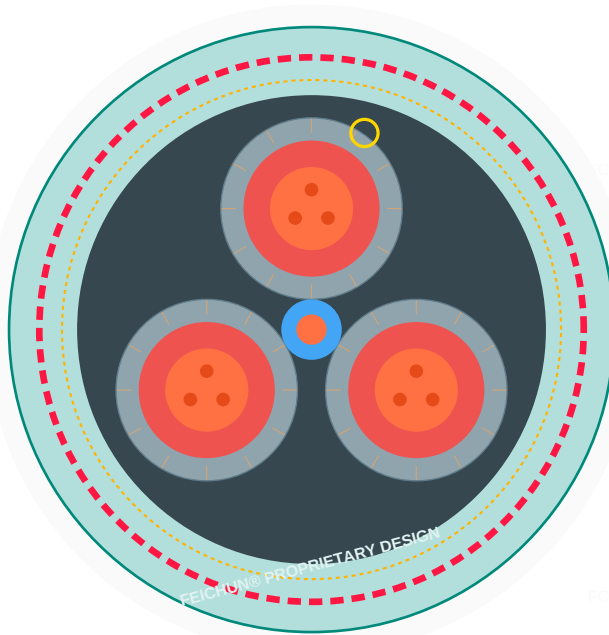
Self-Powered LED High-Visibility Flexible Trailing Cable

TYPE 440-LED

1.1 kV – 22 kV

SELF-POWERED LED VISIBILITY

A flexible trailing cable for power supply to mobile machinery and equipment — continuous miners, shuttle cars, mobile substations, and general mobile plant — featuring integrated self-powered LED illumination for enhanced visibility and personnel safety in underground and surface mining environments.

HIGHLY VISIBLE CABLE · SELF-POWERED LED · PLUG-AND-PLAY · NO INFRASTRUCTURE CHANGE · FEICHUN® EXCLUSIVE

- Translucent FR-TPU Heavy Duty Sheath
- Integrated LED Strip (Warning Red 620–630 nm)
- Aramid Stress-Relief Braid
- Semi-Conductive Elastomeric Cradle
- Composite Cu/Polyester Braid Insulation Screen
- EPR Insulation (Phase Cores)
- Tinned Copper Conductors (Class 5)
- EPR Insulated Extensible Pilot Core
- Induction Pickup Coil (≥ 3.3 kV) /
- Solid-State Shunt Module (< 3 kV)

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 braid insulation screen over each phase core.
- Pilot Core** — EPR insulated extensible pilot conductor.
- Cradle** — Semi-conductive elastomeric cradle.
- Induction Pickup** — Helically wound pickup coil for EM energy harvesting (≥ 3.3 kV variants).
- Shunt Module** — Internal solid-state capacitive voltage divider (< 3 kV variants).
- LED Strip** — Industrial-grade flexible LED strip, warning red (620–630 nm), silicone encapsulated.
- Stress-Relief Layer** — FeiChun® aramid braid surrounding LED FPC circuits.
- Outer Sheath** — Heavy duty translucent FR-TPU/PUR (FeiChun® proprietary formulation FC-TPU™).

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FC-TPU™ Modified Translucent Polyurethane | Patent Pending | FeiChun Exclusive

Note: The TYPE 440 is FeiChun's most versatile trailing cable platform, covering 1.1 kV through 22 kV with composite braid screening for superior EMC performance. The 440-LED variant adds full-length LED illumination via FeiChun's proprietary FC-TPU™ translucent sheath, delivering 3–5× the abrasion resistance of conventional mining-grade rubber.

