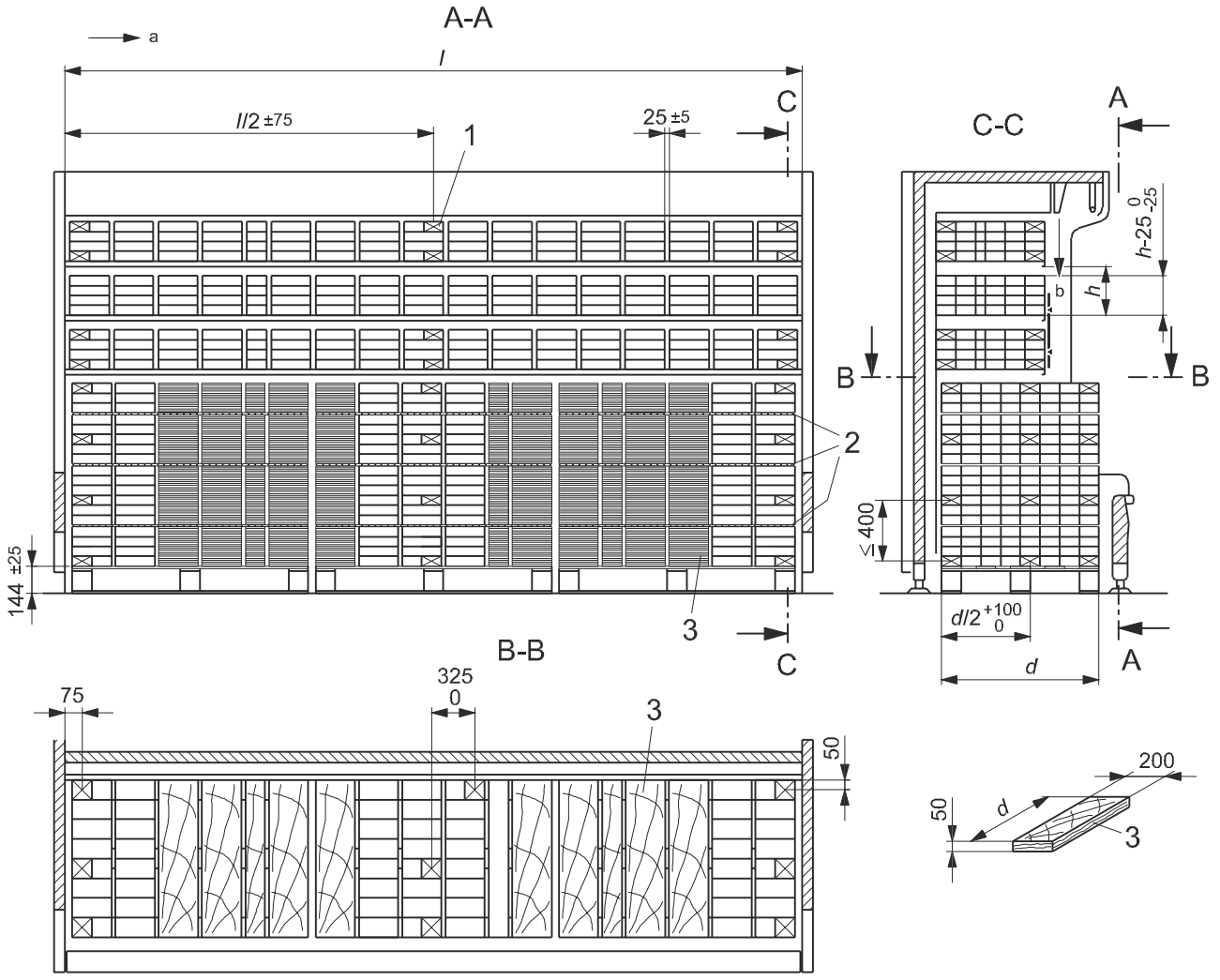
Dimensions in millimetres

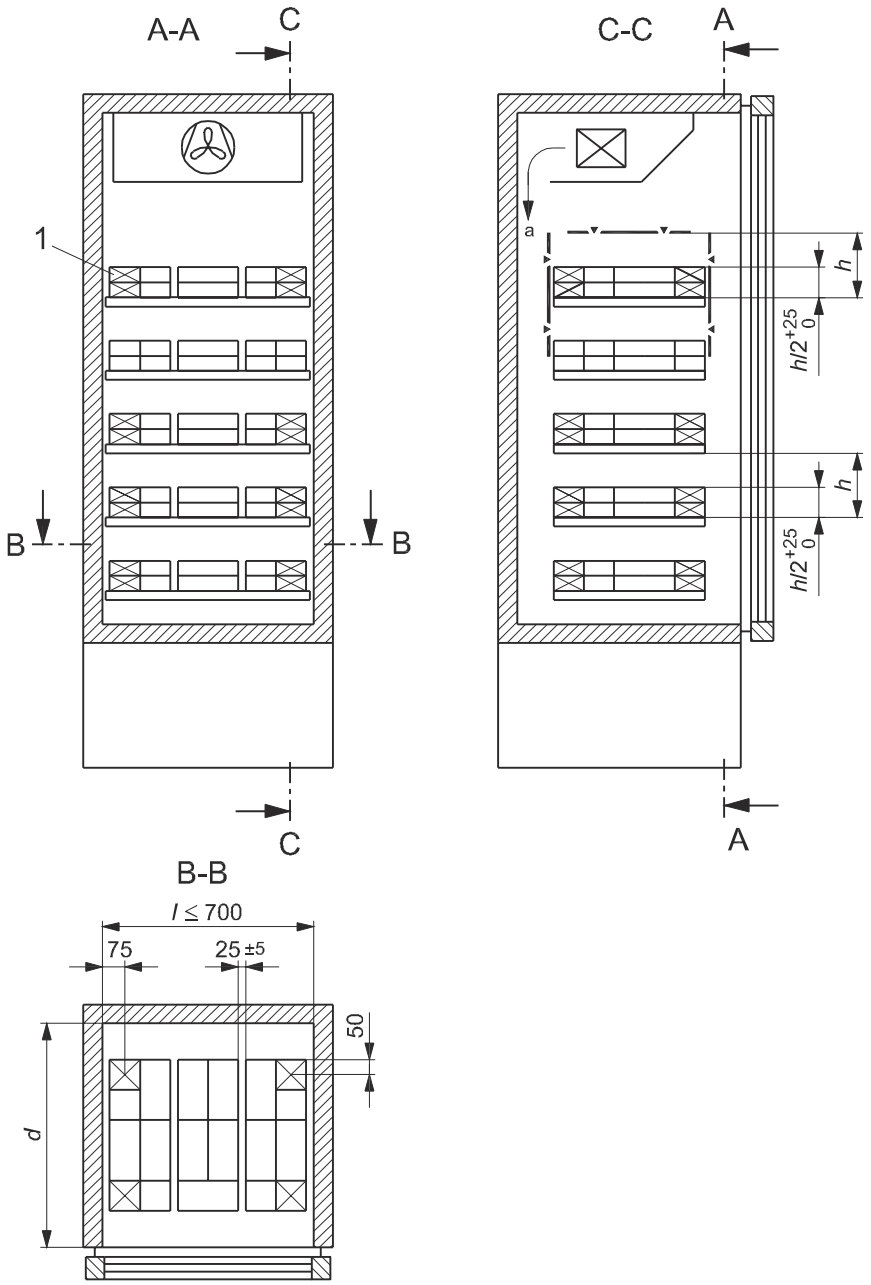


Key

1 M-package
2 grids
3 wood loading
d depth of base deck
h height at load limit
l length of the cabinet
a air currents parallel to the plane of the opening (in longitudinal direction)
b direction of forced air flow

Figure 26 — Roll-in and Multi-deck chilled cabinet (3 shelves) with high load limit in the base, provided with forced air cooling (vertical, open and closed)

Dimensions in millimetres



Key

1 M-package
l length of cabinet
d depth of base deck
h height at load limit
a direction of forced air flow

Figure 27 — Vertical frozen cabinet (4 shelves) with glass door

5.3.2.4 Running in

When a cabinet with a remote condensing unit is tested, the operating conditions should comply with those stated by the cabinet manufacturer.

Adjustable automatic controllers should be set in such a way that the required M-package temperature class of the cabinet is reached. Where the controller is not adjustable, the cabinet should be tested as delivered.

