



Facility and Equipment Thermal Guidelines for Data Center and Other Data Processing Environments

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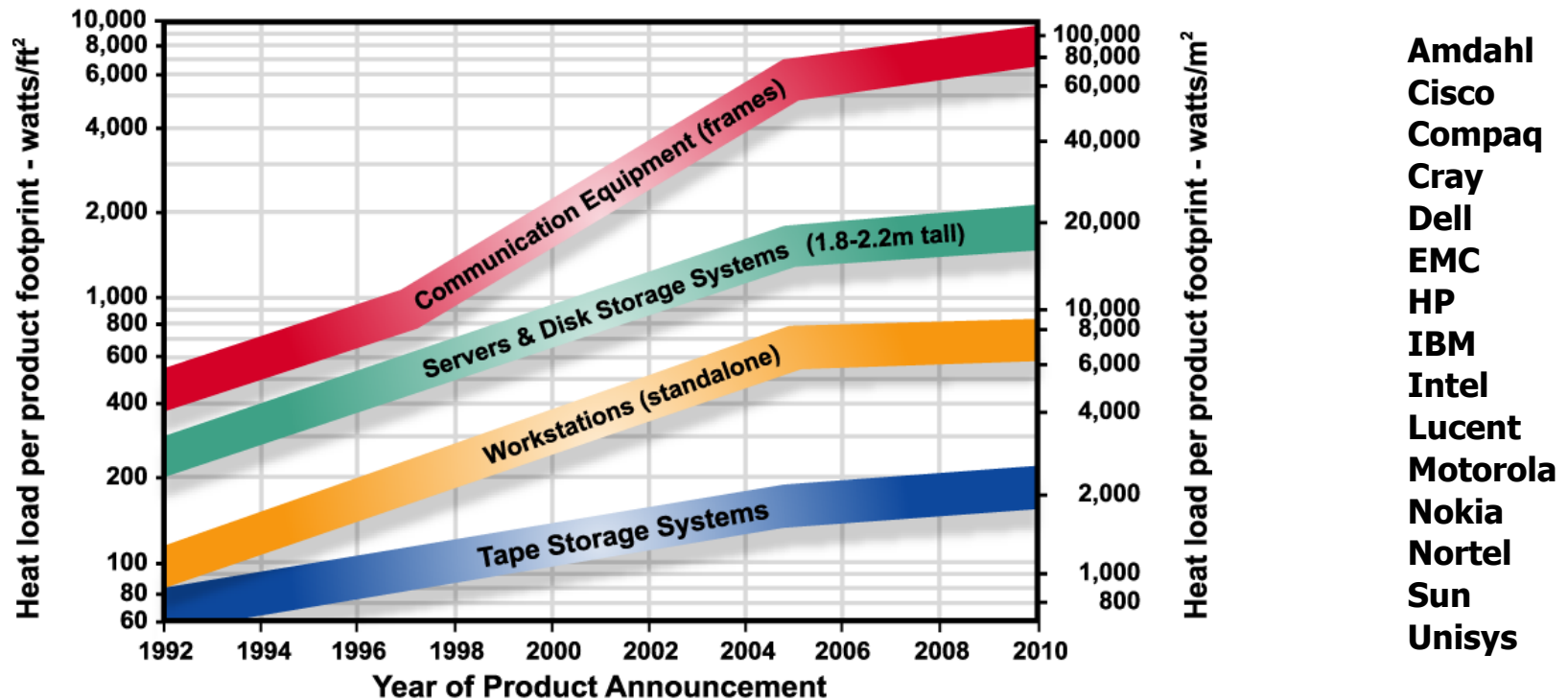
Principal

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Product Heat Density Trend Chart



- Amdahl
- Cisco
- Compaq
- Cray
- Dell
- EMC
- HP
- IBM
- Intel
- Lucent
- Motorola
- Nokia
- Nortel
- Sun
- Unisys



Purpose of the ASHRAE HDEC Guideline

1. Provide a roadmap that will enable standardized operating environments for equipment.
2. Provide guidelines for facility operations personnel and equipment manufacturers on how to design systems for fault tolerant performance.
3. Provide guidance on how to evaluate and test the operational “health” of the data center.
4. Provide a methodology for reporting the environmental characteristics of a computer system.



Environmental Class Definitions

- **Class 1:** Tightly controlled environmental parameters; generally raised floor; Ex.: Servers and storage products.
- **Class 2:** Loosely controlled environmental parameters; Ex.: Servers and storage products.
- **Class 3:** Little control on environmental parameters; Ex.: Workstations, PCs, portables, and printers.
- **Class 4:** No environmental control; Ex.: Point-of-sales equipment.

