FACT-FINDING STUDY ON

POWERING OVER DATA CABLES

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With the increased use of remotely powered devices and increasing levels of power needed to support these devices, concerns have been raised in the International Standards development community about the safety and performance effects of increased heat on the cables. This is especially true when the cables are routed in large bundles or when installed in areas with elevated ambient conditions (above 30°C).

A fact finding study was initiated to investigate the effects of higher levels of power applied over communications cables within the limits permitted by the National Electrical Code. Tests were conducted using 24 AWG Cat. 5e cables in various conditions, including a single conductor in free air, different size bundles in conduit, and a 576-cable bundle in an open wire tray. The test protocol was consistent with similar industry studies, though broader in scope, with the focus on power (volts, watts, amps) rather than applications and the potential safety concerns.

Once enough comparison data was available, testing was repeated using select conditions on other cable constructions, which varied by materials, gauge size, and design. In addition, tests were performed and data generated to support the industry development of new ampacity tables for the NEC that take into account increased heating associated with increasing bundle sizes.

The data reinforced industry findings that increasing the number of cables in a bundle results in ever-increasing temperatures. Bundling is often used for this type of cabling. Studies have shown that interior cables in a bundle are subjected to the greatest heating effects and that larger bundles produce the most heating.

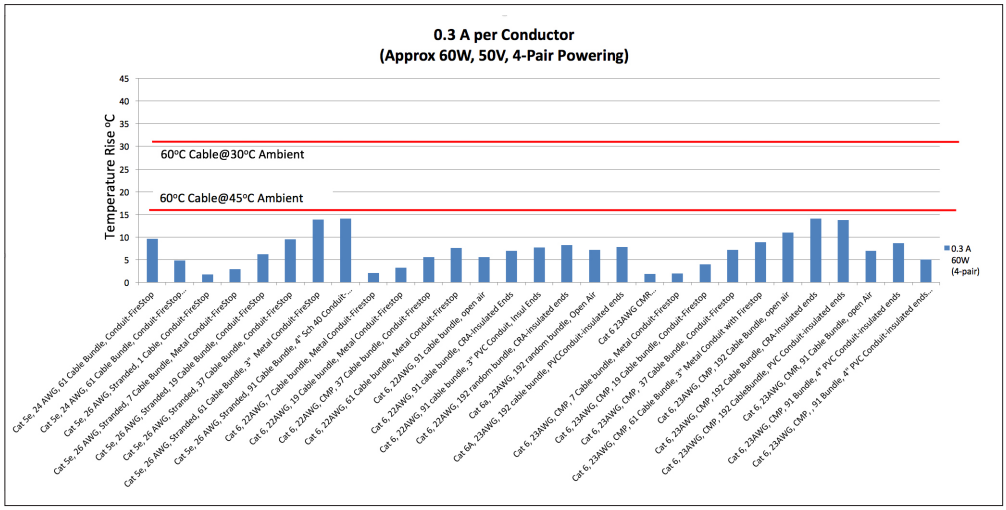

Chart 1. Results of cable type tests at 60 watts.

Not surprisingly, given the tens of thousands of successful installations already in place, the data showed that for existing low power implementations of powering (<60 watts), such as PoE and PoE+, there is little chance of overheating the cables regardless of cable type, bundle size or installation method. See Chart 1. However, once the cables are used in the 100 watt powering range, overheating occurs under many installation conditions. See Chart 2 for more information.

This example shows an increase in temperature from about 2°C for a single enclosed cable to over 35°C for a 91-cable enclosed bundle.

Considering that the future outlook for some LAN cable powering schemes pushing 1 ampere per conductor—or about 200 watts (using 4 pair powering)—the data shows that a significant number of installation conditions and cable types overheat. These findings are cause for great concern.

