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Part 5: Thermal management

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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Environmental Engineering (EE).

The present document is part 5 of a multi-part deliverable. Full details of the entire series can be found in part 1 [3].

The present document applies to all telecommunications rack/cabinet; miscellaneous rack/cabinets and subracks forming part of the public telecommunications network.

National transposition dates	
Date of adoption of this EN:	10 December 2004
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Introduction

The power density of equipment has been rising and will continue to do so for the foreseeable future. Equipment suppliers have tried to overcome their thermal issues in isolation resulting in different solutions being developed. When different racks from various suppliers are co-located they can have a detrimental effect on each other. The present document specifies the thermal management requirements to prevent equipment having a detrimental thermal influence on surrounding equipment.

1 Scope

The present document specifies the preferred thermal management solutions for subracks, racks/cabinets and miscellaneous racks/cabinets (as described in EN 300 119 series [5]) installed indoors in restricted access locations (as defined in EN 60950-1 [2]), for the removal of heat dissipated by one or more subracks in an ETSI rack.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[1] ETSI EN 300 019: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[2] CENELEC EN 60950-1: "Information technology equipment - Safety - Part 1: General requirements".

[3] ETSI EN 300 119-1: "Environmental Engineering (EE); European telecommunication standard for equipment practice; Part 1: Introduction and terminology".

[4] ETSI EN 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".

[5] ETSI EN 300 119: "Environmental Engineering (EE); European telecommunication standard for equipment practice".

[6] ETSI TR 102 489: "Environmental Engineering (EE); European telecommunications standard for equipment practice; Thermal Management Guidance for equipment and its deployment".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

ambient: spatial maximal temperature of the air entering the rack/cabinet

cabinet: free-standing and self-supporting enclosure for housing electrical and/or electronic equipment

NOTE: It is usually fitted with doors and/or panels, which may or may not be removable.

equipment: for the purposes of EN 300 119-5, the term equipment shall mean equipped subracks, racks/cabinets and miscellaneous racks/cabinets

integrator: end user/operator of telecommunication or IT equipment or their agent (for example, an equipment manufacturer could be an operator's agent)

micro-climate: conditions found within the rack/cabinet creating a local ambient for the subrack

NOTE: In practice this will typically result in elevated temperatures and reduced relative humidities to those quoted in EN 300 019-1-3 [4].

miscellaneous rack/cabinet: accommodates subracks of several different types of equipment and suppliers and shall be freely configurable by the end user or their agent

rack: free-standing or fixed structure for housing electrical and/or electronic equipment

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ARCM Any Rack/Cabinet and Miscellaneous Rack/Cabinet
MRC Miscellaneous Rack/Cabinet

4 General requirements

4.1 Thermal performance

The supplier of the equipment shall design the equipment so that the product fulfils the indoor environments as detailed in EN 300 019-1-3 [4]. On request, the supplier shall be able to provide, as a minimum, the information included in annex A.

4.2 Temperature of touchable parts

Requirements for safety are outside the scope of the present document. For safety reasons it is important that the temperature rise of touchable parts are within guidelines to ensure the safety of personnel. Safety standards are published by CENELEC, for example a CENELEC product safety standard is EN 60950-1 [2].
Specifically see clause 4.5 "Thermal Requirements".

4.3 Temperature of issuing air

If the air issuing from the equipment racks/cabinets under worst case conditions (maximum ambient temperature) can come into contact with equipment cables, the temperature of the air shall not exceed 75°C. See CENELEC product safety standard EN 60950-1 [2], specifically clause 4.5 "Thermal Requirements", table 4b.

5 Thermal management

It is a primary requirement for all equipment to be cooled by natural convection. The mechanical architecture of the ARCM shall be designed to promote natural convection. Assisted cooling methods should be employed only when natural convection methods are unable to deal with the relevant heat dissipation.

The terms left and right used in this clause are viewed from the front of the ARCM.

