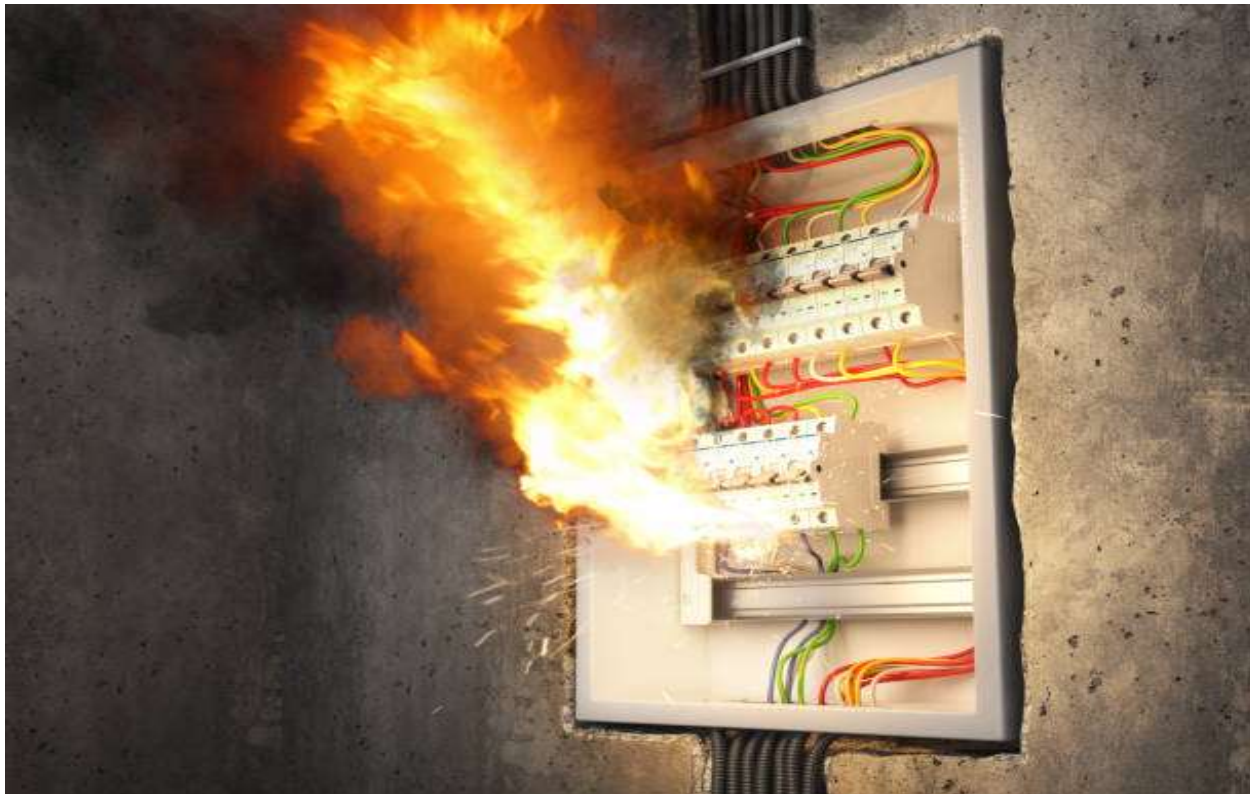


OVER LOAD AND WIRE SHOCK

M.E.S

3.10.26

I (a) Sample Photos of Electrical Wire Shock



Overload & wire shock



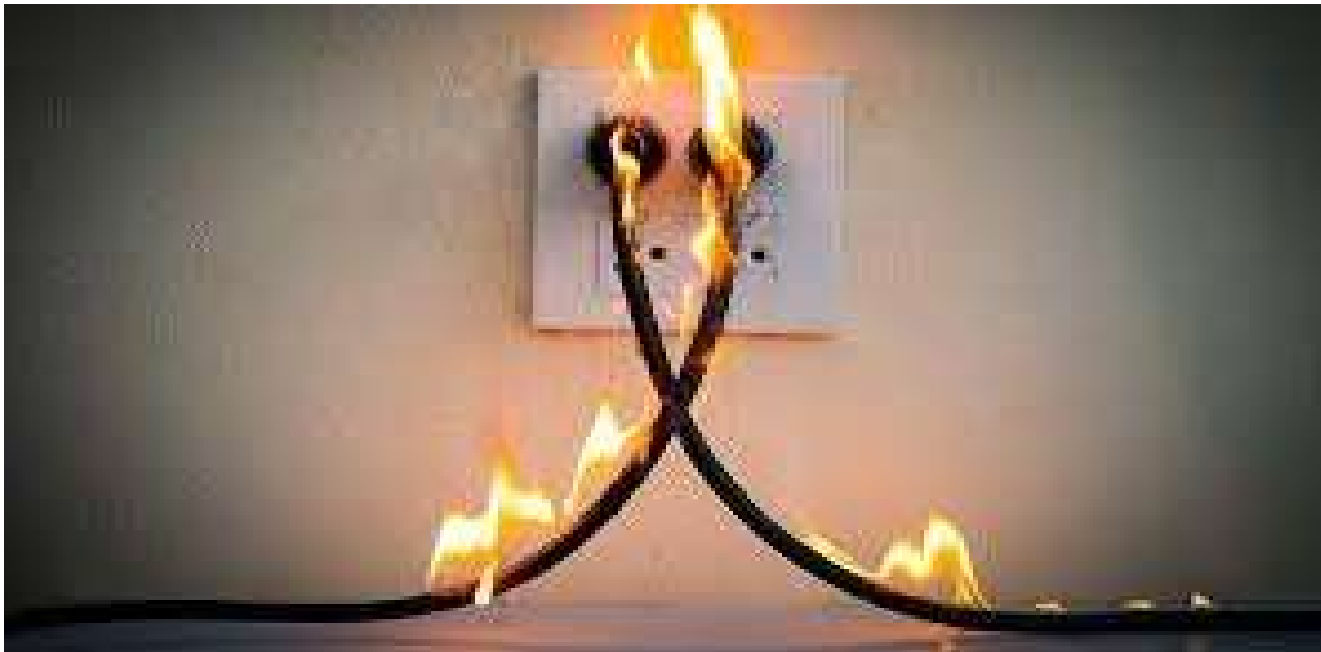
Overload & wire shock



Overload & wire shock



Overload & wire shock



Overload & wire shock



Overload & wire shock



Overload & wire shock



Overload & wire shock



Overload & wire shock

(b) Design Current (I_B)

