

IEC-Guided LV 0.6/1 kV Copper Cable Sizing: ΔV and I^2t

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حساب مقاطع الكابلات النحاسية للجهد المنخفض 1/0.6 ك.ف حسب مواصفات IEC: هبوط الجهد و I^2t

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Received: 11-11-2025	Accepted: 19-12-2025	Published: 01-03-2026
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الملخص:

نقدم في هذا البحث مسار عمل (Workflow) موجّهًا وفقاً لمعايير اللجنة الكهروتقنية الدولية (IEC) لاختيار، وتركيب، والتحقق من كابلات الجهد المنخفض (1/0.6 كيلو فولت) أحادية القلب المصنوعة من النحاس والمعزولة بمادة XLPE/PVC، وذلك باستخدام معلمات مُحَقَّقة من الشركات المصنعة ومعادلات قياسية لحساب المقاومة المعتمدة على درجة الحرارة، وهبوط الجهد ثلاثي الأطوار، وتحديد مقاسات كابات قصر الدائرة (اللا تبادلية الحرارية). تم استخلاص البيانات المدخلة من جداول بيانات كابلات النواة الواحدة (SDI) لشركة "نيكسانز" (بمقاطع: 16، و 120، و 150 مم²)، وجرى التحقق منها مرجعياً مقابل الجدول C4 لشركة "بريسميان"؛ في حين تتوافق أطرف حماية الأجهزة (Device envelopes) مع تعيينات الفصل لشركة "ABB" و "Eaton" بما يتسق مع المعايير IEC/EN 60898-1 و IEC/EN 60947-2. نقوم بحساب ظروف هبوط الجهد (ΔV) مقابل الطول عند طاقة استيعابية تبلغ $I_z 0.8$ (معامل قدرة = 0.90، جهد 400 فولت، ثلاثي الأطوار)، وجدولة الأطوال القصوى المسموح بها لهبوط جهد بنسبة $\Delta V \leq 4\%$ ، وتقديم مخططات لـ $I_{perm} = \frac{kS}{\sqrt{t}}$. يقارن تحليل التكافؤ عبر الموردين بين هبوط الجهد (ΔV) المحسوب باستخدام مقاومة نيكسانز المتتابة (R_{AC}) عند درجة حرارة التشغيل مضافاً إليها المفاعلة التثليلية الثلاثية (Trefoil reactance)، مقابل مقاومة بريسميان المستمرة عند 20 درجة مئوية (R_{20}) المصححة إلى 80 درجة مئوية مضافاً إليها مفاعلة بريسميان، مما أسفر عن توافق وثيق (متوسط الخطأ المئوي المطلق $MAPE \approx 2.68\%$ ، وجذر متوسط مربع الخطأ $RMSE \approx 0.075\%$ كنقاط مئوية، مع ذكر فترات الثقة 95%). ويستعرض مثال تطبيقي خطوات الاختيار والتنسيق المتكاملة مع فئة أجهزة محددة بالاسم. وتتميز هذه الطريقة بقابليتها للتدقيق والمراجعة بمطابقتها وبيانات الموردين ومعايير IEC/IEEE/EN المرجعية [1]، [14].

الكلمات الدالة: المعيار الدولي IEC 60287، المعيار الدولي IEC 60364-5-52، المعيار الدولي IEC 60949، هبوط الجهد (أو انخفاض الجهد)، السعة التيار ومترية، القصر الحراري اللا تبادلي، تنسيق الحماية، كابلات الجهد المنخفض، التحقق من الصحة.

Abstract

We present an IEC-guided workflow to select, install, and verify low-voltage (0.6/1 kV) single-core Cu XLPE/PVC cables using manufacturer-verified parameters and standard equations for temperature-dependent resistance, three-phase voltage drop, and adiabatic short-circuit sizing. Inputs are taken from

Nexans SDI datasheets (16, 120, 150 mm²) and cross-checked against Prysmian Table C4; device envelopes follow ABB/Eaton tripping assignments consistent with IEC/EN 60898-1 and IEC/EN 60947-2. We compute ΔV -length envelopes at $0.8 \cdot I_z$ (pf = 0.90, 400 V, 3 ϕ), tabulate maximum permissible lengths for $\Delta V \leq 4$ %, and provide $I_{perm} = kS/\sqrt{t}$ maps. A cross-vendor parity analysis contrasts ΔV computed with Nexans RAC at operating temperature plus trefoil reactance versus Prysmian R20 corrected to 80 °C plus Prysmian reactance, yielding close agreement (MAPE \approx 2.68 %, RMSE \approx 0.075 %-points, 95% CIs reported). A worked example demonstrates end-to-end selection and coordination with a named device class. The method is auditable against vendor data and IEC/IEEE/EN standards [1],[14].

