



Copper vs. aluminum conductor

There is a common misconception that a distribution transformer with copper windings is in some way more efficient, more reliable, or has higher short-circuit strength when compared to a transformer with aluminum windings.

Recommendation

Improvements in technology regarding the use of aluminum in transformers have made aluminum-wound transformers the ideal choice for today's applications.

Rationale Operating cost

Eaton designs Cooper Power series aluminum-wound transformers with windings of a larger cross-sectional area than would be used for a copper wound unit. This larger cross-sectional area translates to a lower current density and an equivalent operating temperature. By reducing the current density in the windings, a low-loss design can be achieved with aluminum or copper windings.

Reliability

A transformer's life is defined by the life of its insulation system. Because Eaton's Cooper Power series aluminum-wound and copper-wound units run at equivalent operating temperatures, the insulation systems age at the same rate for each design.

Lower first cost

Whether operating efficiency is a goal or not, aluminum windings are less expensive than copper windings. The following example shows two equivalent loss designs, one with aluminum windings and one with copper windings.

The bottom line

Eaton designs its Cooper Power series aluminum-wound coils using the same thermal, dielectric and mechanical performance requirements as for its copper-wound coils. In pad-mounted and substation designs, Eaton's Cooper Power series aluminum-wound transformers and copper-wound transformers serve their loads equally well.



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Example: 2500 kVA, 3-phase pad-mounted transformer, 13800 Delta - 480Y/277

	All Aluminum Winding	All Copper Winding	Copper Primary Aluminum Secondary
No load losses (watts)	2402	2015	2097
Load losses (watts)	14,732	16,558	16,032
Total losses (watts)	17,134	18,573	18,129
Efficiency at 50% load	99.53%	99.53%	99.53%
Efficiency at 100% load	99.32%	99.27%	99.28%
Dimensions (H x W x D)	81" x 104" x 73"	81" x 94" x 72"	81" x 99" x 70"
Price	Baseline	+13.8%	+8.5%

In this example, while the efficiencies at 50% load are equivalent because of the Department of Energy (DOE) requirements, when compared to the price of the aluminum wound unit, the copper-aluminum-wound transformer is 8.5% more expensive, while the copper-wound transformer is 13.8% more expensive.

For an in-depth, technical explanation on this issue, please see reference document TC202003EN.

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