

Circuit Breaker (CB)

Perangkat pengaman arus lebih yang bekerja membuka dan memutus rangkaian secara non-otomatis dan memutus rangkaian secara otomatis ketika arus yang mengalir dirangkaian melebihi rating arus yang telah ditentukan tanpa menimbulkan kerusakan pada peralatan (CB dan rangkaian) pada saat terjadi gangguan

Klasifikasi

Berdasarkan Pemakaian:

1. LVCB (Low Voltage Circuit Breaker, $< 600 \text{ V}$)
2. MVCB (Medium Voltage Circuit Breaker, $600 \text{ V} - 1000 \text{ V}$)
3. HVCB (High Voltage Circuit Breaker, $> 1000 \text{ V}$)

Berdasarkan Konstruksi:

1. MCCB (Molded Case Circuit Breaker)
2. ICCB (Insulated Case Circuit Breaker)

Berdasarkan Medium:

1. Air : Medium pemutus udara.
2. Oil : Medium pemutus minyak
3. Gas : Medium pemutus gas (SF_6)

Konstruksi MCCB 3 Fasa

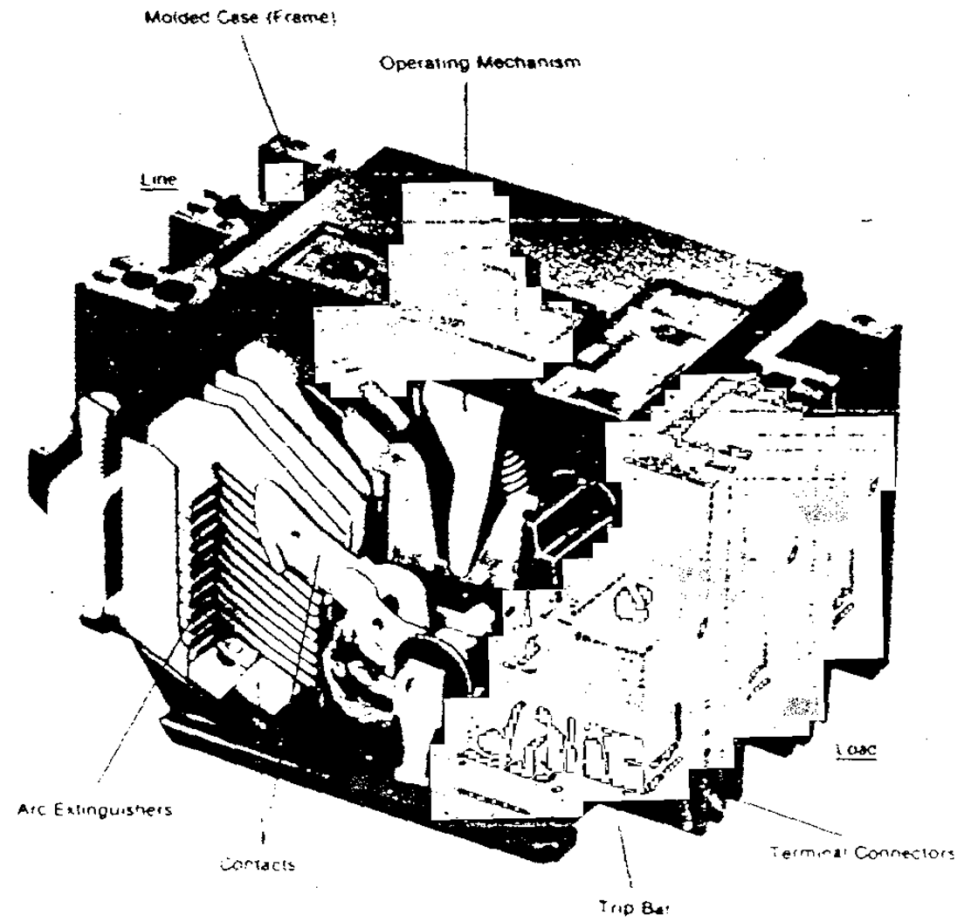
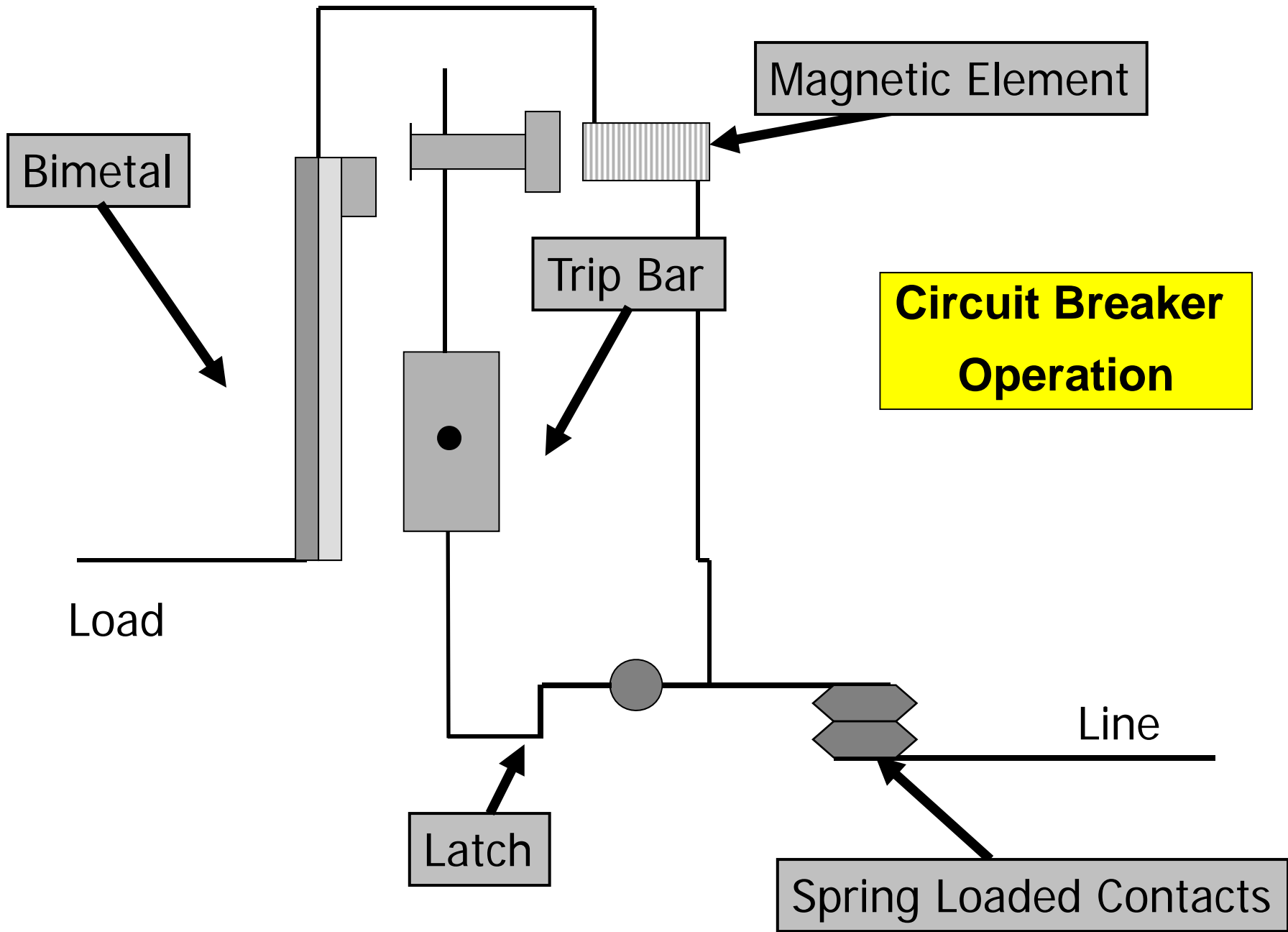
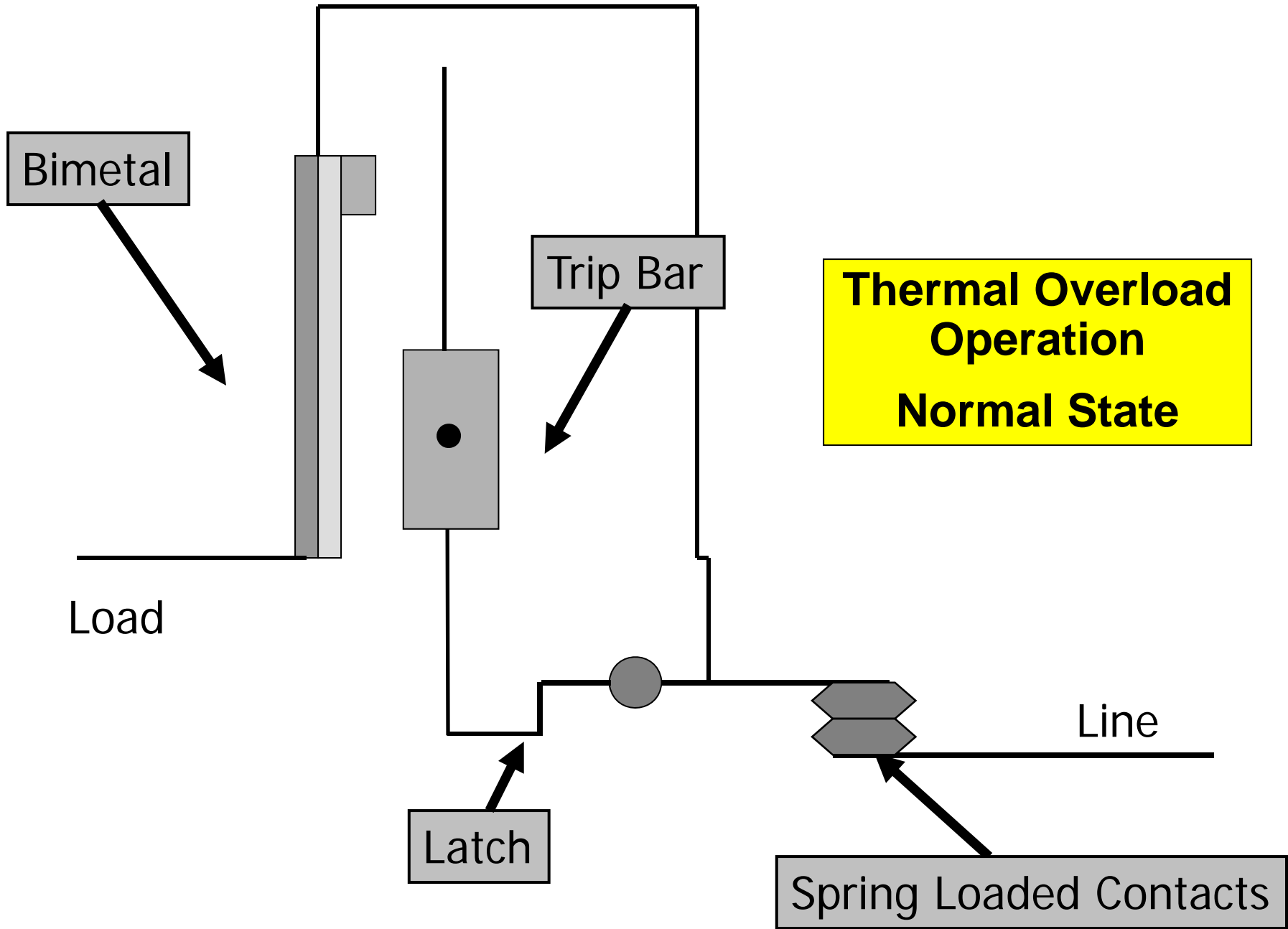
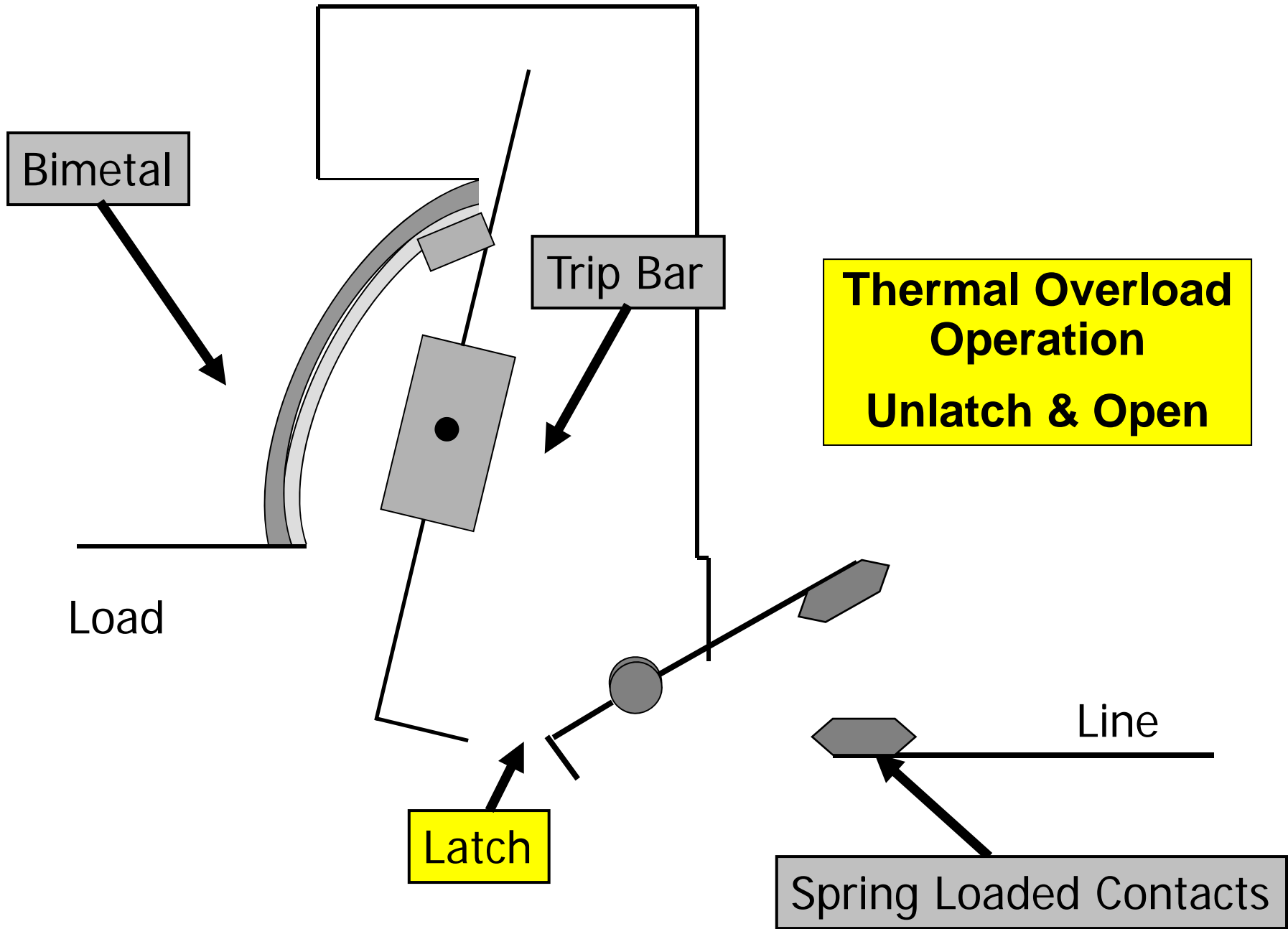
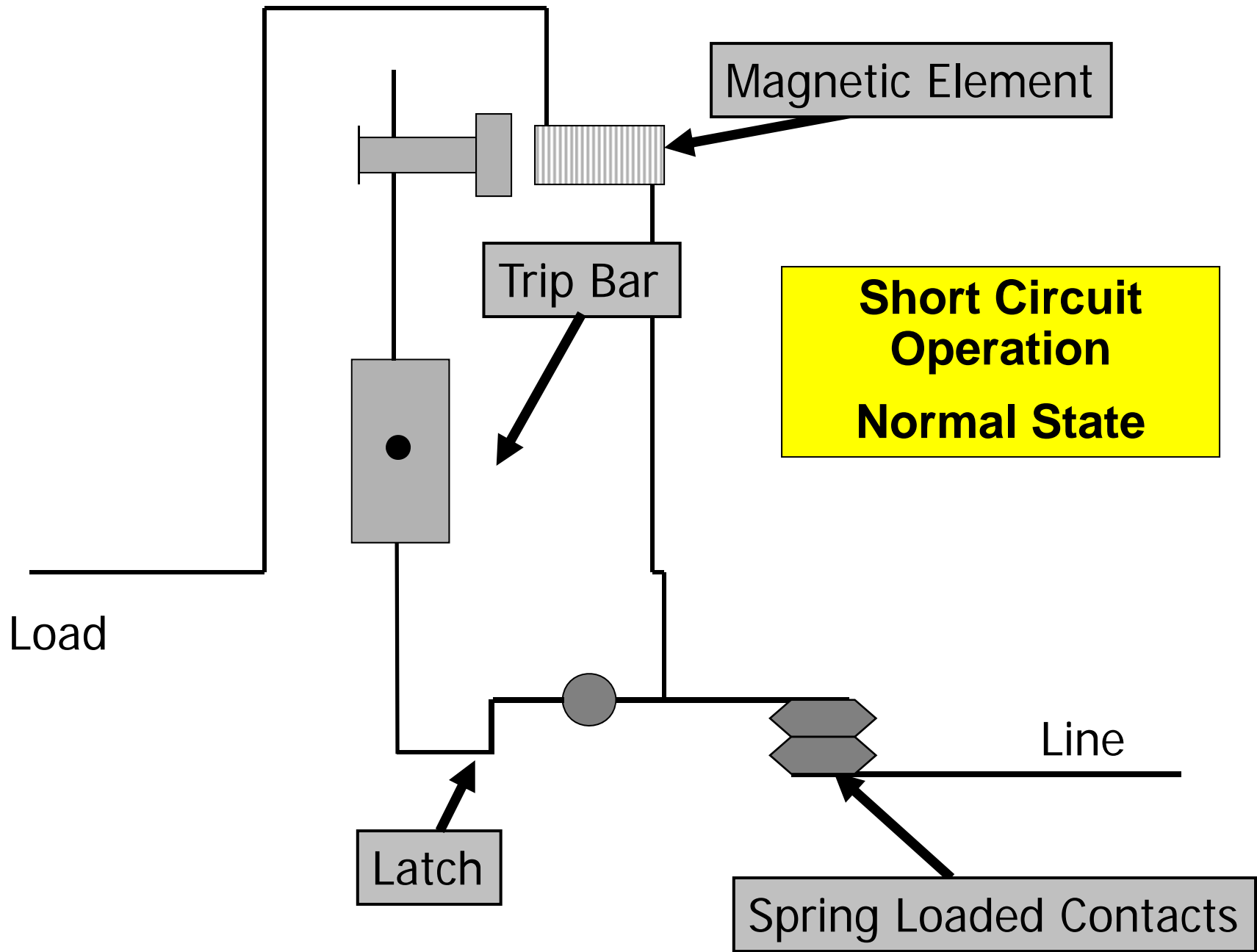


