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Ambient temperature Considerations for IEEE 802.3bt 4PPoE task force

See comment 242 Draft 2.2 *Cl* **33** *SC* **33.1.3.1** *P* **56** *L* **36**

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Outline

- Definition(s) of ambient temperature
- ANSI/TIA-569-D-1 environment requirements
- TIA TSB-184-A considerations
- NEC® 2017 code considerations
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Ambient temperature definition

www.dictionary.com – temperature of the surrounding environment; technically the temperature of the air surrounding a power supply or cooling medium; abbreviated ABM. Word Origin based on ambient meaning “surrounding”.

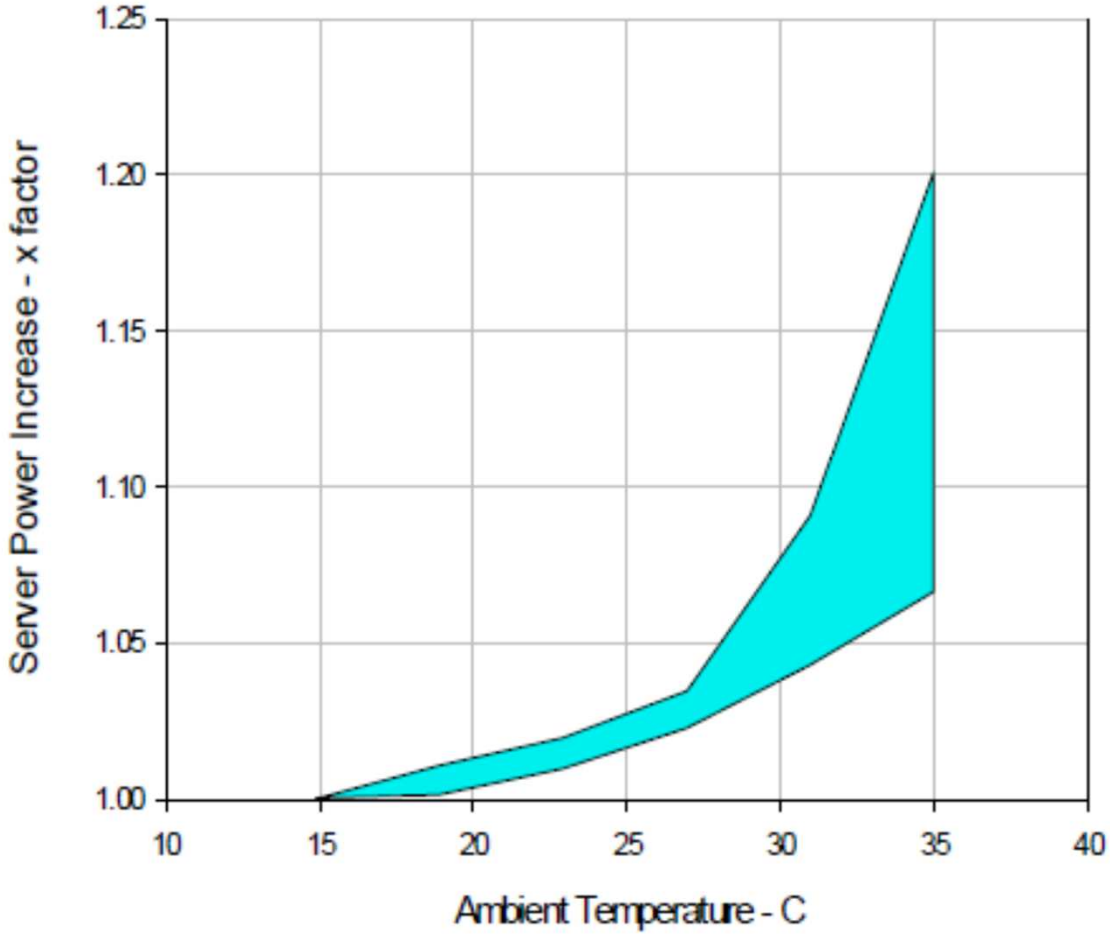
ANSI/TIA-569-D-1 requirements

ASHRAE Class	Space (see clause)	Environmental requirements
Class A1	See note 1	• Temperature: 15 – 32 °C (59 – 90 °F) dry bulb[2] • Maximum rate of temperature change: 5 °C (9 °F) per hour in spaces where tape drives are present, otherwise 20 °C (36 °F) per hour • Humidity range, noncondensing: -12 °C (10 °F) DP and 8% RH to 17 °C (63 °F) DP and 80% RH
Class A2	See note 1	• Temperature: 10 – 35 °C (50 – 95 °F) dry bulb[2] • Maximum rate of temperature change: 5 °C (9 °F) per hour in spaces where tape drives are present, otherwise 20 °C (36 °F) per hour • Humidity range, noncondensing: -12 °C (10 °F) DP and 8% RH to 21 °C (70 °F) DP and 80% RH
Class A3	See note 1	• Temperature: 5 – 40 °C (41 – 104 °F) dry bulb[2,3] • Maximum rate of temperature change: 5 °C (9 °F) per hour in spaces where tape drives are present, otherwise 20 °C (36 °F) per hour • Humidity range, noncondensing: -12 °C (10 °F) DP and 8% RH to 24 °C (75 °F) DP and 85% RH
Class A4	See note 1	• Temperature: 5 – 45 °C (41 – 113 °F) dry bulb[2,3] • Maximum rate of temperature change: 5 °C (9 °F) per hour in spaces where tape drives are present, otherwise 20 °C (36 °F) per hour • Humidity range, noncondensing: -12 °C (10 °F) DP and 8% RH to 24 °C (75 °F) DP and 90% RH
Class B	Distributor room (6.4) Distributor enclosure (6.6) Entrance room or space (6.5) Access provider space (7) Service provider space (7) Common distributor room (8.2)	• Temperature: 5 – 35 °C (41 – 95 °F) dry bulb[2,3] • Humidity range, noncondensing: 8% RH to 28 °C (82 °F) DP and 80% RH
Class C	See note 1	• Temperature: 5 – 40 °C (41 – 104 °F) dry bulb[2,3] • Humidity range, noncondensing: 8% RH to 28 °C (82 °F) DP and 80% RH

