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Walk-in cold rooms — Definition, thermal insulation performance and test methods

Part 1: Prefabricated cold room kits

National foreword

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European foreword

This document (EN 16855-1:2017) has been prepared by Technical Committee CEN/TC 44 “Commercial and Professional Refrigerating Appliances and Systems”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

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Introduction

The drafting of this European Standard was driven by the necessity to compare the systems placed on the market on the base of the minimum thermal insulation requirements and to establish the average level of energy consumption for a future minimum energy performance standard definition, with reference to the EU policy on increasing energy efficiency of energy related products (Directive 2009/125/EC) in the frame of the EU "20-20-20" targets. It also aims to identify the reference standards for calculation, measurement of insulation properties, to identify the best practice rules for elimination of thermal bridges, assembly techniques and provisions to be taken in order to ensure the best level of insulation and power consumption.

1 Scope

This European Standard applies to prefabricated walk-in cold room kits and components. It provides test or calculation methods to assess thermal insulation performances under normal end-use conditions.

Performance characteristics of walk-in cold rooms are to be assessed in terms of thermal insulating properties, in order to give a basis on which assessing energy consumption related properties of walk-in cold rooms, and of their components.

Performance characteristics are to be assessed for every single component of the walk-in cold room, and for the assembled walk-in cold room as a whole.

The normal end-use conditions of a walk-in cold room are considered to be:

— installation inside an existing building;

— not exposed to external weather conditions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12667:2001, *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance*

EN 12939, *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance*

EN 13162, *Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification*

EN 13163, *Thermal insulation products for buildings - Factory made expanded polystyrene (EPS) products - Specification*

EN 13164, *Thermal insulation products for buildings - Factory made extruded polystyrene foam (XPS) products - Specification*

EN 13165, *Thermal insulation products for buildings - Factory made rigid polyurethane foam (PU) products - Specification*

EN 13166, *Thermal insulation products for buildings - Factory made phenolic foam (PF) products - Specification*

EN 13167, *Thermal insulation products for buildings - Factory made cellular glass (CG) products - Specification*

EN 14509:2013, *Self-supporting double skin metal faced insulating panels - Factory made products - Specifications*

EN ISO 6946, *Building components and building elements - Thermal resistance and thermal transmittance - Calculation method (ISO 6946)*

EN ISO 10077-1, *Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1)*

EN ISO 10077-2, *Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO 10077-2)*

EN ISO 10211:2007, *Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations (ISO 10211)*

EN ISO 14683, *Thermal bridges in building construction - Linear thermal transmittance - Simplified methods and default values (ISO 14683)*

ISO 4590, *Rigid cellular plastics — Determination of the volume percentage of open cells and of closed cells*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
walk-in cold room
thermally insulated enclosure kit made of prefabricated sandwich panels intended for the storage of chilled and/or frozen perishable items, accessible via at least one door, and which is large enough to let somebody walk in it

3.1.1
prefabricated walk- in cold room kits
walk-in cold room kits delivered to installation sites ready for assembly without any rework of the sandwich panel

3.1.2
pre-assembled walk-in cold room
walk-in cold room shipped to the customer already assembled, for which no on-site assembly is required

3.1.3
prefabricated walk-in cold room with floor
walk-in cold room having six insulated walls and equipped with a thermally insulated floor

3.1.4
prefabricated walk-in cold room without floor
walk-in cold room having five insulated walls and without a thermally insulated floor

3.1.5
walk-in cold room components
elements that, when assembled together, compose a walk-in cold room

Note 1 to entry: Components can be for example: panels, doors, corners.

3.2
sandwich panel
building product consisting of two metal faces positioned on either side of a core that is a thermally insulating material, which is firmly bonded to both faces so that the three components act compositely when under load

[SOURCE: EN 14509:2013, definition 3.17]

3.3
perimetrical profile
cross section and characteristics of the perimetrical surface of the sandwich panel related to the joint system, realized with a male-female perimetrical profile, gasket perimetrical profile and camlock perimetrical profile or a combination of them or none of them

3.3.1
male-female perimetrical profile
design solution that allows sealing, structural resistance, thermal insulation, correct alignment at installation

3.3.2
gasket perimetrical profile
design solution that allows sealing by embedding into a sandwich panel a sealing material

3.3.3
camlock perimetrical profile
design solution that allows sealing, structural resistance, mechanical locking between adjacent sandwich panels

3.4
overall heat transfer coefficient
measure of the global insulating thermal performance of a walk-in cold room envelope, assembled with doors and all ancillaries, in terms of heat flux per unit area per degree difference in temperature

3.5
mean surface area
S
surface area calculated by the geometric mean between the outside surface area and the inside surface area

3.6
surface heat transfer coefficient
heat flux per unit area per degree difference in temperature

3.7
surface thermal resistance
ratio between temperature difference and heat flux through the surface

3.8
air curtain
technical equipment, producing a controlled stream of air aimed across an opening to create an air seal, that separates different environments, while allowing flow of traffic and unobstructed vision through the opening

3.9
strip curtain
provision, made of strips, preventing sudden heat gains, when opening doors

3.10 Types of door

3.10.1
hinged door
door whose actuation takes place by means of rotation of the door leaf around the axis of rotation of the hinges

3.10.2
sliding door
door whose actuation takes place by means of sliding of the door leaf parallel to the wall

3.10.3
swing door
hinged door whose door leaf can rotate in both directions

3.10.4
roll shutter
door whose actuation takes place by means of rolling and unrolling of the flexible door leaf

3.11
mechanical closing device
mechanical device that helps self-closing of the door, and avoids door leaf to remain ajar, used to reduce energy losses and keep internal temperature

3.12
door switch device
switch to control evaporator fan motors, internal lighting, alarm and other device improving energy saving

3.13
thermal bridge
part of the walk-in cold room where the otherwise uniform thermal resistance is significantly changed by a material and/or geometrical discontinuity

3.13.1
linear thermal bridge
thermal bridge with a uniform cross-section along one of the three orthogonal axes

[SOURCE: EN ISO 10211:2007, definition 3.1.2]

3.13.2
punctual thermal bridge
localized thermal bridge whose influence can be represented by a punctual thermal transmittance

[SOURCE: adapted from EN ISO 10211:2007, definition 3.1.3]

3.14
insulating material
thermally insulated product with a declared thermal conductivity lower than 0,06 W/(mK) at 10°C

3.15
ageing
worsening of the thermal properties of an insulating material or structure along time

3.16
linear thermal transmittance
heat flow rate in the steady state divided by length and by the temperature difference between the environments on either side of a thermal bridge

3.17
punctual thermal transmittance
heat flow rate in the steady state divided by the temperature difference between the environments on either side of a thermal bridge (W/K)

3.18
walk-in cold room ceiling
covering of the walk-in cold room

3.19
core
layer of material, having thermal insulating properties, which is bonded or injected between two metal faces

3.20
face
facing
lightly profiled or profiled thin metal sheet firmly bonded to the core

3.21
fixing (fastening) system
system fastening panels to the supporting system or other components to the panels or components to each other

3.22
joint
interface between two panels where the meeting edges have been designed to allow the panels to join together in the same plane

[SOURCE: EN 14509:2013, definition 3.13]

3.23
junction
connection between adjacent panels and corners

Note 1 to entry: For example wall to wall, wall to ceiling, wall to floor.

3.24
storage temperature
target storage temperature which is intended to be maintained within the operating walk-in cold room

3.25
medium storage temperature
MT
any temperature above −5 °C, for chilled perishable items storage

3.26
low storage temperature
LT
any temperature below −5 °C, for frozen perishable items storage

3.27
gross storage volume
internal dimensions of the cold room, measured from floor to ceiling and from left to right (total height x total width x total length in cubic meters (m^3))

Note 1 to entry: When measuring in meters, the precision for measurements is to be of two decimals; tolerance shall be of ± 0,5 cm.

3.28
thermal conductivity
property of a material to conduct heat

3.29
thermal insulation
property of a material of reducing transfer of thermal energy through its thickness

3.30
supporting profile
system not structural part of the building, used to permanently support ceiling panels (when necessary), cooling systems, and other equipment of the walk in cold room

3.31
significant figure
digit that carry meaning contributing to the number precision, considering that leading zeros and trailing zeros placeholders merely indicating the scale are not significant

3.32
product sample
part of the sandwich panel or door leaf obtained by cutting in the central part of the same product, including any facings and core material

3.33
test specimen
slice of core material to be tested, taken from the middle thickness at an equal distance from the product sample edges

3.34
group of walk-in cold room components
walk-in cold room components of similar chemical and physical characteristics, produced on the same production line

4 Symbols and abbreviations

U_{tot} overall heat transfer coefficient (W/m^2K)

Uj single component heat transfer coefficient (W/m^2K)

W heating power (W)

S surface (m^2)

R thermal resistance (m^2K/W)

D thickness (m)

λ thermal conductivity coefficient (W/mK)

h surface heat transfer coefficient (W/m^2K)

l length (m)

Ψ linear thermal transmittance of the joints per metre length of the panel (W/mK)

X punctual thermal bridges transmittance (W/K)

Subscripts

n nominal

i internal

e external

c core

f facing

s surface

f fluid (air)

w wall

a air

j generic index

5 Performances

5.1 General

Performance characteristics of walk-in cold rooms shall be assessed in terms of thermal insulating properties, in order to give a basis on which assessing energy consumption related properties of walk-in cold rooms, and of their components.

Performance characteristics shall be assessed for every single component of the walk-in cold room and for the assembled walk-in cold room as a whole.

For the calculations or tests, the reference point for walk-in cold rooms working at medium storage temperature is T = +5 °C, and for low storage temperature is T = - 18 °C.

5.2 Thermal insulation performances

Thermal insulation performances of walk-in cold room kits are assessed by considering the relevant characteristic of every single component of a walk-in cold room, which shall be assessed by test and/or by calculations. Components of walk-in cold rooms can be identified as follows:

1) wall and ceiling panels;

2) floor panels;

3) door(s);

4) window(s);

5) fixing systems and junctions;

6) supporting profiles.