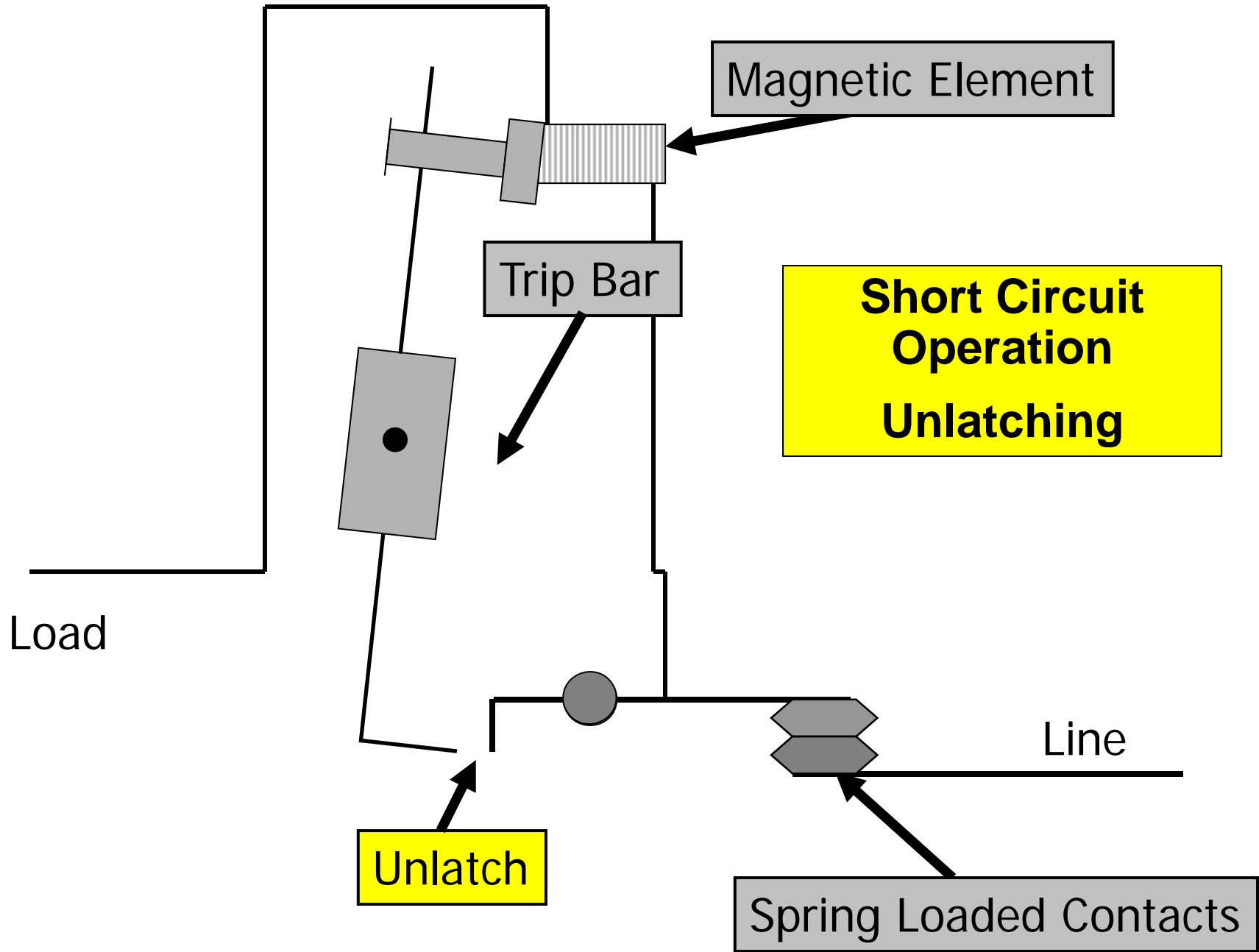
Fig. 6.3 Typical Three-Pole Molded-Case Circuit Breaker