- **TCO:** Telecom Central Office. Tightly controlled environmental parameters; overhead air distribution; Ex.: Switches, routers, transport equipment.



Environmental Requirements

Product Operation ¹								Product Power Off ¹		
Class	Dry Bulb Temperature (C)		Relative Humidity (%)		Max. Dew Point (C)	Max. Elevation (m)	Max Rate of Change (C/hr.)	Dry Bulb Temperature (C)	Relative Humidity(%)	Max. Dew Point (C)
	Allowable	Recommended	Allowable	Recommended						
1	15 to 32 ²	20 to 25	20 to 80	40 to 50	21	3050	5	5 to 45	8 to 80	27
2	10 to 35 ²	20 to 25	20 to 80	40 to 50	21	3050	5	5 to 45	8 to 80	27
3	5 to 35 ^{2,3}	NA	8 to 90 ³	NA	28	3050	NA	5 to 45	8 to 90	29
4	5 to 45 ^{2,3}	NA	8 to 80	NA	28	3050	NA	5 to 45	8 to 80	29





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4	5 to 45 ^{2,3}	NA	8 to 80	NA	28	3050	NA	5 to 45	8 to 80	29

1. With tapes, the minimum temperature is 15°C, maximum temperature is 32°C, minimum relative humidity is 20%, maximum relative humidity is 80%, maximum dew point is 22°C, and maximum rate of change cannot exceed 1°C/hr.
2. Derate maximum dry bulb temperature 1°C/300m above 900m.
3. With a diskette in the drive the minimum temperature is 10°C and maximum RH is limited to 80%.