For comparison walk-in cold rooms with and without thermally insulated floor will be considered.

Air infiltration through the open door will be considered in terms of devices to avoid or limit the ingress of ambient air, from the environment outside the walk-in cold room. A classification of the used device will be proposed, in order to evaluate the contribution to the improvement of walk-in cold room performance characteristics in terms of energy consumption.

5.3 Other performances

5.3.1 Air permeability

Considering a useful life of the cold room of 10 years, taking into account the extremely low air permeability of the metal facings, air permeability of the panels is considered to have negligible effects on the behaviour of the room. Consequently, no assessment is required.

5.3.2 Water vapour permeability

The content of 5.3.1 is also valid for water vapour permeability.

6 Methods to assess thermal insulation performances of prefabricated walk-in cold room components

6.1 General

The assessment of energy consumption related characteristics of single components of a walk-in cold room will be performed considering the following aspects:

1) thermal conductivity of modular panels core;

2) thermal transmittance of wall and ceiling panels;

3) thermal transmittance of floor panels;

4) thermal transmittance of doors;

5) thermal transmittance of windows;

6) thermal transmittance of corners;

7) influence of the supporting profiles.

Gaskets are considered components of the doors, and sealants are considered part of the fixing system that is tested like reported in the points of this paragraph.

6.2 Thermal conductivity of the insulating core of wall, ceiling and floor panels

Assessment of thermal conductivity of core material of components at 2), 3) and 4) of 6.1 is performed according to EN 12667 or EN 12939 for products of high thickness.

Thermal conductivity shall be determined according to Annex A and B, and declared by the manufacturer according to the following conditions:

— average temperature is 10 °C;

— measured values shall be expressed with three significant figures;

— the thermal resistance, R_D, shall always be declared; the thermal conductivity, λ_D, shall be declared when possible;

— the thermal resistance, R_D, and the thermal conductivity, λ_D, shall be expressed as representative limit values of at least 90 % of production, with a level of confidence of 90 %;

— the thermal conductivity value $\lambda_{90/90}$ shall be rounded to three significant figures expressed in W/mK and declared as λ_D rounded to three significant figures and expressed W/Mk;

— the declared thermal resistance, R_D, shall be calculated according to the nominal thickness, d_N, and the relevant thermal conductivity value $\lambda_{90/90,}$ unless measured directly;

— the thermal resistance value, $R_{90/90}$, when calculated according to the nominal thickness, d_N, and the relevant thermal conductivity value, $\lambda_{90/90}$, shall be rounded downwards to three significant figures and expressed in m^2K/W, and declared as R_D with three significant figures and expressed in m^2K/W;

— the thermal resistance value, $R_{90/90}$, for those products whose thermal resistance is measured directly, shall be rounded downwards to three significant figures and expressed in m^2K/W, and declared as R_D with three significant figures and expressed in m^2K/W.

Thermal resistance and thermal conductivity shall be determined in accordance with EN 12667 or EN 12939 for thick products and under the following conditions:

— at a mean temperature of (10 ± 0,3) °C;

— after conditioning of test specimens that shall be stored for at least 6 h at (23 ± 5) °C and (50 ± 5) % relative humidity, unless otherwise specified in the test standard;

— taking into account the effect of ageing according to Annex B.

Thermal resistance and thermal conductivity shall be determined directly at measured thickness. In the event that this is not possible, they shall be determined by measurements on other thicknesses of the product providing that:

— the product is of similar chemical and physical characteristics and is produced on the same production unit;

— and it can be demonstrated in accordance with EN 12939 that the thermal conductivity does not vary more than 2 % over the range of thicknesses where the calculation is applied.

When measured thickness is used for testing of thermal resistance and thermal conductivity, the test thickness should be the smallest of the measured points on the test specimen (and not the mean) as far as possible to avoid any air gaps during testing.

For other core materials the test methods reported in the following relevant standard apply: EN 13162; EN 13163; EN 13164; EN 13166; EN 13167.

6.3 Thermal transmittance of wall and ceiling panels

The thermal transmittance (U) of the panel, in terms of thermal conductivities, is determined by calculation with Formula (1):

$$U = \frac{1}{R_{si} + \frac{t_{ni}}{\lambda_{fi}} + \frac{\sum S_{dj}}{\lambda_j} + \frac{t_{ne}}{\lambda_{fe}} + R_{se}} \tag{1}$$

where:

S_d is the nominal thickness of each slab of the panel (ignoring the thickness of the facings) (m);

t_{ni} is the nominal thickness of the internal facing (m);

t_{ne} is the nominal thickness of the external facing (m);

λ is the design thermal conductivity of the single layer of the panel W/(m·K);

λ_{fi} is the design thermal conductivity of the internal facing W/(m·K);

λ_{fe} is the design thermal conductivity of the external facing W/(m·K);

R_{si} is the internal surface resistance (m^2·K/W);

R_{se} is the external surface resistance (m^2·K/W).

The internal surface resistance (R_{si}) and the external surface resistance (R_{se}) shall be determined according to EN ISO 6946.

If several thicknesses of wall and ceiling panels are available, the worst case in terms of thermal insulation characteristics shall be considered.

Alternatively manufacturers may assess thermal insulation performance of each thickness.

6.4 Thermal transmittance of floor panels

6.4.1 General

Thermal transmittance of floor panels will be assessed by test or calculation.

Thickness of floor panels may be made of several layers of different insulating materials, such as: basic core material (same as wall and ceiling panels), reinforcement layer that allows walkability of floor. Reinforcement layer is on the internal side of walk-in cold room, and may be exposed or covered by a metal sheet with a dedicated floor finish.

The various insulating layers that make up the thickness of floor panels normally have different thermal insulation performances.

Floor panels are normally available with several different finishes, and thicknesses; therefore, the worst case, in terms of insulation performances, shall be assessed.

Alternatively, manufacturers may assess thermal insulation performance of each floor finish.

6.4.2 Test method

Test on floor panel is performed on a sample of the same dimensions of wall and ceiling panels, completed with all reinforcement layers and floor finishes, according to the procedure described in EN 12667. Sample will include all different layers of insulating materials that may compose panel thickness.

6.4.3 Calculation method

If thermal conductivity of the insulating core material (MW, EPS, XPS, PUR, PIR, PF, CG, etc.), and any other insulating layer that make up the thickness of floor panel are known by test (core) or tabulated values (other layers), the calculation method may be used.

Test on core material shall be performed according to the procedure described in EN 13162, EN 13163, EN 13164, EN 13165, EN 13166, EN 13167 or other relevant standard.

Test on core material shall be performed on a sample of the same dimensions of wall and ceiling panels, according to the procedure described in EN 14509.

For calculation of thermal transmittance of floor panels, the Formula (1) shown in 6.3 applies.

6.5 Thermal conductivity of doors

Assessment of thermal conductivity of components at 4) of 6.1, doors, is performed according to EN ISO 10077-1 and EN ISO 10077-2.

Thermal transmittance of critical nodes of the door frame (U_f) shall be calculated according to EN ISO 10077-2; thermal transmittance of the whole door (U_W) shall be calculated according to the relevant paragraphs of EN ISO 10077-1.

When provided, the contribution of any power operated technical solution to avoid gasket freezing (e.g. heating cable), shall be considered in terms of power consumption, as indicated in 7.3.

For the calculation of thermal transmittance U_W of the whole door, the weighted average between the thermal transmittance of critical nodes (U_f), and the thermal transmittance of the insulating door leaf (U_p) shall be considered. The following formula shall apply.

$$U_w = \frac{\sum A_p U_p + \sum A_f U_f}{\sum A_p + \sum A_f} \qquad (2)$$

where

U_w is the thermal transmittance of the whole door;

U_p is the thermal transmittance of the insulating door leaf W/(m²·K);

U_f is the thermal transmittance of the door frame-W/(m²·K);

A_p is the area of the insulating panel (door leaf) (m²);

A_f is the area of the door frame (m²).

The calculation of A_p and A_f shall be done according to EN ISO 10077-1.

If several thicknesses of door leaf are available, the worst case in terms of thermal insulation characteristics shall be considered.

Alternatively manufacturers may assess thermal insulation performance of each available thickness.

6.6 Thermal conductivity of windows

Assessment of thermal conductivity of components at 5) of 6.1, windows, is performed according to EN ISO 10077-1 and EN ISO 10077-2.

Thermal transmittance of critical nodes of the window frame (U_f) shall be calculated according to EN ISO 10077-2; thermal transmittance of the whole window (U_W) shall be calculated according to the relevant paragraphs of EN ISO 10077-1.

6.7 Thermal transmittance of corners

Thermal transmittance of corners will be assessed by calculation, according to EN ISO 10211; where relevant, also EN ISO 10077-2 may be used.

Common solutions used for corners are:

— extruded profile corner, with empty cavities;

— injected foamed corner;

— injected foamed corner incorporated into the panel.

If several thicknesses of corners are available, the worst case in terms of thermal performance shall be considered.

Alternatively manufacturers may assess thermal insulation performance of each available thickness.

6.8 Influence of supporting profiles

According to definition 3.29, supporting profiles may be made of several materials that have tabulated values of thermal conductivity and thermal resistance. The influence of the supporting profiles shall be calculated according to examples reported in EN ISO 14683, if applicable, or according to EN ISO 10211, where calculation systems are described.

6.9 Thermal bridges of the cold room

6.9.1 General

Walk-in cold rooms are designed and built with particular attention to avoid any thermal bridges that may affect the thermal performances of the whole walk-in cold room.

6.9.2 Thermal bridges in doors

The evaluation of the overall thermal transmittance of doors, as described in 6.5, takes into account all effects of any discontinuities in insulation that may be present in the door.

Therefore, the effect of any critical node that may be present is already included in the proposed calculation method, and no further study is required.