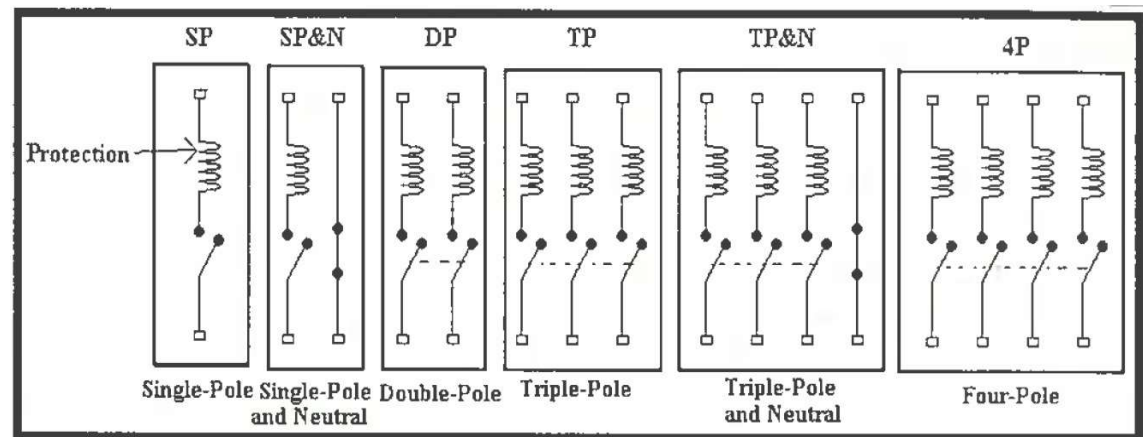
$$I_B = \text{Max demand } W \div 230 \div \cos \theta \text{ (Single Phase)}$$

$$I_B = \text{Max demand } W \div \sqrt{3} \div 400 \div \cos \theta \text{ (Three Phase)}$$

Operating switches 1 Gang 1 Way Switch , 2 Gang 1Way Switch,1 Gang 2 Way Switch , etc... are not protective devices.

(c) Protective devices

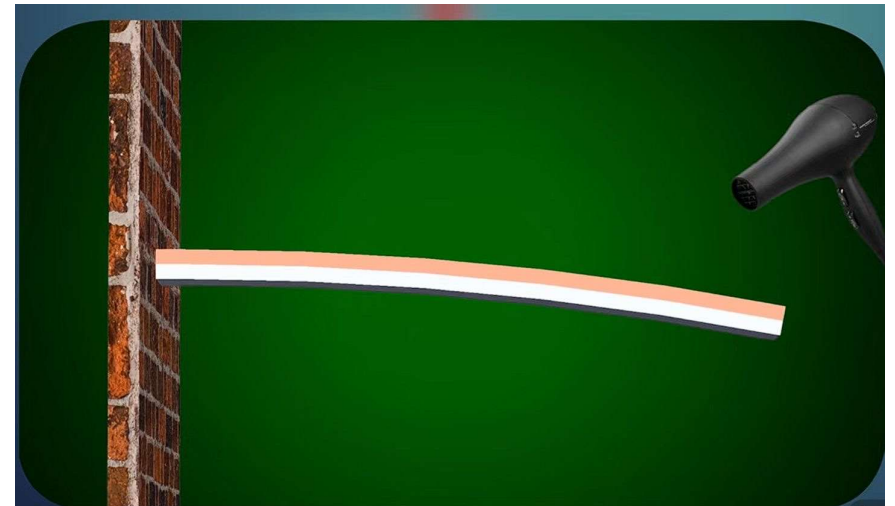
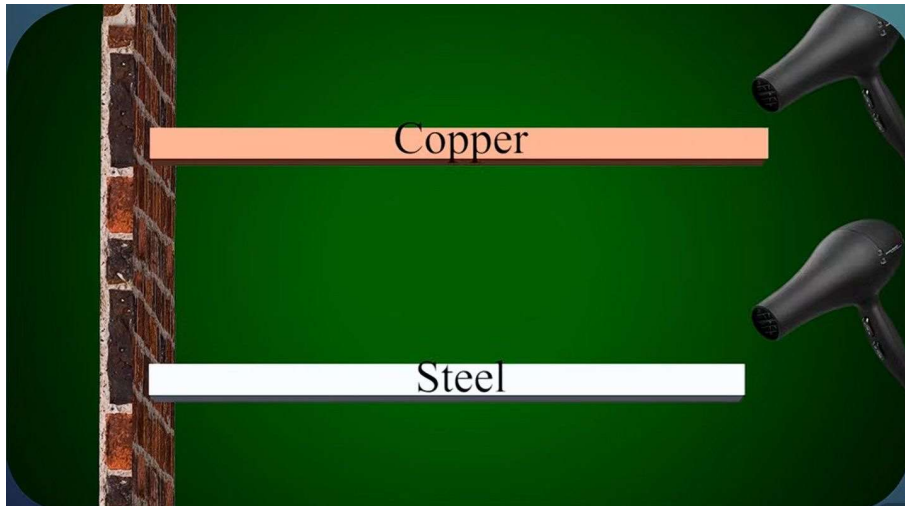
Miniature Circuit Breaker (M.C.B)



Miniature Circuit Breakers (MCBs) are manufactured in fixed ratings from 6A, 10A, 16A, 20A, 25A, 32A, 40A, 50A, 63A, 80A & 100A.

(d) How do they work?