Environmental Requirements

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	Allowable	Recommended	Allowable	Recommended						

- The environmental sections of GR-63-CORE address operating conditions as well as testing of brand new equipment for adequate robustness. The latter environmental limits (short-term) are based on conditions that may— with certain low probability—occur in various telecommunications environments. Note that GR-63-CORE does not provide any guidelines for facility operation. GR-3028-CORE, on the other hand, provides recommended facility operating conditions such as temperature and humidity.

Test Conditions (short-term)

Dry Bulb Temperature	
Frame Level	-5° to 50°C (per GR-63-CORE)
Shelf Level	-5° to 55°C (per GR-63-CORE)
Max Rate of Change	0.5°C/min. (per GR-63-CORE)
	1.6°C/min. (per GR-3028-CORE)
Relative Humidity	
Max Dew Pt	5 to 90% (per GR-63-CORE)
	28°C (per GR-63-CORE)

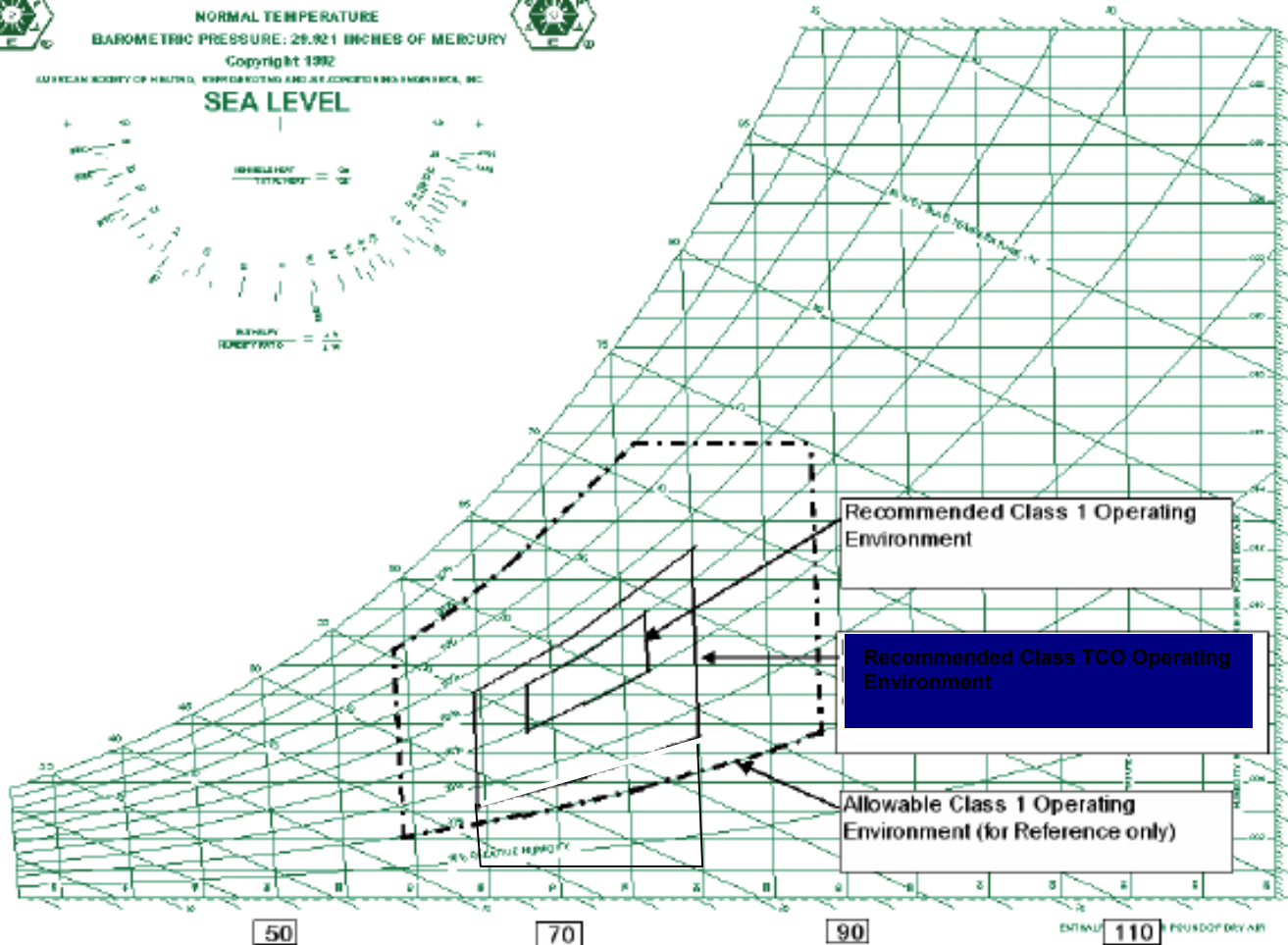
- Operating conditions per GR-63-CORE.
- Derate maximum dry bulb temperature 10°C at and above 1800 m.
- Also ANSI T1.304-1997.
- Recommended facility operation per GR-3028-CORE.
- Telcordia recommendation.