6.9.3 Thermal bridges in panel to panel joint

Depending on the design of the panel, the panel to panel joints may have different solutions; however, although at the interface between two adjacent panels there is a slightly reduction of the actual thickness of the insulating core material, the discontinuity is guaranteed, and there is no direct connection between the internal and external sides of the panels.

The continuity of the insulation through the joints, male–female perimetrical and/or camlock perimetrical profile, is guaranteed by the correct activation of the locking system, that is integral part of each panel, that puts into contact the insulating core material of two adjacent panels directly, or through an interposed gasket.

If no experimental data are available, EN 14509:2013, A.10.4, shall apply. The contribution factor of longitudinal joints Type I or Type V of EN 14509:2013, Figure A.20 and EN 14509:2013, Table A.4 shall apply, according to the design of the joint. Alternatively manufacturers may assess thermal bridges in panel to panel joints according to their design of the worst case or to each available thickness.

6.9.4 Thermal bridges in panel to floor joint for walk-in cold rooms without insulated floor

In case of walk-in cold rooms without insulated floor, wall panels are connected to the floor through an extruded profile made with a low thermal conductivity material or other insulated profile. The contribution of the used profile to any linear thermal bridges that may be present at the interface of the panel to floor joint, shall be calculated according to EN ISO 10211. If other material profiles are used, characterized by a high thermal conductivity, their thermal conductivity shall be considered as contribution to the thermal bridge.

The contribution of the not insulated floor to the overall heat transfer coefficient of the walk-in cold room is considered as described in 7.2.

6.9.5 Thermal bridges at corner joints

The connection between panels of orthogonal walls, or partition walls, is realized through specific junctions that may be filled with insulating core material made with a low thermal conductivity material.

For foamed joints, as for panel to panel joints seen in 6.9.3, although there is a slightly reduction of the actual thickness of the insulating core material, the discontinuity is guaranteed, and there is no direct connection between the internal and external sides of the panels.

For panels that include a foamed corner joint in the design, the same considerations of panel to panel joint described in 6.9.3 shall apply.

For extruded profile corner, made with a low thermal conductivity material, the connection path between the internal and external sides of the joint is obstructed by the design of the profile, in order to avoid thermal transmission. The evaluation of the thermal performance of extruded profile corner is made according to 6.7.

The evaluation of the thermal bridges is covered by the evaluation of the thermal transmittance (U) of the corner at 6.7, with the method proposed by EN ISO 10211.

6.9.6 Thermal bridges of pass through holes

Pass through holes include wires, pipes and pressure relief valves, when provided. The contribution of pass through holes made on site or factory made and for those made for the passage of electric wires or pipes shall be considered as a punctual thermal bridge. The value shall be determined in accordance with EN ISO 10211. If the contribution of the punctual thermal bridge is negligible, the thermal bridge shall not be considered in the calculation. The contribution of the heating system of pressure relief valves shall be considered in terms of power consumption as shown in 7.3.

6.9.7 Thermal bridges of refrigerating units

The thermal bridges related to the refrigerating units are not included in this standard. Examples of instructions for unit’s installation in the walk-in cold room are reported in Annex D.

7 Methods to assess thermal insulation performances of prefabricated walk-in cold room kits and total power consumption

7.1 General

The proposed method to assess thermal insulation performances of a prefabricated walk-in cold room kit is a calculation method that will consider contribution of all previously assessed components.

The combination of all contributions will give the overall heat transfer coefficient of the walk-in cold room.

7.2 Overall heat transfer coefficient of walk-in cold room kits

The data from the thermal conductivity tests of panels, doors, windows, and floor shall be combined in one parameter defined as "overall heat transfer coefficient", that is calculated at the actual air velocities inside and outside of the walk-in cold room during standard operation.

In the case of walk-in cold rooms without floor (3.1.4), a virtual surface is considered in the place of the floor that is not part of the kit. The U value of this surface is calculated for a slab of concrete of 100 mm of thickness, a thermal conductivity λ = 2W/(m·K), and an area equal to that corresponding to the external dimensions of room.

The thermal conductivity of the core material that shall be used in these calculations is the value referred to aged foam. The thermal conductivity coefficients are measured as prescribed in 6.2, or according to EN 13162 (MW), EN 13163 (EPS), EN 13164 (XPS), EN 13166 (PF), EN 13167 (CG), with reference to the different insulating core materials.

The data of the surface resistances shall be determined according to EN ISO 6946.

The overall heat transfer coefficient is defined by the following formula:

$$U_{tot} = \frac{\sum U_j S_j + \sum \Psi_j l_j + \sum \chi_j}{\sum S_j} \qquad (3)$$

where

U_j are the heat transfer coefficients of the single components and S_i the relative areas;

Ψ_j are the linear thermal transmittances of the joints per meter length of panel W/(m·K);

S_j are the areas corresponding to the components whose U_i is the heat transfer coefficient;

χ_j are the heat losses due to the punctual thermal bridges per 1K of temperature difference.

χ_j values can be determined, when not negligible, in accordance with EN ISO 10211.

7.3 Total power consumption of walk-in cold room

The evaluation of the total power consumption of a walk-in cold room, taking into consideration the contribution of thermal insulation properties of the envelope, and power consumption of all electrical ancillaries, can be calculated using the following formula.

$$P_{tot} = U_{tot} A \cdot (T_1 - T_2) + P_{heating\,cable} + P_{heating\,mat} + \sum P_j \tag{4}$$

where

- P_{tot} is the total power consumption of the walk-in cold room;
- U_{tot} is the overall heat transfer coefficient;
- A is the overall internal surface of the walk-in cold room;
- T_1 is the external temperature;
- T_2 is the internal temperature;
- P_j is the power consumption of any power operated technical solution.

NOTE Power operated technical solutions include any system that requires energy to perform accessory functions (e.g. heating cable, heating mat, pressure relief valves, air curtain, illumination, door automation, gasket freezing).

In case of walk-in cold rooms with internal partitions, the overall internal surface "A" shall be determined considering the surfaces of the external insulated envelope only.

The walk-in cold room is considered to work in stationary conditions.

8 Installation of walk-in cold rooms

It is very important to provide a correct installation and maintenance of walk-in cold rooms in order to ensure the overall thermal performances and the integrity of the walk-in cold rooms along its working life.

The main issues to be considered are:

— suitability of the location;

— positioning of the floor;

— positioning of the wall and ceiling panels;

— positioning and adjustment of doors and windows;

— positioning of pressure relief valves;

— sealing and finishing.

A guide for correct installation and maintenance is given in Annex D.

9 Attestation of conformity - Factory Production Control (FPC)

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform to the declared performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

NOTE An FPC system conforming with the requirements of EN ISO 9001 is considered to satisfy the FPC requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The procedure and action to be taken in cases of non-conformity shall be clearly stated.

When products of the same family are produced using the same process equipment, the manufacturer may use common initial type test results providing that conformity can be shown, in which case factory production control procedures shall be the same.

Where a manufacturer operates different production lines or units in the same factory or production lines or units in different factories, and these are covered by a single overall FPC system, the manufacturer shall keep control records for each separate production line or unit.

The manufacturer can decide whether to carry out FPC tests internally or externally.

Annex A
(normative)

Determination of the declared values of thermal resistance and thermal conductivity

A.1 General

It is the responsibility of the manufacturer to determine the declared values of thermal resistance and thermal conductivity. He will have to demonstrate conformity of the product to its declared values. The declared values of thermal resistance and thermal conductivity of a product are the expected values of these properties during an economically reasonable working life under normal conditions, assessed through measured data at reference conditions.

A.2 Input data

The manufacturer shall have at least ten test results for thermal resistance or thermal conductivity, obtained from internal or external direct measurements in order to calculate the declared values. The direct thermal resistance or thermal conductivity measurements shall be carried out at regular intervals spread over a period of the last twelve months. If less than ten test results are available that period may be extended until ten test results are obtained, but with a maximum period of three years, within which the product and production conditions have not changed significantly.

For new products, the ten thermal resistance or thermal conductivity tests shall be carried out spread over a minimum period of ten days.

The declared value shall be calculated according to the method given in A.3 and shall be recalculated at intervals not exceeding three months of production.

A.3 Declared values

A.3.1 General

The derivation of the declared values, R_D and λ_D, from the calculated values, $R_{90/90}$ e $\lambda_{90/90}$, shall use the rules given in 6.2, which include the rounding conditions.

A.3.2 Case in which the thermal resistance and thermal conductivity are declared

The declared values R_D and λ_D, shall be derived from the calculated values, $R_{90/90}$ and $\lambda_{90/90}$, which are determined using Formulae (A.1), (A.2) and (A.3).

$$\lambda_{90/90} = \lambda_{mean} + k \cdot s_{\lambda} \quad \text{(A.1)}$$

$$S_{\lambda} = \sqrt{\frac{\sum_{i=1}^{n} (\lambda_i - \lambda_{mean})^2}{n-1}} \quad \text{(A.2)}$$

$$R_{90/90} = d_N / \lambda_{90/90} \quad \text{(A.3)}$$

Values for *k* shall be taken from Table A.1.

A.3.3 Case in which only the thermal resistance is declared

The declared value R_D shall be derived from the calculated value $R_{90/90}$ which is determined using Formulae (A.4) and (A.5).

$$R_{90/90} = R_{mean} - k \cdot S_R \quad \text{(A.4)}$$

$$S_R = \sqrt{\frac{\sum_{i=1}^{n}\left(R_i - R_{mean}\right)^2}{n-1}} \quad \text{(A.5)}$$

Table A.1 — Values for k for one sided 90 % tolerance interval with a confidence level of 90 %

Number of test results	k		Number of test results	k
10	2,07		24	1,71
11	2,01		25	1,70
12	1,97		30	1,66
13	1,93		35	1,62
14	1,90		40	1,60
15	1,87		45	1,58
16	1,84		50	1,56
17	1,82		100	1,47
18	1,80		300	1,39
19	1,78		500	1,36
20	1,77		2000	1,32
22	1,74			
NOTE For other numbers of test results use ISO 12491, or linear interpolation.				

