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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

ITU-T L.1300 – Supplement on experimental studies on plates and ducts installed at equipment inlets and outlets

ITU-T L-series Recommendations – Supplement 12

International Telecommunication Union

Supplement 12 to ITU-T L-series Recommendations

ITU-T L.1300 – Supplement on experimental studies on plates and ducts installed at equipment inlets and outlets

Summary

Supplement 12 to ITU-T L-series Recommendations describes experimental studies on plates and ducts installed at equipment inlets and outlets based on Recommendation ITU-T L.1300. More precisely, this Supplement provides a problem description of practical solutions for correcting airflow direction for equipment, highlighting, at the same time, examples of practical solutions as well as experimental results.

History

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ITU-T L.1300 – Supplement on experimental studies on plates and ducts installed at equipment inlets and outlets

1 Scope

This Supplement describes experimental studies on plates and ducts installed at equipment inlets and outlets based on [b-ITU-T L.1300]. The scope of this Supplement includes:

– a problem description of practical solutions for correcting airflow direction for equipment;

– examples of practical solutions; and

– experimental results.

2 Definitions

None.

3 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

BT Bottom-to-Top

CRAC Computer Room Air Conditioner

PDU Power Distribution Unit

RL Right-to-Left

VAV Variable Air Volume

4 Problem description of practical solutions for correcting airflow direction for equipment

This clause describes examples of practical solutions for airflow correction. It will enable the recognition of the practical solutions to be taken for equipment in which airflow correction is necessary.

5 Examples of practical solutions

The installation of a plate or duct at the inlet and outlet of the equipment is a practical solution to correct the airflow direction of the equipment.

An example of ducts installed in equipment with bottom-to-top (BT) airflow direction is shown in Figure 1. Installation of such ducts corrects the airflow direction to front-to-rear and separates the intake air and the exhaust air. Such separation prevents the equipment from sucking in the exhaust air of adjacent equipment and prevents increases in its temperature. Experimental studies on plates and ducts installed at the inlets and outlets of equipment with bottom-to-top airflow direction and with right-to-left (RL) airflow direction are shown below.

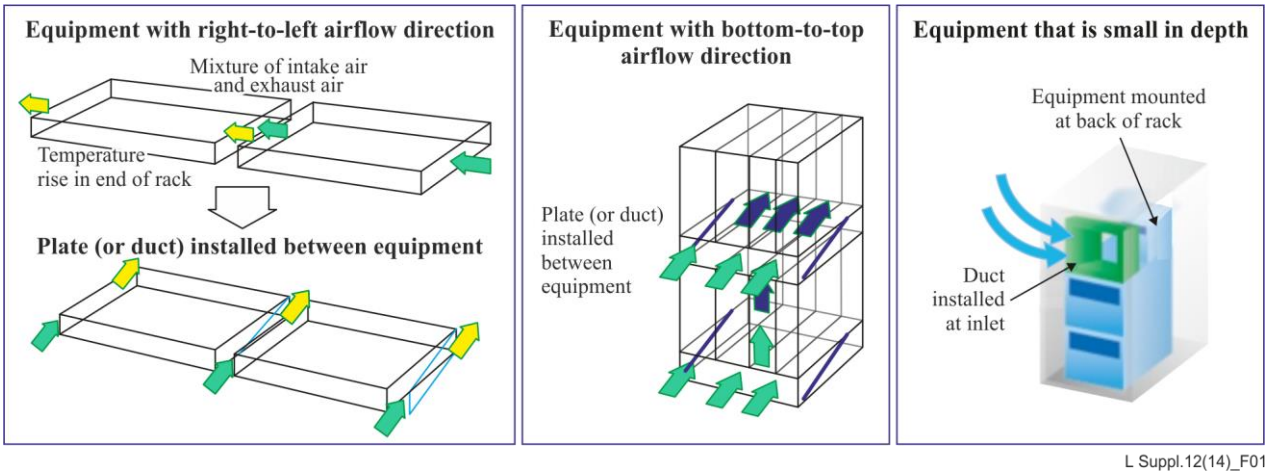


Figure 1 – Examples of types of rack mount equipment in which airflow correction is necessary

An example of a duct installed at the inlet of equipment that is small in depth is shown in Figures 2 and 3. Such a duct directs the cold air in front of the rack to the inlet of the equipment and enables cold air to be supplied to the equipment sufficiently.

