

Tech Talk – Aluminum Medium-Voltage Cable

With the continued focus on cost reduction, aluminum conductors are being evaluated, specified and installed with more frequency in the industrial market. This shift from copper to aluminum has raised several questions about the specification of aluminum conductors for medium-voltage cables, and its impact on cable performance.

This memo will address:

- (1) The evolution of aluminum conductors.
- (2) The specification of aluminum conductors as it relates to both low-and medium-voltage cable.
- (3) General Cable's position and recommendation for aluminum medium-voltage cables.

For industrial medium-voltage cable designs employing aluminum conductors, General Cable recommends the use of **Compact Class B AL-1350 Aluminum**. This conductor has proven itself over many years of service and is currently utilized in primary and secondary cable designs for the North American underground residential distribution grid.

How did we arrive at this recommendation?

Let's first look back at how aluminum evolved starting with a brief history and summary of the development of aluminum conductors in the wire and cable industry.

In the 1960s, when the price of copper spiked dramatically, many non-utility industries started evaluating aluminum conductors as a replacement for copper conductors for residential, commercial, and industrial applications to keep costs in check. At the time, the only electrical-grade aluminum available was AL-1350, which was being used in the electrical transmission and distribution markets. While AL-1350 worked well in these utility applications, its use in other applications (particularly residential) was not nearly as successful.

In low voltage commercial and residential installations, the combination of the AL-1350 conductors and the available cable terminations, which were designed for copper building wire, created some very serious issues. The AL-1350 aluminum conductors experienced comparatively high creep and thermal expansion levels, which along with terminations that were not specifically designed for use with aluminum conductors contributed to the loosening of terminations, creating a safety hazard. As a result, aluminum building wire use in the low voltage residential and commercial markets decreased significantly for several decades, even though the connection problems were solved in the early 1970s.

The solution for this issue was twofold: improved connectors for aluminum conductors and new electrical-grade aluminum alloys. In the early 1970's a new aluminum alloy called AA-8000 series was developed by several companies. The AA-8000 series alloy incorporated other chemical elements that eliminated the creep issues previously associated with AL-1350, making it suitable for low voltage applications. Additionally, the connectors were also improved, eliminating the differences in thermal expansion between the conductors and connectors.

With these advancements, AA-8000 series aluminum has now become the standard for low-voltage aluminum conductors and its use is mandated for aluminum cables rated 2000 V and less in accordance with the National Electrical Code.

Does that mean AL-1350 is not viable as an electrical conductor?

This is not the case at all. In fact, these issues were only associated with the termination of low-voltage cables. During the time that the issues discussed above were occurring with low-voltage AL-1350 aluminum cables, AL-1350 conductors continued to be used in far greater quantities in the medium-voltage market without incident, as there were no termination issues associated with medium-voltage cables regardless of conductor type.

So which one is the right choice for medium voltage applications (AL-1350 or AA-8000)?

The good news is that both AL-1350 and AA-8000 will perform well as a conductor material for medium-voltage cables and are recognized by the medium voltage UL standards. While specifying AA-8000 series alloy is required on low-voltage cables for commercial and residential use, there is really no benefit to specifying a particular aluminum grade for medium-voltage cables. Today, most manufacturers continue to use AL-1350 for medium-voltage cables. Allowing both AL-1350 and AA-8000 will leave your specification open, providing access to the full range of cable manufacturers' product offerings helping to minimize cost and lead times.

Summary

While there is a great deal of history, there are also many misconceptions around the use of aluminum conductors. This document provides clarification on these misconceptions, and provides insights and background on aluminum medium-voltage cable and supports General Cable's recommendation to use Compact Class B AL-1350 aluminum conductors as offered in our aluminum Uniblend® XLF medium-voltage cable product line.