Annex B
(normative)

Determination of the aged values of thermal resistance and thermal conductivity

B.1 General

This Annex describes the method to evaluate the ageing effect of the PUR/PIR core material of the sandwich panels. For the evaluation of the ageing effect of other core materials, the relevant European Standard shall apply.

The proposed method takes in consideration the actual end-use application of sandwich panels used for walk-in cold rooms, and the normal environment conditions that a walk-in cold room is subject to during its working life.

The normal end-use conditions of a walk-in cold room are considered to be:

a) installation inside an existing building;

b) not exposed to external weather conditions;

c) internal side of panels subject to temperatures within the indicative range −40 °C ≤ T ≤ 12 °C;

d) external side of panels subject to temperatures within the indicative range −8 °C ≤ T ≤ 30 °C; temperatures below 0 °C, or higher than 20 °C, may be reached if the walk-in cold room is located inside not air-conditioned premises.

The proposed ageing method is valid for closed cells PUR/PIR sandwich panels manufactured using foaming agents with high molecular weight, such as hydro fluorocarbons, hydro chlorofluorocarbons, hydrocarbons, that normally remain inside the core material for a much longer time than a reasonable working life of the walk-in cold room. Those foaming agents are therefore considered “permanent”.

The foaming agents can be mixed with carbon dioxide (CO_2), a “not permanent” foaming agent that can quickly diffuse outside the core material.

The ageing effect of the core material and worsening of its thermal characteristics, of PUR/PIR core materials is mostly determined by the diffusion of the external air inside the core material, and the diffusion of CO_2 towards the external environment, if the faces of sandwich panels do not impede both phenomenons.

In case new foaming agents result to be of the “permanent” type, with diffusion coefficients similar to those of the hydro fluorocarbons, hydro chlorofluorocarbons, and hydrocarbons, the methods described in this annex can be applied.

For mixtures of permanent foaming agents, the following procedures shall be followed:

— If the accelerated ageing procedure of B.4 is used, the safety increment in accordance with Table B.1 for that foaming agent in the mixture with the highest value shall be used.

— If the fixed increment procedure of B.5 is used, the normality test shall be performed first. The result from the normality test will give the decision, which increment shall be taken. If the test result is not higher than the required limit value in B.5.2 for a certain foaming agent in the mixture, the increment in accordance with Table B.2 for this foaming agent shall be taken to determine the aged value of thermal conductivity.

— If new foaming agents are shown to be ‘permanent types’ (meaning having diffusion coefficients similar to the established values for pentanes and hydro fluorocarbons), the ageing methods defined in this annex can be used. New limit values for the fixed increment procedure (B.5) and different safety increments for the accelerated ageing procedure (B.4) may be required.

B.2 Sampling and conditioning

Select a product sample including any product facings such that the area dimensions of the product sample shall not be less than those specified in EN 12667:2001, Table A.1 which correspond to the product thickness, or shall be equal to the maximum product dimensions.

Condition the product sample at (23 ± 3) °C and (50 ± 10) % relative humidity for at least 16 h before cutting the test specimen.

Cut the test specimen from the central area of the product sample. The test specimens shall conform to those specified in the EN 12667:2001, Table A.1. The facings shall be removed just before performing the test and the test shall be carried out within 8 h.

B.3 Measurement of the initial value of the thermal conductivity

The initial value of the thermal conductivity shall be derived from the measurement of the thermal resistance made one day to eight days after manufacture.

Prepare the test specimen for thermal resistance measurements in accordance with B.2.

Measure the thermal resistance of the test specimen in accordance with EN 12667, EN 12939 and 6.2. Calculate and report the initial value of thermal conductivity rounded to three significant figures expressed in W/(m·K).

B.4 Evaluation of the thermal conductivity value with the accelerated ageing

B.4.1 Procedure

The accelerated aged value of thermal conductivity shall be determined according to the following procedure:

— measure the accelerated aged value in accordance with B.4.2;

— add safety increment in accordance with B.4.3.

For diffusion open products, it is allowed to carry out an acceleration test (see EN 13165). Depending on the outcome of this acceleration test, the safety increments of B.4.3 may be reduced (see EN 13165 or the relevant EN according to the nature of the core material).

B.4.2 Measurement of thermal conductivity value with accelerated ageing

The full product, including any facings, shall be conditioned. The area dimensions of the product sample shall not be less than those specified in EN 12667:2001, Table A.1 which correspond to the product thickness, or shall be equal to the product dimensions. For products with diffusion tight facings, the maximum size of the product sample shall be 800 mm x 800 mm.

The measured accelerated aged value of thermal conductivity shall be derived from the aged thermal resistance obtained after subjecting the product sample to the accelerated ageing treatment. The ageing treatment shall begin not earlier than one day after manufacture and preferably not later than 50 days after manufacture.

Store the product sample at 70 ± 2 °C for 175 ± 5 days.

Prepare the test specimen for thermal resistance measurement in accordance with B.2. Measure the thermal resistance of the test specimen in accordance with EN 12667, EN 12939 and 6.2.

Calculate and report the measured accelerated aged thermal conductivity value rounded to three significant figures expressed in W/(m·K).

B.4.3 Addition of safety increments (to be used with the accelerated ageing method only)

The value obtained according to B.4.2 shall be increased with the safety increments shown in Table B.1.

Table B.1 — Safety increments to be added to the thermal conductivity value measured with the accelerated ageing method

Type of product/faces [b]	Foaming agent [a]	Safety increment [W/(m·K)] for products with nominal thickness $d_N \leq 80mm$	Safety increment [W/(m·K)] for products with nominal thickness $d_N > 80mm$
Faced with diffusion tight facings	Pentane HFC 134a, 245fa, 227ea, 365mfc	0,001 0	0,001 0

a Safety increments for 100 % CO_2 – blown products will be determined when sufficient information is available·

b See B.5.1 for the description of diffusion tight facings.

When requested the manufacturer shall state the type of foaming agent used for the product.

Report the value rounded to three significant figures expressed in W/(m·K). This value shall be used to determine the aged value of thermal conductivity, if no acceleration test data provides additional information (see EN 13165 or the relevant EN according to the nature of the core material).

B.5 Fixed increments method

B.5.1 Conditions

The fixed increment procedure described below shall only be used if:

a) the product has fulfilled the requirements of the normality test given in B.5.2, except for CO_2 blown only products;

b) (100 %) CO_2 blown only products have a closed cell content, determined according to ISO 4590, not less than 90 %;

c) the product contains any of the foaming agents such as pentanes and/or hydro fluorocarbons or a mixture of these with CO_2, or only CO_2;

d) for products with diffusion tight facings shall consist of a metal sheet with thickness ≥ 50µm, or the facings shall show an equivalent performances. Faced products, which do not show an increase of thermal conductivity of more than 0,001 W/(m·K), when tested for (175 ± 5) days at (70 ± 2) °C are considered to be covered with diffusion tight facings (maximum size of the sample 800 mm x 800 mm and maximum thickness of 50 mm);

e) If both longitudinal edges of products with min. length of 800 mm or longer are covered by the gastight facings, the width of the product can be less than 600 mm.

For products with diffusion tight facings which have smaller dimensions than these limit values, the procedure given in B.4 should be followed.

B.5.2 Normality test method

Products blown with ‘permanent’ foaming agents shall fulfil the requirements of the following procedure:

— select two product samples from the same sandwich panel one to eight days after manufacture;

— condition them both for 16 h at (23 ± 3) °C and (50 ± 10) % relative humidity;

— cut a test specimen from one of the two product samples of minimum dimensions 200 mm length and width x 20 (+2, −0) mm thickness from the central area of the product sample;

— determine the initial value of thermal conductivity of the test specimen in accordance with B.3;

— store the second product sample at 70 ± 2 °C for 21 ± 1 days recondition for 16 h at (23 ± 3) °C and (50 ± 10) % relative humidity;

— cut a test specimen from the second product sample of minimum dimensions 200 mm length and width x 20 (+2, −0) mm thickness from the central area of the product sample;

— determine the aged value of thermal conductivity of the test specimen in accordance with EN 12667, EN 12939, and 6.2.

The difference between the aged and the initial values of thermal conductivity shall not be more than 0,0060 W/(m·K) for pentane blown, for 245fa, 227ea, 365mfc blown products and for permanent foaming agents having comparable characteristics, and 0,0075 W/(m·K) for 134a blown products.

If the difference is more than the values stated herein, the fixed increment method cannot be used, and the aged thermal conductivity shall be obtained in accordance with B.4.

NOTE At the next review of the standard the value of the difference between the aged and the initial values of thermal conductivity is to be further checked by experimental data.

B.5.3 Calculation of the aged value of the thermal conductivity

The aged value of the thermal conductivity shall be determined by adding fixed increments to the initial value of thermal conductivity.

Determine the initial value of thermal conductivity in accordance with B.3.

Add at the relevant increment given in Table B.2.

Report the calculated aged value of thermal conductivity rounded to three significant figures expressed in W/(m·K).

Table B.2 — Increments for the calculation of the aged value of the thermal conductivity

Foaming agent	Increment [W/(m·K)			
	Type of faces			
	None or permeable to diffusion			Impermeable to diffusion
	Nominal thickness			
	d_N < 80mm	80mm ≤ d_N < 120mm	d_N ≥ 120mm	
Pentane	0,0058	0,0048	0,0038	0,0015
HFC 245fa [a], 227ea, 365mfc	0,0060	0,0048	0,0038	0,0015
HFC (134a)	0,0075	0,0065	0,0055	0,0025
100 % CO_2	0,0100	0,0100	0,0100	0,0060

[a] If in a foaming agent mixture pentane is used together with HFC 245fa or/and 227ea or/and 365mfc, the increment of 0,0060 W(m·K) for dN < 80mm shall be used for such a foaming agent mixture.

When requested the manufacturer shall state the type of foaming agent used for the product.

