

# **Equipment Thermal Guidelines for Data Processing Environments**

## **ASHRAE TC 9.9 Reference Card**

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**Table 2.1 2015 Thermal Guidelines—SI Version (I-P Version in Appendix B)**

<b>Equipment Environment Specifications for Air Cooling</b>							
<b>Class <sup>a</sup></b>	<b>Product Operation<sup>b,c</sup></b>				<b>Product Power Off<sup>c,d</sup></b>		
	<b>Dry-Bulb Temperature<sup>e,g</sup>, °C</b>	<b>Humidity Range, Noncondensing<sup>h, i, k, l</sup></b>	<b>Maximum Dew Point<sup>k</sup>, °C</b>	<b>Maximum Elevation<sup>e, j, m</sup>, m</b>	<b>Maximum Rate of Change<sup>f</sup>, °C/h</b>	<b>Dry-Bulb Temperature, °C</b>	<b>Relative Humidity<sup>k</sup>, %</b>
<b>Recommended (Suitable for all four classes; explore data center metrics in this paper for conditions outside this range.)</b>							
<b>A1 to A4</b>	18 to 27	−9°C DP to 15°C DP and 60% rh					
<b>Allowable</b>							
<b>A1</b>	15 to 32	−12°C DP and 8% rh to 27°C DP and 80% rh <sup>k</sup>	17	3050	5/20	5 to 45	8 to 80 <sup>k</sup>
<b>A2</b>	10 to 35	−12°C DP and 8% rh to 27°C DP and 80% rh <sup>k</sup>	21	3050	5/20	5 to 45	8 to 80 <sup>k</sup>
<b>A3</b>	5 to 40	−12°C DP and 8% rh to 27°C DP and 85% rh <sup>k</sup>	24	3050	5/20	5 to 45	8 to 80 <sup>k</sup>
<b>A4</b>	5 to 45	−12°C DP and 8% rh to 27°C DP and 90% rh <sup>k</sup>	24	3050	5/20	5 to 45	8 to 80 <sup>k</sup>
<b>B</b>	5 to 35	8% to 29°C DP and 80% rh <sup>k</sup>	28	3050	N/A	5 to 45	8 to 80 <sup>k</sup>
<b>C</b>	5 to 40	8% to 29°C DP and 80% rh <sup>k</sup>	28	3050	N/A	5 to 45	8 to 80 <sup>k</sup>

\* For potentially greater energy savings, refer to Appendix C for the process needed to account for multiple server metrics that impact overall TCO.

## Notes for Table 2.1, 2015 Thermal Guidelines—SI Version (I-P Version in Appendix B)

- a. Classes A3, A4, B, and C are identical to those included in the 2011 edition of *Thermal Guidelines for Data Processing Environments*. The 2015 version of the A1 and A2 classes have expanded RH levels compared to the 2011 version.
- b. Product equipment is powered ON.
- c. Tape products require a stable and more restrictive environment (similar to 2011 Class A1). Typical requirements: minimum temperature is 15°C, maximum temperature is 32°C, minimum RH is 20%, maximum RH is 80%, maximum dew point is 22°C, rate of change of temperature is less than 5°C/h, rate of change of humidity is less than 5% rh per hour, and no condensation.
- d. Product equipment is removed from original shipping container and installed but not in use, e.g., during repair, maintenance, or upgrade.
- e. Classes A1, A2, B, and C—Derate maximum allowable dry-bulb temperature 1°C/300 m above 900 m. Above 2400 m altitude, the derated dry-bulb temperature takes precedence over the recommended temperature. Class A3—Derate maximum allowable dry-bulb temperature 1°C/175 m above 900 m. Class A4—Derate maximum allowable dry-bulb temperature 1°C/125 m above 900 m.
- f. For tape storage: 5°C in an hour. For all other ITE: 20°C in an hour and no more than 5°C in any 15 minute period of time. The temperature change of the ITE must meet the limits shown in the table and is calculated to be the maximum air inlet temperature minus the minimum air inlet temperature within the time window specified. The 5°C or 20°C temperature change is considered to be a temperature change within a specified period of time and not a rate of change. See Appendix K for additional information and examples.
- g. With a diskette in the drive, the minimum temperature is 10°C (not applicable to Classes A1 or A2).
- h. The minimum humidity level for Classes A1, A2, A3, and A4 is the higher (more moisture) of the –12°C dew point and the 8% rh. These intersect at approximately 25°C. Below this intersection (~25°C) the dew point (–12°C) represents the minimum moisture level, while above it, RH (8%) is the minimum.
- i. Based on research funded by ASHRAE and performed at low RH, the following are the minimum requirements:
  - 1) Data centers that have non-ESD floors and where people are allowed to wear non-ESD shoes may want to consider increasing humidity given that the risk of generating 8 kV increases slightly from 0.27% at 25% rh to 0.43% at 8% (see Appendix D for more details).
  - 2) All mobile furnishing/equipment is to be made of conductive or static dissipative materials and bonded to ground.
  - 3) During maintenance on any hardware, a properly functioning and grounded wrist strap must be used by any personnel who contacts ITE.
- j. To accommodate rounding when converting between SI and I-P units, the maximum elevation is considered to have a variation of ±0.1%. The impact on ITE thermal performance within this variation range is negligible and enables the use of rounded values of 3050 m (10,000 ft).
- k. See Appendix L for graphs that illustrate how the maximum and minimum dew-point limits restrict the stated relative humidity range for each of the classes for both product operations and product power off.
- l. For the upper moisture limit, the limit is the minimum absolute moisture of the DP and RH stated. For the lower moisture limit, the limit is the maximum absolute moisture of the DP and RH stated.
- m. Operation above 3050 m requires consultation with IT supplier for each specific piece of equipment.

# Environmental Conditions and Class Definitions

## 1. Environmental Conditions

**Recommended:** Facilities should be designed and operated to target the recommended range.

**Allowable:** Equipment should be designed to operate within the extremes of the allowable operating environment. In addition to the allowable dry-bulb temperature and dew-point ranges, the maximum relative humidity and maximum elevation values are part of the allowable operating environment definitions.

## 2. Environmental Class Definitions

**General:** Compliance with a particular environmental class requires full-performance operation of the equipment over the entire allowable environmental range, based on non-failure conditions.

**Class A1:** Typically a data center with tightly controlled environmental parameters (dew point, temperature, and relative humidity) and mission-critical operations; types of products typically designed for this environment are enterprise servers and storage products.

**Class A2/A3/A4:** Typically an information technology space with some control of environmental parameters (dew point, temperature, and relative humidity); types of products typically designed for this environment are volume servers, storage products, personal computers, and workstations. Among these three classes, A2 has the narrowest temperature and moisture requirements. A4 has the widest environmental requirements.

**Class B:** Typically an office, home, or transportable environment with minimal control of environmental parameters (temperature only); types of products typically designed for this environment are personal computers, workstations, laptops, and printers.

**Class C:** Typically a point-of-sale or light industrial or factory environment with weather protection, sufficient winter heating, and ventilation; types of products typically designed for this environment are point-of-sale equipment, ruggedized controllers, or ruggedized computers and PDAs.

**NEBS:** In accordance with Telcordia GR-63-CORE (Issue 2, April, 2002) and GR-3028-CORE (Issue 1, Dec, 2001). Typically a telecommunications central office with some control of environmental parameters (dew point, temperature, and relative humidity); types of products typically designed for this environment are switches, transport equipment, and routers.

**Product Operation:** Product equipment is powered ON.

**Product Power Off:** Product equipment is removed from the original shipping container and installed but not in use, e.g., during repair, maintenance, or upgrade.