Keywords: IEC 60287; IEC 60364-5-52; IEC 60949; voltage drop; ampacity; adiabatic short circuit; protection coordination; LV cables; validation.

Introduction

The rigorous design of low-voltage (LV) cable installations critically hinges upon the concurrent satisfaction of three fundamental engineering principles. First, the chosen cable must exhibit demonstrable current-carrying capacity (ampacity) conformity, meticulously adjusted to account for specific installation conditions. Second, stringent adherence to voltage-drop (ΔV) limits at the point of utilization is paramount to ensure efficient power delivery and optimal equipment performance. Third, robust protection coordination must be meticulously established, guaranteeing that the let-through energy of protective devices remains strictly below the thermal withstand limits of the associated cabling. These foundational requirements are underpinned by a comprehensive suite of international normative standards, including IEC 62440 (detailing cable usage and limiting conditions), IEC 60364-5-52 (governing wiring systems and voltage drop considerations), IEC 60228 (specifying conductor characteristics), IEC 60287 (addressing thermal current ratings), and IEC 60364-4-43 / IEC 60949 (pertaining to short-circuit current capabilities) [1],[7]. This scholarly contribution specifically grounds the precise sizing for voltage drop (ΔV) and short-circuit thermal withstand (I^2t) in empirically verified manufacturer constants—comprising resistance (R), reactance (X), nominal current-carrying capacity (I_z), outer diameter (OD), and bending radius. Furthermore, it significantly advances the field by incorporating a rigorously quantified cross-vendor validation, drawing upon additional independent data [8],[14].

2. Contributions

- (i) Vendor-anchored ΔV workflow using R_{AC} at operating temperature and X directly from datasheets, avoiding ad-hoc skin/proximity assumptions [8],[11].
- (ii) Quantified cross-vendor validation (Nexans vs Prysmian) with MAPE/RMSE and bootstrap confidence intervals.
- (iii) Device-specific coordination via $I^2t \leq K^2 S^2$ with pass/fail tables at practical fault levels, consistent with IEC/EN 60898-1 and IEC/EN 60947-2 [6], [7], [12],[14].
- (iv) Worked example from requirements to final choice (ΔV , I^2t , mechanics), suitable for design dossiers.

3. Related Work

Standards (IEC 60287/60364 family) and vendor tables remain the backbone for LV cable rating and impedance [1],[7], [8],[11]. IET guidance and CIGRÉ reports broaden practice on derating, external influences, and reliability [18],[20], [26]. This paper emphasizes verifiable manufacturer constants and adds quantified validation—often missing in tabular-only approaches.

4. Data Sources (vendor-verified)

From Nexans SDI (0.6/1 kV Cu XLPE/PVC single-core) we extracted: R_{dc} at 20 °C, R_{AC} at 50 Hz (operating temperature), X at 50 Hz (trefoil/flat), outer diameter, installed minimum bend radius, and 3-phase “unenclosed

spaced” ampacity I_z for 16, 120, 150 mm² (Table A; Figs. 1–2) [8],[10]. We cross-checked R_{20} and X trends against Prysmian Table C4 (Table B) [11]. Elsewedy catalogues inform temperature correction and AC augmentation context [9]. Device envelopes (MCB characteristics and breaking capacities) follow ABB/Eaton literature aligned with IEC/EN 60898-1 and IEC/EN 60947-2 [12],[14].