Environmental Requirements



ASHRAE PSYCHROMETRIC CHART NO.1
 NORMAL TEMPERATURE
 BAROMETRIC PRESSURE: 29.921 INCHES OF MERCURY
 Copyright 1992
 AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
 SEA LEVEL



50

70

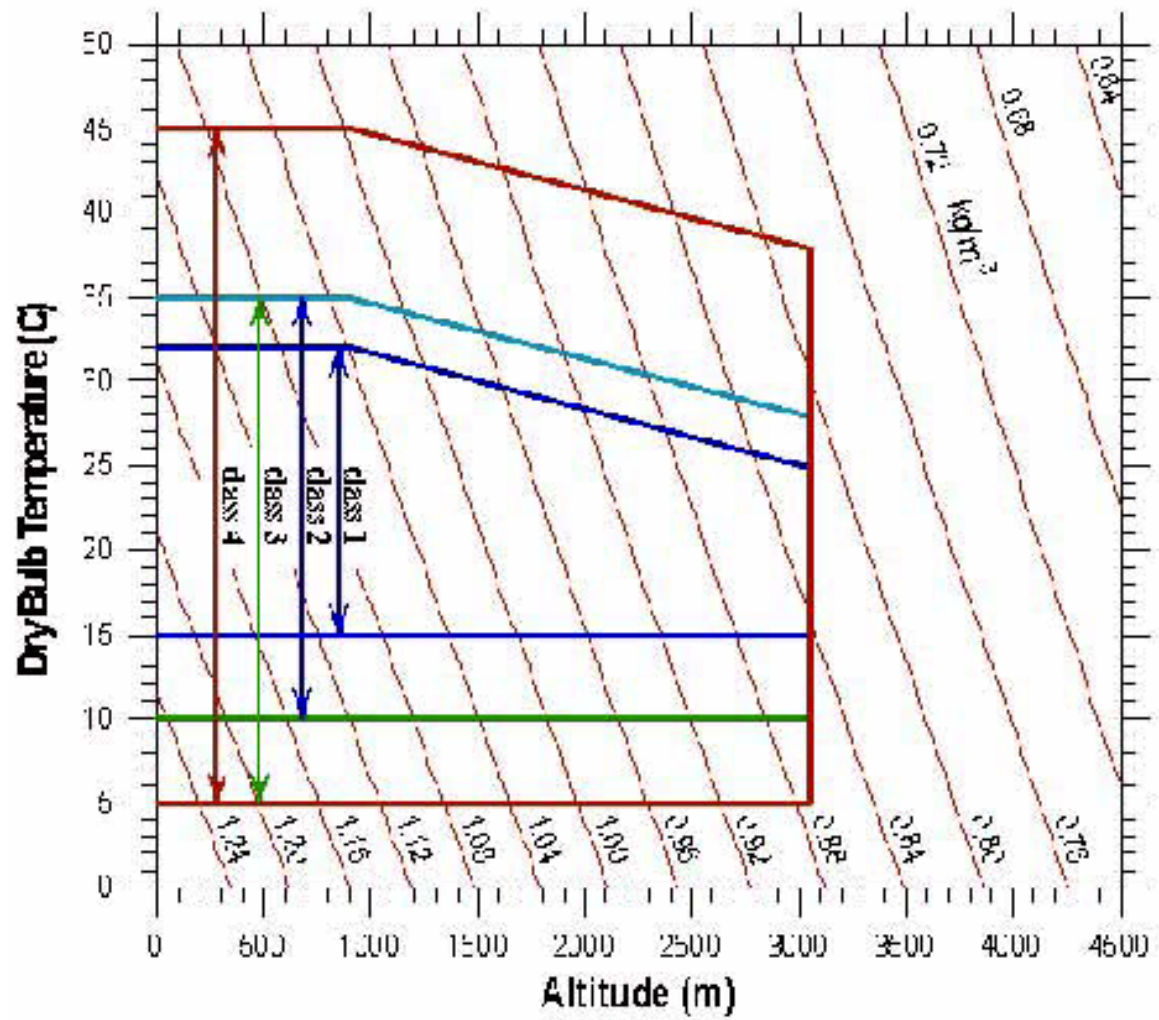
90

110

Dry Bulb Temp (°F)