(Copper and Steel)



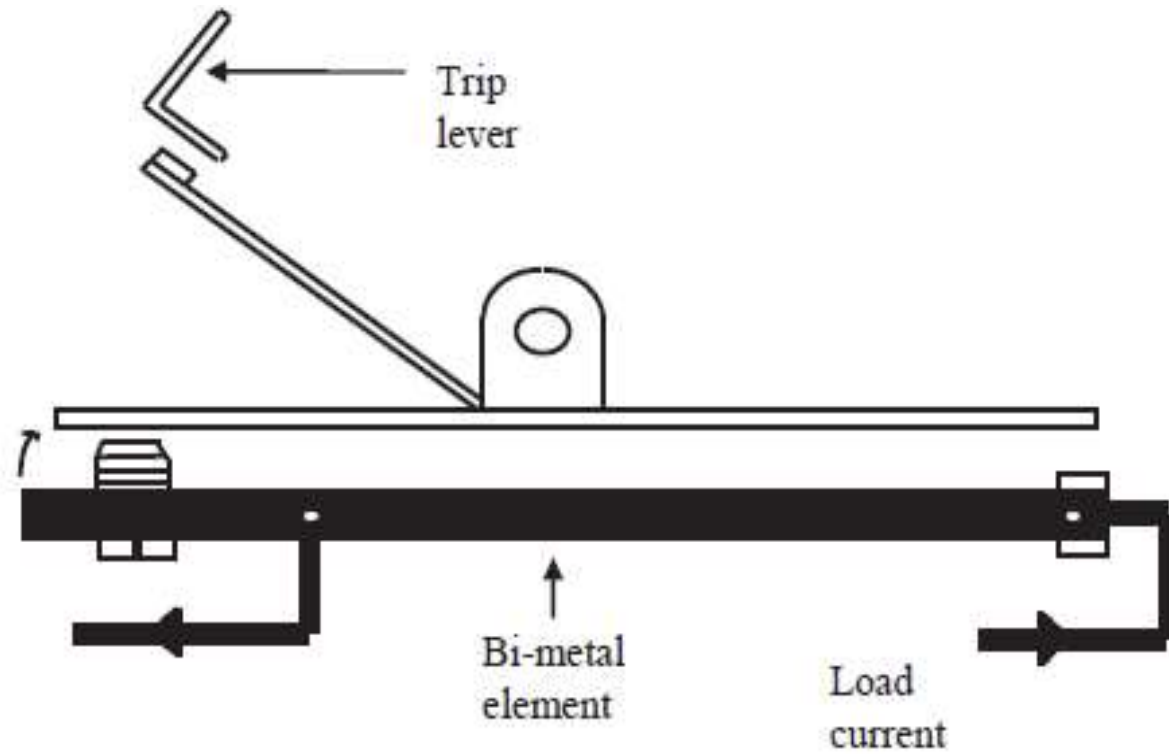


Figure 4.a.1 Principle of tripping by a bi-metal

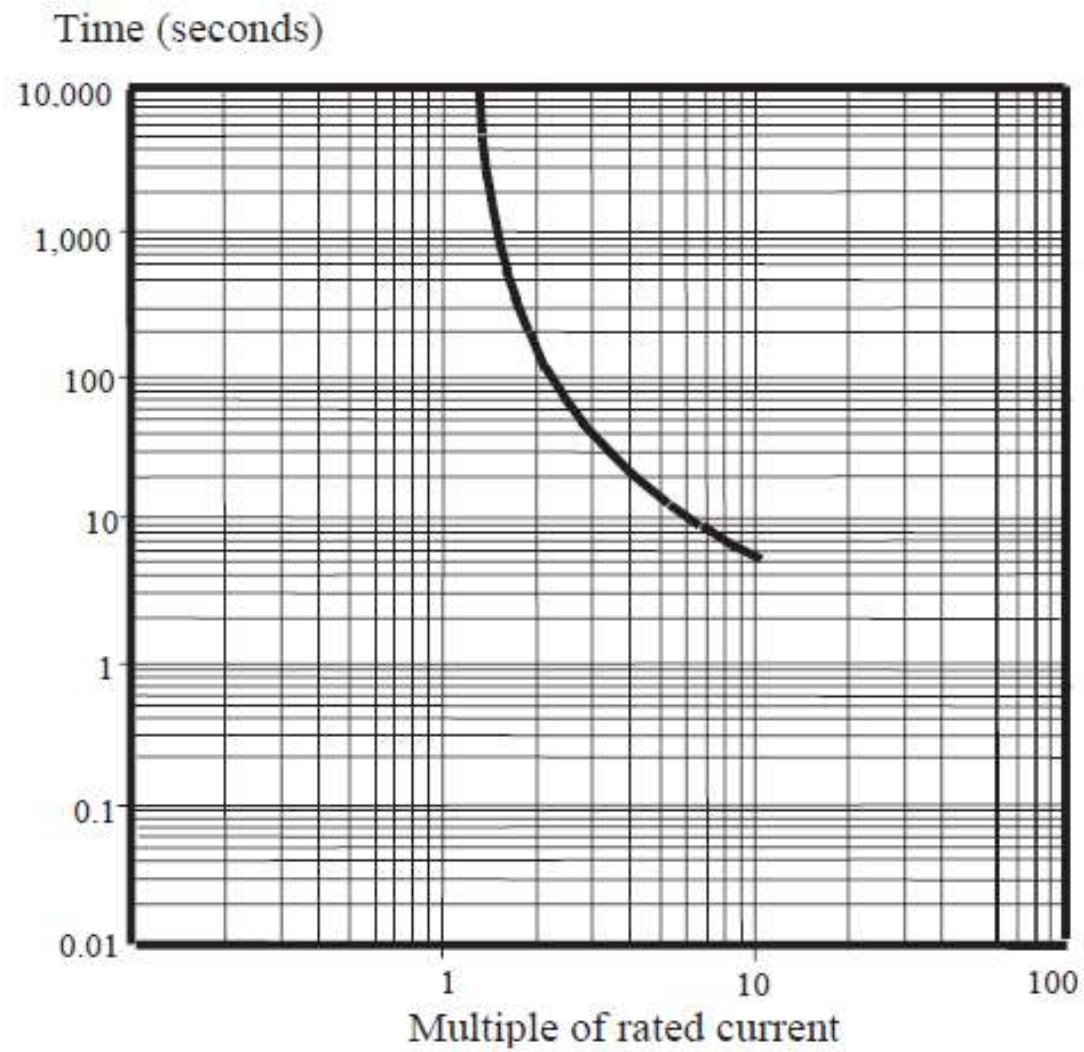