5. Governing Equations (display, LTR)

- (1) $R_\theta = R_{20}[1 + \alpha(\theta - 20^\circ\text{C})]$ (temperature-corrected DC resistance) [3], [9]
- (2) $R_{AC}(\theta) = R_\theta(1 + Y_s + Y_p)$ (AC resistance at operating temperature; skin/proximity) [4], [9], [11]
- (3) $\Delta V = 3 I (R \cos \phi + X \sin \phi) L$ (three-phase ΔV ; L in km; R, X in Ω/km) [2], [11]
- (3a) $\Delta V\% = 100 \Delta V/V_{LL}$ (percentage drop at 400 V L-L) [2]
- (4) $I^2 t \leq K^2 S^2$ (adiabatic short-circuit criterion) [6], [7]
- (4a) $I_{\text{perm}}(t) = \frac{KS}{\sqrt{t}}$ (permissible fault current vs clearing time) [6], [7]
- (5) $I_1 = 1.13I_n, I_2 = 1.45I_n$ (MCB thermal thresholds; Type-C instantaneous $\approx 5\text{--}10 \cdot I_n$) [12], [13]
- (6) $I_{\text{op}} = 0.8I_z$ (design loading used in envelopes)

Symbols (units): $R_{20}(\Omega/\text{km})$, $\alpha(\text{K}^{-1})$, $\theta(^{\circ}\text{C})$, $R_{AC,\theta}(\Omega/\text{km})$, X (Ω/km), I(A), L(km), $V_{LL}(\text{V})$, k ($\text{A}\sqrt{\text{s}}\cdot\text{mm}^{-2}$, Cu/XLPE), S(mm^2), t(s), $I_n(\text{A})$

6. Methodology (expanded)

6.1 Inputs & Assumptions

- System: 3 ϕ , 400 V, 50 Hz; pf = 0.90 (base), extended to PF $\in [0.8, 1.0]$ for sensitivity.
- Installation method: vendor’s “unenclosed, spaced”; I_z taken directly from the datasheet [8],[10].
- Operating current: $I_{\text{op}} = 0.8 \cdot I_z$ (Eq. 6).
- Formation: base case trefoil for X; flat treated in sensitivity.
- Voltage-drop limit: $\Delta V \leq 4\%$ at utilization, per IEC 60364-5-52 planning practice [2].
- Operating temperature: vendor-consistent (e.g., 70–90 $^{\circ}\text{C}$ class); when converting $R_{20} \rightarrow R_\theta$, use (1) with $\alpha \approx 0.00393 \text{ K}^{-1}$ for Cu [3], and set θ per scenario.

6.2 Material/Protection Constants

- α (Cu): 0.00393 K^{-1} [3].
- k (Cu/XLPE): as per IEC 60949/60364-4-43 tables [6], [7] (state the exact value used in your calculation sheet; uncertainty $\pm 5\%$ carried into §9).
- MCB envelope (Type-C): instantaneous $\approx 5\text{--}10 \cdot I_n$; thermal $I_1 \approx 1.13I_n, I_2 \approx 1.45I_n$ [12], [13]. If the application requires $I_{cu} > 10 \text{ kA}$, use MCCB/fuse per IEC 60947-2.

6.3 Calculation Workflow (deterministic path)

1. Ampacity & loading: from Table A, compute $I_{\text{op}} = 0.8I_z$.
2. Line impedance: adopt vendor R_{AC} at operating temperature and X (trefoil). If only R_{20} is available, convert via (1) and augment to R_{AC} per vendor/IEC context [4], [9], [11].
3. Voltage drops: compute ΔV by (3) and $\Delta V\%$ by (3a) for a trial length L.
4. Maximum length: rearrange (3)/(3a):

$$L_{\text{max}} = (\Delta V\%/100) * V_{LL} / (\sqrt{3} * I_{\text{op}} * (R * \cos \phi + X * \sin \phi))$$

5. Short-circuit withstand: from (4a), compute $I_{\text{perm}}(t) = kS/\sqrt{t}$ for t = 5 s, 0.2 s, 0.1 s.

6. Device coordination: ensure $\min_t I_{\text{device}}^2(t) < k^2 S^2$ at the maximum credible I_{psc} (near the source). Where proprietary I-t data are not embedded, bracket clearing using 0.1 s (conservative) and 0.02 s (energy-limiting action).

1.1.1 6.4 ESTIMATING PROSPECTIVE SHORT-CIRCUIT CURRENT I_{psc}

Use a loop-impedance estimate from feeder/source data or a system study (outside scope). For coordination tables herein, scenarios 4 kA, 8 kA, 20 kA bracket typical LV points; note that 20 kA exceeds many 60898 MCB break capacities and would require MCCB/fuse upstream [6], [7], [12], [14].