The manufacturer's recommended routine of defrosting should be followed. Before tests are started, the cabinet should be switched on and allowed to run for at least 2 h at the specified climate class with no packages in the cabinet and without erratic functioning of the refrigerating system, controls or defrosting operations. Otherwise, the running-in period should be continued accordingly.

After the running-in period the cabinet shall be filled with test packages and M-packages according to 5.3.2.3 for the tests.

After loading, the cabinet shall be operated until stable conditions have been reached (see 5.3.2.5) and during the test period (see 5.3.2.6) the test room should be maintained at the desired climate class as specified in 5.3.1, while the temperatures of the M-packages are recorded.

5.3.2.5 Stable conditions

The temperatures vary cyclically and the length of the cycle is dependent on the time between two successive defrost periods.

A cabinet is considered to operate under stable conditions if, during a period of 24 h, the temperature of each M-package agrees within ±0,5 °C at the corresponding points on the temperature curve. Changes or adjustments to the settings of the test room and to the cabinet during the stabilization period are not allowed.

For closed refrigerated cabinets, stable conditions shall be determined prior to the doors opening sequence (see 5.3.3.2) and, if the cabinet is fitted with lighting, the lights shall be continuously left switched on.

For open refrigerated cabinets fitted with lighting and night covers, stable conditions are reached with the cabinet continuously opened with the light continuously switched on.

5.3.2.6 Test period

After stable conditions have been reached, the test period shall be not less than 24 h for all cabinets. Changes or adjustments to the settings of the cabinet during the test period are not allowed.

5.3.2.7 Lighting and night-covers

5.3.2.7.1 Lighting

If the test cabinet is fitted with lighting, carry out the tests according to 5.3.3, 5.3.4, 5.3.5 and 5.3.6 as follows:

a) firstly, leave the cabinet lighting switched on continuously for a period of 24 h;

b) secondly, leave the cabinet lighting switched on for a period of 12 h, followed by 12 h with cabinet lighting switched off.

5.3.2.7.2 Night-covers

If night-covers are supplied for open cabinets, carry out the tests as follows:

a) firstly, with the night-covers removed, leave the cabinet lighting on continuously for a period of 24 h;

b) secondly, with the night-covers removed, leave the cabinet lighting switched on for a period of 12 h, followed by 12 h with the night-covers on and the cabinet lighting switched off.

5.3.2.8 Accessories

An additional, separate test shall be conducted if performance-enhancing accessories are fitted, and this shall be stated in the test report (see Clause 6).

5.3.2.9 Liquid refrigerant inlet condition

The liquid refrigerant temperature at the cabinet inlet shall not be more than 10 °C above the specified test room temperature. During the test no "flash gas" condition shall occur. This shall be confirmed by observation.

5.3.2.10 Power supply

The tolerance on power supply shall be ±2 % for voltage and ±1 % for frequency in relation to the nominal values given on the marking plate or otherwise stated.

5.3.2.11 Testing several cabinets in the same room

If more than one cabinet in the same room is being tested, appropriate arrangements, such as the use of partitions, shall be made in order to ensure that the conditions surrounding each cabinet are in accordance with the test requirements specified in 5.3.1 to 5.3.2.

5.3.3 Temperature test

5.3.3.1 Test conditions

The cabinet shall be located and loaded in accordance with 5.3.1 and 5.3.2, operated in accordance with the manufacturer's instructions at the conditions appropriate to the test room climate class for which it is intended (see 5.3.1.3.1), and then operated for the test period defined in 5.3.2.6, during which measurements shall be recorded. Lighting, and night-covers, if any, shall be manipulated according to 5.3.2.7.

5.3.3.2 Closed refrigerated cabinets

The test for closed refrigerated cabinets shall always be carried out on the complete cabinet, regardless of the number of doors or lids. Each door or lid shall be opened for frozen food applications six times per hour, while for chilled food applications, each shall be opened 10 times per hour. Doors that are used for service, cleaning or loading of the cabinet only shall not be opened during this test. Where more than one door or lid pertains to the cabinet under test, the sequence in which the doors and lids are opened shall be staggered, i.e. in the case of two doors for frozen food applications: door 1 at 0 min, door 2 at 5 min, door 1 at 10 min, door 2 at 15 min, etc. For chilled food applications, door 1 at 0 min, door 2 at 3 min, door 1 at 6 min, door 2 at 9 min, etc.