Figure 4.a.2 Time-current Characteristic of a thermal trip

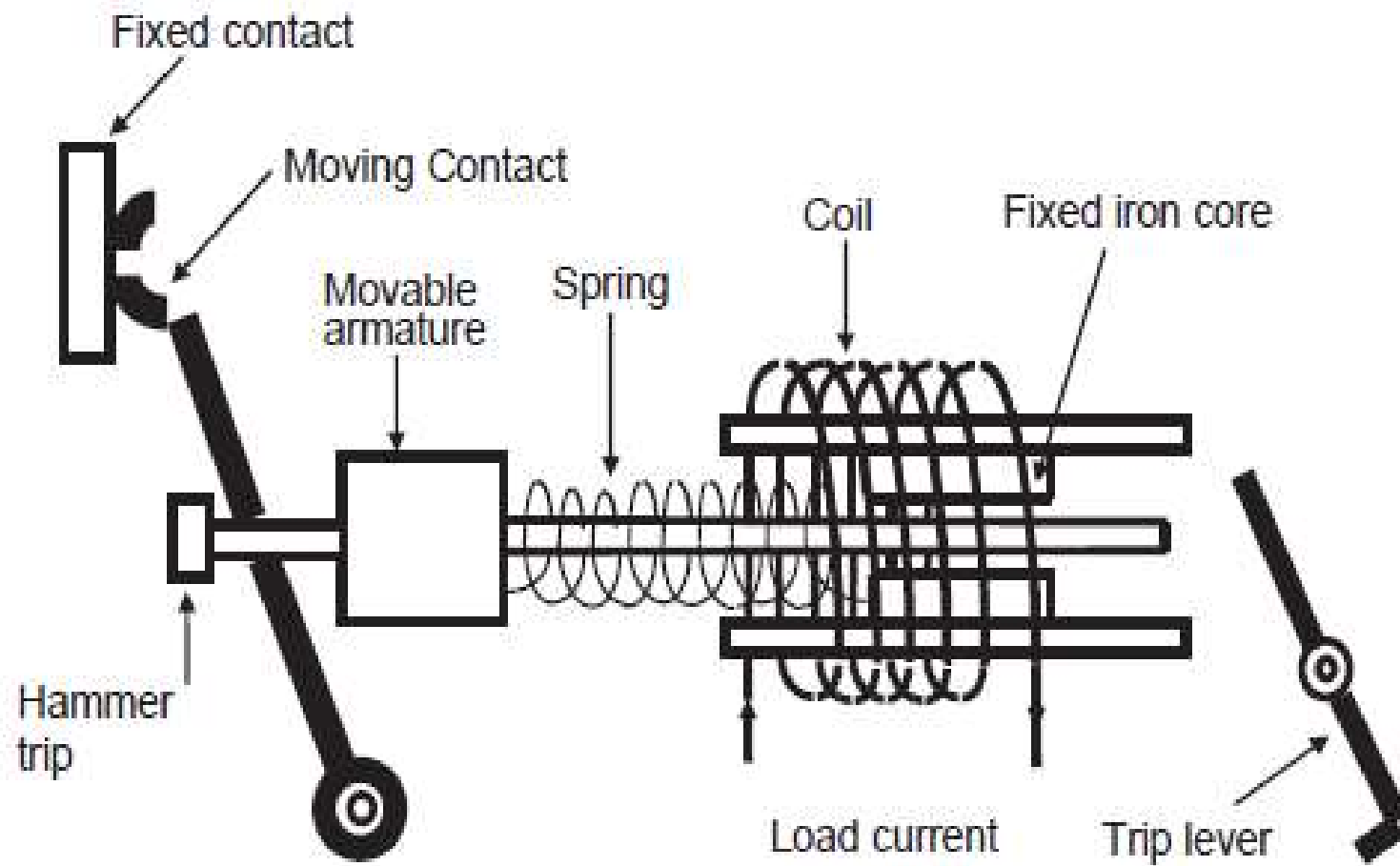


Figure 4.a.3 Principle of tripping by an electromagnetic device

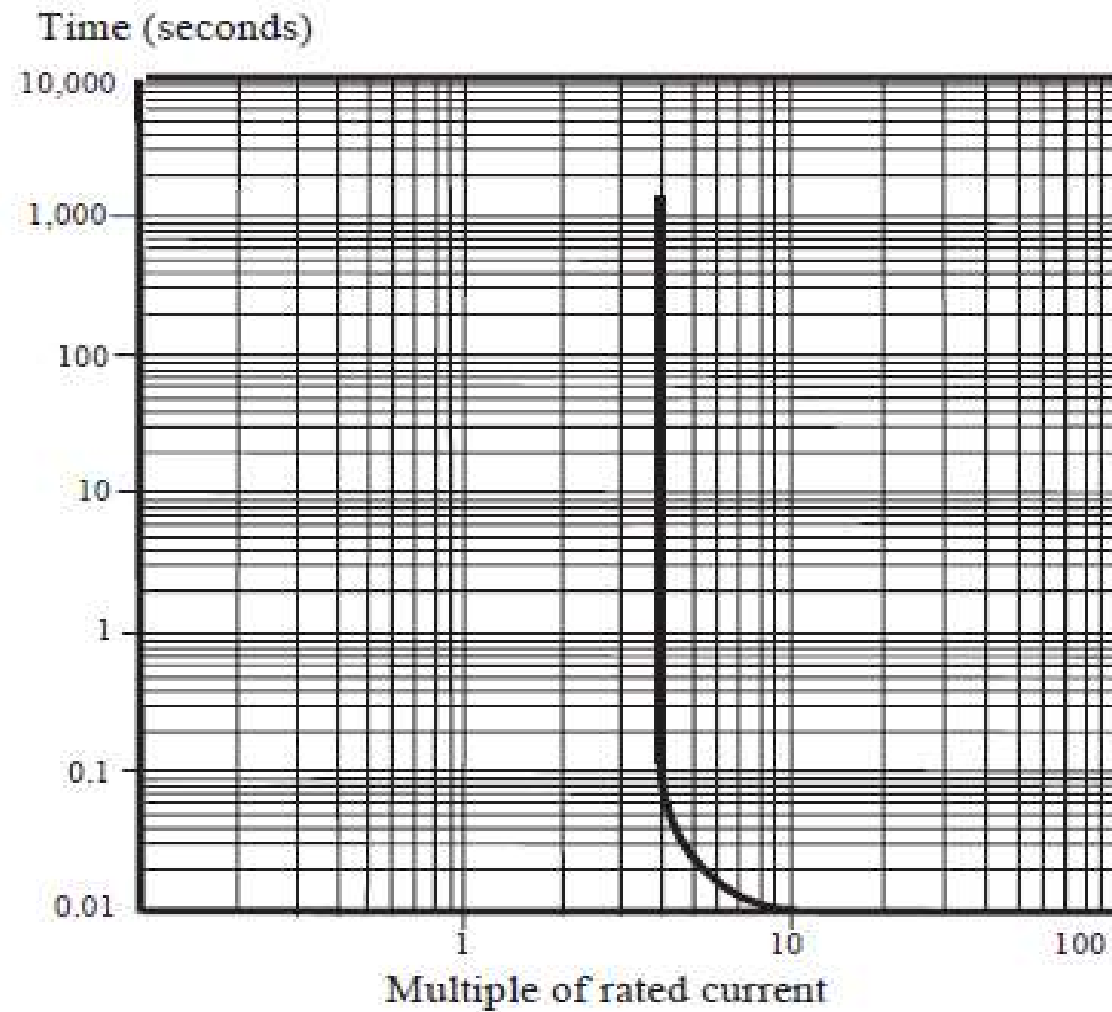