1.1.2 6.5 SENSITIVITY SCENARIOS

Evaluate ΔV for: PF = 0.8, 0.9, 1.0; trefoil vs flat (X variation); ± 5 °C on θ ; grouping/duct factors per IEC 60364-5-52 [2], [5].

6.6 Validation Protocol (with confidence intervals)

- Dataset: sections {16, 120, 150} mm² × lengths {25, 50, 100} m at 0.8·I_z, pf 0.90.
- Nexans model: R=R_{AC} (operating), X trefoil (datasheet).
- Prysmian model: R80=R20[1+α(80–20)] from Table C4; no AC augmentation.
- Metrics: MAPE = $\frac{1}{N} \sum |\Delta V_N - \Delta V_P| / \Delta V_P$ and RMSE = $\sqrt{\frac{1}{N} \sum (\Delta V_N - \Delta V_P)^2}$ in % points.
- Uncertainty: non-parametric bootstrap (N=20,000 resamples) on the 9 pairs to obtain 95% CIs for MAPE and RMSE.

1.2 7. Results

1.2.1 7.1 ELECTRICAL CONSTANTS AND AMPACITY (NEXANS SDI)

Table A lists inputs used; Fig. 1 compares R_{dc}(20 °C) vs R_{AC} (50 Hz); Fig. 2 shows I_z vs section.

Table A — Nexans SDI inputs (0.6/1 kV Cu XLPE/PVC, single-core)

Section (mm ²)	R _{dc} 20 °C (Ω/km)	R _{AC} 50 Hz (Ω/km)	X ₅₀ trefoil (Ω/km)	OD (mm)	Min bend radius installs (mm)	I _z , 3φ (A)
16	1.150	1.470	0.087	9.3	37	108
120	0.153	0.188	0.084	19.6	78	410
150	0.124	0.153	0.084	21.3	85	472

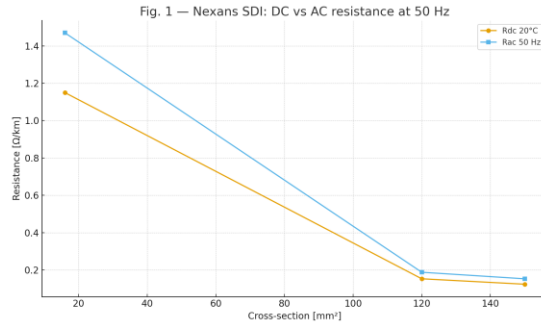


Fig. 1. Nexans SDI (16/120/150 mm²): DC (20 °C) vs AC (50 Hz) resistance.

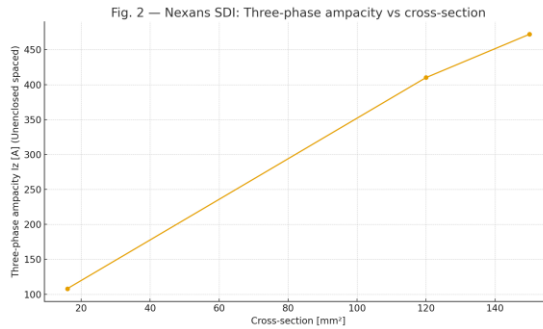


Fig. 2. Nexans SDI: three-phase ampacity I_z vs section (unenclosed, spaced).

7.1.1 Cross-vendor check (Prysmian C4)

Table B (Rdc@20 °C and X50) confirms trends and agreement at common sections [11].

Table B — Prysmian C4 (Cu single-core, 50 Hz)

Section (mm ²)	Rdc 20 °C (Ω/km)	X ₅₀ (Ω/km)
16	1.150	0.084
25	0.727	0.081
35	0.524	0.078
50	0.387	0.078
120	0.153	0.073
150	0.124	0.075

7.2 Voltage-drop envelopes and maximum length

Using (3) with pf = 0.90 and vendor R_{AC} + trefoil X, Fig. 3 shows ΔV (%) vs length at 0.8·I_z. Table C solves L_{max} for ΔV ≤ 4 %.