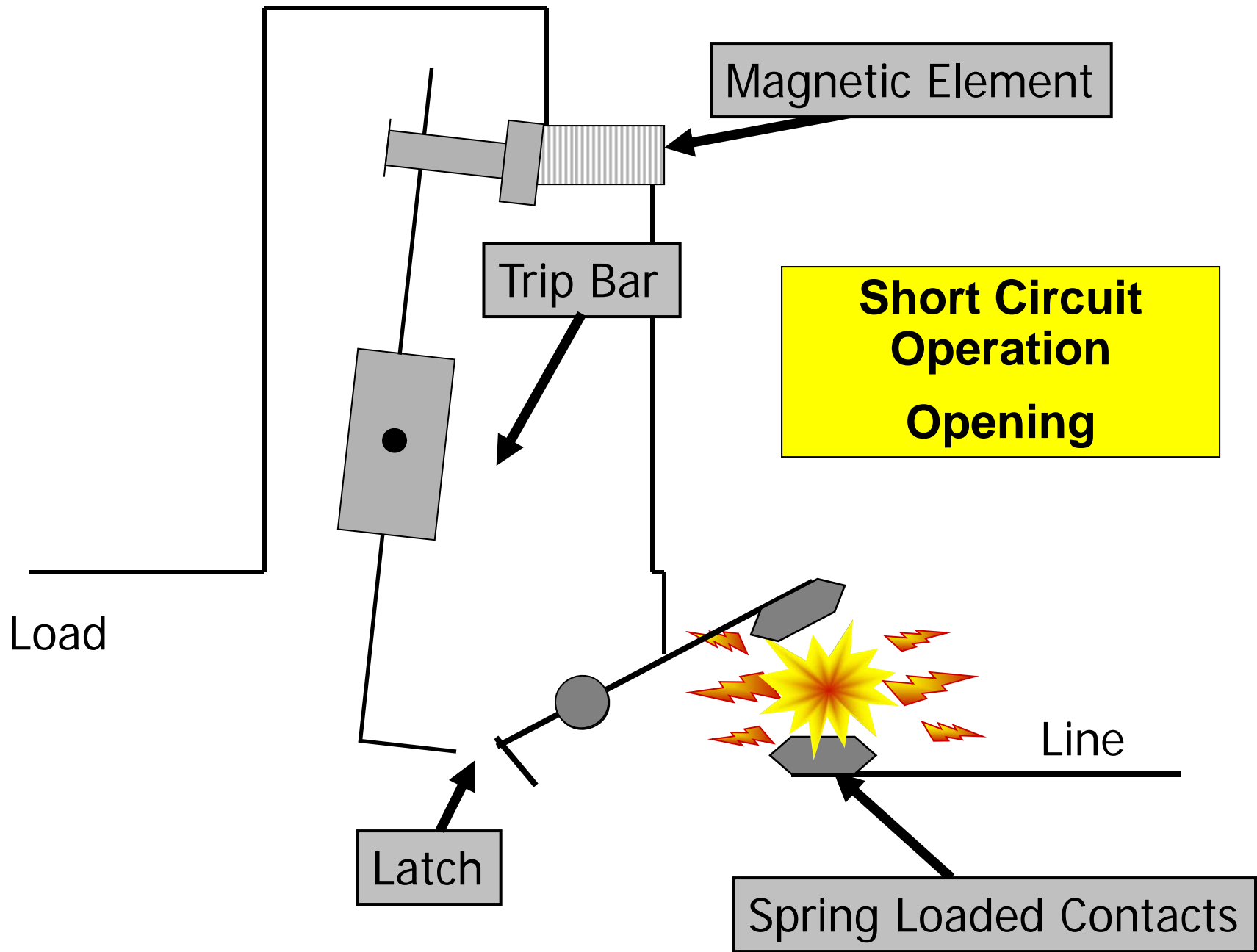


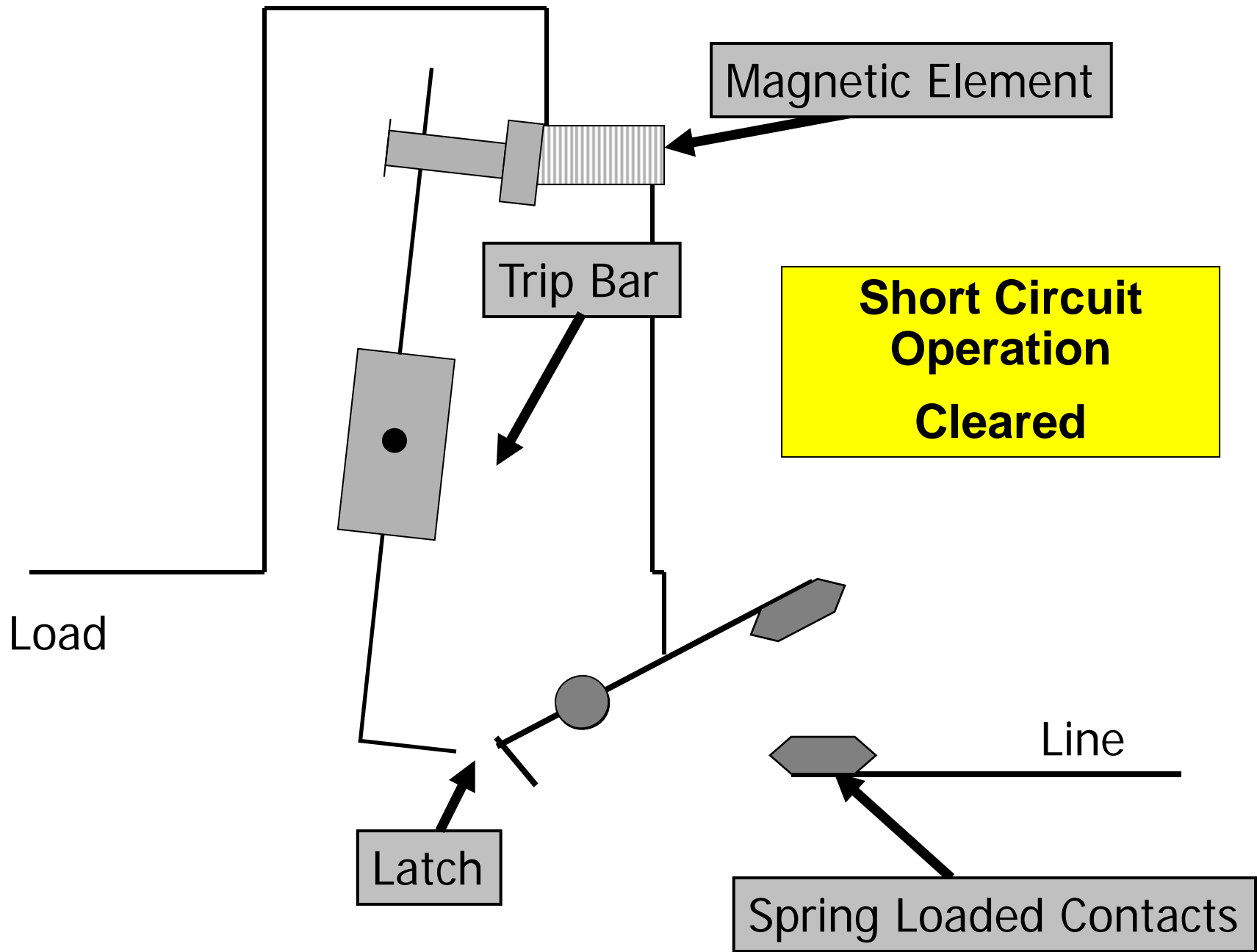












Coordination - Characteristic Thermal-Mag Circuit Breakers

Thermal Magnetic Molded Case Circuit Breaker Time-Current Curve

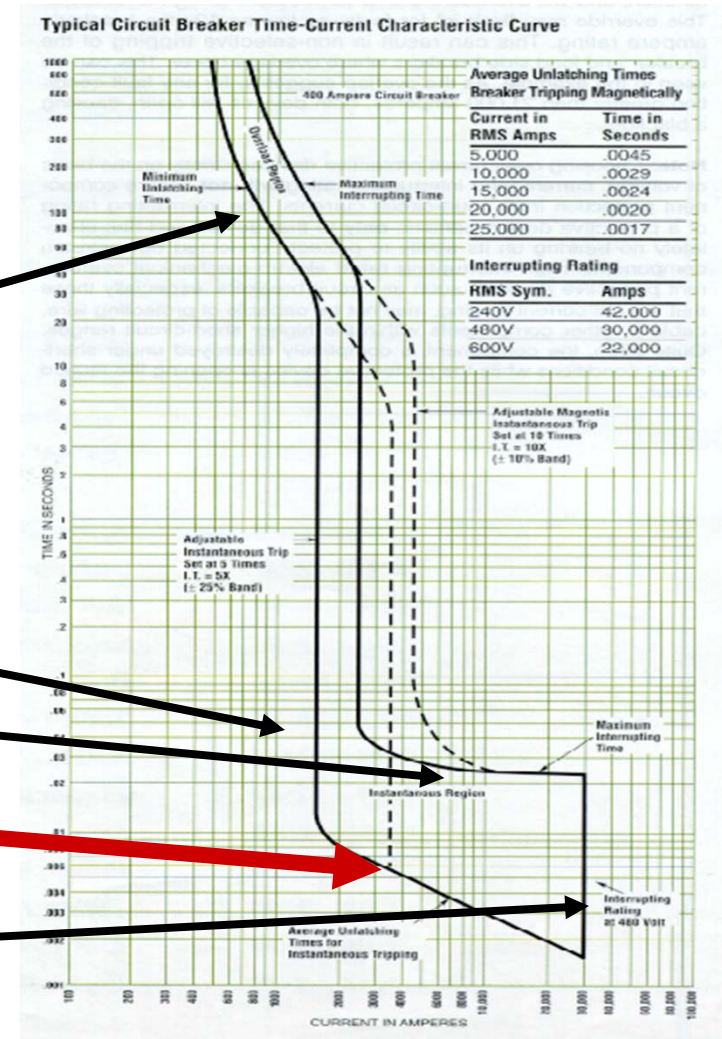
◆ Overload Region

◆ Instantaneous Region

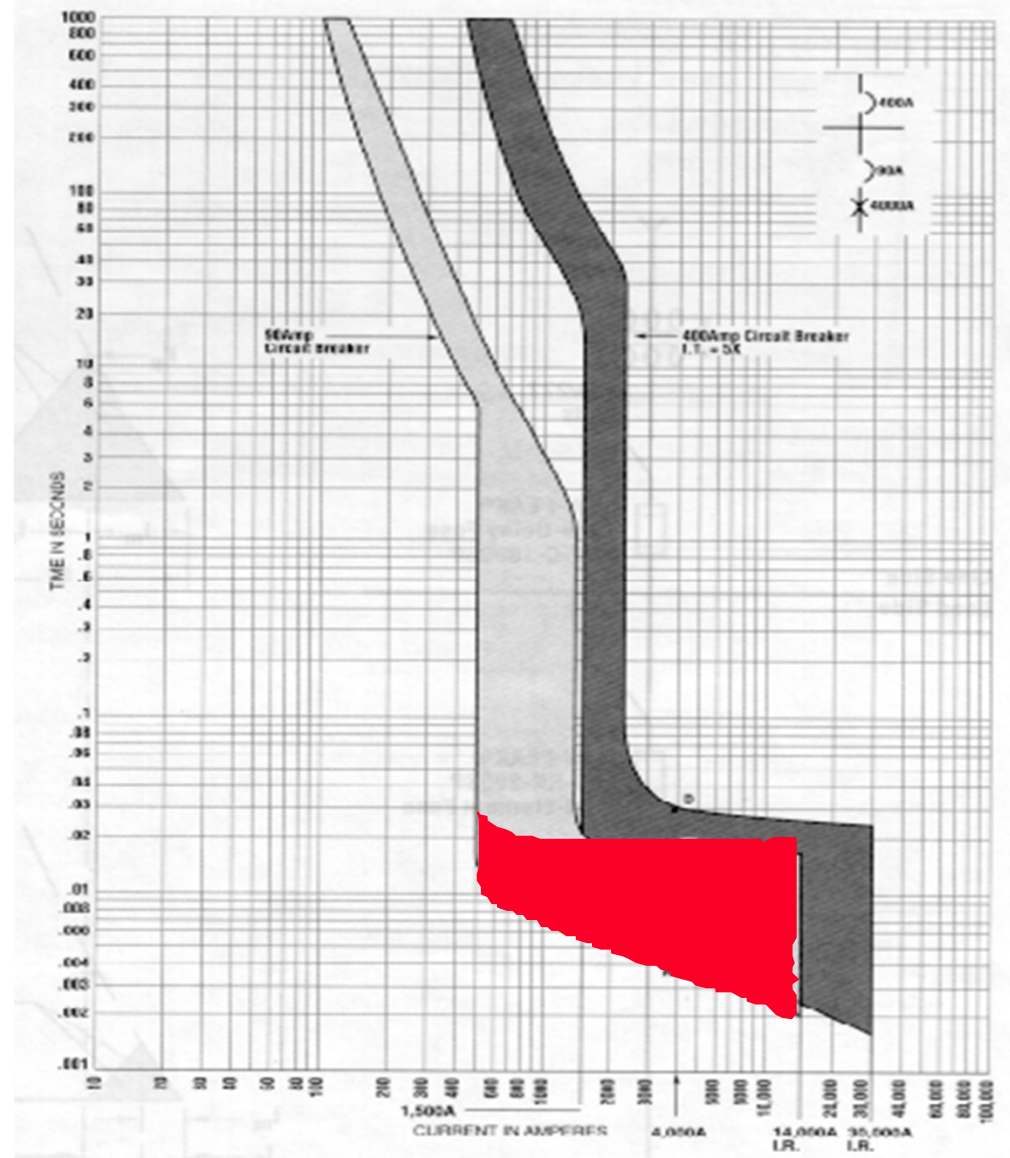
◆ Interrupting Time