Figure 4.a.4 Multiple of rated current

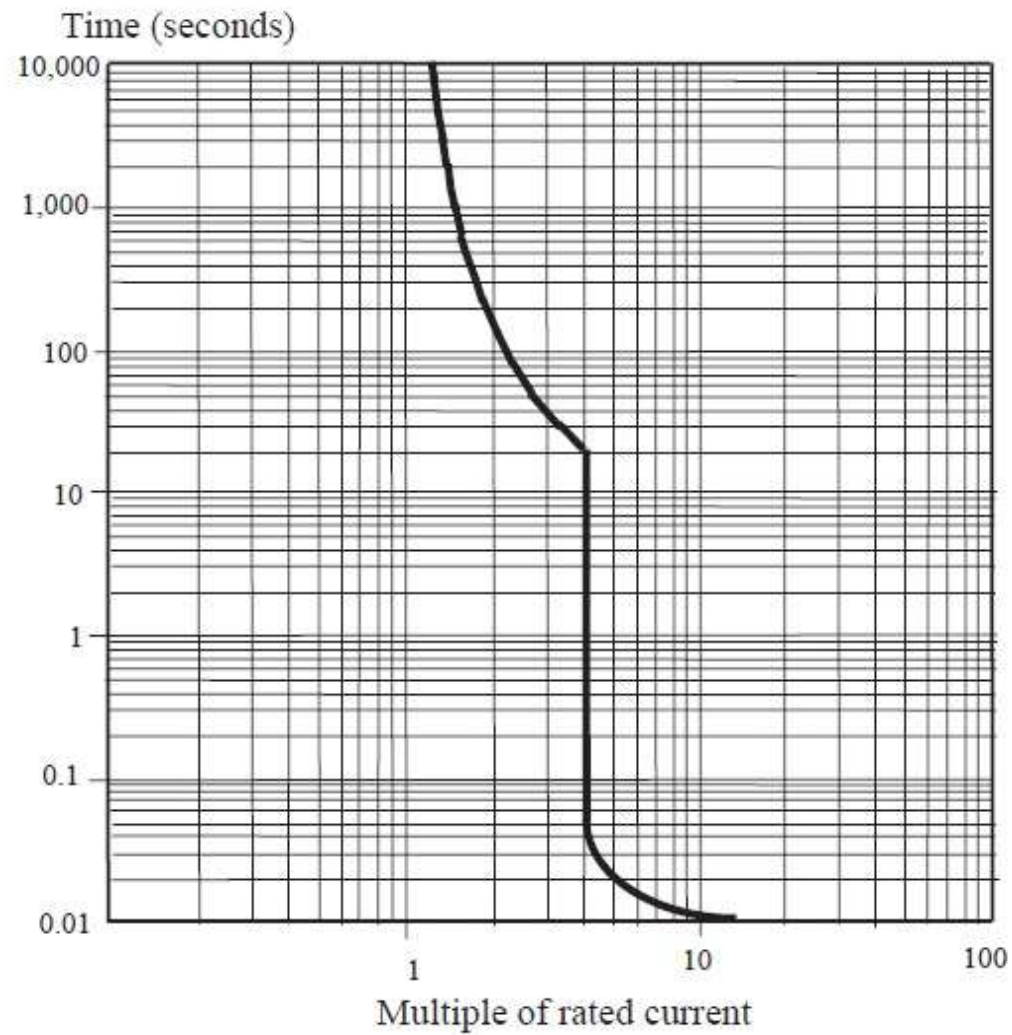


Figure 4.a.5 Time current characteristic of the combined tripping

fig 3.7 Type B circuit breaker to BS EN 60898