2D.1 TYPE 440-LED — Dimensional & Electrical Data

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Type	Part No.	Voltage	Cond. Size mm ²	Cond. Dia. mm	Screen Area mm ²	Dia. Over Screen mm	Pilot Size mm ²	LED Power Method	Sheath Thk. mm	Cable O.D. mm	Wt. kg/ 100 m
440-LED.1	MCO-440L.1-025	1.1kV	25	11.1	11.3	12.3	4.45	Shunt	4.7	44.5	305
	MCO-440L.1-035	1.1kV	35	12.3	12.4	13.5	6.15	Shunt	5.0	48.0	371
	MCO-440L.1-050	1.1kV	50	14.1	14.4	15.3	8.06	Shunt	5.4	53.0	467
	MCO-440L.1-070	1.1kV	70	15.9	16.5	17.1	12.69	Shunt	5.8	58.5	597
	MCO-440L.1-095	1.1kV	95	18.1	18.2	19.3	12.69	Shunt	6.4	64.8	756
	MCO-440L.1-120	1.1kV	120	19.9	20.3	21.1	13.75	Shunt	6.8	70.0	910
	MCO-440L.1-150	1.1kV	150	22.0	22.3	23.2	16.92	Shunt	7.3	76.0	1115
440-LED.3	MCO-440L.3-025	3.3kV	25	15.5	14.8	16.4	4.45	Induction	6.0	61.5	469
	MCO-440L.3-035	3.3kV	35	16.7	16.1	17.6	6.15	Induction	6.3	65.0	547
	MCO-440L.3-070	3.3kV	70	19.9	19.6	20.8	12.69	Induction	7.0	74.0	790
	MCO-440L.3-095	3.3kV	95	21.7	20.6	22.6	12.69	Induction	7.5	79.5	938
	MCO-440L.3-120	3.3kV	120	23.3	27.2	24.5	13.75	Induction	7.8	84.5	1100
	MCO-440L.3-150	3.3kV	150	25.0	39.6	26.2	16.92	Induction	8.2	89.5	1308
440-LED.6	MCO-440L.6-025	6.6kV	25	19.5	18.3	20.4	4.45	Induction	7.1	73.5	608
	MCO-440L.6-035	6.6kV	35	20.7	20.3	21.6	6.15	Induction	7.4	77.0	694
	MCO-440L.6-050	6.6kV	50	22.3	21.3	23.2	8.06	Induction	7.7	81.2	801
	MCO-440L.6-095	6.6kV	95	25.7	29.6	26.9	12.69	Induction	8.5	92.0	1112
	MCO-440L.6-120	6.6kV	120	27.3	32.3	28.5	13.75	Induction	8.9	96.8	1269
	MCO-440L.6-150	6.6kV	150	29.0	47.3	30.8	16.92	Induction	9.3	103.0	1488
440-LED.1 1	MCO-440L.11-025	11kV	25	24.7	24.1	25.6	4.45	Induction	8.5	89.0	868
	MCO-440L.11-035	11kV	35	25.9	30.2	27.1	6.15	Induction	8.8	93.2	980
	MCO-440L.11-050	11kV	50	27.5	32.2	28.7	8.06	Induction	9.1	97.5	1102
	MCO-440L.11-070	11kV	70	29.1	34.6	30.3	12.69	Induction	9.5	102.5	1263
	MCO-440L.11-120	11kV	120	32.2	51.0	34.3	13.75	Induction	10.3	113.5	1644
	MCO-440L.11-150	11kV	150	33.9	54.5	36.0	16.92	Induction	10.7	118.5	1840
440-LED.2 2	MCO-440L.22-035	22kV	35	31.4	53.2	33.5	6.15	Induction	10.4	112.0	1398
	MCO-440L.22-050	22kV	50	33.0	54.1	35.1	8.06	Induction	10.7	116.2	1532
	MCO-440L.22-070	22kV	70	34.6	58.0	36.7	12.69	Induction	11.1	121.0	1715

Dimensions and weights are nominal ± manufacturing tolerances. Cable O.D. includes FeiChun® LED strip, aramid braid, and FPC surge-protection circuits. Weights approx. 8–12 % greater than standard Type 440 equivalents. **LED Power Method:** ‘Shunt’ = FeiChun® FC-CVD™ capacitive voltage divider (< 3 kV). ‘Induction’ = FeiChun® FC-EMH™ electromagnetic energy harvesting (≥ 3 kV).

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2D.2 FeiChun® Self-Powered LED Illumination Technology

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FC-EMH™ Electromagnetic Energy Harvesting | FC-CVD™ Capacitive Voltage Divider

The TYPE 440-LED incorporates FeiChun's proprietary 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 440-LED, energise — the cable glows. The Type 440 platform's wide voltage range (1.1–22 kV) necessitates **two distinct energy harvesting architectures**:

A. High-Voltage Variants (≥ 3.3 kV) — FC-EMH™ Induction Harvesting

- Pickup Coil Integration:** During cable stranding, a FeiChun® induction pickup wire is helically wound in the interstices between the braid-screened phase cores, within the semi-conductive elastomeric cradle. The composite copper/polyester braid screen of the Type 440 partially attenuates magnetic coupling; FeiChun's coil geometry is specifically tuned to compensate, achieving efficient energy harvesting despite the metallic braid presence.
- Operating Principle:** Load current produces alternating magnetic flux; the pickup coil generates an EMF per Faraday's law ($E = -N \cdot d\Phi/dt$). FeiChun's FC-EMH™ module rectifies and regulates the harvested energy to stable 12 V / 24 V DC.
- Galvanic Isolation:** Zero direct galvanic connection between illumination and HV circuits. Satisfies intrinsic-safety principles per AS/NZS 60079.11.

B. Low-Voltage Variants (< 3 kV) — FC-CVD™ Capacitive Shunt

- Micro FC-CVD™ Module:** FeiChun's ultra-compact flexible capacitive voltage divider is integrated within the cable lay-up. High-impedance tap draws only tens of milliamps.
- Onboard Rectification & Regulation:** Flexible-substrate rectifier and LDO regulator produce clean 12 V / 24 V DC for the LED strip.
- Zero Infrastructure Change:** Existing gate end boxes, couplers and plugs used without any modification — true plug-and-play.

2D.3 FeiChun® Integrated Surge Protection (FC-SPM™)

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FC-SPM™ Surge Protection Module | 4-Layer Architecture | FeiChun Exclusive

Mobile mining equipment generates severe transients during motor starting and fault events. FeiChun's FC-SPM™ multi-layer surge protection module is integrated within the cable:

Layer	Component	Function & Operating Principle
1	Magnetic Saturation	FeiChun® tuned coil geometry enters saturation beyond threshold — physically capping energy at source.
2	TVS Diodes	Micro TVS suppressors clamp surges in picoseconds, diverting energy to earth.
3	Zener / LDO	Precision regulation locks LED rail to 12 V / 24 V DC. Eliminates flicker.
4	PTC Resettable	Polymer PTC auto-resets after overcurrent. No replacement required.