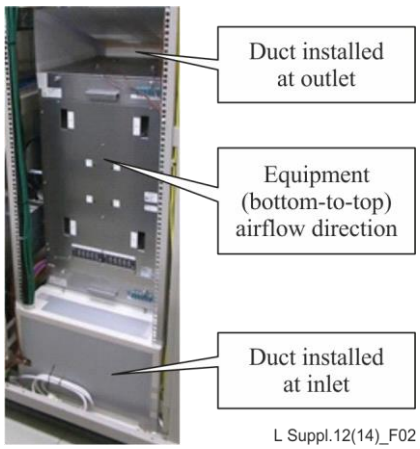


Figure 2 – Example of duct installation in equipment with bottom-to-top airflow direction

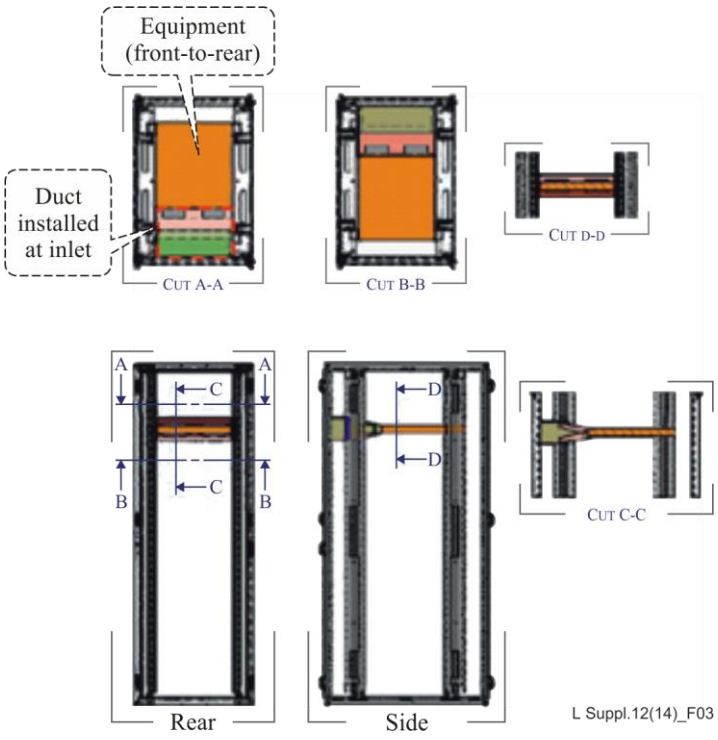
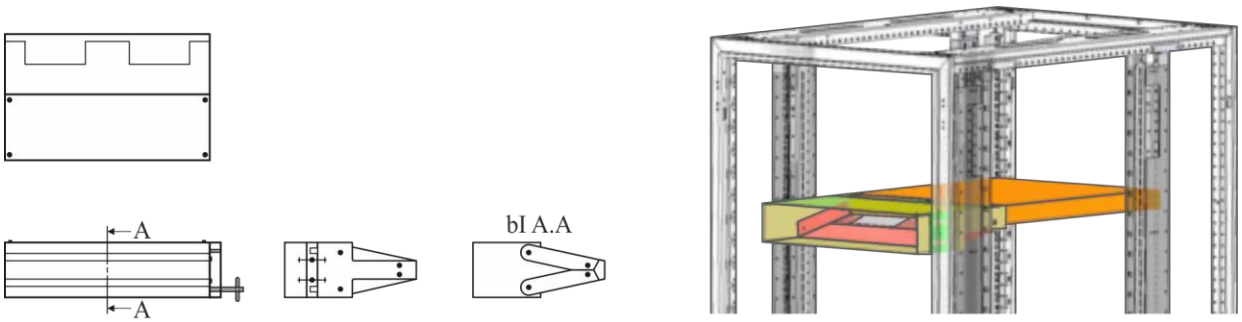


Figure 3 – Example of duct installation in equipment that is small in depth

An example of the description given in an installation manual is shown in Figure 4.