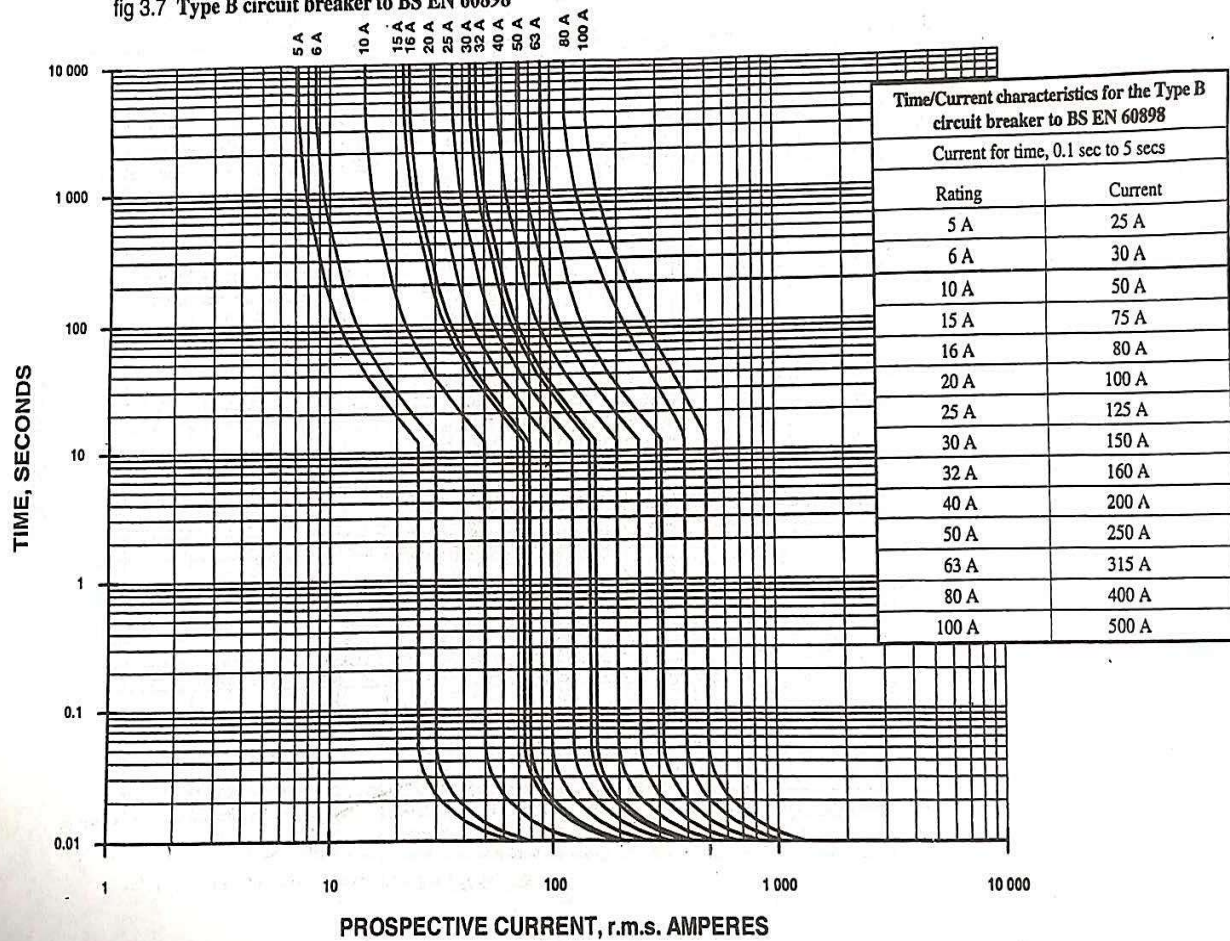


fig 3.8 Type C circuit breaker to BS EN 60898

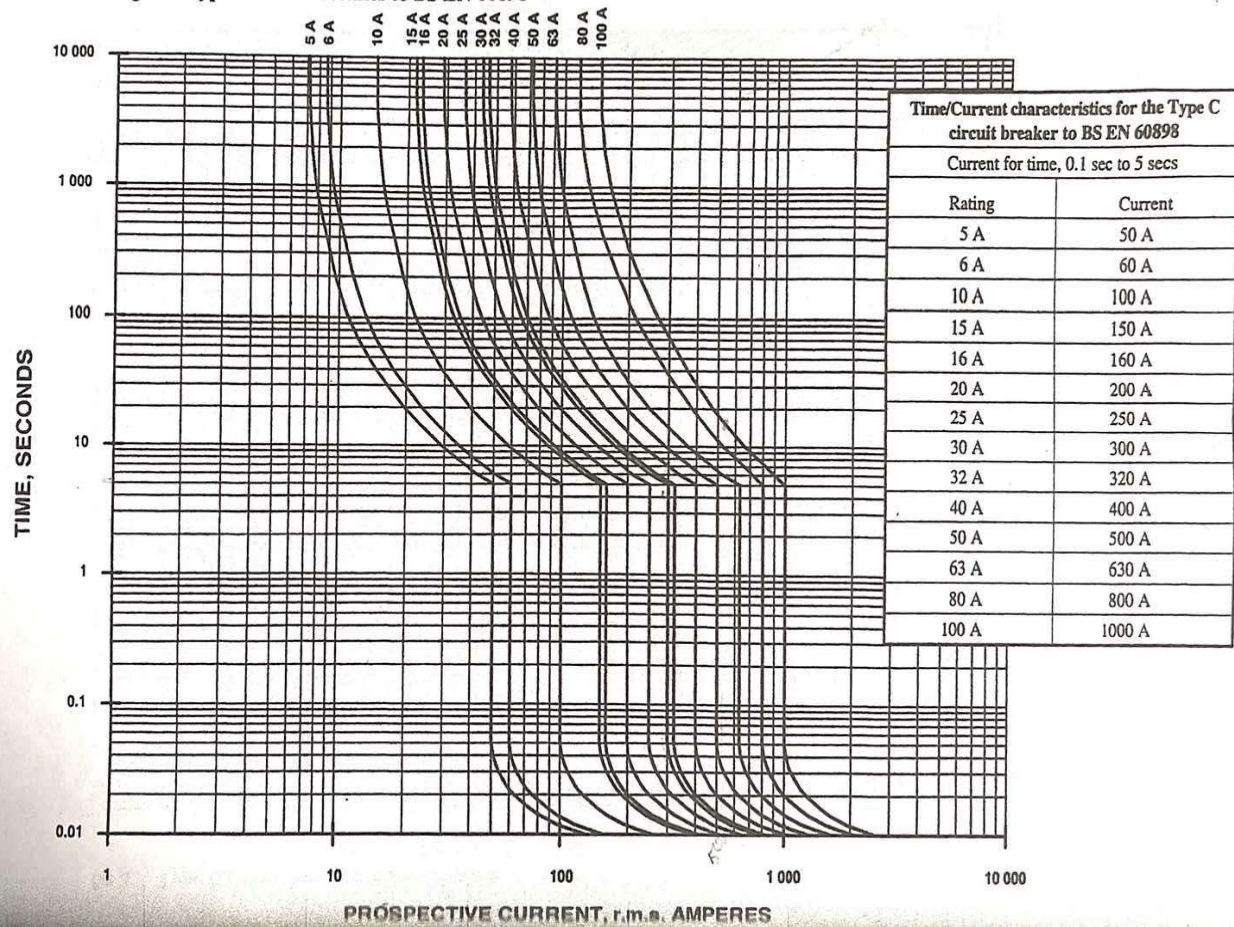
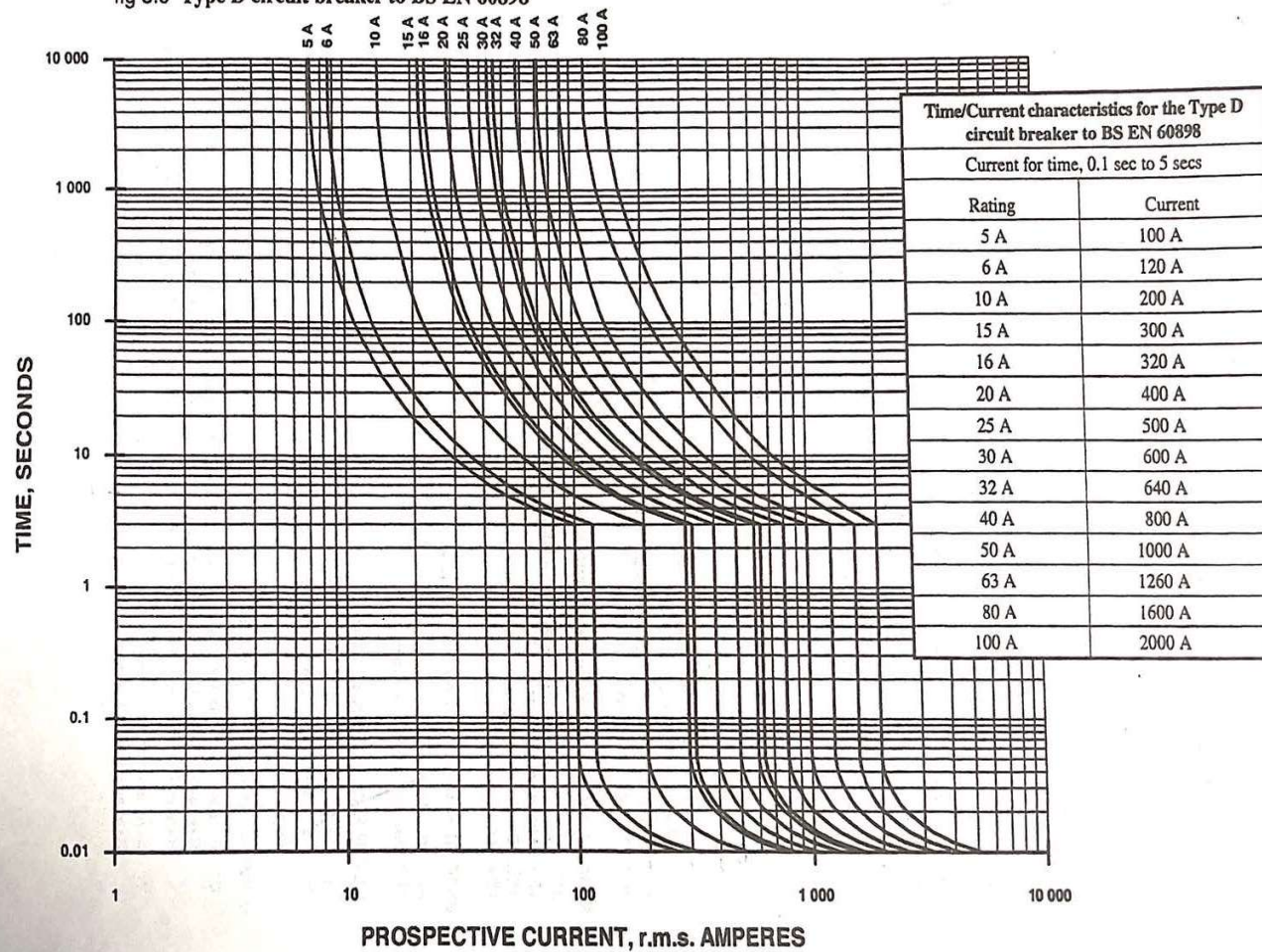


