Temperature rise of cables inside cable trays

Overview

Thermal Contraction and Expansion of Cable Tray All materials expand and contract due to temperature changes.

Key Takeaways

Cables in trays experience temperature rise due to mutual heating, load, and limited ventilation, with center cables often running 8–15°C hotter than edge cables under identical conditions.Factors Affecting Temperature Rise

Mutual Heating: When multiple cables are grouped in a tray, each cable contributes heat to its neighbors. This raises the effective ambient temperature, reducing the permissible current-carrying capacity. Thermal imaging shows that center cables in a loaded tray can be 8–15°C hotter than edge cables, highlighting the limitations of uniform derating factors used in standard tables like IEC 60364-5-52 and AS/NZS 3008.1.1:2017 . Tray Type and Ventilation: Open trays allow natural airflow, helping dissipate heat, while solid bottom trays restrict airflow, causing higher temperature rise. Solid bottom trays with covers provide protection against dust and EMI but require careful thermal analysis to determine ampacity, as there are no explicit standards for these configurations . Cable Load and Arrangement: Overloading cables or tightly packing them increases heat accumulation. Layered arrangements or separating high-load cables onto different levels can reduce heat transfer between cables . The material of the tray (aluminum or steel) also affects heat conduction and dissipation . Environmental Conditions: Ambient temperature, humidity, and airflow around the tray influence cooling. Hot, still, or humid environments exacerbate temperature rise, accelerating insulation aging and reducing cable lifespan .

Calculation and Mitigation

Derating Factors: Standard tables provide a single derating factor for grouped cables, assuming equal load and spacing. For more accurate results, IEC 60287-2-1:2023 allows calculation of thermal resistance for each cable individually, considering position, surrounding medium, and neighboring heat contributions . Design Considerations:

• Use open or ventilated trays where possible.

• Include heat release holes or forced airflow for high-density installations.

• Select tray materials with good thermal conductivity.

• Avoid overfilling trays; maintain spacing to allow heat dissipation.

• Consider future cable additions to prevent excessive temperature rise . Practical Example: For a 30-inch wide tray carrying multiple #3/0 AWG and smaller cables, the total cross-sectional area should not exceed the allowable fill area (e.g., 35 sq. in.) to maintain safe temperature rise and comply with NEC standards .

Key Takeaways

• Center cables heat more than edge cables; uniform derating may be insufficient.

• Tray design, ventilation, and cable arrangement are critical to controlling temperature rise.

• Accurate thermal modeling or conservative design practices are recommended for high-density or solid bottom trays.

• Monitoring and maintenance ensure long-term safety and performance of cable installations. By considering these factors, engineers can minimize temperature rise, extend cable life, and maintain safe operation in cable tray systems.

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