Design of the duct (left) and image of duct installation to the equipment (right)

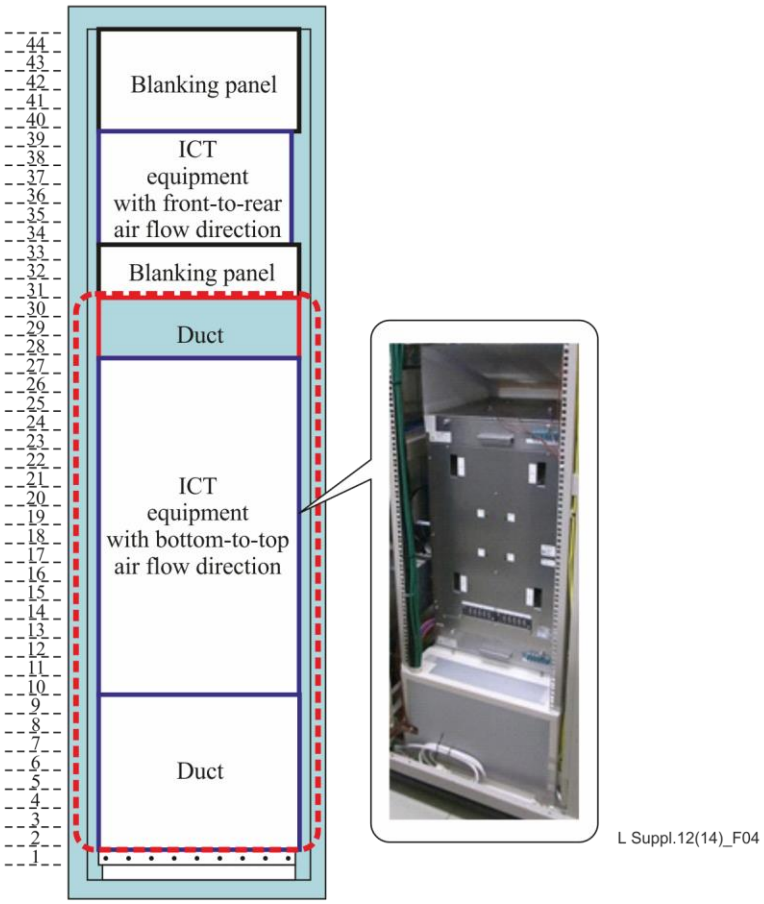


Image of equipment mounted on the rack (left) and of duct installation attached to the equipment (right)

Figure 4 – Example of a description given in an installation manual

6 Experimental results

The purpose of the experimental studies was to evaluate the effectiveness of the plates and ducts installed at the inlets and outlets of equipment with different airflow direction from the data centre airflow design.

6.1 Outline of experiment

The layout of the experiment room, and equipment used for the experiment are illustrated in Figures 5 and 6 respectively. Four types of equipment and power distribution units (PDUs) were mounted on two open racks. A plate or a duct was installed at the inlet and the outlet of two types of rack mount equipment, whose airflow direction was bottom-to-top (Type BT) and right-to-left (Type RL).

The temperature was measured at 100, 500, 1'000, 1'500, and 2'100 mm above floor level, at the front and the rear of the rack. It was also measured inside the raised floor, at the inlet and the outlet of the adjacent equipment. The room temperature setting and the outlet temperature setting of the computer room air conditioning (CRAC) were 24°C and 19°C, respectively. The CRAC was set to keep the air supply temperature constant and to operate in variable air volume (VAV) mode.

The left side of Figure 7 depicts the airflow in Rack 1. Equipment Type RL, mounted in Rack 1, sucks in the exhaust air from equipment Type BT, mounted under equipment Type RL, and from equipment Type RL, mounted in Rack 2. This causes an increase in the temperature of the intake air of equipment Type RL in Rack 1.

As a measure to avoid this phenomenon, the following three cases were investigated, as shown on the right side of Figure 7.

(1) Installing a duct at the outlet of equipment Type BT mounted in Rack 1.

(2) Installing a duct at the inlet of equipment Type BT mounted in Rack 1, in addition to (1).

(3) Installing a plate at the inlet and the outlet of equipment Type RL mounted in Racks 1 and 2, in addition to (1) and (2).