◆ Unlatching Time

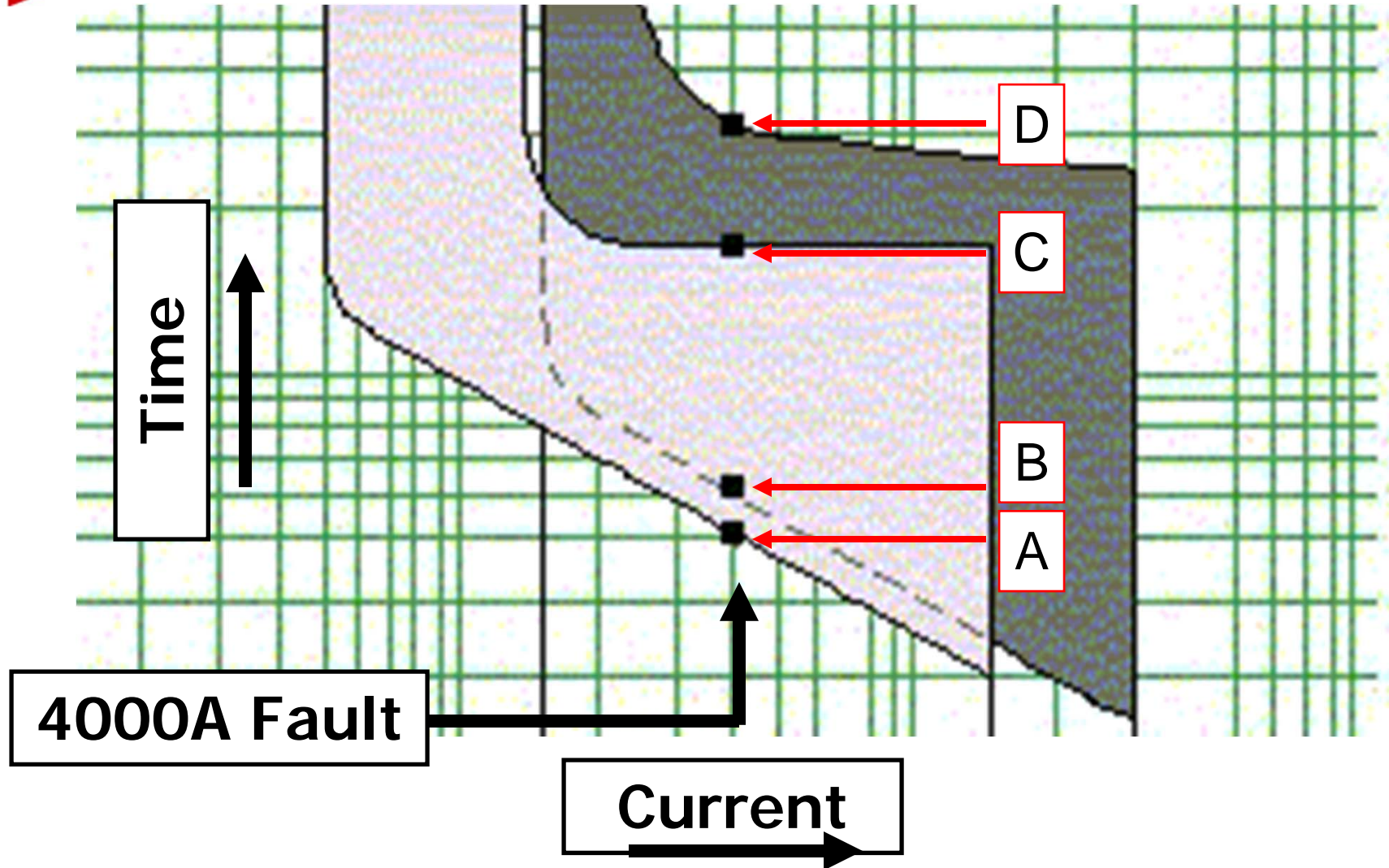
◆ Interrupting Rating



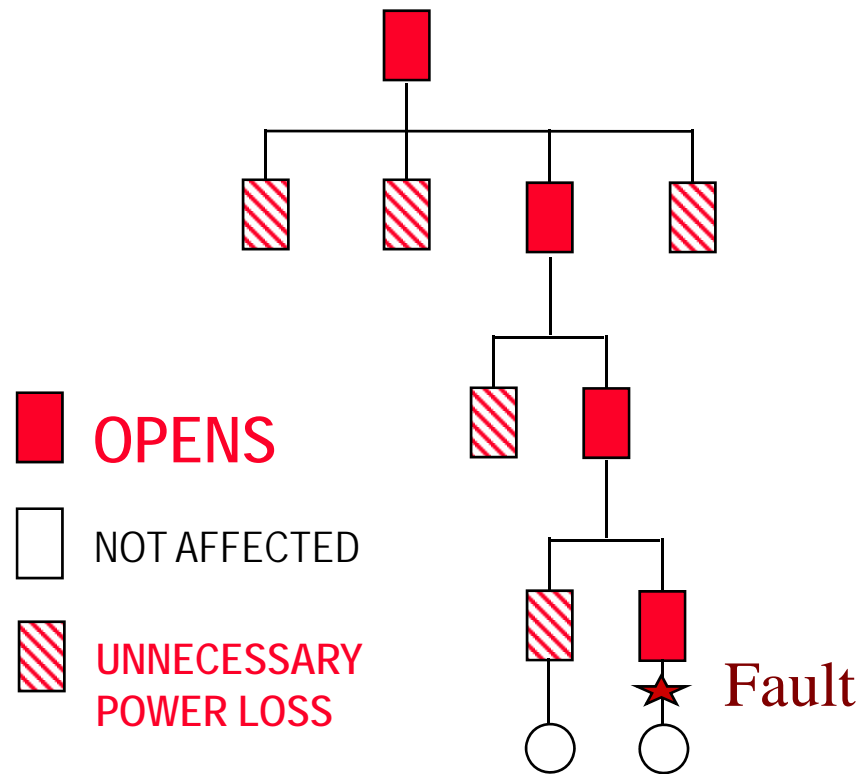
Coordination - Thermal-Mag Circuit Breakers (See SPD)



Selective Coordination

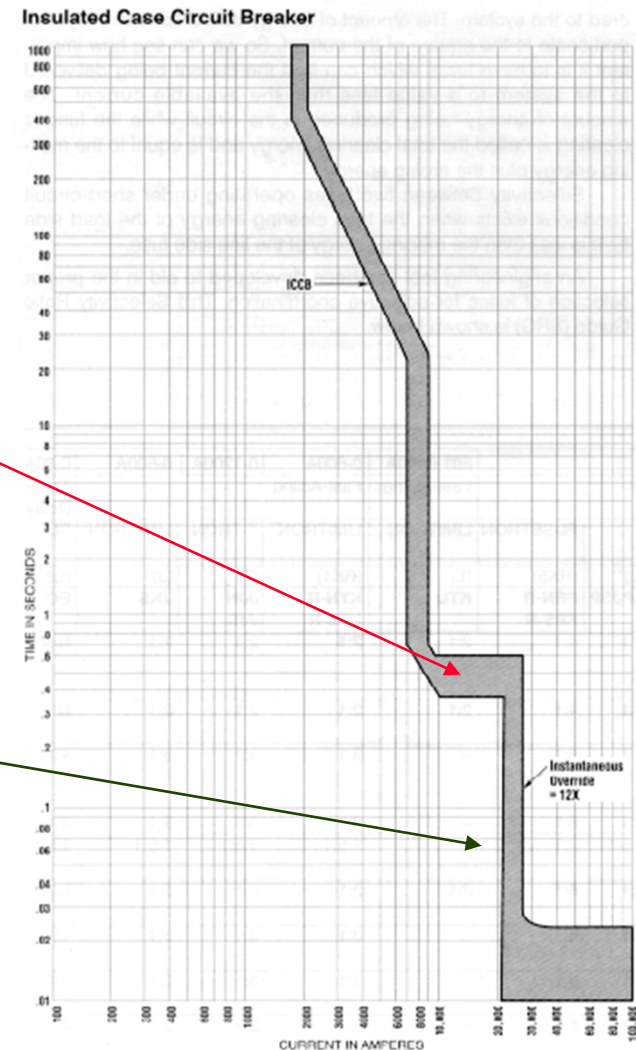


Lacking Coordination



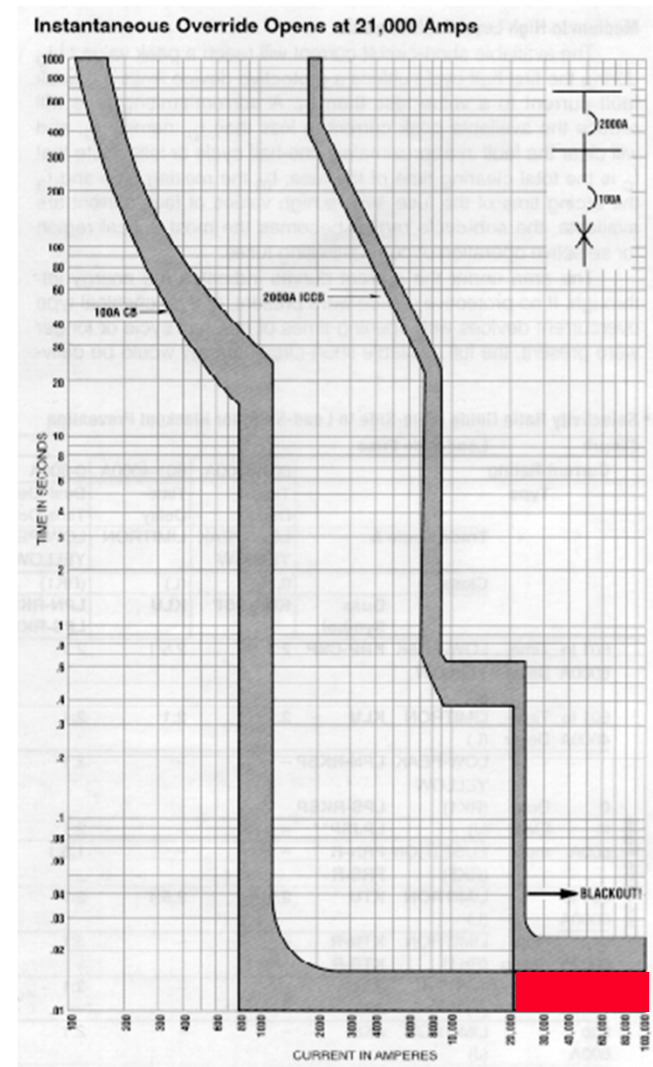
Selective Coordination - Insulated Case Circuit Breakers (See SPD)