Hinged lids and doors shall be opened beyond an angle of 60°. Sliding glass doors or lids shall be opened beyond 80 % of the maximum area which can be opened.

For frozen food applications, the door or lid shall be opened for a total of 6 s, while for chilled food applications, the door or lid shall be opened for a total of 15 s. During this opening period, the doors or lids shall be kept open beyond the minimum required opening, that is 4 s for frozen food applications and for 13 s for chilled food applications.

Prior to the start of the 12-h period of door opening, each door or lid shall be opened once for 3 min. Where a cabinet is provided with more than one door or lid, each door or lid shall be opened once for 3 min consecutively.

Within the test period, the doors or lids shall be opened cyclically for 12 h within 24 h. The 12-h cycle of door or lid opening shall start at the beginning of the test period.

For closed cabinets, only the test of 5.3.2.7.1 b) is required.

5.3.3.3 Island with air discharge in the middle

5.3.3.3.1 The test for island with air discharge in the middle shall consider the following design variations:

a) one chest, parts of the air distribution (fans, air ducts) and/or the refrigeration system (evaporator) are used for both sides of the cabinet;

b) one chest, air distribution and refrigeration system are completely separated; the sides of the island are equal and symmetric; all electrical components (fan motors, anti-sweat heaters, defrost heaters), the evaporators and thermostatic expansion valves are the same in each refrigerated volume, and the temperature control system, such as the defrost control system, are symmetrically mounted and independently operative in each specific refrigerated volume.

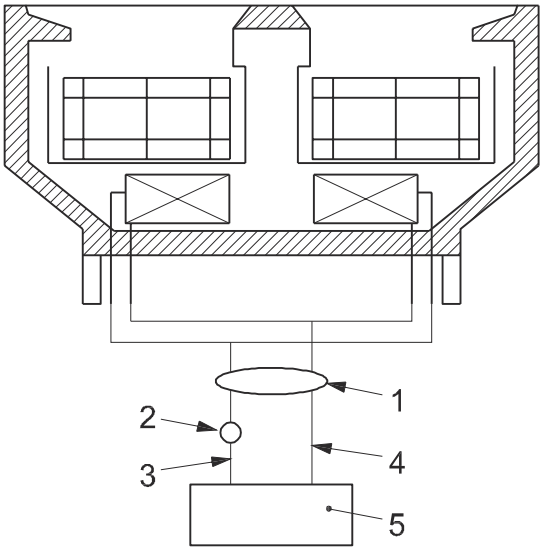
Test procedure:

— For design variation a)

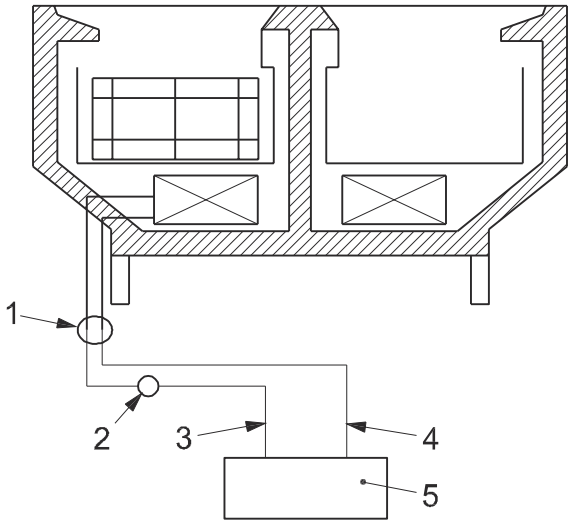
The piping has to be organized in such a way that the whole cabinet is connected to a single refrigeration plant by one main liquid and one main suction line. Even if the island has two evaporators with separate piping, the suction and the liquid lines shall be connected to two main lines (one suction, one liquid line) inside or outside the cabinet. All temperatures, pressure and mass flow measurements of the refrigerant shall be taken on the main lines. The piping shall be thermally insulated from the cabinet outlet to the locations where the measurements are taken. Both sides of the cabinet shall be loaded with M-packages and the temperature from both sides shall be monitored [see Figure 28 a)].