5.1 Subrack air flow paths

The preferred air flow route into a subrack is in at the left, front or bottom and out at the right, back or top.

5.2 ARCM air flow paths

The preferred air flow route for an ARCM is air in at the front and air out of the top.

If ventilated floor exists, the air inlet can be at the bottom.

NOTE 1: The mixing of parallel and serial air flows within the same ARCM is not preferred but may be implemented, see TR 102 489 [6].

NOTE 2: For subrack parallel air flows, methods shall be provided to prevent air mixing between subracks.

NOTE 3: The performance of the various options may be compromised by removal/omission of ARCM covers and panels.

NOTE 4: Care should be taken to ensure that the cabling does not adversely affect (restrict) the air flow.

Annex A (normative): Equipment characterization data to be provided by the manufacturer

In many applications power dissipation from telecommunication systems has increased and it has become increasingly important that integrators have information available that enables them to predict the performance of the room ventilation system in delivering cooling to the equipment. In fact, the thermal performance of the facility is now becoming as critical as the thermal performance of the ARCM and subrack. The data required by annex A should enable the integrator to review and revise the configuration of the facility and, where MRCs are used, review and revise the configuration within the MRC.

To allow analysis of the likely performance, the following data shall be provided to the integrators. The data required varies depending on the configuration being supplied/installed. Two configuration options are:

a) equipment in natural convection;

b) equipment in forced convection.

Any thermal modelling to be undertaken using this data will require geometric information as well as airflow and thermal data. Therefore the data includes geometric information identified elsewhere in the mechanical standard so that this represents a complete list. This duplicate geometric information is shown in italics in recognition of the duplication.

The recommended environmental test conditions should be within the range as specified for the EN 300 019 series [1]. The actual environmental test conditions used for collection of data shall be provided with the characterization data.

A.1 General identification

All ARCMs and rack mounted equipment characterized for thermal management purposes shall have the following identification and physical geometry characteristics specified.

A.1.1 Identification

- Manufacturer.
- Model.

A.1.2 Physical geometry

The size and geometry of the equipment:

- Size:
  - height;
  - width;
  - depth.

In addition to the general identification and physical size, described in this clause, equipment should have the following information defined such that its effect on airflow and heat transfer can be determined.

Equipment can be considered as a rectangular volume containing elements that restrict airflow and dissipate heat. The data supplied will characterize the airflow rate and consequent temperature rise for the equipment in free space.

A.2 Equipment in natural convection

For equipment in natural convection the following data shall be provided to the operators or their agents:

- The total power dissipation for the maximum load configuration.
- The temperature rise for the maximum load configuration.

Where the airflow or temperature is substantially non-uniform from one outlet to another then the supplier shall provide the temperature rise for each outlet.

- The size, position and porosity of the vents/grids. If the faces of the equipment are essentially open, then the vent size will be the size of that face of the equipment with the porosity being 100 % or a free area ratio of 1,0.

A description of the vent type shall also be given from the following list:

- Open.
- Perforated.
- Slotted.
- Grille.
- Mesh.

An airflow characterization capturing the generic nature of the flow regime shall be given to generically identify faces of the equipment that can have inflow or outflow. For example, for a piece of equipment that complies with the present document this shall be "Front in, top out". Where the equipment is sealed so that heat is lost only by surface convection, conduction and radiation then the type shall be "None".

NOTE 1: Where an operator/end user wishes to use a model of the equipment for thermal simulation a model may be calibrated (the resistance to flow adjusted) to match the temperature and power data provided.

NOTE 2: Where there is no power dissipation then the porosity of the equipment shall be given.

A.2.1 Temperature measurements

- The air temperature leaving the equipment shall be quoted for a measurement in the centre of the face 10 mm away from each open face.

NOTE: It is not necessary to provide the air velocity for natural convection; however, the data may be quoted in order to give greater understanding of the performance.

A.3 Equipment with built-in fans - forced convection

An item of equipment can be considered as a box with defined inlet and exhaust vents with associated flow rates and temperature rise.