- ◆ 2000A Insulated Case Circuit Breaker
- ◆ STD Is an Option - Allows breaker to delay opening
- ◆ Instantaneous Override built-in: may be as low as 12X the breaker rating
- ◆ Will often result in lack of coordination



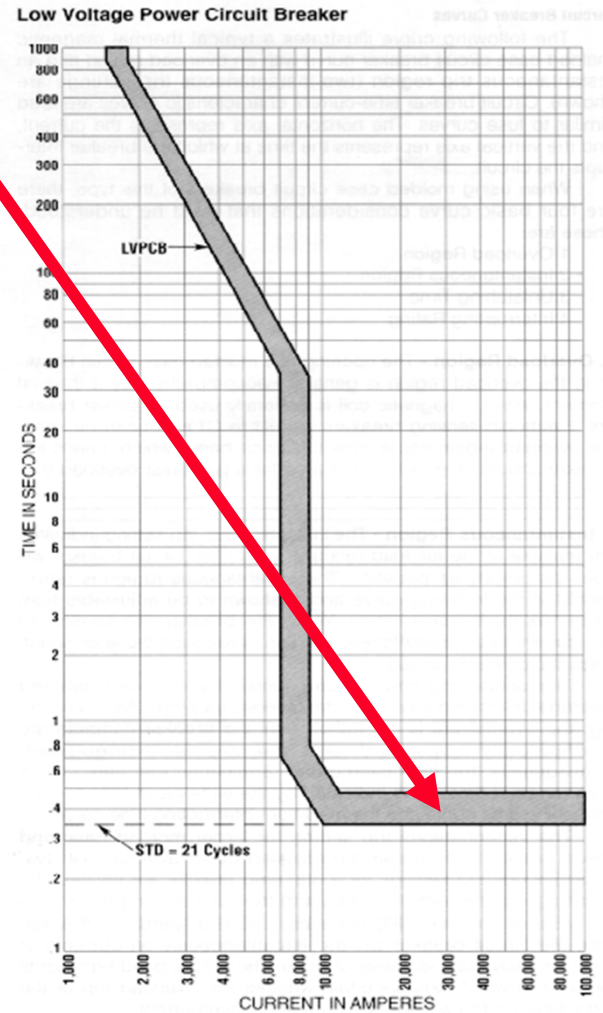
Selective Coordination - Insulated Case Circuit Breakers (See SPD)

- ◆ 2000A Insulated Case with STD and Instantaneous Override and 100A Molded Case Thermal Magnetic Circuit breaker - **NO Coordination in Short-Circuit Region (above 21,000A)**



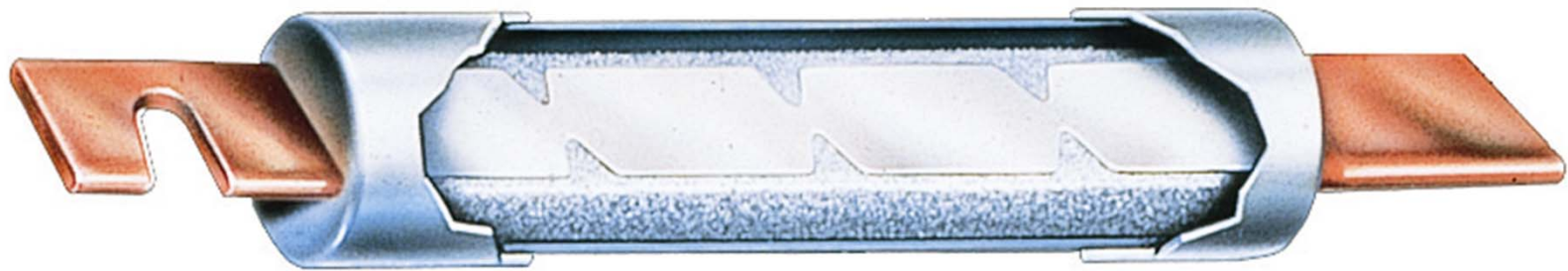
Selective Coordination - LV Air Power Circuit Breakers (See SPD)

- ◆ Short Time Delay - **Allows the fault current to flow for up to 30 cycles.**
- ◆ Used to coordinate with downstream
- ◆ Subjects equipment to high mechanical and thermal stresses, **often violating 110.10**
- ◆ **Arc Flash/ Blast Risks Much Higher**
- ◆ High Cost, Larger Equipment





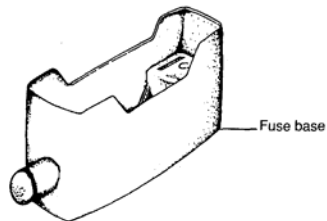
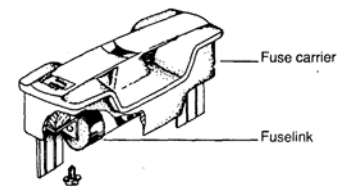
FUSES



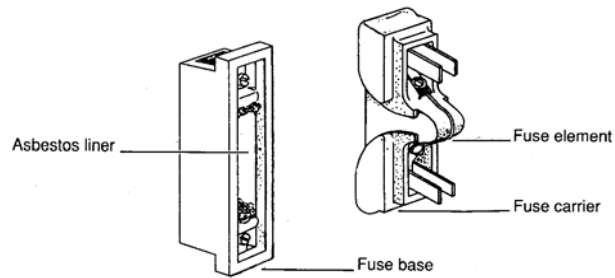
 **COOPER** Bussmann

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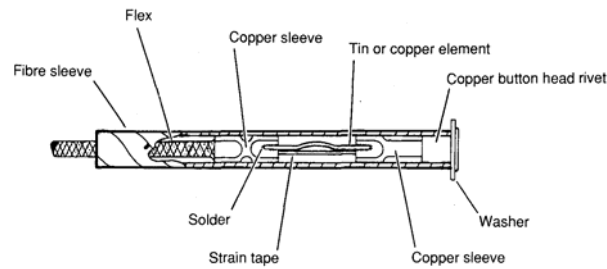
Tipe Fuse Berdasarkan Konstruksi



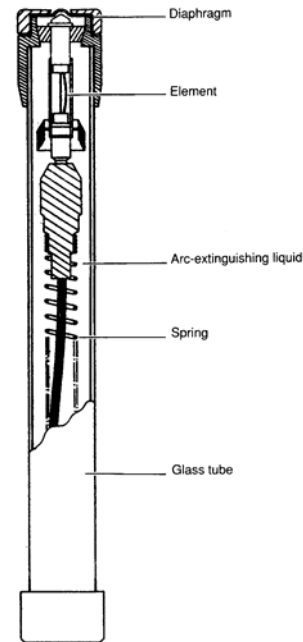
a. cartridge fuse



b. semi-enclosed fuse



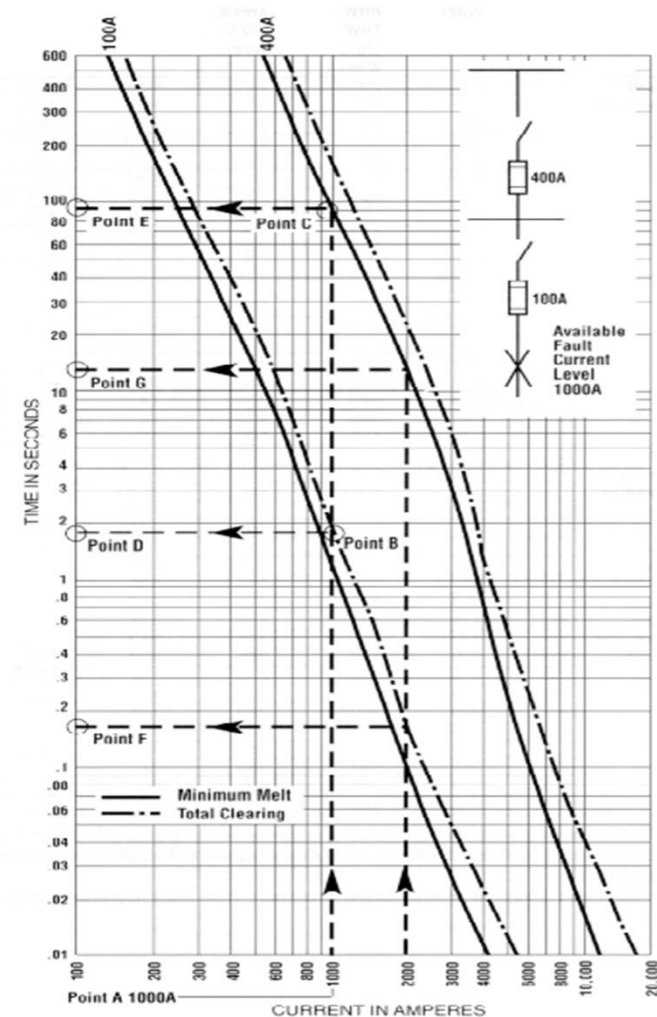
c. Expulsion fuse



d. Liquid fuse

Selective Coordination:Fuses (See SPD)