NOTES:

1. Class A1, Class A2, Class A3, Class A4 and Class C are not referenced by this Standard. They are included for reference by specific premises standards.
2. Reduce maximum temperature at altitude above 900 m (3000 ft): A1, A2, B, C: 1 °C per 300 m (1.8 °F per 1000 ft); A3: 1 °C per 175 m (1.8 °F per 575 ft); A4: 1 °C per 125 m (1.8 °F per 410 ft).
3. Minimum temperature with a diskette in a drive is 10 °C (50 °F).
4. The ASHRAE *Thermal Guidelines for Data Processing Environments* provide both recommended and allowable ranges. The requirements in this table are based on the allowable ranges.

Ambient temperature vs. Server Power in ASHRAE A2 environment



Source ASHRAE TC 9.9

TIA TSB-184-A

6.2 Ambient temperature

Different segments of a link can have different ambient temperatures, which may influence the amount of remote power that can be delivered. The maximum ambient temperature along the link (length of at least 1 m) should be used as the basis for the calculation of the maximum current capacity. Discontinuities in environments such as penetrations through walls are expected to be less than 1 m in length. For the purposes of this document, a maximum ambient temperature of 45°C is presumed in conjunction with cabling with a maximum rating of 60°C, thus allowing a maximum temperature rise of 15 °C on any cable within the bundle due to dc powering. For applications that operate at higher ambient temperatures or temperatures rises, consult component or system manufacturers for additional guidance. See annex A for additional information, including the temperature rise associated with different current capacities for various categories of cable.

NEC® 2017 code

NEC 2017 uses an ambient temperature of 30 C (86 F) and has a table 310.15(B)(2) of adjustment factors for other ambient temperatures.

Additional guidelines include

(1) Ambient temperature — ambient temperature may vary along the conductor length as well as from time to time.
(2) Heat generated internally in the conductor as the result of load current flow, including fundamental and harmonic currents.
(3) The rate at which generated heat dissipates into the ambient medium. Thermal insulation that covers or surrounds conductors affects the rate of heat dissipation.
(4) Adjacent load-carrying conductors — adjacent conductors have the dual effect of raising the ambient temperature and impeding heat dissipation.

NEC NFPA 70 2017 article 725.144

Table 725.144, Ampacities of Each Conductor (in Amperes) in a 4-Pair Class 2 or Class 3 Data Cables, Based on Copper Conductors at Ambient Temperature of 30°C (86°F) with all Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (140°F) and 90°C (194°F) Rated Cables

AWG	Number of 4-Pair Cable in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C
26	1.0	1.0	1.0	1.0	1.0	1.0	0.7	0.8	1.0	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	N/A	N/A	N/A
24	2.0	2.0	2.0	1.0	1.4	1.6	0.8	1.0	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3.0	3.0	3.0	1.4	1.8	2.1	1.0	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7

Note 1: For bundle sizes over 192 cable, or for conductor sizes smaller than 26AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.

Informational Note: The conductor sizes in data cables in wide-spread use are typically 22-26 AWG.

ISO/IEC TS 29125

6.4. Factors affecting temperature increase

6.4.1 General

The steady state temperature for the conductor of any power carrying cable is reached when the generation of heat within the cable (Joule effect) is equal to the heat dissipated into the environment, be it the open atmosphere, trays, ducts or other cables which may also be power carrying cables.

6.4.2 Installation near equipment

Ambient temperature near equipment will be higher and also installation of telecommunications cables and cords in hot aisles will lead to higher ambient temperature around the patch cord bundle.

6.4.4 Reducing temperature increase

The recommendation of ISO/IEC 14763-2 for cable bundles of no more than 24 is further reinforced for remote powering due to:

- installation factors,
- possible high ambient temperature,
- the use of 0,4 mm conductor diameter cords,
- higher currents up to 500 mA per conductor with all 4 pairs energized.

6.4.5 Cable bundle suspended in air

The maximum ambient temperature of 50 °C is possible in certain environments and operating conditions. To allow for this ambient temperature and limit the temperature rise to 10 °C, for the minimum Category 5 cables supporting 500 mA per conductor, it is necessary to limit the bundle size to a smaller number than 100 cables.

Summary

- Maximum ambient temperature is 60 C in both ISO/IEC/JTC 1/SC 25/WG 3 and TIA TR42 for communications applications
- For remote power delivery up to Type 3 and 100 cable bundles, the maximum supported ambient had to be reduced to 50 C in ISO and 45 C in TIA
- For type 4 we can control the temperature rise to be below 10 C by reducing the bundle size based on the tables/charts in ISO, TIA, and NEC
- The recommendation of maximum 24 cables per bundle will support Type 4 in air or conduit over 24 AWG or better cables

Proposed Resolution of comment 242, Add:“ For Type 4 PSEs, managing the temperature rise can require a reduction in the maximum number of cables bundled. See ISO/IEC TS 29125, TIA TSB-184-A, as well as applicable local codes and regulations, e.g., ANSI/NFPA 70 - National Electric Code® (NEC®) for more information.”