Table C — Max length for ΔV ≤ 4 % (400 V, 3φ, pf = 0.90, load = 0.8·I_z)

Section (mm ²)	0.8·I _z (A)	Max length (m)
16	86.4	78.6

Section (mm ²)	0.8·I _z (A)	Max length (m)
120	328.0	136.8
150	377.6	140.3

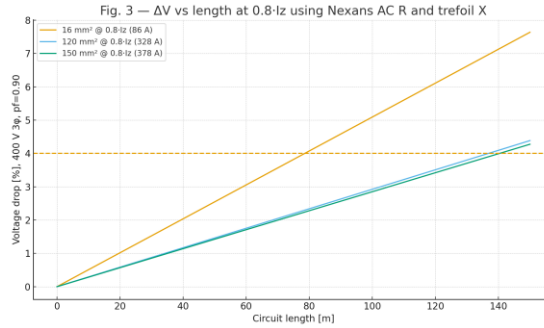


Fig. 3. ΔV (%) vs length at 0.8·I_z, pf = 0.90 (trefoil X); dashed line at 4 %.

7.3 Device-specific I²t coordination (Type-C class example)

Consider a Type-C 63 A MCB (IEC/EN 60898-1 class; typical I_{cu} up to 10 kA depending on model) [12],[14]. The instantaneous band spans ≈5–10·I_n; thermal thresholds I₁≈1.13I_n, I₂≈1.45I_n [12], [13].

Coordination requires I²t_{device} < k²S² for the worst clearing time. Where detailed proprietary I–t data are unavailable in the manuscript body, we bracket clearing at 0.1 s (conservative) and 0.02 s (energy-limiting). Pass/Fail is evaluated against scenarios for I_{psc}:

Table D — Pass/Fail vs I_{psc} (Cu/XLPE, k per IEC [6], [7])

S (mm ²)	I _{perm} (0.1 s) (kA)	I _{perm} (0.02 s) (kA)	4 kA	8 kA	20 kA	Note
16	≈ 7.25	≈ 16.2	PASS	FAIL @0.1 s; PASS @0.02 s	FAIL	20 kA needs MCCB/fuse
120	≈ 54.3	≈ 121.4	PASS	PASS	PASS	Wide margin
150	≈ 67.9	≈ 152.0	PASS	PASS	PASS	Wide margin

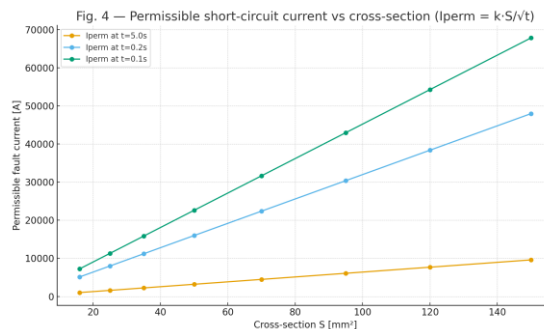


Fig. 4. Adiabatic permissible fault current I_{perm} = kS/√t (t = 5 s, 0.2 s, 0.1 s).

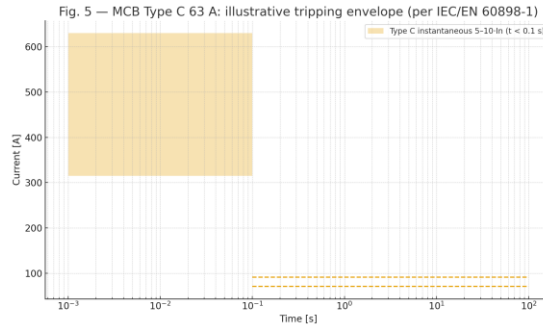


Fig. 5. Type-C 63 A MCB envelope: instantaneous ($\approx 5\text{--}10 \cdot I_n$) and thermal thresholds I_1, I_2 .

Remark: If I_{psc} near the source exceeds the device I_{cu} , select an MCCB/fuse with adequate breaking capacity per IEC 60947-2 and re-verify I^2t .