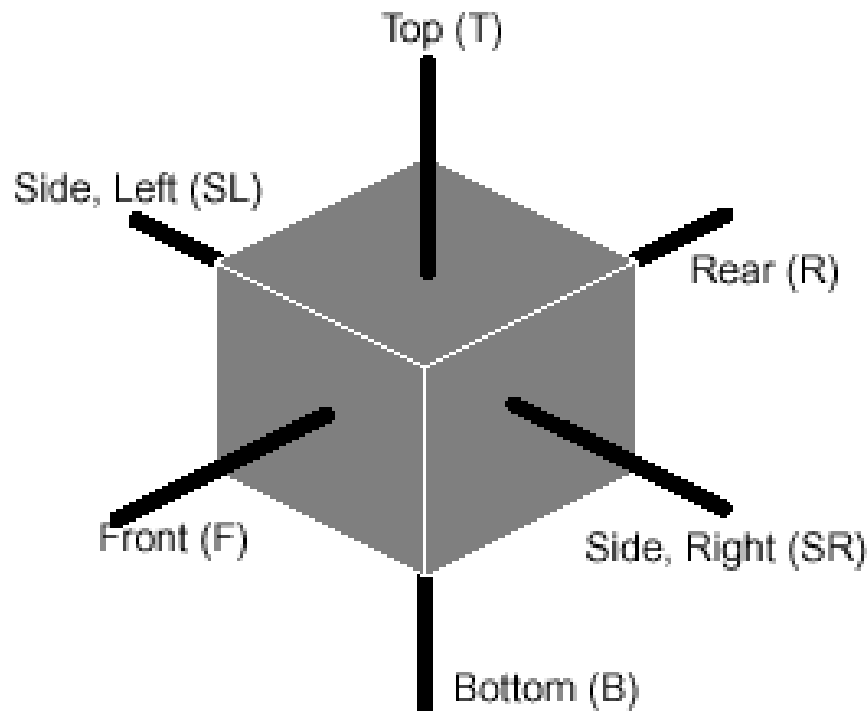
Environmental Requirements





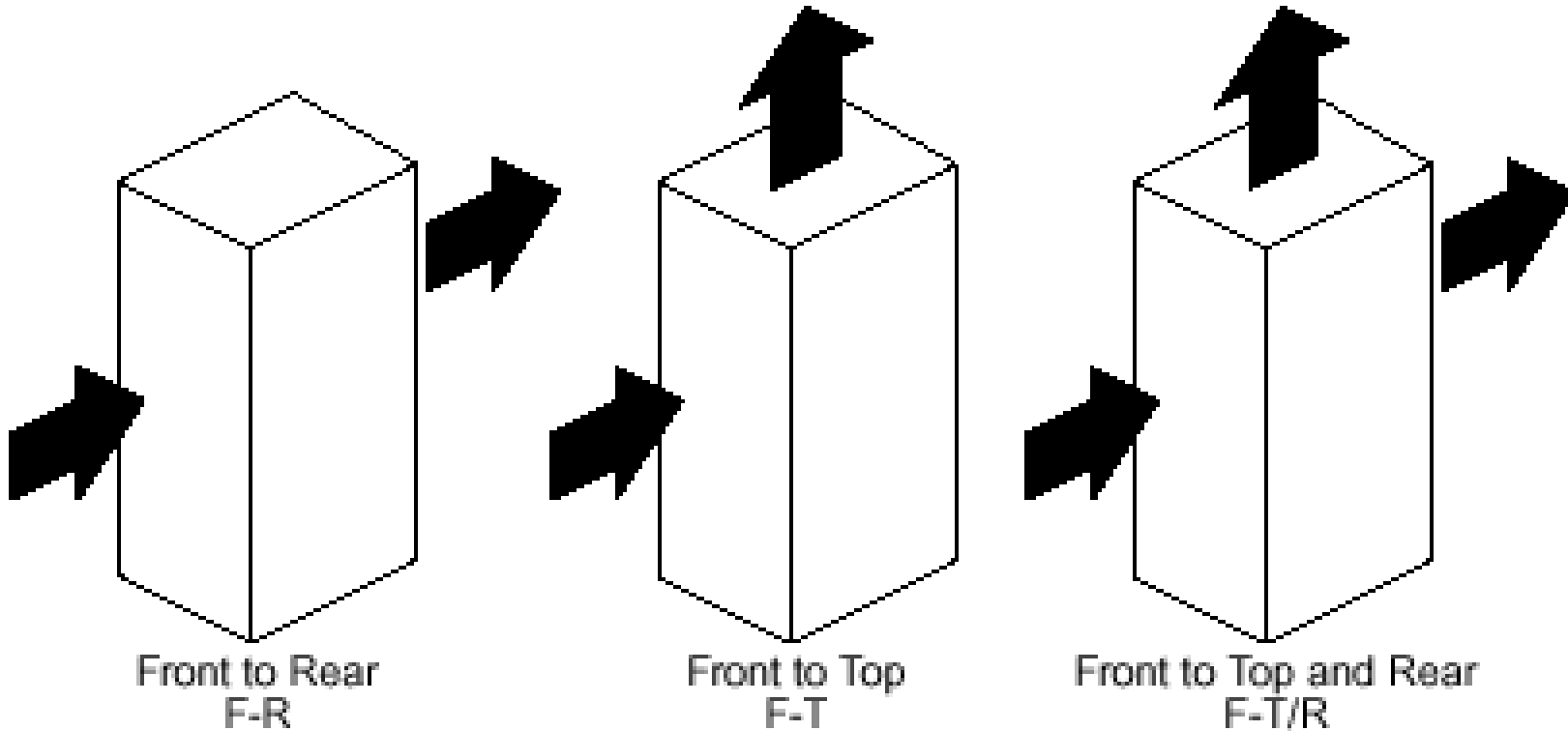
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Equipment Air Cooling Syntax