B.6 Declaration of the aged values of thermal resistance and thermal conductivity

B.6.1 General

The statistical variation as required in Annex A for the declaration of thermal resistance and thermal conductivity shall be calculated using either the initial or the aged values of thermal conductivity.

The initial values shall be determined in accordance with B.3 and the aged values in accordance with B.4 or B.5.

B.6.2 Walk-in cold rooms components groups

The manufacturer shall declare either:

— separate thermal values for each single component and each single thickness and then determine the $\lambda_{90/90}$ value on each thickness for each product;

or

— a thermal value for a group of a walk-in cold rooms component including all or a range of thicknesses using the $\lambda_{90/90}$ value of this product group for the corresponding thickness range.

The manufacturer shall decide whether to create groups and the size of the groups. The determined thermal values of thin, medium and thick components shall be included in the statistics of a product group which covers all thicknesses or a range of thicknesses.

A minimum of ten initial or aged values shall be determined for each group of walk-in cold rooms components.

B.6.3 Values of initial thermal conductivity used to calculate the λ90/90 value

$$\lambda_{90/90} = \lambda_{mean,i} + k_i \cdot s_{\lambda,i} + \Delta\lambda_a \qquad \text{(B.1)}$$

or

$$\lambda_{90/90} = \lambda_{mean,i} + k_i \cdot s_{\lambda,i} + \Delta\lambda_f \qquad \text{(B.2)}$$

$$R_{90/90} = d_N / \lambda_{90/90} \qquad \text{(B.3)}$$

Where $\lambda_{mean,i}$, k_i and $s_{\lambda,i}$ are calculated from the measured initial values of thermal conductivity in accordance with Annex A.

The ageing increment, $\Delta\lambda_a$, is determined as mean value of the thermal conductivity increase from measurements of two specimens by taking the difference between the measured aged value in accordance with B.4 and the measured initial value in accordance with B.3. The two specimens shall be taken from the same sandwich panel or door leaf, which is identified as the worst-case in a groups of walk-in cold rooms components (e.g. the thinnest product).

The fixed ageing increment, $\Delta\lambda_f$, is the increment in accordance with B.5. For a product group the fixed ageing increment of the worst-case product shall be taken.

B.6.4 Values of aged thermal conductivity used to calculate the λ90/90 value

$$\lambda_{90/90} = \lambda_{mean,a} + k_a \cdot s_{\lambda,a} \qquad \text{(B.4)}$$

$$R_{90/90} = d_N / \lambda_{90/90} \qquad \text{(B.5)}$$

Where $\lambda_{mean,a}$, k_a and $s_{\lambda,a}$ are calculated from the measured aged values of thermal conductivity in accordance with Annex A.

Annex C
(informative)

Walk-in cold rooms documentation

Components for walk-in cold rooms can be accompanied by the following documentation provided by the manufacturer:

— Declaration of walk-in cold room components U values;

— User manual, including mounting instructions.

The collection of the single values of U can be done according to Tables C.1, C.2, C.3 and C.4, where the manufacturer can display/report declared values.

Table C.1 — Overall U values for single components

U values for single component W/(m²·K)		
	Medium storage temperature	Low storage temperature
	Actual value	Actual value
Walls and ceiling		
Floor		
Door		
Windows		

Table C.2 — Overall Ψ values for single joints

Ψ values for single joint W/(m·K)		
	Actual value	
Wall – to - wall linear thermal bridge		
Wall – to - floor linear thermal bridge		
Wall – to - ceiling linear thermal bridge		
Wall – to - door linear thermal bridge		

Table C.3 — Overall χ values for single punctual thermal bridge

χ for every punctual thermal bridge (W/K)		
	Actual value	
X_1		
……	………………………………………………..	…………………………...
χ_n		

For each test or calculation, a value shall be derived.

The final result is reported in Table C.4, when the door is considered to be closed and the walk-in cold room is at stationary conditions.

Table C.4 — Overall walk-in cold room characteristics

	Global heat transfer coefficient	**Ageing factor**	**Air infiltration load through the open door(s)**
Unit	$W/(m^2 \cdot K)$	Dimensionless (%)	No unit
Quotation			

In Table C.5, where the reference values (quotation) for a quantitative evaluation of air infiltration load through the open door are given. The proposed classification has the aim to give a guideline to classify the different solutions that manufacturers may apply to walk-in cold rooms, in order to limit the air infiltration load through the open door. Classification numbers go from 0 (worst case, high air infiltration), up to 5 (best case, lowest air infiltration).

Table C.5 — Air infiltration load through the open door(s)

Type	**Quotation**
Simple door	0
Automatic door	1
Mechanical door closer	1
Air curtain	4
Strip curtain	5

The combination of two or more types gives as quotation the sum of the single quotations.

Annex D
(informative)

Guide on installation

D.1 General

The installation of walk-in cold rooms is normally handled directly by the customer that relies on specialized companies, as requested in the installation instructions manual supplied with the product.

D.2 Preliminary provisions

The staff required for installation depends on the size of the walk-in cold room, and normally should not be less than 2 people. The equipment needed to complete the installation is listed below:

— metric scale;

— bubble leveller;

— twine for tracing;

— hexagonal wrench for activating locking system (or similar, according to manufacturer's used locking system);

— manual or electric saw;

— drill;

— riveter;

— manual or electric screwdriver;

— caulking gun.

According to walk-in cold room height, it might be necessary to use manual or automatic lifting equipment, such as forklift, scaffolding, etc.

Before starting the assembly it is good practice to assess that the floor, where the walk-in cold room is to be installed, has the following characteristics:

— perfectly flat;

— at bubble level (horizontal, not inclined);

— without hollows, holes, ondulations or difference in level.

Otherwise, it is necessary to level the floor before proceeding with the assembly.

For walk-in cold rooms with recessed floor, it is mandatory to assess that the dimensions of the hole hosting floor panels is larger than the actual dimension of the floor, and in particular, it should be:

— 50 mm larger on all directions;

— 200 mm larger on the door side;

— as deep as the floor panel thickness or few mm less.

Walk-in cold rooms should be installed on stable and finished floors; floors made of sand, gravel, land or other yielding materials are not suitable.

It is suggested to check the available material, and compare it with the shipment list, or the assembly instruction manual, in order to verify that all needed material has been provided by the manufacturer.

The faces of the panels are usually protected by a removable protective film; therefore, at the beginning of the installation, it is necessary to partially remove the protective film from the edges of panels, in order to ease the complete removal at the end of the assembly of the walk-in cold room.

Unless otherwise advised by the manufacturer, walk-in cold rooms should not be installed outside, exposed to weather or to direct solar radiation. Moreover, in order to avoid moisture problems, walk-in cold rooms should be positioned at a minimum distance of 100 mm from the existing walls, as well as from walls of adjacent walk-in cold rooms.

D.3 Installation, assembly and locking of panels

D.3.1 General

Panels are equipped with a locking system that allows the assembly and fixing of the joints between adjacent panels, or between panel and corner joint.

The use of eccentric hooks embedded in the core material of the panels, is one of most common solutions used by manufacturers, in order to allow the connection between panel to panel, and panel to corner. This type of locking system enhances the mechanical properties of the system as well as improving the thermal and restricting air movement.

In order to activate the locking system it is necessary to insert the hexagonal wrench, or other device according to manufacturer’s instruction, provided with the walk-in cold room material, inside the dedicated holes in the panels.

The side of the panels with the dedicated holes for the activation of the locking system should be positioned on the internal side of the walk-in cold room.

In order to properly lock two adjacent panels, it is necessary to rotate the hexagonal wrench until the maximum elongation point of the hook is reached; by proceeding with the rotation of the hexagonal wrench the locking system tightens the grab, until the two adjacent panels are perfectly connected and the joint is mechanically sealed.

To properly align two adjacent panels during the assembly, some manufactures provide specific aligners that should be inserted in the dedicated position before joining the panels.

D.3.2 Installation of floor panels

D.3.2.1 General

If all prescriptions described in D.2. have been followed, the assembly of the walk-in cold room can begin by tracing a line on the floor, indicating the perimeter of the walk-in cold room.

D.3.2.2 Walk-in cold room with insulated floor

The assembly begins by positioning the floor panels in the correct order and by joining them using the system provided by the manufacturer. Before completely joining floor panels, the perimeter of the edges of the walkable side should be sealed using silicone suitable for use in walk-in cold rooms. The silicone line should be approximately 2 cm thick in order to allow impermeability to water of the joints.

Once the silicon line has been put into place, floor panels can be joint together, as well as corner joints if foreseen by the manufacturer. After positioning floor panels, the operators should activate the locking system provided by the manufacturer in order to lock the panels and corner joints together, and grant the correct thermal insulation.

For walk-in cold rooms for low storage temperature use, in order to prevent condensation, moisture and freezing of the area under the walk-in cold room floor, it is suggested to allow air circulation under floor panels, by using adequate ventilation profiles or system, or to install a heating mat. For large or very large floors, a case by case solution should be looked for.

If the installation of the floor panels is made on ventilation profiles or system, it is important to remind that the load bearing capacity of the floor will be considerably reduced according to the used materials and structure of the profiles.

The usual layout of ventilation profiles foresees to position two adjacent profiles at opposite edges of the walk-in cold room, and all intermediate profiles every 400 mm or less, according to floor panels layout and load bearing capacity of the floor.

D.3.2.3 Walk-in cold room without insulated floor

The assembly begins by tracing a line on the floor, that indicates the perimeter of the walk-in cold room, and by positioning and fixing U profiles, or any other ancillary provided by the manufacturer in order to keep wall panels in place, and connecting them to the floor.

Before connecting the ancillaries to the floor, it is good practice to seal the connection between the ancillaries and the floor by using silicone suitable for use in walk-in cold rooms. The silicone line should be approximately 20 mm thick, on both internal and external lower edges of the profile in order to allow impermeability to water of the connection between floor and ancillary.