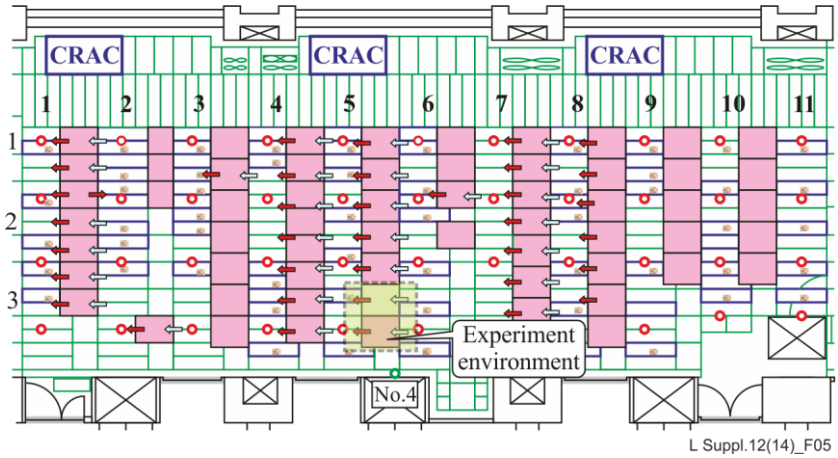


Figure 5 – Layout of experiment room

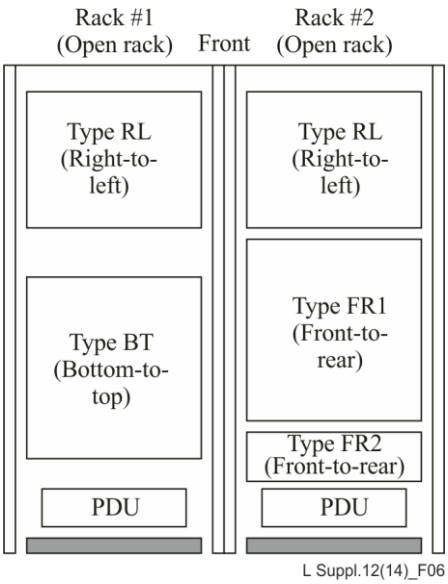


Figure 6 – Experiment environment

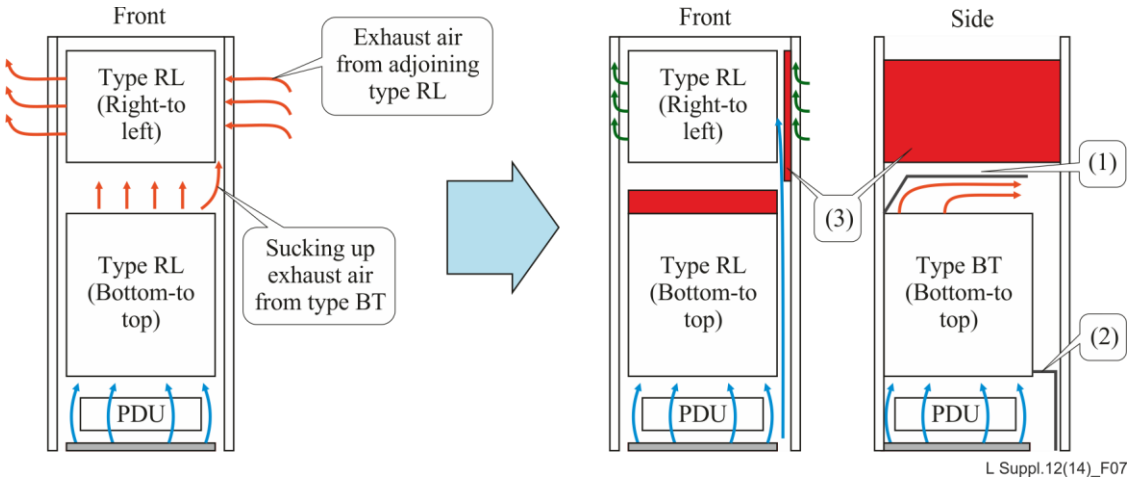


Figure 7 – Cases investigated

6.2 Results

(1) Figure 8 reports the results obtained by installing a duct at the outlet of equipment Type BT mounted on Rack 1.