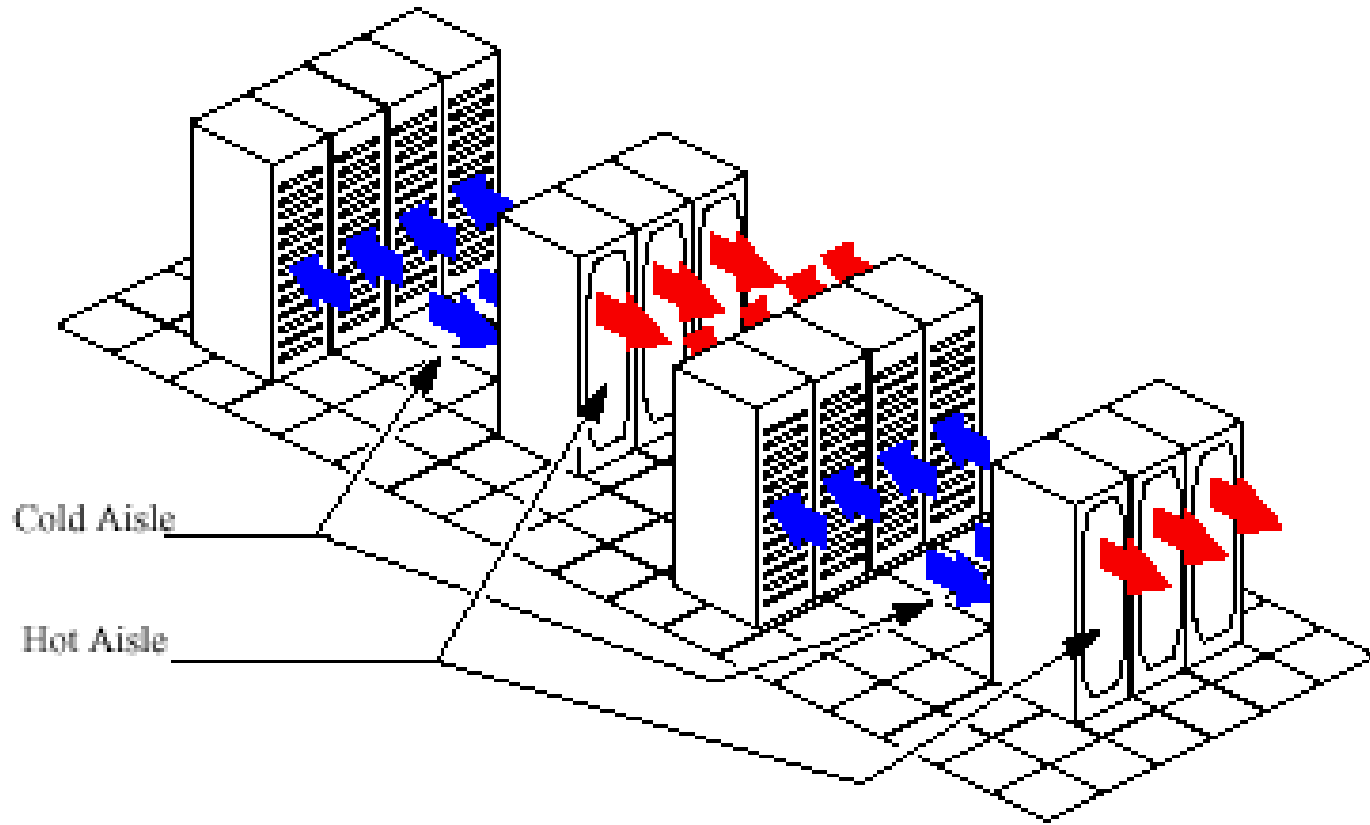


Air Cooling Guidelines



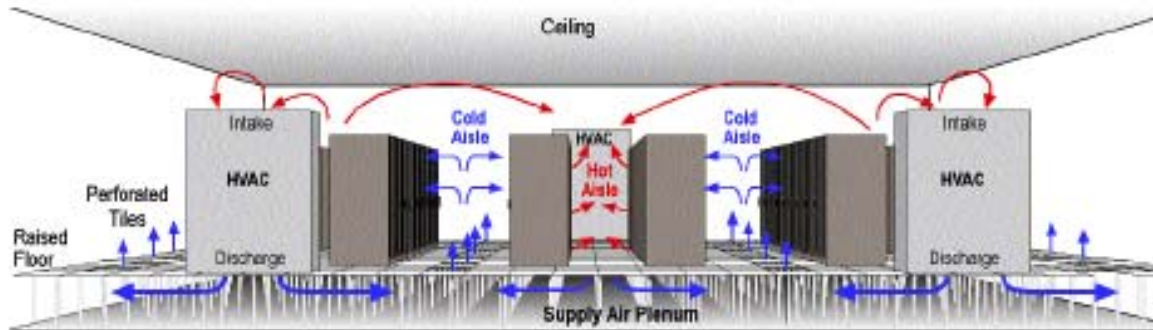


Cold Aisle/Hot Aisle





Implementation of Cold Aisle/Hot Aisle



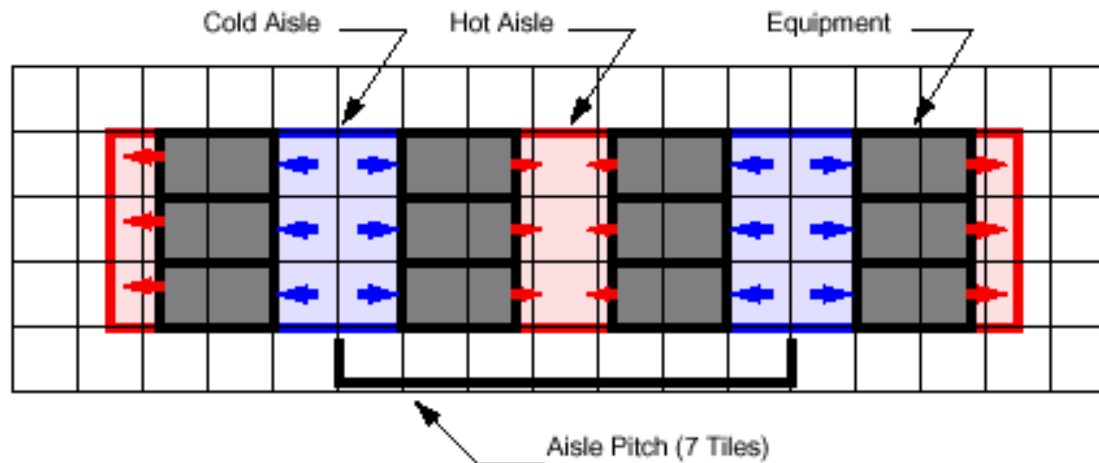
Data Center

Central Office





Equipment Spacing