Time Current
Curves

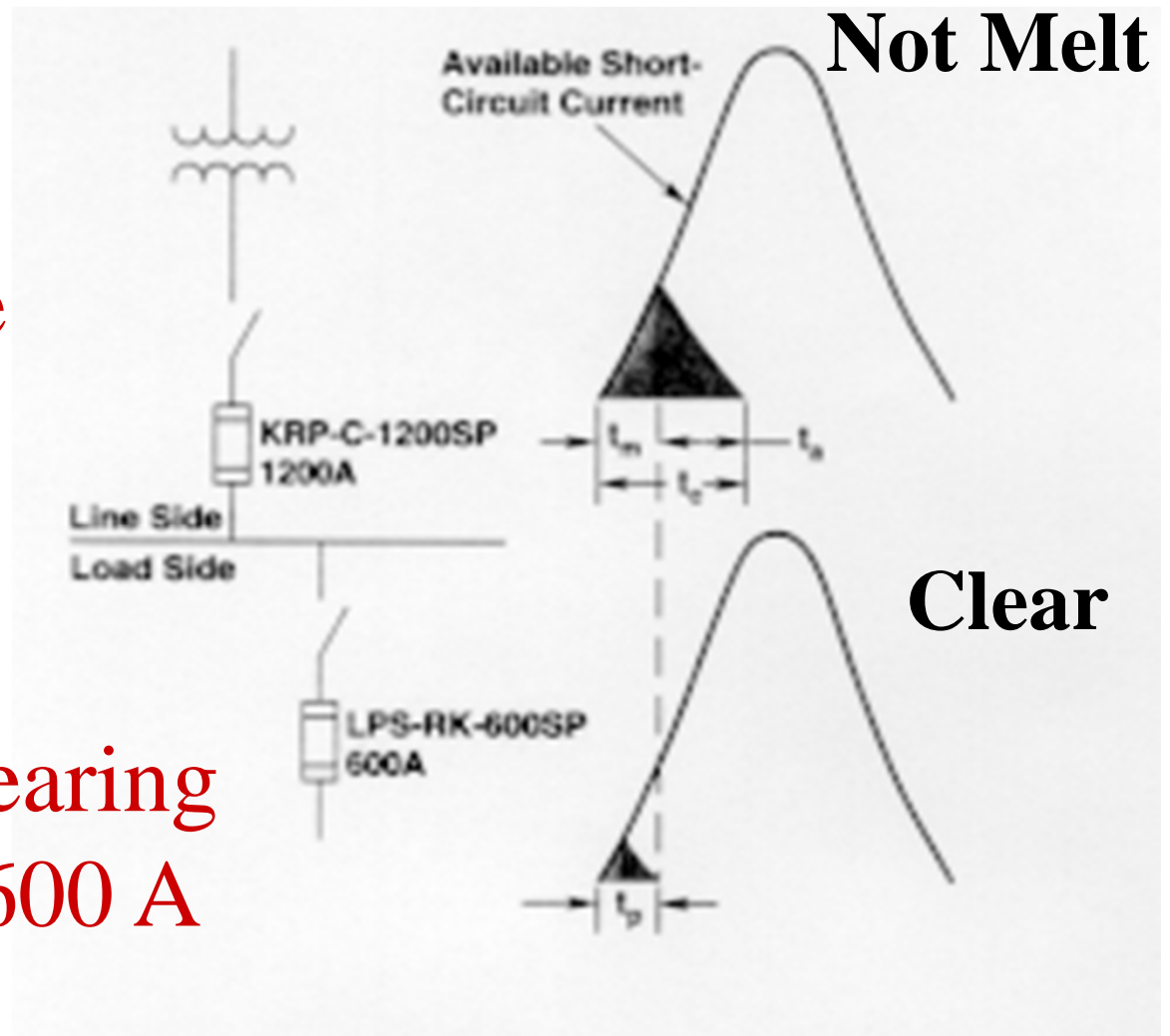


Selective Coordination:Fuses (See SPD)

Selectivity Ratio
Guide Based on
Thermal Principle

Based on I^2t

I^2t melting > I^2t Clearing
1200 A 600 A



Selective Coordination (See SPD)

* Selectivity Ratio Guide (Line-Side to Load-Side)

| Circuit | | Load-Side Fuse | | | | | | | | | | |
|----------------|-----------------------|------------------|----------|-----------------|----------|-------------|----------|--------|----------|-------|-------|------------|
| Type | Current Rating | Type | | | | | | | | | | |
| | | 0-600A | 0-1200A | 0-600A | 0-60A | Fast-Acting | | | | | | Time-Delay |
| Trade Name & | Class | LOW-PEAK YELLOW | LIMITRON | LOW-PEAK YELLOW | FUSETRON | LIMITRON | LIMITRON | T-TRON | LIMITRON | SC | | |
| Class | Buss Symbol | (L) | (L) | (RK1) | (J)** | (RK5) | (L) | (RK1) | (T) | (J) | (G) | |
| | | KRP-CSP | KLU | LPN-RKSP | LPJSP | FRN-R | KTU | KTN-R | JJN | JKS | SC | |
| | | | | LPS-RKSP | FRS-R | | | KTS-R | JJS | | | |
| Time-Delay (L) | LOW-PEAK YELLOW (L) | KRP-CSP | 2:1 | 2.5:1 | 2:1 | 2:1 | 4:1 | 2:1 | 2:1 | 2:1 | 2:1 | N/A |
| Time-Delay (L) | LIMITRON (L) | KLU | 2:1 | 2:1 | 2:1 | 2:1 | 4:1 | 2:1 | 2:1 | 2:1 | 2:1 | N/A |
| Dual Element | LOW-PEAK YELLOW (RK1) | LPN-RKSP | - | - | 2:1 | 2:1 | 8:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| | (J) | LPS-RKSP LPJSP** | - | - | 2:1 | 2:1 | 8:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| Fast-Acting | FUSETRON (HK5) | FRN-R | - | - | 1.5:1 | 1.5:1 | 2:1 | - | 1.5:1 | 1.5:1 | 1.5:1 | 1.5:1 |
| | | FRS-R | - | - | 1.5:1 | 1.5:1 | 2:1 | - | 1.5:1 | 1.5:1 | 1.5:1 | 1.5:1 |
| Fast-Acting | LIMITRON (L) | KTU | 2:1 | 2.5:1 | 2:1 | 2:1 | 2:1 | 2:1 | 2:1 | 2:1 | 2:1 | N/A |
| | LIMITRON (RK1) | KTN-R | - | - | 3:1 | 3:1 | 3:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| | | KTS-R | - | - | 3:1 | 3:1 | 3:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| Fast-Acting | T-TRON (T) | JJN | - | - | 3:1 | 3:1 | 3:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| | | JJS | - | - | 3:1 | 3:1 | 3:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| Fast-Acting | LIMITRON (J) | JKS | - | - | 2:1 | 2:1 | 2:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| | | | - | - | 2:1 | 2:1 | 2:1 | - | 3:1 | 3:1 | 3:1 | 4:1 |
| 0 to 60A | Time-Delay (G) | SC | SC | - | - | - | - | - | - | - | - | - |

Load Side Fuse

Line Side Fuse

**LOW-PEAK® : LOW-PEAK®
2:1 Line:Load Ratio**

Selectivity Ratio Table Assures Coordination!

No Plotting required!