D.3.3 Installation of wall panels

After the assembly of floor panels, or positioning of U profiles for walk-in cold room without floor, the construction of the walk-in cold room can proceed by positioning of the wall panels.

The general rule is to start with a corner and two orthogonal wall panels at the most distant corner from the door position; according to the assembly instructions provided by the manufacturer, it is important to assess the correct orientation of the wall panels before starting the positioning; in order to be able to properly connect two adjacent panels, all panels will have the same orientation.

When available, the use of aligners can help the correct positioning and alignment of two adjacent panels.

After positioning wall panels, the operators should activate the locking system provided by the manufacturer in order to lock the panels and corner joints together, and grant the correct thermal insulation.

The installation of wall panels should proceed on both sides of the first two orthogonal walls, and completing the top edge of wall panels by positioning and fixing the corner joints, if foreseen by the assembly system. Once these two walls have been completed, the third wall can be installed; only the wall where the door is to be located is left incomplete. The door panel is the last element of the walk-in cold room to be put into place.

D.3.4 Installation of ceiling panels

Once the three walls of the walk-in cold room where the door is not to be installed are completed, the installation of ceiling panels can begin.

Before proceeding, it is recommended to position any ancillaries, temporary shelves or aligners that may help the operators to keep ceiling panels in place, while connecting them with the locking system. In order to avoid any risks for the operators or not correct installation, in this phase it is important to follow the instructions provided by the manufacturer.

For walk-in cold rooms with large or very large ceilings, it may be necessary to install a supporting frame or beam, in order to keep in place ceiling panels. Considering the large variety of supporting frames and solutions that may be available, it is not within the scope of the present standard to evaluate them and provide assembly instructions or recommendations; it is therefore recommended to precisely follow the manufacturer's instructions.

D.3.5 Installation of partition walls

When it is necessary to join two or more walk-in cold rooms the best solution is to avoid two adjoining walls, design the system of walk-in cold room as a whole and separate the different rooms using partition walls.

It is not recommended to build two separate walk-in cold room that have two walls installed too closely, because this may cause low air exchange and presence of moisture.

To separate two adjacent walk-in cold room there are normally two solutions:

— modular partition walls;

— not modular partition walls.

Modular partition walls: in this case, the whole walk-in cold room has been designed as divided into two or more smaller walk-in cold rooms from the beginning, and partition walls are integral part of the walk-in cold room structure. The assembly procedure is the same foreseen for other wall panels, as if the walk-in cold room is a single one. The position of the partition wall is decided during the design procedure and, most of the times, cannot be relocated in another position. The modular partition walls are assembled while assembling the walk-in cold room.

Not modular partition walls: in this case, the walk-in cold room has been designed as a single room, and only after it has been decided to separate it into more rooms. It is therefore necessary to install a not modular partition wall that will not be integral part of the structure of the walk-in cold room, and can be installed in any position.

The assembly of the not modular partition wall is similar to the installation of the wall panels of a walk-in cold room without floor. The ancillaries used to position and hold the not modular partition wall panels are fixed to the other panels of the walk-in cold room already assembled, all around the perimeter of the partition wall. During the positioning and fixing of the ancillaries, it is good practice to apply a 2 cm wide line of silicone on both edges of the profiles, in order to grant water and air tightness.

The not modular partition walls are assembled after assembling the walk-in cold room.

D.3.6 Installation of doors

A walk-in cold room in standard configuration normally foresees the installation of a hinged door, of the same thickness of all other panels. In alternative, sliding doors may be available.

Since manufactures may use several different design solutions, the present paragraph briefly describes the main measures to be taken into consideration by the operators when adjusting the door after installation. For the installation procedure, it is recommended to carefully follow the manufacturer instructions.

Once the installation of the door is completed, and the door leaf is in close position, it is necessary to do the following:

1) enter inside the walk-in cold room and close the door; check that there is no pass through of light along the whole gasket perimeter;

2) check that the gaskets of the door leaf correctly adhere to the door frame; it should not be possible to insert a finger through the gasket if the installation is correct;

3) check that the height adjustment of the door leaf is correct;

4) check that the horizontal adjustment of the door leaf is correct.

If the door is not correctly adjusted, and the door leaf closure is not perfect, it is necessary to adjust the position of the door leaf using the adjusting system foreseen by the manufacturer. Normally, hinged doors for use in walk-in cold room can be adjusted in three ways: height, horizontal alignment, tightness.

— Height adjustment: the height of the door leaf can be adjusted by operating on the dedicated nut bolt, that is visible by removing the covers of the hinges.

— Horizontal adjustment: the horizontal adjustment of the door leaf can be made by acting on the screws that connect the hinges to the door frame; the screws are visible when the covers of the hinges are removed.

— Tightness adjustment: the adjustment of the pressure applied by the door leaf on the door frame through the gasket can be adjusted by acting on the screws that connect the hinges to the door leaf; the screws are accessible after removing the covers and any other cap that may be present to hide the fixing elements. The adjustment can be completed by adjusting the internal latch in order to allow the correct tightness on the door handle side.

WARNING — During the adjustment procedure, the screws should not be removed completely, but lightly unscrewed, until it is possible to move the door leaf to the desired position. A complete removal of the screws may cause the falling of the door leaf, with possible damages to the door or to the operators.

In walk-in cold rooms for low temperature use, the doors are equipped with a heating cable that avoid the creation of ice, and therefore damages, along the perimeter of the gasket. The connection of the heating cable to the electric line should be done by trained operators, and includes the ground connection. It is also necessary to foresee adequate electric protections, dimensioned according to the power of the heating cable, that varies with the dimensions of the doors.

The supply voltage is 230 V and the power is given by the following formula:

$$P\, expressed\, in\, Watts = P_{hc} \times \left(2 \times net\, door\, width + 2 \times door\, height\right) \quad \text{(D.1)}$$

where

P_{hc} is the power consumption of the heating cable per meter of length.

For the calculation of the needed energy, it can be considered a heating cable with a power consumption P_{hc} = 20W/m. Therefore, to calculate the total contribution to energy consumption of the heating cable this value shall be multiplied by the length in meters of the heating cable.

EXAMPLE

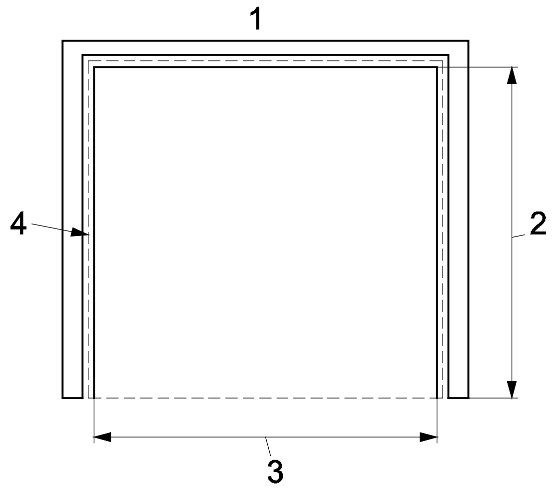
Door width: 2 m

Door height: 3 m

Total length of heating cable:

L = 2 m + 2 m + 3 m + 3 m = 10 m

$P_{tot} = L \cdot P_{hc}$ = 10 m * 20W/m = 200 W



Key

1 door frame

2 height of heating cable

3 width of heating cable

4 heating cable

Figure D.1 — Example of a heating cable in walk-in cold rooms for low temperature use

D.3.7 Installation and final provisions for sealing

According to the assembly system used by the manufacturer, panels are connected by the locking system that allows a complete adhesion of the edges in order to create a uniform thermal barrier that avoids air infiltration.

The locking system is normally activated by inserting a specific key inside holes located around the perimeter of the panel, on the internal side of the walk-in cold room. At the end of the assembly, these holes should be closed by inserting custom made caps, provided by the manufacturer. For floor panels, it is good practice to apply a line of silicone on the edges of the holes, before inserting the cap, in order to make them water tight.

The excess silicone protruding from panel to panel joints, and from the caps, should be removed not before 24 h, when it has become dry and hard.

Before activating the walk-in cold room and introducing any goods for storage, it is good practice to wait not less than 24 h, provided that the walk-in cold room has been adequately aired, and that no strange odors are present.

D.3.8 Installation and information for any additional finishes

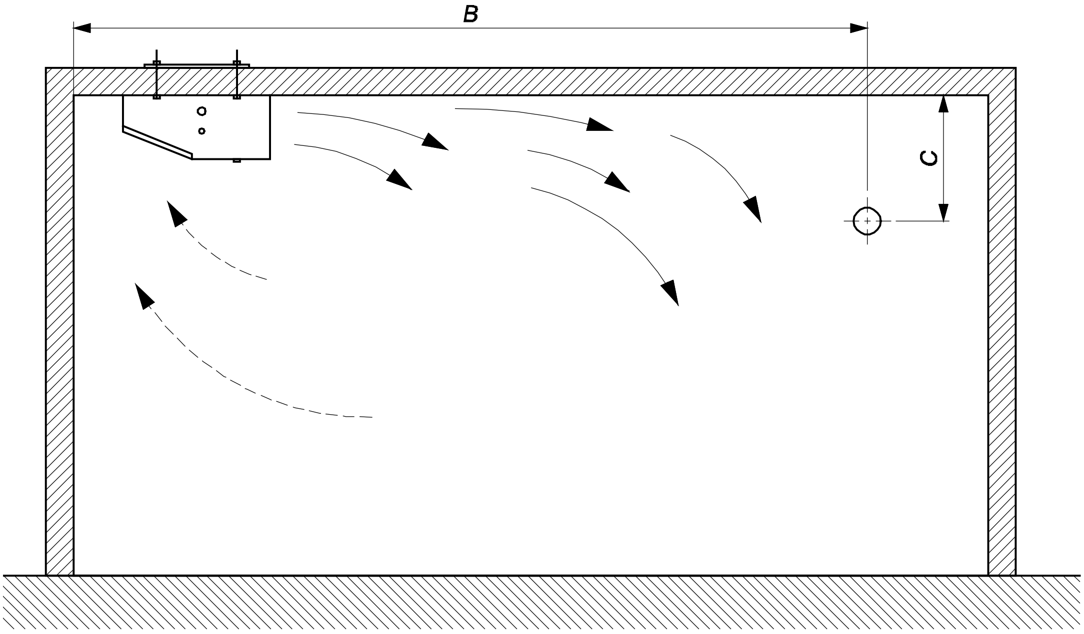
D.3.8.1 Installation of pressure relief valves

Pressure relief valves allow maintaining equal the external and internal pressure of a walk-in cold room, and it is normally recommended to install these devices in number and dimensions adequate to the dimensions of the walk-in cold room.