fig 3.9 Type D circuit breaker to BS EN 60898



Instantaneous Tripping

Type	Instantaneous Tripping Current
B	Above $3 I_N$ up to and including $5 I_N$
C	Above $5 I_N$ up to and including $10 I_N$
D	Above $10 I_N$ up to and including $50 I_N$

(e) Tripping Characteristics

Tripping characteristics

Acc. to	Tripping characteristics	Rated current I_n	Thermal release ¹⁾			Electromagnetic release ²⁾		
			Currents: conventional non-tripping current I_1	conventional tripping current I_2	Tripping time	Range of instantaneous tripping	Tripping time	
IEC/EN 60898-1	B	6 to 63 A	$1.13 \cdot I_n$	$1.45 \cdot I_n$	$> 1 \text{ h}$ $< 1 \text{ h}^{3)}$	$3 \cdot I_n$ $5 \cdot I_n$	$0.1 \dots 45 \text{ s } (I_n \leq 32 \text{ A}) / 0.1 \dots 90 \text{ s } (I_n > 32 \text{ A})$ $< 0.1 \text{ s}$	
	C	0.5 to 63 A	$1.13 \cdot I_n$	$1.45 \cdot I_n$	$> 1 \text{ h}$ $< 1 \text{ h}^{3)}$	$5 \cdot I_n$ $10 \cdot I_n$	$0.1 \dots 15 \text{ s } (I_n \leq 32 \text{ A}) / 0.1 \dots 30 \text{ s } (I_n > 32 \text{ A})$ $< 0.1 \text{ s}$	
	D	0.5 to 63 A	$1.13 \cdot I_n$	$1.45 \cdot I_n$	$> 1 \text{ h}$ $< 1 \text{ h}^{3)}$	$10 \cdot I_n$ $20 \cdot I_n$	$0.1 \dots 4 \text{ s } (I_n \leq 32 \text{ A}) / 0.1 \dots 8 \text{ s } (I_n > 32 \text{ A})$ $< 0.1 \text{ s}$	
IEC/EN 60947-2	K	0.5 to 63 A	$1.05 \cdot I_n$	$1.2 \cdot I_n$	$> 1 \text{ h}$ $< 1 \text{ h}^{3)}$	$10 \cdot I_n$ $14 \cdot I_n$	$> 0.2 \text{ s}$ $< 0.2 \text{ s}$	
	Z	0.5 to 63 A	$1.05 \cdot I_n$	$1.2 \cdot I_n$	$> 1 \text{ h}$ $< 1 \text{ h}^{3)}$	$2 \cdot I_n$ $3 \cdot I_n$	$> 0.2 \text{ s}$ $< 0.2 \text{ s}$	

¹⁾ The thermal releases are calibrated to a nominal reference ambient temperature; for B, C, D the reference value is 30 °C, for K and Z the reference value is 20 °C. In the case of higher ambient temperatures, the current values fall by approx. 6 % for each 10 K temperature rise.