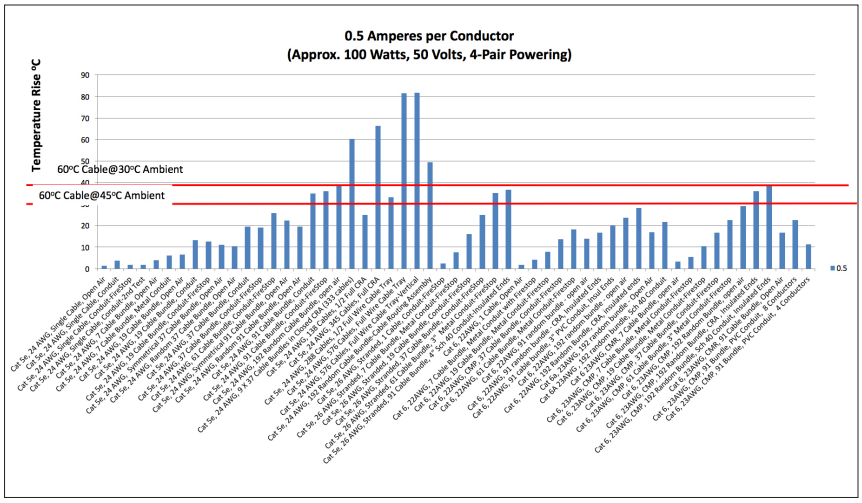

Chart 2. Results of cable type tests at 100 watts. To see charts for 30, 60 and 200 watts, e-mail editorial@wirenet.org for a PDF.

One key observation was that even very small increases in current resulted in significant increases in the measured temperature: in the first case, an increase of 0.1 amperes resulted in a temperature change of over 15°C; in the second case, involving a larger bundle size, a 0.1 ampere change resulted in a temperature rise of over 20°C. See Chart 3.

Another observation of particular interest was that changes in cable construction had a very large impact on measured temperatures. Chart 4 shows the temperature difference between a Cat. 6a cable and a Cat. 6 cable, both 23 AWG. The design and construction had a significant effect on the thermal dissipation capabilities of the cable despite the identical wire gauge.

Extensive testing and research demonstrated that cable heating can be managed by four main factors: (1) increased AWG size, (2) cable design variations, (3) material selection, and (4) installation practices.

This led to the development of test-based requirements for limited power (LP) cables, which can take advantage of these factors.

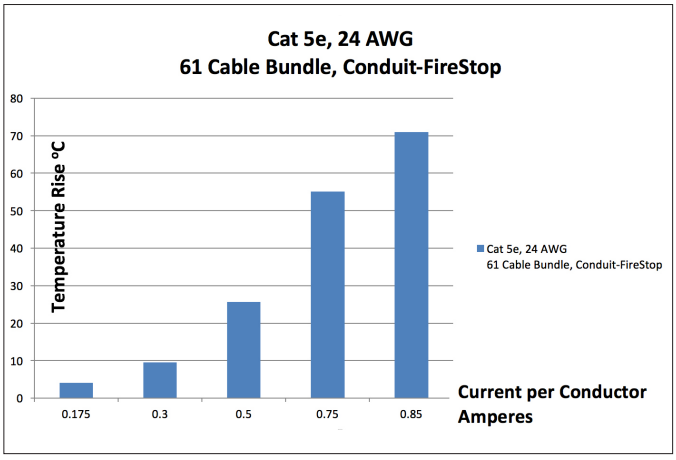

Chart 3. Temperature effect of increasing amperes on a 61-cable bundle.

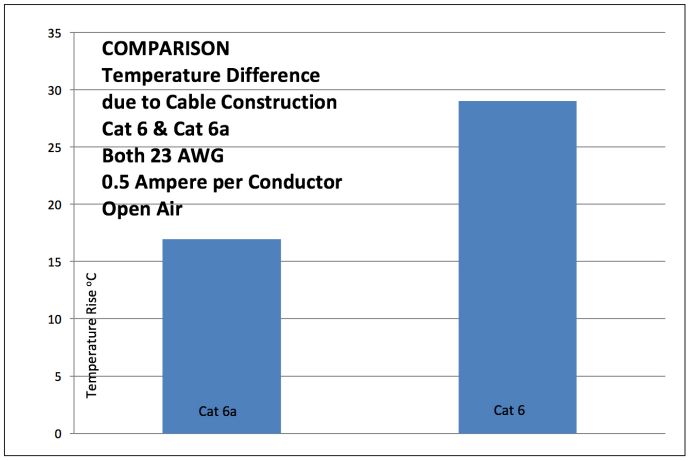

Chart 4. The effect of different cable constructions on temperature

Rather than restrict the cable design, a single testing approach was selected to maximize opportunity for design innovation. See Figure 1. The consideration of reasonable installation extremes in the test plan minimizes the need for onerous restrictions on cable installation planning.

UL is confident that by taking advantage of advances in cable design, LP cables will provide an attractive alternative to ampacity tables and bundle size limitations. They provide an uncomplicated way to prepare installations for increasing power levels, and they are not as susceptible to the issues caused by excessive heat generation. UL continues to do research as part of an ongoing process to support growth and innovation in the cabling industry.

Should you have any questions about this new program, please contact Anthony Tassone at Anthony.T.Tassone@ul.com.

Figure 1. "-LP" cable testing

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