CHAPTER 43: OVERCURRENT AND THE ADIABATIC EQUATION

HOW LONG CAN A CABLE SURVIVE A FAULT?

Chapter 43 is protection against **overcurrent** — overload and fault current. First, what a fault actually is:

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Short circuit

A fault between

live conductors

: line to neutral, or line to line. (Line to earth is an

earth fault

, not a short circuit.) A nail through a cable does it. The current takes the

shortest, lowest-resistance path

, which is why a nail bridging line and neutral gives a bigger current than the longer path back through the CPC.

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Overload

The circuit is healthy, but you've asked it to carry more current than it was designed for.

APPENDIX 3 — THE TIME/CURRENT CURVES

Appendix 3 holds the time/current characteristic graphs — the "graphs of doom". Find your device type and rating along the top, find your fault current along the bottom, follow up to the curve, read the disconnection time off the side.

Use the little tables instead.
Appendix 3 prints, with each set of curves, a table of overcurrent characteristics giving the current needed to operate the device in **0.1 s to 5 s**. For a **6 A type B**, that's **30 A** — which is just 6 × 5 again. Far quicker than reading a log scale under exam pressure.

434.5 — HOW LONG THE CABLE CAN TAKE IT

The adiabatic equation answers "will the conductor survive until the device operates?"

$$t = k^2S^2 \div I^2$$

t = time in seconds · **S** = conductor csa in mm² · **I** = effective fault current in amps · **k** = a factor from Table 43.1

Table 43.1 gives k. You pick your row by insulation type, initial temperature, conductor material and whether the csa is above or below 300 mm²:

CABLE	CONDUCTOR	K
70 °C thermoplastic, ≤ 300 mm² (final temp 160 °C)	**Copper**	**115**
70 °C thermoplastic, ≤ 300 mm² (final temp 160 °C)	Aluminium	76

1.5 MM² TWIN & EARTH, 360 A FAULT CURRENT

$t = k^2S^2 \div I^2$
$t = 115^2 \times 1.5^2 \div 360^2$
$t = 13\ 225 \times 2.25 \div 129\ 600$
$t = 29\ 756 \div 129\ 600$
$t = 0.23$ seconds

What it means: the 1.5 mm² conductor can carry 360 A for 0.23 s before it is damaged. Check in Appendix 3 that the device opens faster than that. A type B of 6–20 A needs only 30–100 A to open in 0.1 s, so at 360 A it opens well inside 0.23 s. **Cable protected** (Compare t with the device's operating time, not with Table 41.1.)

Don't panic about this one.

Unless you go on to do design, someone else will have done these calculations before you install anything. It's here so you understand how the pieces connect — and because the formula itself has been a multiple-choice answer.

- **Chapter 43** · protection against overcurrent
- **434.5** · adiabatic equation $t = k^2S^2/I^2$
- **Table 43.1** · k values (copper 115, aluminium 76)
- **Appendix 3** · time/current curves and characteristic tables

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