— For design variation b)

Only one side of the cabinet may be tested considering it like a single case. Only the tested side(s) shall be loaded with M-packages and connected to the refrigerant plant [see Figure 28 b)].



a) Design variation a)



b) Design variation b)

Key

1 temperature and pressure measurements as in a single case (see 5.3.6.2.1 and Figure 30)
2 refrigeration mass flow meter (see 5.3.6.2.1 and Figure 30)
3 liquid supply (see 5.3.6.2.1 and Figure 30)
4 vapour return (see 5.3.6.2.1 and Figure 30)
5 condensing unit

Figure 28 — Island with air discharge in the middle

5.3.3.3.2 As far as DEC and REC measurement and calculations are concerned (see 5.3.6), the following shall be considered.

— For design variations b), single side test:

the total value of REC is double the value calculated for the single side tested;

the total value of DEC is double the value calculated for the single side tested.

— For design variations b), double side tests, follow design variation a).

— For the calculation of TDA, see Figure A.8.

5.3.3.4 Temperature curves of M-packages

From the recorded temperatures of all M-packages, the following curves shall be plotted as a function of time:

For frozen cabinets:

1) the temperature of the warmest M-package (i.e. the one with the highest peak temperature during defrost or door opening θ_{ah}) (see curve a - Figure 29);

2) the temperature that during test period T, excluding the periods during defrost or during the door openings, presents the highest minimum value θ_{al} (see curve c – Figure 29a);

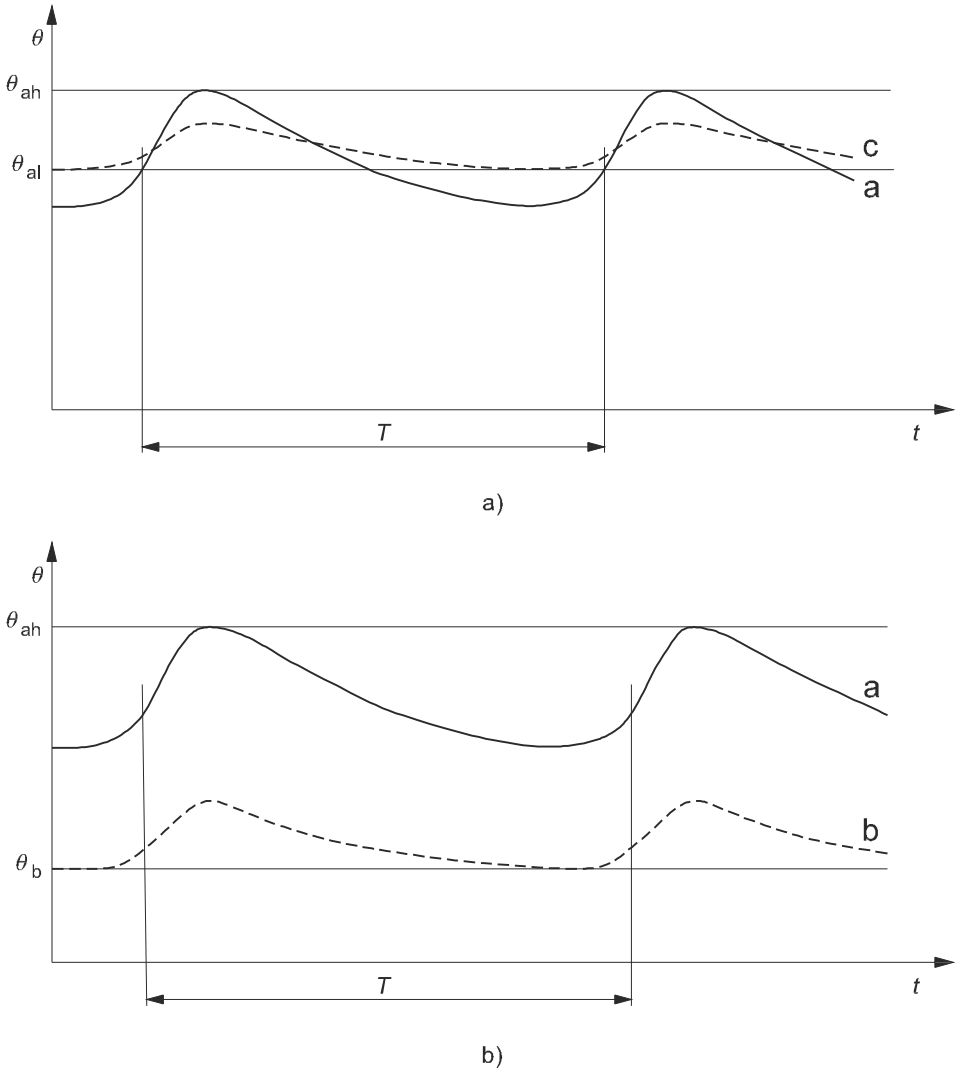
For chilled cabinets:

