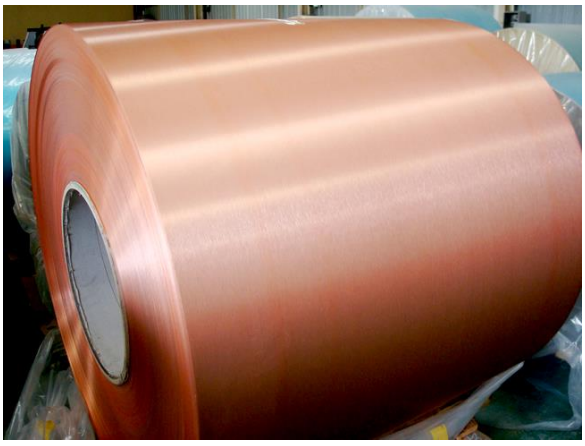
ALFA TRANSFORMER

TRANSFORMERS
It's What We Do.

COPPER VS ALUMINUM

WHICH IS BETTER?



As with most questions of this type pertaining to transformers, a lot depends upon the application and the individual preferences of the person specifying the transformer. Quite often the reason cited for specifying copper windings is copper's high electrical conductivity. Although copper is better conductivity-wise than aluminum, copper is more expensive than aluminum and raw copper prices tend to widely fluctuate making cost forecasting difficult.

During World War II, copper became scarce and was used primarily for the war effort. Several industries turned to aluminum as an alternative to copper because it was in good supply, was very stable price-wise and was less expensive than copper. In the 1940's high-power transmission power lines were converted from copper to aluminum and secondary power distribution networks began utilizing aluminum in the 1950's. Today, virtually all standard transformer lines from the major manufacturers are wound with aluminum.

Although copper wound transformers tend to be smaller than comparable aluminum wound transformers, aluminum transformers offer some distinct advantages over copper wound units:

- Both copper and aluminum oxidize over time. Aluminum conductors oxidize until all exposed aluminum surfaces are covered with an oxide layer. At that point oxidation stops unless the aluminum oxide barrier is somehow broken and the aluminum conductor is re-exposed to the air. Aluminum oxide inhibits chemical reaction of the metal with the wire insulation. Aluminum oxide is also a good electrical insulator. Copper on the other hand oxidizes completely over time. Copper also acts as a mild catalyst, hastening the decay of the wire insulation. All of these factors combine to give aluminum wound transformers a longer life than comparable copper wound units, typically about five years.
- The heat storage capacity of aluminum is approximately 2.33 times that of copper (specific heat of aluminum is 0.214 cal/gram/°C, specific heat of copper is 0.092 cal/gram/°C). With aluminum wound transformers having a superior thermal storage capacity than copper wound units, they can withstand more surge and overload currents than copper units (normally exhibited when a motor starts.)
- Although the conductivity of copper is better than that of aluminum, on a per pound basis aluminum is over twice as good a conductor as copper.

Aluminum wire has received a negative connotation over the years primarily because of the care that must be taken in making connections. Copper proponents are quick to refer to hotel and mobile home fires that occurred where aluminum wire was present. Upon close examination it was found that the root causes of these problems is related to incorrect wiring devices being used. Copper and aluminum expand at different rates when heated. If aluminum wire is used with wiring devices solely rated for use with copper wire, the connection heats up causing the resistance of the connection to increase and the temperature to continue to escalate. Most transformer manufacturers address this problem by making a transition between the aluminum windings, either to a copper lead wire (or bus bar) or by terminating to an AL/CU lug (or connector).

So why are copper wound transformers still specified? Again, we have to look at the application. Copper wound units may be specified because of space limitations. Copper wound units could also be specified due to the environment the transformer would be exposed to. If the environment would be corrosive to aluminum, copper wound transformers would make sense. Of course some people may just like copper wound transformers better for their own reasons.

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