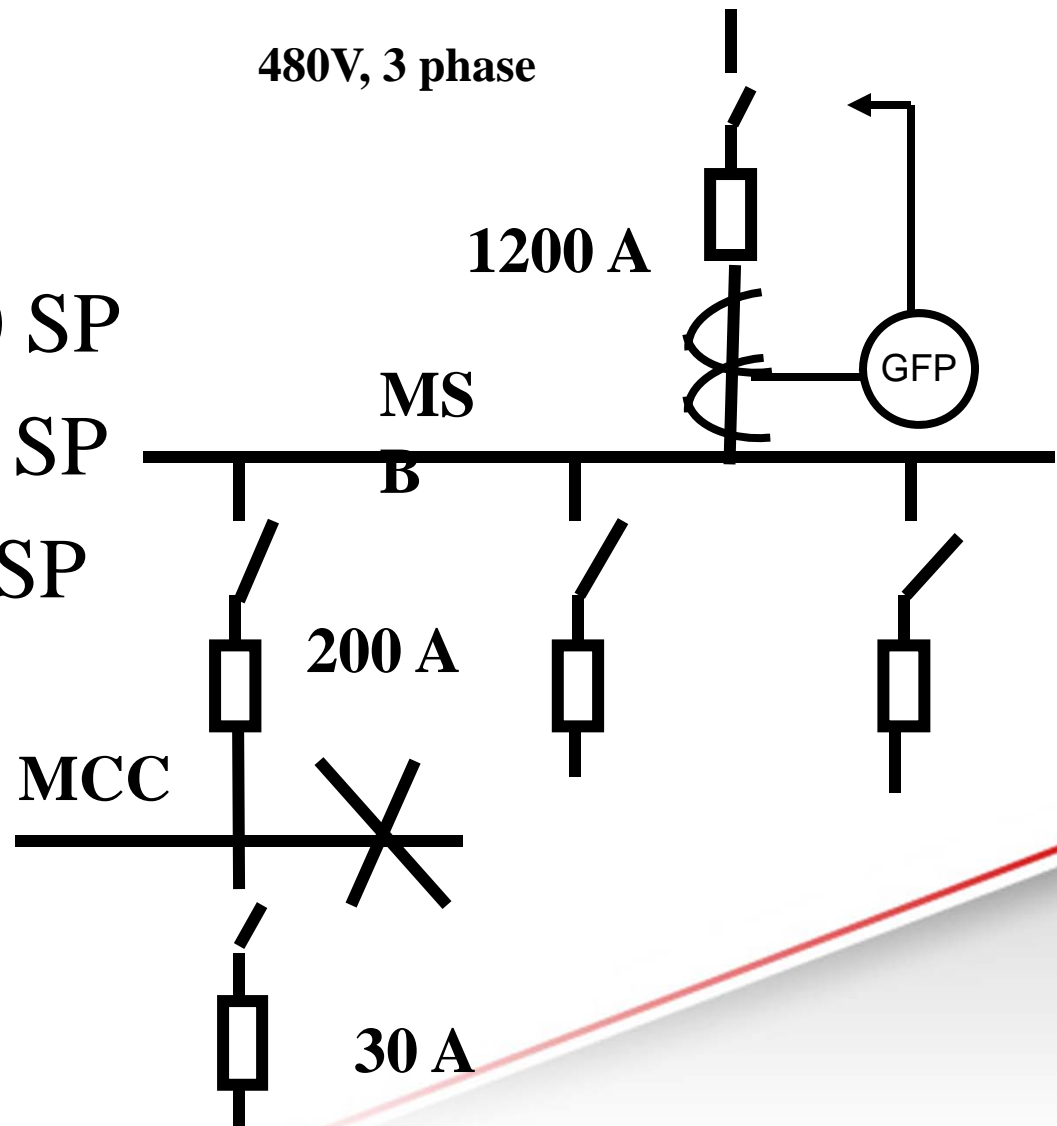
Selective Coordination - Fuses

Example:

Main: KRP-C 1200 SP

Feeder: LPS-RK 200 SP

Branch: LPS-RK-30 SP



Selective Coordination - Fuses

Use Selectivity Table

Main KRP-C 1200 SP

Feeder LPS-RK 200 SP

Branch LPS-RK 30 SP

What happens: Branch Circuit $I_{sca} = 5000 \text{ A}$ or
 $50,000 \text{ A}$ or $300,000 \text{ A}$?

Selective Coordination- Fuses

Lineside KRP-C 1200SP to Loadside LPS-RK 200SP

$1200/200 = 6:1$ Table only need **2:1**

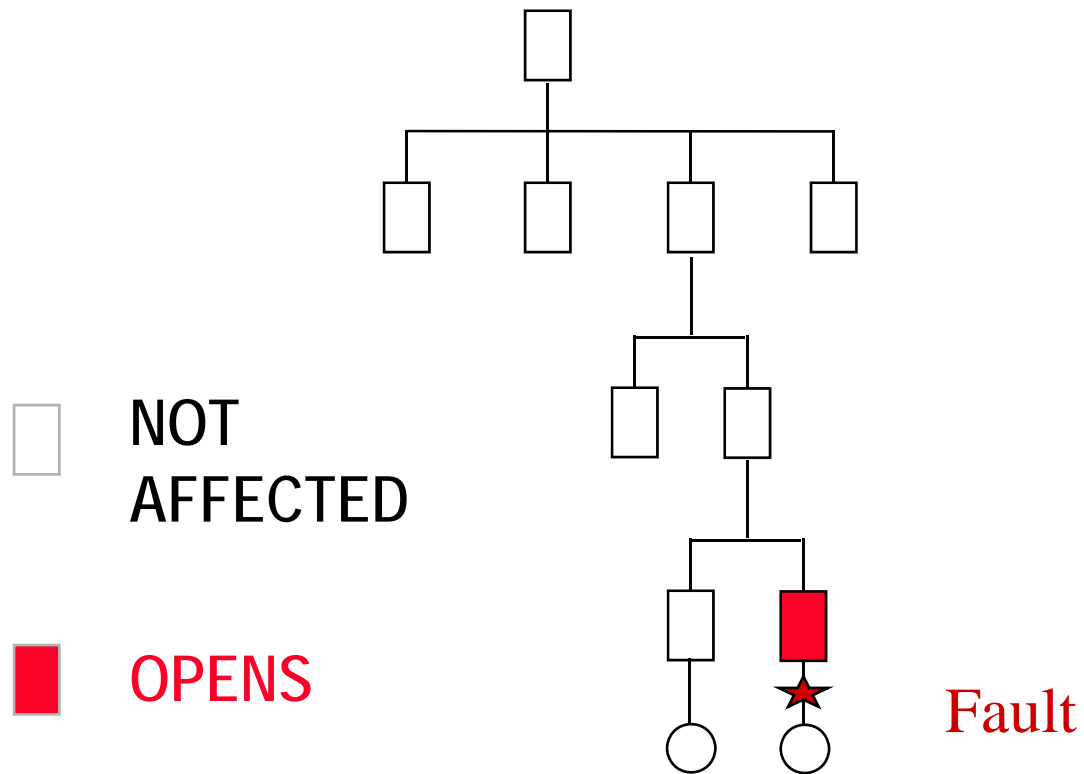
Selective Coordination

Lineside LPS-RK 200SP to Loadside LPS-RK 30SP

$200/30 = 6.67:1$ Table only need **2:1**

Selective Coordination

Selective Coordination



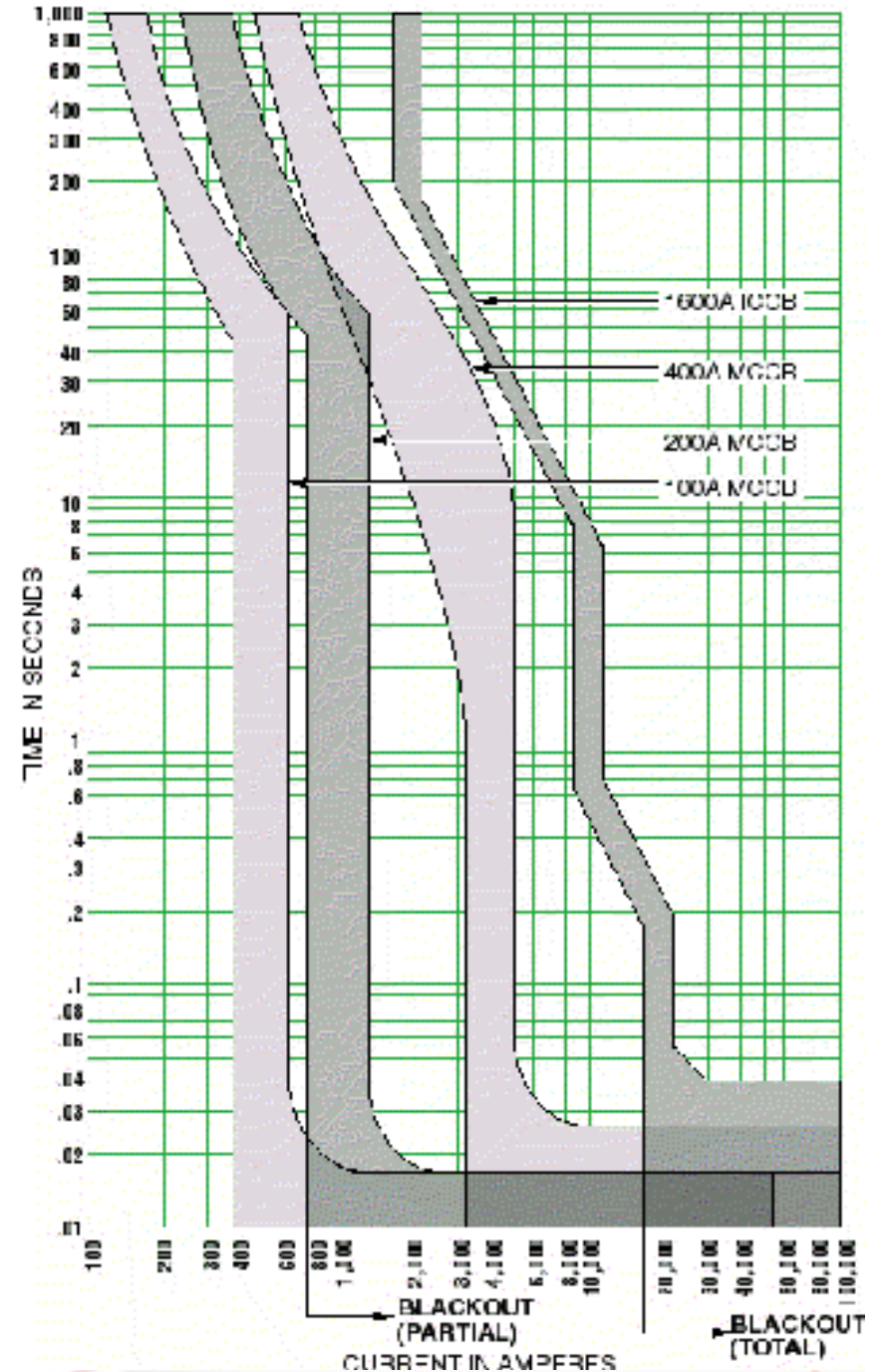
Selective Coordination

Simple Rules for Checking

- **Circuit Breakers** (instantaneous trip)
- **Fuses**

Can you look at this
and assess whether
coordinated?

You do not even
need to draw curve!



Simple Rule:

(Amp rating) x (I.T. setting) =
Isca @ which CB will unlatch:

| <u>CB</u> <u>Amp</u> | <u>IT</u> <u>Set</u> | <u>IT</u> <u>Amp Pickup</u> |
|-------------------------|-------------------------|--------------------------------|
| 100 | 5X | 500 |
| 200 | 5X | 1,000 |
| 400 | 10X | 4,000 |
| 1600 | 12X | 19,000 |