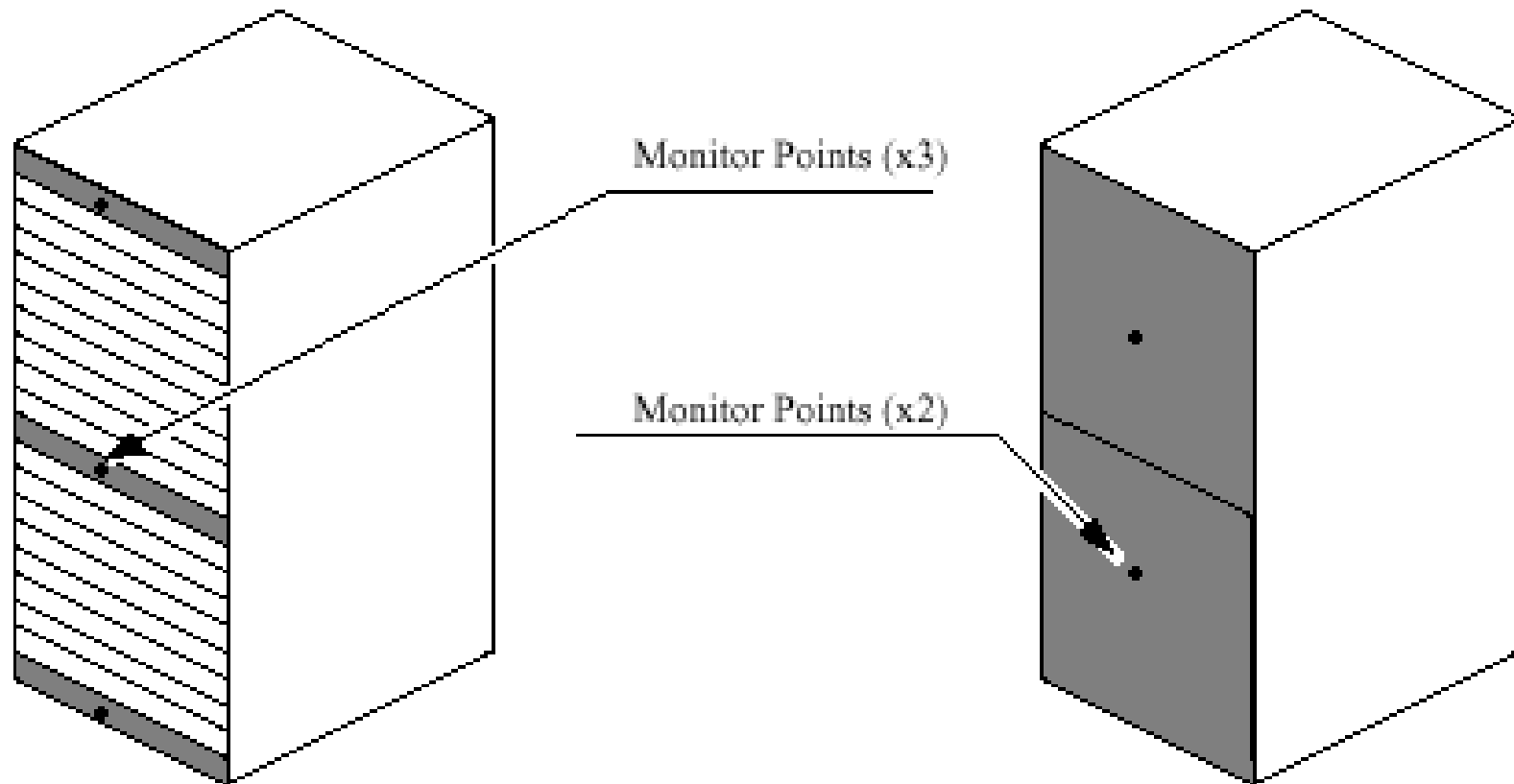


Tile Size	Aisle Pitch (cold aisle to cold aisle)	Nominal Cold Aisle Size ¹	Max Space allocated for Equipment with no overhang ²	Hot Aisle Size
2 ft. (US)	14 ft.	4 ft.	42 inches (1066.8 mm)	3 ft.
600 mm (Global)	4200 mm	1200 mm	1042.8 mm (41 inches)	914.4 mm (3 ft.)