²⁾ The indicated tripping values of electromagnetic tripping devices apply to a frequency of 50/60 Hz. The thermal release operates independent of frequency.

³⁾ As from operating temperature (after $I_1 > 1 \text{ h}$)

(f) Temperature Derating

Temperature Derating

MCBs are designed and calibrated to carry the nominal rated current at 30°C reference temperature. Installation / operation at higher ambient temperature requires progressively less current to trip the MCB within the designated time/current zone. The derating table below describes the effect of temperature on MCB thermal tripping characteristic. For example a 16A MCB will trip on 13.4A thermal current when operating at 50°C ambient. (In – nominal thermal tripping current)

In (A)	-5°C	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	55°C	60°C
2	2.56	2.48	2.4	2.32	2.24	2.16	2.08	2	1.92	1.84	1.76	1.68	1.6	1.52
4	5.12	4.96	4.8	4.64	4.48	4.32	4.16	4	3.84	3.68	3.52	3.36	3.2	3.04
6	7.68	7.44	7.2	6.96	6.72	6.48	6.24	6	5.76	5.52	5.28	5.04	4.8	4.56
10	12.8	12.4	12	11.6	11.2	10.8	10.4	10	9.6	9.2	8.8	8.4	8	7.6
13	16.6	16.1	15.6	15.1	14.6	14.0	13.5	13	12.5	12.0	11.4	10.9	10.4	9.9
16	20.5	19.8	19.6	18.6	17.9	17.3	16.6	16	15.4	14.7	14.1	13.4	12.8	12.2
20	25.6	24.8	24	23.2	22.4	21.6	20.8	20	19.2	18.4	17.6	16.8	16	15.2
25	32	31	30	29	28	27	26	25	24	23	22	21	20	19
32	41.0	39.7	38.4	37.1	35.8	34.6	33.3	32	30.7	29.4	28.2	26.9	25.6	24.3
40	51.2	49.6	48	46.4	44.8	43.2	41.6	40	38.4	36.8	35.2	33.6	32	30.4
50	64	62	60	58	56	54	52	50	48	46	44	42	40	38
63	80.6	78.1	75.6	73.1	70.6	68.0	65.5	63	60.5	58.0	55.4	52.9	50.9	47.9
80	95.1	93.1	91.0	88.9	86.8	84.6	82.3	80	77.6	75.1	72.6	70	67.2	64.4
100	121.1	118.3	115.5	112.5	109.5	106.5	103.3	100	96.6	93.1	89.4	85.6	81.6	77.5
125	144.3	141.7	139.0	136.3	133.6	130.8	127.9	125	121.9	118.9	115.7	112.4	109.1	105.6

(g) Grouping Factor

Inside enclosure the heating effect of MCBs installed in close proximity (in groups) needs to be taken into consideration. Certain amount of watt loss from each device will contribute to raise the ambient temperature of the breaker above the ambient temperature of the enclosure. Apply Grouping factor K(g) to derate MCB thermal trip current accordingly.

No of Device (n)	1	$2 \leq n < 4$	$4 \leq n < 6$	$6 \leq n$
K (g)	1	0.95	0.9	0.85

(h) Application example

Three MCBs are to be installed side by side inside an enclosure. The ambient temperature inside the enclosure is at 40°C. The required maximum load current draw per MCB = 22A. Determine whether 25A MCB would provide suitable solution.

- From the Temperature Derating table,
The nominal trip current (I_n) of 25A MCB operating at 40°C is derated to 23A.
- From the Grouping Factor table,
Three MCBs installed side by side has a grouping factor $K(g) = 0.95$.
- Combined effect of temperature derating & grouping factor,
 $23 \times 0.95 = 21.85A$

In this application the 25A MCB would trip at 21.85A and therefore be unsuitable to supply the max 22A load that is required . In this case a 32A MCB should be selected instead.

(i) Continuous and Noncontinuous Loads

Where a branch circuit supplies continuous loads or any combination of continuous and noncontinuous loads , the rating of the overcurrent device shall not be less than the noncontinuous load plus 125 percent of the continuous load.

(j) NEC Article 100

Under the National Electrical Code (NEC) Article 100, a continuous load is defined simply as: “ A load where the maximum current is expected to continue for 3 hours or more.”

Common Residential Loads (Room Only) Considered Continuous

- ❖ Fixed Storage – Type Water Heaters : Storage water heaters with capacities under 450 liters (120 gallons) are treated as continuous loads under specific code rules (such as NEC 422.13).
- ❖ Certain HVAC Equipment : Heat pumps, air conditioners, or continuous ventilation blower systems if they are expected to run continuously for periods of 3 hours or more at maximum load.

(k) Application example (2)

CL 15kVA ; MD = 9kVA

$$I_B = 9 \div 0.23 = 39.13A$$

Select $I_N = 50A$ DP MCB

Select 30 A DP 30mA RCCB (LTG)

40A DP 30mA RCCB (Power)

Check continuous Load,

Water heater = 1.5 kVA

A/C – 1 = 1.0 kVA

A/C – 2 = 2.2 kVA

total 4.7 kVA

$$I_B = 4.7 \div 0.23 = 20.43A$$

$$+25\% = 20.43 \times 0.25 = 5.1$$

Total load current + additional 25% continuous load current = $39.13 + 5.1 = 44.23\text{A}$

From the temperature derating table

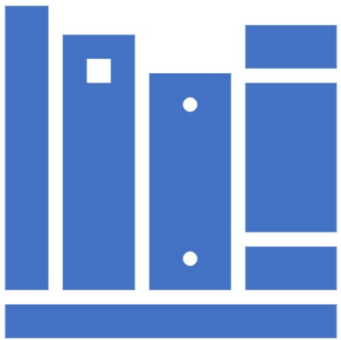
The nominal trip current (I_N) of 50A MCB operating at 35°C is treated to 48A.

From the grouping factor table

One MCB and Two RCCB installed side by side has grouping factor $c_g = 0.95$.

Combine effect of temperature derating and grouping factor $48 \times 0.95 = 45.6\text{ Amp}$.

In this application , the 50A DP MCB would trip at 45.6 amp and therefore be suitable to supply the max 39.13 load that is required.



Presentation End