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Development and Improvement of Neutral Zone

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APM system

- Driverless Medium-Capacity Urban Transport System
  - Operates on dedicated tracks with rubber tires → Low noise, High curvature, High inclination
  - Three-phase AC600V electrification system
  - Side-contact collection type → solid power rail

- General Specification
  - Maximum speed : 60 kph
  - Capacity : Approximately 90 ppl per 1 car
  - Size : Approximately 2.8 m(W) x 10 m(L) x 3.5 m(H)
  - 2~3 car per 1 unit, 1~3 unit per 1 trainset
  - Each unit has 2 pantograph

Neutral Zone

- Multiple power supply sources may be installed depending on line length and capacity.

- AC electrification system causes phase shift
  - The power source cannot be directly connected
    → Neutral zones are required

- Side-contact collection from solid power rail
  - Design of Neutral zones is different from overhead line

Isolation Method

- Voltage gap
  - Line to line : AC600V
  - Phase to neutral : AC600V / √3
- Various insulation methods
  - Air, Resin, Wood
- Neutral Zone method commonly used in APM is introducing
  - Air Section with End approach on both ends
  - Middle Section with insulation sections on both ends
  - Air Gap Units

Neutral Zone type 1

- Middle Section with insulation sections on both ends

- Middle section: De-energized power rail longer than the trainset
- Both ends: Highly abrasion-resistant insulating material

Neutral Zone type 1

- Middle Section with insulation sections on both ends

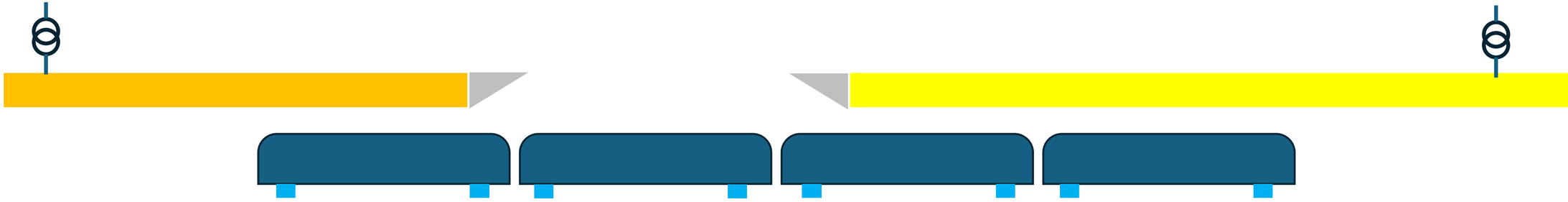
- Advantage
  - Easy rescue if stopped in the NZ
- Disadvantage
  - Short Maintenance cycle

Neutral Zone type 1

- Middle Section with insulation sections on both ends

Neutral Zone type 2

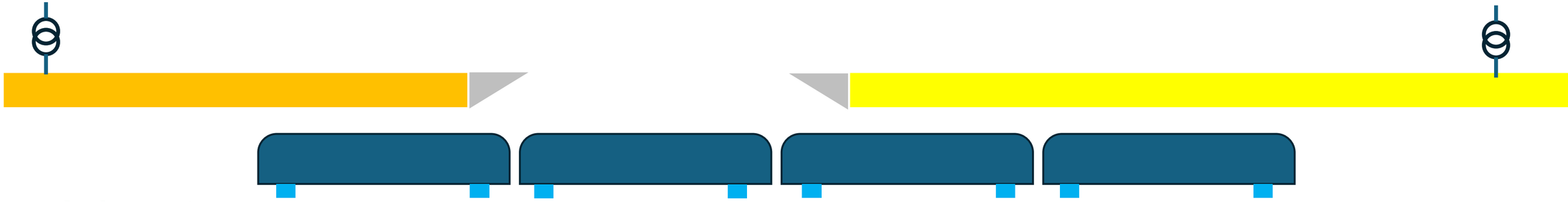
- Air Section with End approach on both ends



- Middle section: Air space longer than the length of a vehicle unit
- Both ends: End approach to facilitate smooth pantograph separation and contact