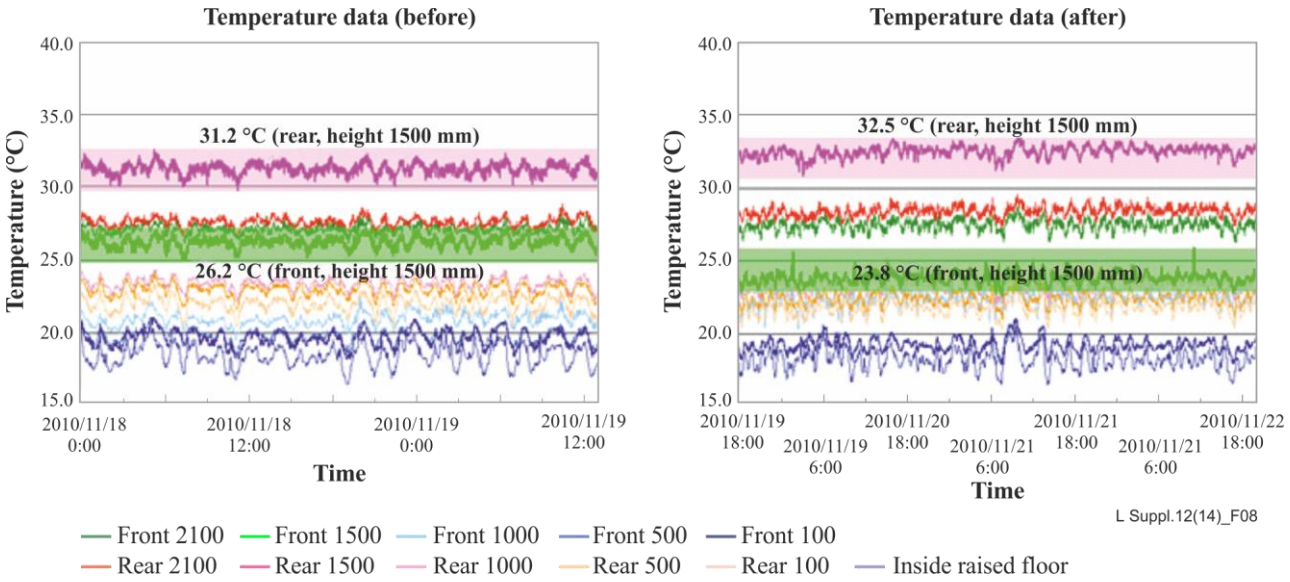


Figure 8 – Results of Rack 1 after installing a duct at the outlet

Temperature decrease was observed at 1'500 mm above floor level at the front of the rack (26.2°C→23.8°C). This shows that the duct prevented the exhaust air from circulating to the front of the rack.

Temperature increase was observed at 1'500 mm above floor level at the rear of the rack (31.2°C→32.5°C). This shows that the duct led the exhaust air to the rear of the rack.

(2) Figure 9 reports the result obtained by installing a duct at the inlet of the equipment Type BT mounted in Rack 1, in addition to (1).

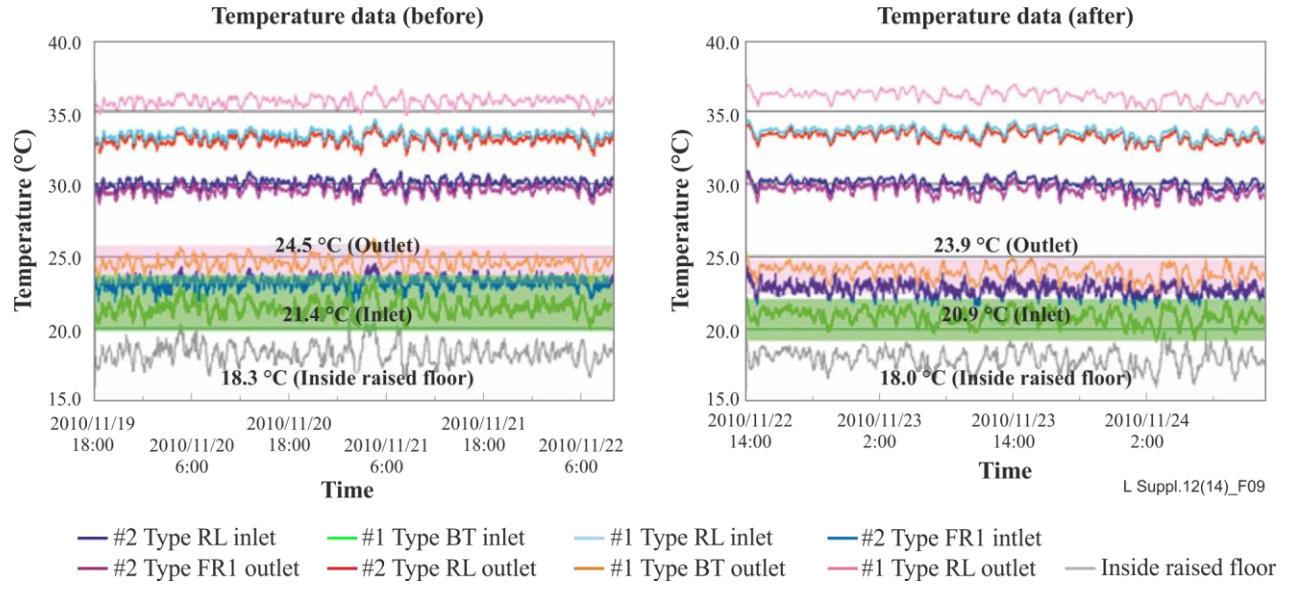


Figure 9 – Results of Rack 1 after installing a duct at the outlet and at the inlet