3) the temperature of the warmest M-package (i.e. the one with the highest peak temperature θ_{ah}) (see curve a Figure 29b);

4) the temperature of the coldest M-package (i.e. the one with the lowest minimum temperature θ_b) (see curve b - Figure 29b).

All other M-package temperatures shall be available for reference if required.

In the case of cabinets with multiple temperature classes, curves a, b and c shall be prepared separately for each temperature class.



Key

θ	temperature
θ_{ah}	highest temperature of warmest M-package
θ_b	lowest temperature of coldest M-package [for chilled cabinets only; see 4.2.2 (Table 1)]
θ_{al}	temperature that during test period T, excluding the periods during defrost or during the door openings, presents the highest minimum value see 4.2.2 (Table 1)
t	time
T	test period
a	temperature curve of warmest M-package
b	temperature curve of coldest M-package
c	temperature curve with the highest minimum value of all M-package

Figure 29 — Relevant temperature curves of M-package

5.3.3.5 Calculation of average mean temperature

The average instant temperature at measuring sample n of all M-packages, θ_{cn} (curve d in Figure 30), is expressed by the Formula (1):

$$\theta_{cn} = \frac{1}{K_{maxc}} \times \sum_{k=1}^{K_{maxc}} \left(\theta_k\right)_n \tag{1}$$

where

n is the time index for the instant measuring sample;

k is the index for the individual M-package;

K_{maxc} is the number of all M-packages;

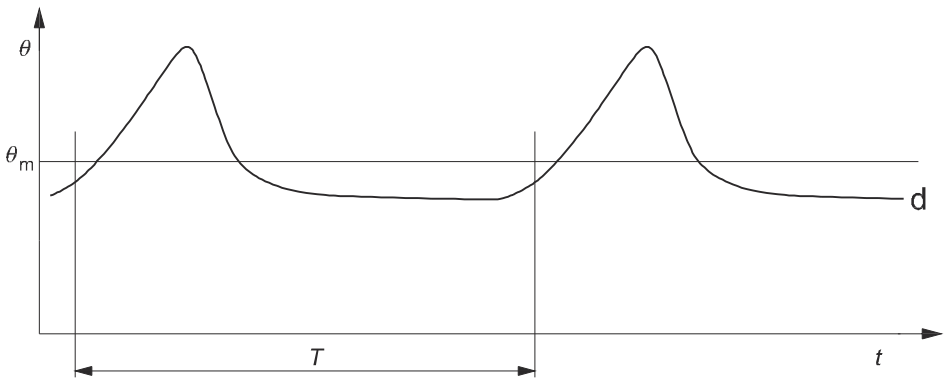
$\left(\theta_k\right)_n$ is the instant measured temperature of M-package k at measuring sample n.

From these average instant temperatures the arithmetic mean temperatures of all M-packages θ_m for the test period shall be calculated as Formula (2):

$$\theta_m = \frac{1}{N_{max}} \times \sum_{n=1}^{N_{max}} \theta_{cn} \tag{2}$$

where N_{max} is the number of measuring samples taken during the test period.

The formula is valid only for constant time intervals during the test period.



Key

θ temperature
θ_m average mean temperature
t time
T test period
d curve of arithmetic mean temperature of all M-packages

Figure 30 — Arithmetic mean temperature of M-packages

The arithmetic mean temperature of M packages curve d shall be plotted together with curves a, b and c and separately for each temperature class in the case of cabinets with multiple temperature classes.

5.3.4 Water vapour condensation test

5.3.4.1 Test conditions

The cabinet shall be located and loaded in accordance with 5.3.1 and 5.3.2, operated in accordance with the manufacturer's instructions at the conditions appropriate to the test room climate class for which it is intended (see Table 3), and then operated for the test period according to 5.3.2.6, during which measurements shall be recorded. Lighting and night-covers, if any, shall be manipulated according to 5.3.2.7. The test may be carried out during the temperature test.