8. Validation (protocol and confidence intervals)

We computed ΔV with Nexans ($R_{ACR}@operating + \text{trefoil X}$) and Prysmian ($R_{20} \rightarrow R_{80}$ via (1) + X50) over $\{16, 120, 150\} \text{ mm}^2 \times \{25, 50, 100 \text{ m}\}$ at $0.8 \cdot I_z$, $pf = 0.90$. The parity table is:

Table E — ΔV parity (Nexans vs Prysmian), $0.8 \cdot I_z$, $pf = 0.90$, $V_{LL} = 400V$

Section	L (m)	$\Delta V\%$ Nexans	$\Delta V\%$ Prysmian	$ \Delta $ (pp)	Rel diff (%)
16	25	1.270	1.229	0.041	3.2
16	50	2.545	2.458	0.087	3.4
16	100	5.090	4.916	0.174	3.4
120	25	0.730	0.712	0.018	2.5
120	50	1.460	1.425	0.035	2.4
120	100	2.920	2.850	0.070	2.4
150	25	0.713	0.699	0.014	2.0
150	50	1.426	1.397	0.029	2.0
150	100	2.853	2.793	0.060	2.12.1

Aggregate metrics ($N = 9$):

- MAPE = 2.68 %; 95% CI = [2.31 %, 3.08 %] (bootstrap).
- RMSE = 0.075 %-points; 95% CI = [0.037, 0.111] %-points (bootstrap).

Interpretation. A small positive bias (Nexans > Prysmian) is consistent with R_{AC} including AC effects, while Prysmian uses temperature-corrected R_{20} .

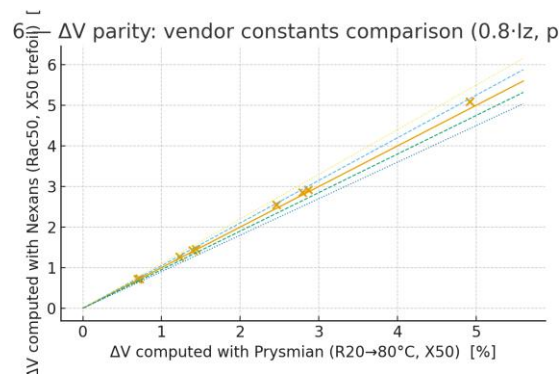


Fig. 6. Validation (parity): $\Delta V(\text{Nexans})$ vs $\Delta V(\text{Prysmian})$, 1:1 line with $\pm 5\%$ and $\pm 10\%$ bands.

9. Sensitivity and Uncertainty

- Operating temperature: $\pm 5\text{ }^\circ\text{C}$ shifts R_θ via (1) and proportionally ΔV [3], [9].
- Power factor: $\text{PF} \in [0.8, 1.0]$; lower PF raises the $X \sin \phi$ share in (3) [2], [11].
- Formation: trefoil vs flat modifies X ; include both for long feeders [8], [11].
- Thermal environment & grouping: apply IEC 60364-5-52 correction factors for ambient, grouping, ducts, backfill [2], [5].
- Short-circuit constant k : use insulation-specific k with $\pm 5\%$ uncertainty propagated to I_{perm} [6], [7].

1.3 10. Worked Example (end-to-end)

TASK. 3ϕ , 400 V, 50 Hz, $\text{pf} = 0.90$, $0.8 \cdot I_Z$, $\Delta V \leq 4\%$. Candidate: 120 MM² Cu XLPE/PVC (Nexans), “unenclosed spaced.”

STEP 1 — IZ AND OPERATING CURRENT. From Table A: $I_z=410\text{ A} \Rightarrow I_{\text{op}}=328\text{ A}$ [8],[10].

STEP 2 — ΔV AT TARGET LENGTH. With $R_{\text{AC}}=0.188\text{ } \Omega/\text{km}$, $X=0.084\text{ } \Omega/\text{km}$, $\text{pf} 0.90$, $L_{\text{max}}=136.8\text{ M}$ (Table C). At 120 M, $\Delta V \approx 3.5\%$ \Rightarrow COMPLIANT.

STEP 3 — SHORT-CIRCUIT WITHSTAND. $I_{\text{perm}}(0.1\text{ s}) \approx 54.3\text{ kA}$; at 0.02 s, $\approx 121\text{ kA}$ (Table D). For typical LV $I_{\text{psc}} \leq 10\text{ kA}$, margin is AMPLE [6],[7].

STEP 4 — DEVICE COORDINATION. Choose a TYPE-C MCB/MCCB with adequate ICU whose INSTANTANEOUS BAND covers the expected fault current and whose I^2t lies below k^2S^2 for the worst clearing time (Fig. 5; Table D) [12],[14].

