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INTERCONNECTION OF INFORMATION TECHNOLOGY EQUIPMENT
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ISO/IEC JOINT TECHNICAL COMMITTEE 1
SUBCOMMITTEE No.25: INTERCONNECTION OF
INFORMATION TECHNOLOGY EQUIPMENT
WORKING GROUP 3: CUSTOMER PREMISES CABLING

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Subject: Liaison to IEEE 802.3 regarding elevated temperature operation of cabling

Dear David,

Thank you for your liaison from the IEEE 802.3 Working Group, approved on July 28, 2016 regarding power delivery over communications cabling (our reference SC 25 N 2591).

At our 19th/22nd September 2016 meeting in Reutlingen, Germany, ISO/IEC JTC1 SC 25 WG3 discussed existing specifications and the challenges of operating communications cabling at higher operating temperatures. The scope of this response is for Environmental Classification C_1 as specified in ISO/IEC 11801-1.

The key points of discussion relating to temperature, together with our observations, are listed below. They are grouped below under 4 topics: 1) Transmission, 2) Electrical, 3) Mechanical and 4) Environmental.

1. **Transmission:**
   ISO/IEC DIS 11801-1:2016 specifies transmission performance for cabling from -10 ^{0}C to 60 ^{0}C. Performance above 60 ^{0}C would need to be studied to determine its impact on all transmission parameters and if its impact on insertion loss (IL) de-rating at higher temperatures is different from the de-rating already specified up to 60 ^{0}C. De-rating of IL for balanced cables up to 60 ^{0}C is shown below:

   "For operating temperatures above 20 °C, IL should be reduced by 0,2 % per °C (20 °C to 60 °C) for screened cables; 0,4 % per °C (20 °C to 40 °C) and 0,6 % per °C (>40 °C to 60 °C) for unscreened cables."

   - In addition, we would like to note that there would be a need for further study of electrical and mechanical performance for cables at operating temperatures that reflect maximum ambient temperature of 60 °C plus current-induced temperature rise associated with power delivery. This work would need to be carried out in coordination with IEC/SC 46C.

2. **Electrical:**
   ISO/IEC DIS 11801-1:2016, Table 82 specifies the temperature range for cables as follows:

   "Temperature range without mechanical or electrical degradation (°C)
   - *installation: 0 to +50*
   - *operation: –20 to +60"*

ISO/IEC DIS 11801-1:2016, clause 10.1.1 specifies that "*Performance of the connecting hardware shall be maintained over temperatures ranging from -10 °C to +60 °C"*

Table 109 specifies a connecting hardware current rating of 0,75A per conductor with a note that this rating is "*Applicable for an ambient temperature of 60 °C."* However, high frequency performance under these conditions has not been studied.

For DC resistance (DCR) and DCR unbalance, we make the following observations:

- DC resistance will increase with temperature by DCR = 0,4 % per °C;
- DCR unbalance (within a pair and pair-to-pair) have not been studied at temperatures greater than 60°C.

Dielectric Constant of insulation material value at temperatures above 60 °C would also need to be investigated.

3. **Mechanical:**
   Materials generally age faster at higher temperatures and the impact of aging on key properties has to be studied. Mechanical performance of cables is assured based on the temperature rating on the cable jacket, where 60 °C represents the vast majority of the installed base.

   Mechanical performance of connecting hardware is assured by our standards for currents up to 0,75 A per conductor at ambient temperatures of 60 °C.

4. **Environmental:**
   Operating at higher temperatures increases the DC resistance significantly leading to additional losses within the cabling. This reduces the efficiency of power delivery with the need to remove the dissipated energy.

   Due to remote power delivery over communications cabling and the associated temperature rise, in addition to ambient temperature, ISO/IEC 11801-1 defines operating temperature as shown below:

   *"**3.1.58 operating temperature:** stabilised temperature of the local environment, measured on the outside sheath of the cable, combining ambient temperature with any increase due to the application being supported"*

In conclusion, extending the temperature range beyond 60 °C would take considerable investment of time, resources, and coordination with IEC component committees. At this time we have no plans to start any projects for operation at temperatures above 60 °C, but we have added this topic to our three year plan to the list of aspects for future consideration.

We would be happy to address any other specific requests or questions you may have regarding operating communications cabling at higher temperatures.

Sincerely,

Albrecht

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