If anti-condensation heaters are provided which can be switched on and off by the user they shall not be switched on. If, however, running water appears externally when the cabinet is subjected to the water vapour condensation test, the test shall be repeated with the anti-condensation heaters switched on.

Before starting the test period, all external surfaces of the cabinet shall be carefully wiped dry with a clean cloth. If the cabinet is fitted with automatic defrosting equipment this test period shall be selected during the period when condensation is most likely to occur.

5.3.4.2 Test results

The cabinet shall be considered satisfactory if the test report shows that during the test period there is no evidence of condensed water vapour having been in direct contact with, or having dripped on to, any test packages and — depending on the method used to detect water vapour condensation — provided the following results have been obtained:

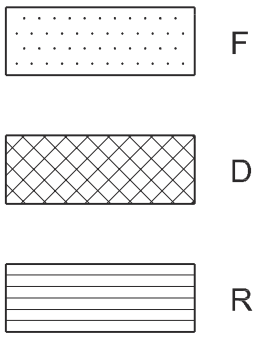
a) all cabinet surfaces, whether adjacent or otherwise, remain free of moisture by the provision of insulation, ventilation or heating to maintain a temperature above dew point for the climate class specified (Table 3);

b) internal surfaces, wherever practical, remain free of moisture collection or ice gather;

c) mirrors that can periodically mist during defrost clear by evaporation on the return to refrigeration cycle.

5.3.4.3 Expression of results

During the test period, external surface areas exhibiting fog, droplets or running water shall be outlined and designated with the letters F, D and R respectively. A coded sketch shall be made showing the maximum area and degree of condensation appearing during the test on all surfaces; the code shown in Figure 31 shall be used.



Key

F fog/mist
D droplets
R running water

Figure 31 — Condensation code

5.3.5 Electrical energy consumption test

5.3.5.1 Test conditions

The cabinet shall be located and loaded in accordance with 5.3.1 and 5.3.2, operated in accordance with the manufacturer's instructions at the conditions appropriate to the test room climate class for which it is intended (see Table 3), and then operated for the test period according to 5.3.2.6, during which measurements shall be recorded. Lighting and night-covers, if any, shall be manipulated according to 5.3.2.7.

The test shall be carried out during the temperature test.

5.3.5.2 Cabinets fitted with incorporated condensing unit

For cabinets with an incorporated condensing unit the direct daily electrical energy consumption (DEC) equals the total daily energy consumption (TEC), as it includes the condensing unit energy consumption. Refrigeration daily electrical energy consumption (REC) is not defined for these cabinets.

Measure the TEC, including the condensing unit energy consumption, reported in kilowatt hours per 24-h period, the compressor switching on/off frequency and the relative running time (ratio of running time to overall duration of a measurement cycle excluding defrost time), with all fitted electrical power-using components switched on.

5.3.5.3 Cabinets with remote condensing unit

For cabinets with a remote condensing unit the DEC does not include the REC which shall be determined in accordance with 5.3.6.

Measure the DEC of the cabinet only, with all fitted electrical power-using components switched on.

The DEC recorded for each test shall be the summation of all electrical energy consumed by the refrigerated cabinet during the test period, without the control unit and, for indirect type refrigerating system, including the pump energy consumption CPEC.

NOTE If, for technical reasons, it is too difficult to measure separately the component powers, it is possible to use the DEC directly measured or the power consumed by any group of single components.

5.3.6 Heat extraction rate measurement when condensing unit is remote from cabinet

5.3.6.1 Test conditions

5.3.6.1.1 General

The cabinet shall be located and loaded in accordance with 5.3.1 and 5.3.2, operated in accordance with the manufacturer's instructions at the conditions appropriate to the test room climate class for which it is intended (see Table 3), and then operated for the test period according to 5.3.2.6, during which measurements shall be recorded. Lighting and night-covers, if any, shall be manipulated according to 5.3.2.7.

The test shall be carried out during the temperature test.

The refrigeration system shall be connected to the cabinet as given below.

The refrigerant inlet and outlet temperatures shall be measured using temperature sensors directly inserted into the pipe or inserted into pockets or clamped between the piping and a copper recovery half-sleeve on the inlet and outlet pipe-lines positioned no further than 150 mm from the cabinet wall [see Figures 32 a) and 33 a)].