Although the number and dimensions of pressure relief valves depends on the actual use of the walk-in cold room, it is here shortly described their correct positioning inside the room and proposed a method to choose the correct dimension.

In order to avoid frost or ice formation on the device, that will decrease its performance, the correct position of a pressure relief valve is at the maximum distance possible from the refrigerating equipment, in an isolated area of the walk-in cold room, and it should not be positioned with the air flux opposed to the air flux coming from the refrigerating equipment.

The pressure relief valve should be positioned at a distance of at least 500 mm, for smaller ones, and of at least 1000 mm, for bigger ones, from the ceiling panels (see Figure D.2) according to supplier of pressure relief valve instructions.

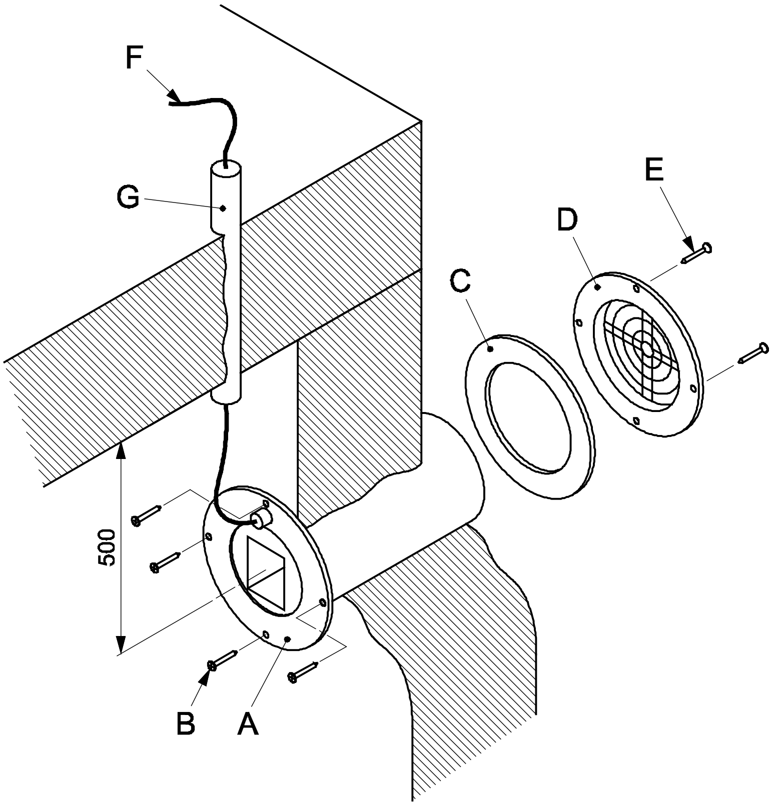


Key

B maximum distance possible from evaporator, according to the walk-in cold room dimensions

C distance from ceiling

Figure D.2 — Positioning overview of pressure relief valve



Key

A pressure relief valve body

B fixing screws for pressure relief valve body

C sealing gasket

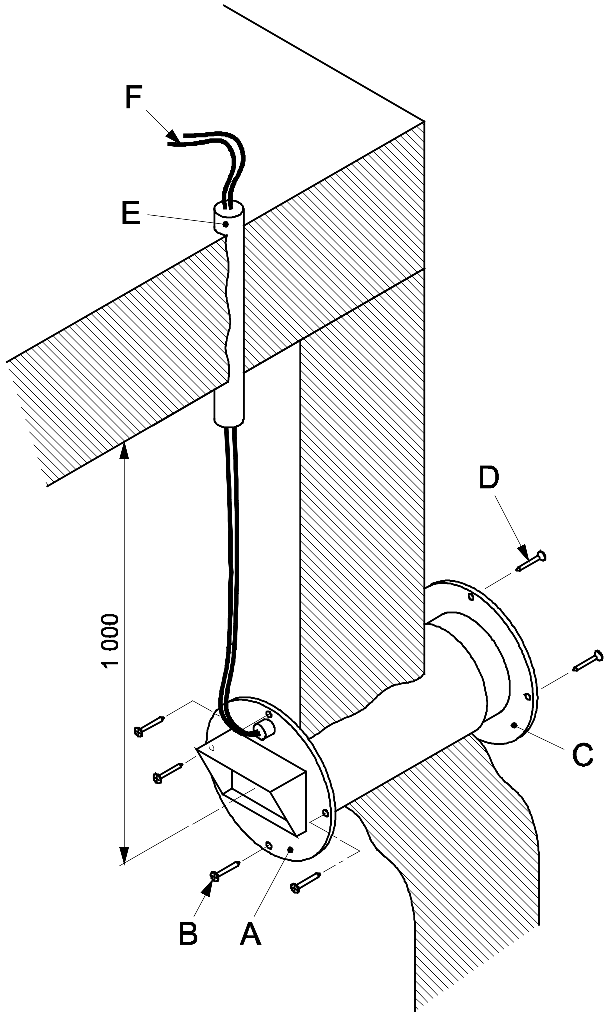
D external cover with net

E fixing screws for cover

F electric wiring

G sealing sheath for electric wiring

Figure D.3 — Example of positioning of pressure relief valve at ≥ 500 mm



Key

A pressure relief valve internal body

B fixing screws for pressure relief valve internal body

C pressure relief valve external body

D fixing screws for pressure relief valve external body

E sealing sheath for electric wiring

F electric wiring

Figure D.4 — Example of positioning of pressure relief valve at ≥ 1000 mm

If the pressure relief valve is not pre-installed in the factory by the manufacturer, installation consists in preparing the hole placing the valve and sealing, connecting the electric wiring cable, when required. Pressure relief valve can also be embedded in the cooling unit. In this case pressure relief valve dimensioning and installation are provided by the manufacturer.

For use of pressure relief valves in low temperature walk-in cold rooms it is possible that some frost may appear on the ceiling panel positioned above the device. This is a normal effect due to the warm external ambient air entering the walk-in cold room.

The air duct of the pressure relief valves should be cleaned at least twice a year, with a jet of compressed air. In the case in which the heating resistance appears to be burned, it is necessary to replace the pressure relief valve promptly.

Pressure relief valves dimensioning: during the working cycle of a cold room, due to the introduction of the goods or defrost of the evaporator, a temperature increase occurs and consequently an increase in the volume of air contained in it, causing a pressure increase, and conversely, for subsequent cooling, occurs a decrease in the volume of air with consequent depression that, in function of the cooling rate, can exceed 30 kg/m^2.

The phenomena described if not properly compensated, can be very dangerous because it could lead to the collapse of the ceiling of the walk-in cold room.

To avoid this risk, it is necessary to install pressure relief devices, whose number and dimensions is function of several parameters, described in the following formula. The installer of the refrigerating system should determine the type, number and dimensions of the pressure relief devices, considering the characteristics of the cooling system.

If ΔT is the temperature variation in [°C/min], it is possible to calculate the necessary air quantity Q that should go through the pressure relief devices:

$$Q = K \cdot V \cdot \Delta T \qquad \text{(D.2)}$$

where

Q is the necessary air quantity [litre/minute];

ΔT is the temperature variation [°C/minute];

K is the costant = 3,66;

V is the volume of the cold room [m^3].

EXAMPLE Walk-in cold room working at T = −25 °C, of total volume V = 1000 m^3 and ΔT = 1 °C/min.

$$Q = K \cdot V \cdot \Delta T = 3{,}66 \cdot 1000 \cdot 1 = 3660 \text{ liter/minute}$$

The installer should choose one pressure relief device that is able to guarantee 3660 l/minute air flux. If such device is not available, the installer may choose 2 or more pressure relief devices that allow an overall air flux of 3660 l/minute.

WARNING — When dimensioning pressure relief devices it is suggested to round up the obtained result, and not underestimate the type and number of pressure relief devices.

D.3.8.2 Installation of windows and glass door

D.3.8.2.1 Windows

For installation of windows of standard dimensions, normally the manufacturer may provide the panel or panels already cut, therefore no cutting is needed on site.

If on site cutting is necessary, it can be performed using proper equipment, avoiding the use of abrasive discs, that may damage the panel finish. After cutting, it is important to carefully remove all filing and smears, that are source of danger and rust. For aggressive environments, cut edges should be protected by applying a line of silicone or by painting exposed metal parts using a paint that is suitable for use in cold rooms, that does not release dangerous substances, suitable for accidental food contact, and that is immune to the proliferation of microorganisms.

When the panel is ready, the installation of the window might start by applying a line of silicone on all edges of the perimeter of the hole, before installing the window frame.

More information about panel cutting are described in the following paragraph.

D.3.8.2.2 Glass doors

For installation of glass doors it may be necessary to cut panels on site; however some walk-in cold rooms manufacturers may provide already cut panels.

If on site cutting is necessary, the same provisions given for the installation of windows are applicable.

Details regarding doors assembly and adjustment are normally provided by the doors' manufacturers.

D.3.8.3 Installation of panel cutting and pass-through holes

D.3.8.3.1 Panel cutting

When on site panel cutting is needed, the following equipment is necessary:

— metric ruler;

— pencil tip or sign;

— drill with 10 mm chuck capacity;

— hole saw for cutting sheet metal 12 mm;

— jigsaw with the blade for steel sheet (or alternatively, a nibbler for cutting sheet metal with at least 3 mm);

— file for sweet iron;

— screwdriver;

— caulking gun.