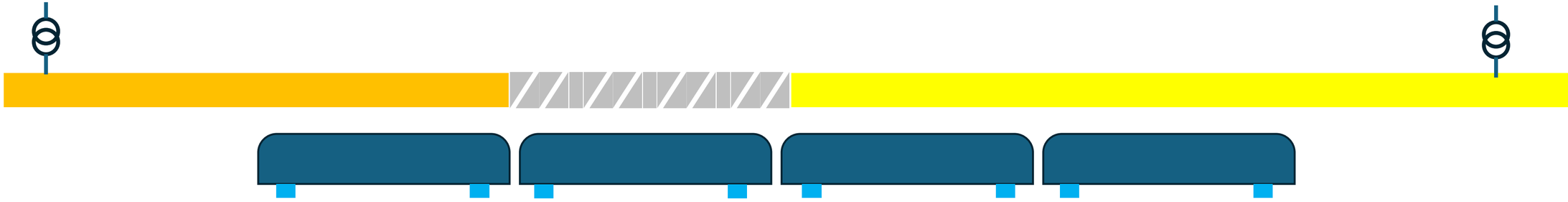
Neutral Zone type 2

- Air Section with End approach on both ends



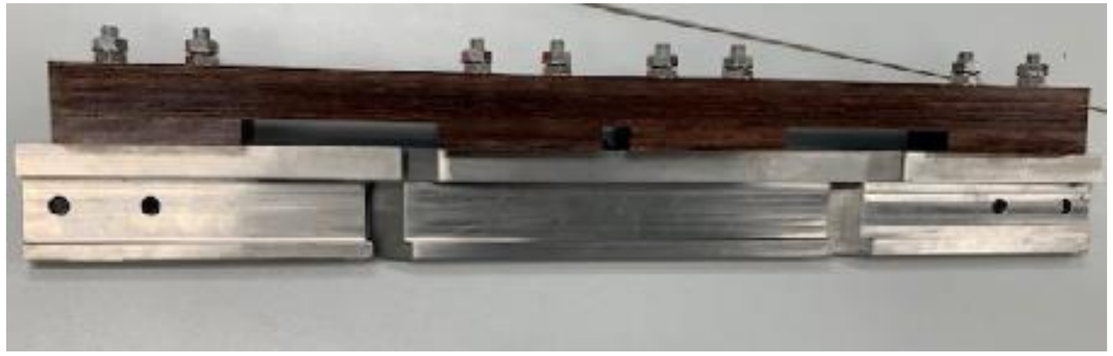
- Advantage
  - Easy to install
- Disadvantage
  - Difficult to pass through at high speed

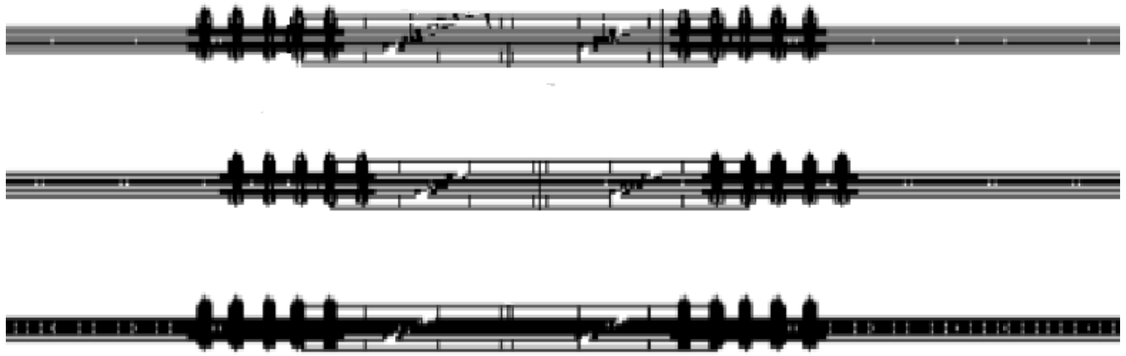
Neutral Zone type 3
- Air Gap Units



- No Middle section or ends
- Continuous Air Gap Unit longer than the length of a vehicle unit