The data supplied shall be as follows:

- The total power dissipation for the maximum load configuration.
- The air temperature rise at the exhaust of the product for the maximum load configuration.

Where the airflow or temperature rise is substantially non-uniform from one outlet to another then the supplier shall provide the temperature rise and air velocity for each outlet.

- The size, position and porosity of the inlet and exhaust grids/vents.

- A description of the grid/vent type shall also be given from the following list:
  - open;
  - perforated;
  - slotted;
  - grille;
  - mesh.
- The airflow characterization:
  - What is the flow regime? This shall generically identify faces of the equipment that can have inflow or outflow. For example, an item of equipment that complies with the standard this shall be "Front in, top out". Where the equipment is sealed so that heat is lost only by surface convection, conduction and radiation then the type shall be "None".

A.3.1 Temperature and air velocity measurements

- The air velocity and temperature leaving the equipment shall be quoted for a measurement in the centre of the face 10 mm away from each open face.
- If the flow rate is likely to be sensitive to obstructions/pressure variations around it then the data shall also be quoted when the outlet face(s) of the subrack are placed 20 mm away from a solid barrier with a minimum size equal to that of outlet face of the subrack. Where the equipment specifies a minimum clearance of greater than 20 mm then the test shall be made with the obstruction at that minimum clearance.
- If the flow rate is temperature dependent (temperature controlled fans have been used) then the data shall be provided as a list for a series of temperature conditions.

A.4 Additional data for an MRC and ancillary components

In addition suppliers may provide MRC and other equipment that cannot be characterized by the general data presented in clauses A.2 and A.3. This clause gives the data that the supplier for that equipment shall also provide.

A.4.1 MRC

To be able to understand the performance of different pieces of equipment when installed with others in an MRC, it is important to know the configuration of the empty MRC. In addition to the information required in clause A.1 the supplier shall define:

- Which of the six faces of the MRC are absent.
- Which faces have openings and for each opening:
  - The size, position and porosity of the inlet and exhaust grids/vents.
  - A description of the grid/vent type shall also be given from the following list:
    - open;
    - perforated;
    - slotted;
    - grille;
    - mesh.

- The shape and size of the mounting flanges for equipment that may obstruct the airflow. If the MRC is not 600 mm wide then the location is also required since this is not standardized in this multi-part deliverable.
- The location and size of solid parts of the frame that may obstruct the airflow. For example, shelves, baffles, etc.
- Where the MRC is supplied with fans/fan trays then the supplier shall also provide details as specified in clause A.4.2.
- Where the MRC is supplied with air filters then the supplier shall also provide details as specified in clause A.4.4.

A.4.2 Fan tray

Fan trays often make an important contribution to air movement in an MRC. These are separate items of equipment not the fans that are an integral part of other equipment, that are added, at the discretion of the operator or their agent, to the MRC to enhance airflow. They can be located at various positions in the MRC. The following data shall be supplied (normally by a specialist fan manufacturer).

A.4.3 Fan tray flow and heat transfer

- Flow direction.
- Fan arrangement - e.g. 3 wide by 2 deep.
- For each fan (or group of fans operating as one):
  - the fan tray characteristic and, if appropriate any temperature dependence;
  - power dissipation.

A.4.4 Air filter

Air filters can restrict the airflow and hence reduce the cooling. These are separate items of equipment not the filters that are an integral part of other equipment, that are added, at the discretion of the operator or their agent, to an MRC to enhance airflow. They can be located at various positions in the MRC. The following data shall be supplied (normally by a specialist filter manufacturer):

- pressure drop;
- reference velocity for which pressure drop is quoted.

The values shall be repeated as point pairs for several reference velocities for a complete representation throughout the normal range of application.

Annex B (informative): Bibliography

- IEC 60721: "Classification of environmental conditions".

History

Document history			
V1.2.1	May 2004	Public Enquiry	PE 20040924: 2004-05-26 to 2004-09-24
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