FeiChun® Manufacturing Implementation

- FC-FPC™ Construction:** FeiChun's proprietary polyimide flexible circuit board hosts all surge-protection SMD components. Bends freely through all trailing cycles.
- FC-POT™ Encapsulation (IP68+):** Full epoxy/silicone potting — 100 % ingress protection. Survives 50+ tonne vehicle crossings.
- FC-ASB™ Aramid Stress Braid:** Woven Kevlar isolation layer absorbs all mechanical stress; LED copper-foil circuits experience zero strain.

2D.4 FeiChun® FC-TPU™ Translucent Outer Sheath

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□ FEICHUN PROPRIETARY FC-TPU™ Modified Translucent Thermoplastic Polyurethane | FeiChun Formula No. FC-2026-TPU-M7

The standard Type 440 employs an opaque heavy duty elastomer sheath. The TYPE 440-LED replaces this with FeiChun's proprietary **FC-TPU™ translucent flame-retardant polyurethane** — developed in-house by FeiChun's polymer engineering division specifically for illuminated mining cable applications.

- **High Light Transmittance** — FC-TPU™ permits clear, uniform transmission of 620–630 nm warning-red LED output. Continuous glow visible from all angles.
- **Flame Retardancy** — Meets AS/NZS 1802 Cl. 13.2 and AS/NZS 2802 Cl. 2.12. Halogen-free; self-extinguishing. FeiChun Formula FC-2026-TPU-M7.
- **Abrasion Resistance** — 3–5× conventional elastomer (Taber, AS/NZS 2802 Cl. 2.10). FeiChun's nano-reinforced TPU matrix resists cutting from broken rock.
- **Tear Propagation Resistance** — FeiChun® micro-fibre reinforcement prevents nick propagation under repeated flexing.
- **UV & Ozone Resistance** — Suitable for surface trailing and stockpile applications.
- **Chemical Resistance** — Resistant to hydraulic fluids, diesel, cutting oils, mine water.

2D.5 Australian & International Standards Compliance

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Standard	Title / Scope	Applicability
AS/NZS 2802:2000	Electric cables — Trailing and reeling — Mining and general use	Primary construction standard. All requirements maintained.
AS/NZS 1802:2003	Electric cables — Reeling and trailing — Underground coal mining	Underground coal-specific requirements.
AS/NZS 60079.11	Explosive atmospheres — Intrinsic safety 'i'	LED circuit: Ex ia IIC Ga/Gb. Galvanically isolated (FC-EMH™) or capacitively limited (FC-CVD™).
AS/NZS 3808:2000	Electrical equipment for coal mines — IS	LED circuit meets Group I (methane) IS requirements.
AS/NZS 62208	Empty enclosures — LV switchgear	Compatible with existing gate end boxes / couplers.
IEC 60502-1/2	Power cables with extruded insulation	EPR insulation and composite braid screen per voltage class.
AS/NZS 1125	Conductors in insulated electric cables	Conductor material, stranding, resistivity.
IEC 60079.0	Explosive atmospheres — General	Construction for hazardous zones.
EN 50575 (CPR)	Construction Products Regulation	FC-TPU™ tested to B2ca-s1,d0,a1 (optional export).

2D.6 Key Advantages & Operational Benefits

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1 Enhanced Visibility for Trailing Plant

Continuous red glow delineates cable paths across mine roadways, panel entries, and surface trailing routes. Personnel visually trace energised cables without portable lighting — critical in smoke, dust, or ventilation-failure scenarios.

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 440. Disconnect → connect → restore power → glow.

3 Widest Voltage Range

The only illuminated trailing cable covering 1.1 kV through 22 kV on a single platform. FeiChun's dual-architecture approach (FC-CVD™ for LV, FC-EMH™ for HV) ensures reliable illumination at every voltage rating.

4 Intrinsically Safe Cold Light

Negligible LED heat. Galvanic isolation (HV) or capacitive limiting (LV) prevents ignition of methane/coal dust — AS/NZS 3808 and AS/NZS 60079.11 compliant.

5 FeiChun® FC-TPU™ Durability

Proprietary translucent sheath delivers 3–5× abrasion resistance vs conventional elastomer. Nano-reinforced matrix. Aramid-protected LED circuits survive crushing loads.

6 Maintenance-Free FC-SPM™ Circuit

Four-layer autonomous surge protection. PTC auto-reset. Designed for full cable service life with zero maintenance on the illumination circuit.

7 Live Cable Indication

Immediate visual confirmation of energisation status — enhancing lock-out/tag-out (LOTO) safety procedures.

8 Full Regulatory Compliance

Derivative of AS/NZS 2802 Type 440. All ratings, earth continuity, pilot monitoring and insulation-resistance specs maintained. No derogation from base standard.

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