Neutral Zone type 3
- Air Gap Units

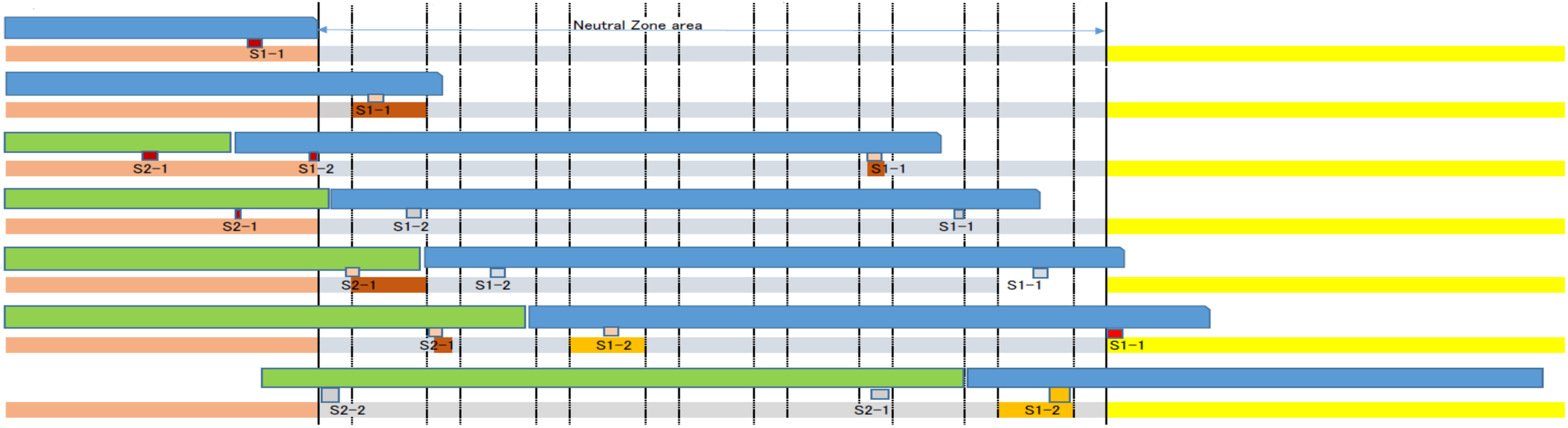




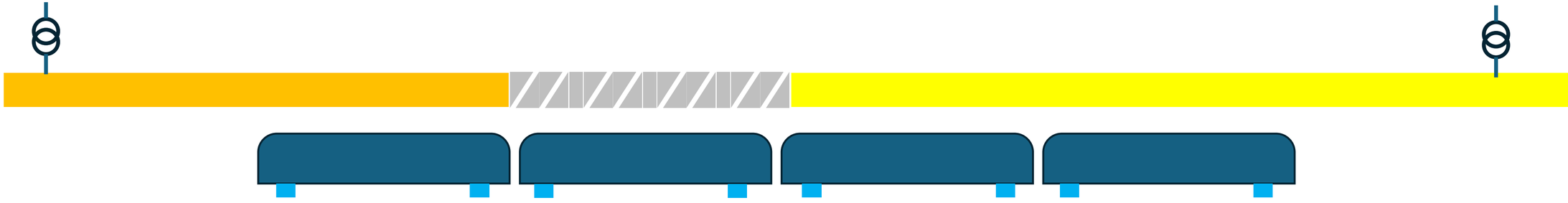
- 3 metals and 1 insulation material
- Metals are insulated by diagonal air gap
- Insulation material supports from behind

Neutral Zone type 3

- Air Gap Units



Neutral Zone type 3
- Air Gap Units



- Advantage
  - Long Maintenance cycle
- Disadvantage
  - Requires precise installation tolerances

Summarize of Neutral Zone type

	1 - Middle Section	2 - Air Section	3 - Air Gap Unit
Middle section	Isolated power rail	Nothing (Air)	Continuous Air Gap Unit
Mechanical wear rate	Slightly High	High	Low
Electrical wear rate (arcing)	Slightly High	Relatively High	Low
Arc occurrence frequency	Occurs when the insulation section is worn	Occurs when passing speed is high	Less likely to occur
Maintenance frequency	Slightly high	Low	Slightly low
Fault Resistance	High	Slightly high	Slightly low
Availability	Slightly high	High	Slightly high
Maintainability	Slightly high	High	Slightly high
Safety	Relatively low	High	Slightly high

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