1. Nominal dimension assumes no overhang; less if front door overhang exists
2. Typically a one meter rack is 1070 mm with the door and would overhang the front tile 3.2 mm for a US configuration and 27.2 mm for global configuration.



Monitoring Points for Measuring Temperature

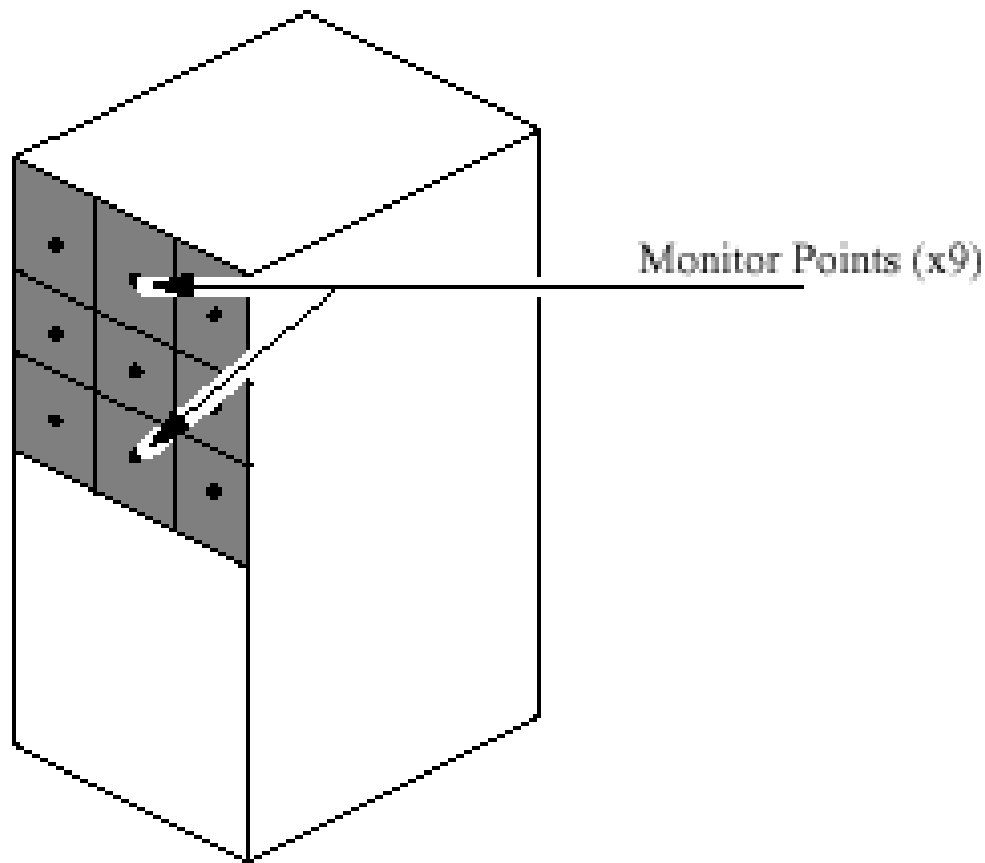




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TG9.HDEC High Density Electronic Equipment Facility Cooling

Monitoring Points for Measuring Temperature



Monitor Points (x9)



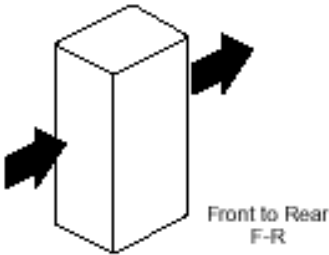
Reporting Equipment Heat Loads

XYZ Co. Model 123 Server

Footprint below does not include service clearance, which is zero on the sides, 46 inches (1168 mm) in the front, and 40 inches (1016 mm) in the rear.

Representative configurations:

Description	Typical Heat Release	Footprint (W x D x H)		Weight		Airflow ¹	
		watts	inches	mm	lbs.	kg.	cfm
Minimum Configuration	1765	30 x 40 x 72	762 x 1016 x 1828	896	406.4	400	680
Full Configuration	10740	61 x 40 x 72	1549 x 1016 x 1828	1529	693.4	750	1275
Typical Configuration	5040	30 x 40 72	762 x 1016 x 1828	1040	471.7	555	943

<p>Airflow Diagram Cooling scheme F-R</p> 	Minimum Configuration	1 CPU-A, 1 GB, 2 I/O
	Full Configuration	8 CPU-B, 16 GB, 64 I/O (2 GB cards, 2 frames)
	Typical Configuration	4 CPU-A, 8 GB, 32 I/O (2 GB cards, 1 frame)

- Report airflow at a dry bulb temperature of 20C, and 101,325 Pa absolute pressure. Under these conditions, dry air has a density of 1.204 kg/m³.