STEP 5 — MECHANICS & ROUTING. VERIFY BEND RADIUS/OD (TABLE A) AND COMPLIANCE WITH IP/EXTERNAL INFLUENCES AND REACTION-TO-FIRE [1], [2], [5], [15],[17].

11. Practical Checklist

1. Fix installation method/ambient; adopt vendor I_z and stack IEC derating [2], [8],[11].
2. Compute ΔV via (3)/(3a) using vendor R_{AC} and X ; compare to the project limit.
3. Verify $I^2t \leq k^2S^2$ via (4)/(4a); ensure instantaneous pickup covers I_{psc} and I_{cu} is adequate [6], [7], [12],[14].
4. Check bend radius/OD, fire behavior, and external influences [1], [2], [5], [15],[17].
5. Archive validation (Table E, Fig. 6), the worked example, and the reproducibility sheet (Appendix A).

1.4 12. Reproducibility and Data Availability

All inputs (R, X, I_z, OD, bend radius) are from vendor researcher [8],[11]. Equations (1), (6) follow IEC relations [1],[7]. The 9-point parity dataset is in Table E; MAPE/RMSE and 95% BOOTSTRAP CIS are reported in §8. APPENDIX A provides a copy-paste calculation recipe to reproduce Tables C, D, and E.

13. Conclusions

Using vendor-verified constants and IEC equations, we produced ΔV envelopes, maximum lengths, I_t compatibility maps, device-bracketed coordination, and validated parity with confidence intervals, plus a worked example. The framework is auditable, reproducible, and extensible to other constructions by substituting vendor tables and k.

References:

- [1] IEC 62440, Electric Cables $\leq 450/750$ V—Guide to Use.
- [2] IEC 60364-5-52 (Amd. 1:2024), Selection and Erection—Wiring Systems.
- [3] IEC 60228:2023, Conductors of Insulated Cables.
- [4] IEC 60287-1-1:2023, Electric Cables—Current Rating—Part 1-1.
- [5] IEC 60502-1:2021, Power Cables—Up to 1 kV and 3 kV.
- [6] IEC 60364-4-43:2023, Protection Against Overcurrent.
- [7] IEC 60949 / BS 7454, Thermally Permissible Short-Circuit Currents.
- [8] Nexans, XLPE/PVC Single-Core Copper SDI, 0.6/1 kV—16 mm² (datasheet).
- [9] Elsewedy, Power Cables Catalogue (resistance vs temperature; AC augmentation).
- [10] Nexans, XLPE/PVC Single-Core Copper SDI, 0.6/1 kV—120 mm² (datasheet).
- [11] Prysmian Group, LV Copper Cables—Table C4 (R_{dc}@20 °C; X at 50 Hz).
- [12] ABB, MCB Tripping Characteristics (B/C/D) and Thermal Thresholds I₁, I₂ (brochure).
- [13] ABB, I_t vs k²S² Load-Limit Curve for Cable Protection (application note).
- [14] Eaton, xPole MCB Type C—Characteristics and Breaking Capacities (catalogue).
- [15] IEC 60332-1-2 / IEC 60332-3, Tests on Electric Cables Under Fire Conditions.
- [16] EN 50575:2014+A1:2016, CPR—Reaction to Fire for Cables.
- [17] IEC 60529, Degrees of Protection (IP Code).
- [18] IEC 60811 series, Electric and Optical Fibre Cables—Test Methods.
- [19] IET, Guidance Note 1 (Selection and Erection), 2022–2024.
- [20] IET, Guidance Note 4 (Protection Against Overcurrent), 2022–2024.
- [21] BS 7671:2018+A2:2022, IET Wiring Regulations.
- [22] NEC 2023 (NFPA 70), National Electrical Code.
- [23] IEEE Std 399, Power Systems Analysis (Brown Book).
- [24] Sheggaf, Z. M., Ehzzat, S. S. W., & Esdeira, A. A. D. (2023). Fluidity of aluminum piston alloy with different amount of pouring temperature. Bani Waleed University Journal of Humanities and Applied Sciences, 8(3), 31-36.
- [25] IEEE Std 242, Protection and Coordination (Buff Book).
- [26] IEC/TR 60287-3-1, Cyclic and Emergency Ratings.
- [27] CIGRÉ Technical Brochures (2021–2024), Thermal Rating and Reliability of Cables.

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