A marked difference in the inlet and the outlet temperature of equipment Type BT was not observed, but the difference from the temperature inside the raised floor became slightly smaller.

A marked temperature difference was not observed at other measurement points.

(3) Figure 10 reports the result obtained by installing a plate at the inlet and the outlet of equipment Type RL mounted in Racks 1 and 2, in addition to (1) and (2).

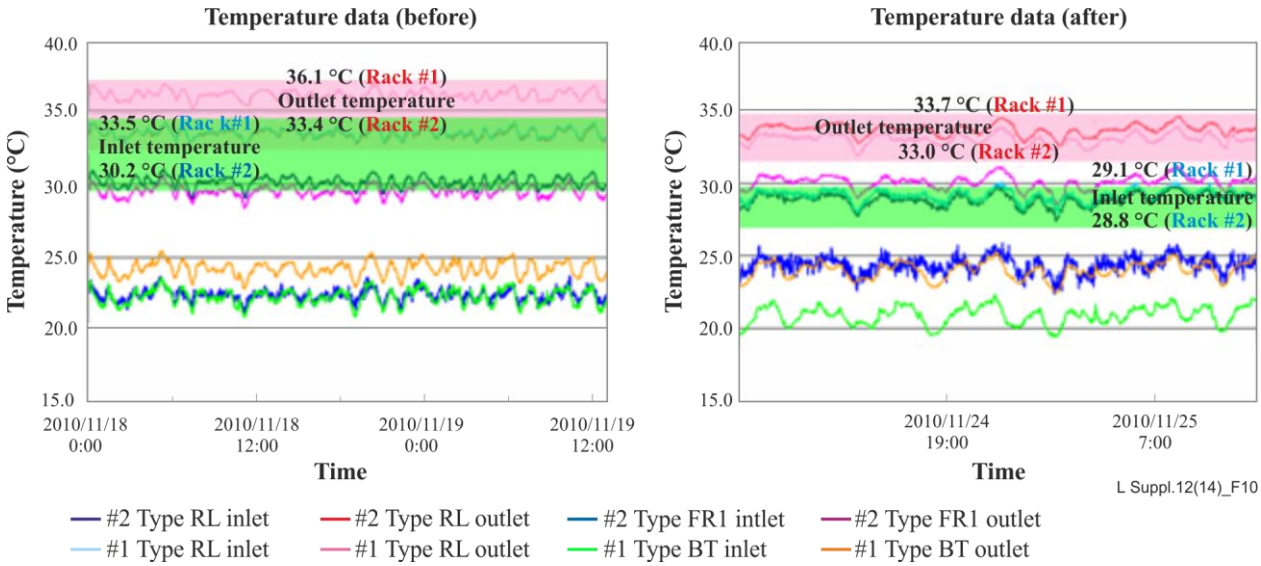


Figure 10 – Results of Rack 1 after installing a plate at the outlet and at the inlet

- Inlet and outlet temperatures of equipment Type RL mounted in Rack 1 were in the same temperature range as those of the adjacent equipment mounted in Rack 2.
- The plate prevented the equipment from sucking in the exhaust air from the adjoining equipment, and the outlet temperature became stable.

6.3 Conclusions

For equipment whose airflow direction is bottom-to-top, the following results were obtained:

- The duct installed at the outlet prevents the exhaust air from circulating to the front of the rack.
- The duct installed at the inlet is likely to prevent exhaust air being sucked in, as with the blanking plate.

For equipment whose airflow direction is right-to-left, the following result was obtained:

- Installation of the plate separates the intake air and the exhaust air, and prevents the equipment from sucking in the exhaust air from the adjoining equipment.

Bibliography

[b-ITU-T L.1300] Recommendation ITU-T L.1300 (2011), *Best practices for green data centres*.

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