Procedure:

According to the dimensions of the window or glass door to be installed, trace a line where the hole will be made. The hole should normally be approximately 4 mm bigger than the window or glass door frame dimensions. If panels to be cut have a thickness that is bigger than the jigsaw blade, the hole should be made from both sides of the panel; therefore, the hole line should be traced on both sides.

— Start by drilling with the drill equipped with a hole saw the four corners of the rectangle where the window or glass door will be inserted. The holes should be inside the traced area. Proceed by cutting the panels with the jigsaw (possibly on both sides) or cut with nibbler.

— If the cut is made from the two sides or with the nibbler, at the end level the surface of the polyurethane along the perimeter of the hole with a hacksaw blade or equivalent.

— Brush up along the perimeter of the hole edges with a file and carefully remove all burrs and residual filings.

— Prepare two cords of silicone around the perimeter of the hole, one on the outer edge and one on the inside edge.

— Insert into the hole, from the outside to the walk-in cold room, the window frame with the glass pane.

— Secure the window frame following the manufacturer assembly instructions.

— Insert the internal part of the window frame from the internal side of the walk-in cold room.

— Finish the corners with silicone of adequate colour.

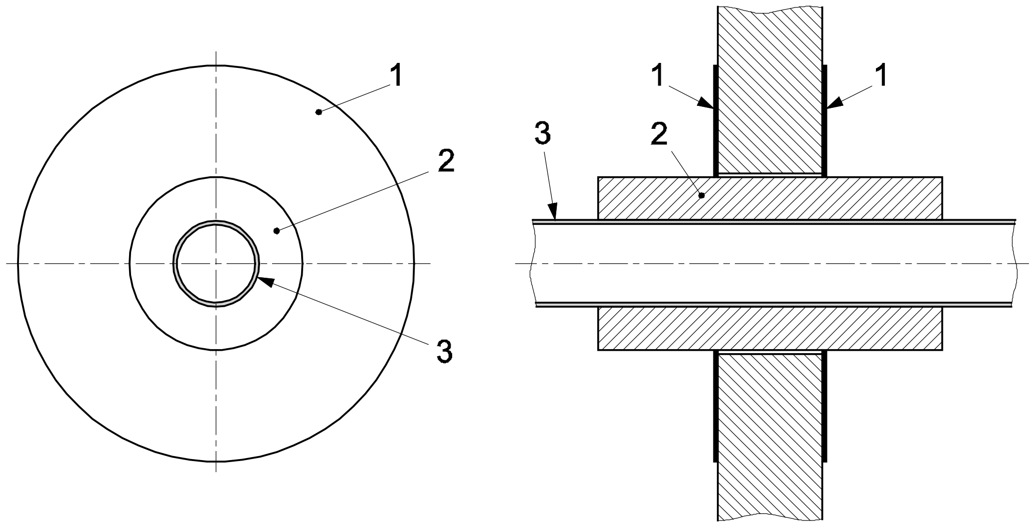
For the installation of glass doors frame follow the instructions provided by the manufacturer.

D.3.8.3.2 Pass-through holes

Walk-in cold rooms manufacturers may provide panels already equipped with pass-through holes, if the information has been provided by the customer. However, when it is necessary to make pass-through holes on site, maximum care should be taken when restoring the thermal insulation, in the portions of the hole not occupied by the pipes, wires or other ancillaries.

After making the hole, it is important to carefully remove all filing and smears, that are source of danger and rust. For aggressive environments, cut edges should be protected by applying a line of silicone or by painting exposed metal parts using a paint that is suitable for use in cold rooms, that doesn't release dangerous substances, suitable for accidental food contact, and that is immune to the proliferation of microorganisms.

In Figures D.5 and D.6, it is illustrated a case of a pipe, and of an electric cable, inserted inside a pass-through hole with the detail of how the thermal insulation has been restored.



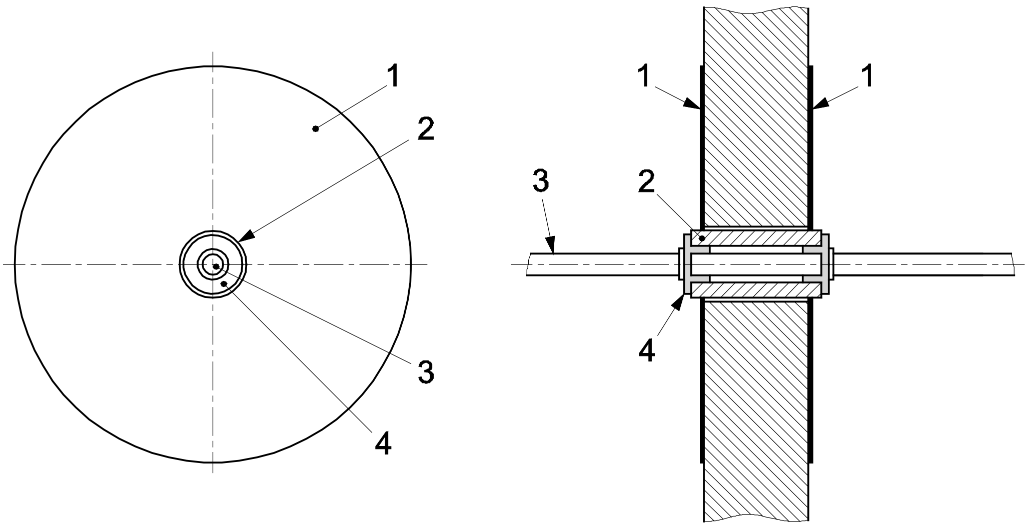
Key

1 circular plate

2 insulation (armaflex rubber hose)

3 pipe

Figure D.5 — Example of pass-through hole for a pipe



Key

1 circular plate

2 stuffing box

3 electric wire

4 sleeve made of fireproof material

Figure D.6 — Example of pass-through hole for electric wire

D.3.8.4 Installation of wiring

The installation of lighting devices and any other electrical device should be made by qualified staff. Due to temperature and humidity conditions that may be inside the walk-in cold room, it is recommended to use watertight devices (switches, lamps, etc.), that are suitable for outdoor use.

D.3.8.5 Installation of eccentric loads

Unless diversely stated by the manufacturer, it is normally not allowed to install eccentric loads to panels for walk-in cold rooms; shelves should not be directly applied to wall panels.

If necessary, walk-in cold rooms should be equipped with adequate shelves or hanging systems.

D.3.9 Installation, provisions for start-up and stop of a walk-in cold room

For walk-in cold rooms with insulated floor made of sandwich panels, it is necessary to leave the door open for at least 24 h after the end of the installation, ventilating thoroughly. In the case where the environmental conditions do not allow adequate ventilation, the temperature is low and humidity is high, it is necessary to increase this period until no peculiar odors are felt inside the walk-in cold room (e.g. Silicone).

For walk-in cold rooms without insulated floor, that have the not insulated concrete floor, it is necessary to respect the right ageing period provided for the concrete, which are:

— at least 28 days in normal environmental conditions, low humidity and a temperature higher than 0 °C;

— at least 60 days in difficult hygrometric conditions, high humidity and low temperatures.

Failure to comply with these rules may result in several problems such as the formation of ice, the raising of the floor, its disaggregation, etc.

Pressure relief devices: as said in previous D.3.8.1, these devices allow to control and prevent pressure variations inside the walk-in cold room, in order to prevent collapse of the structure. Before starting the refrigerating system it is necessary to assess the correct functioning of these devices, and that they are adequately powered for walk-in cold rooms that work at low temperature.

D.3.9.1 Installation and reaching operating temperature

While reaching the operating temperature (cold) of the walk-in cold room, the temperature reduction should be gradual; in particular, the larger the size of the walk-in cold room, or the lower the operating temperature is, the slower the temperature decrease should be. In this phase it is important:

— do not start the process before installing pressure relief devices, when they are foreseen;

— do not start all the fans of the refrigerating system at the same time, if the walk-in cold room is equipped with more than one;

— assess the correct operation of pressure relief devices, when installed;

— keep the door open or ajar until the operating temperature has been reached.

For walk-in cold room without insulated floor (concrete, tiles, etc.) it is recommended to follow the following guidelines:

— *Walk-in cold room at medium storage operating temperature:* from ambient temperature up to 0 °C, do not exceed a variation of 15 °C in 24 h.

— *Walk-in cold room at low storage temperature:* from ambient temperature up to 0 °C, do not exceed a variation of 15 °C in 24 h; subsequently, from an internal temperature of 0 °C up to the operating temperature, do not exceed a variation of 5 °C every 24 h.

D.3.9.2 Installation of shutdown of the refrigerating system

When shutting down the refrigerating system of a walk-in cold room, two cases can be described:

— *Walk-in cold room at medium storage operating temperature*: above 0 °C there are no particular precautions to be taken when shutting down the system.

— *Walk-in cold room at low storage temperature*: the shutdown of the refrigerating system determines an increase of the internal temperature, that causes the appearance of moisture. In order to limit this effect it is recommend to:

a) assess the correct operation of pressure relief devices, when installed;

b) keep defrost function and ventilation running;

c) keep the door closed until the temperature of 0 °C is reached;

d) open the door after the temperature of 0 °C or higher is reached.

Furthermore, it should be taken in consideration that:

— the opening of the door in walk-in cold rooms at low storage temperature allows the ingress of a large quantity of humid air that condenses on the cold walls;

— the temperature increase is dangerous for the resistance of the materials (dimensional variations, humidity, etc.).

Therefore, repairs and maintenance should be brief and limited to what is strictly necessary. It would be better to make the repairs and maintenance at low temperature.

D.3.9.3 Installation of restart of the refrigerating system

For the restart of the refrigerating system, follow the same procedure used for the first start-up of the system, described at the beginning of D.3.9.

In the case of a restart of the refrigerating system after a defrost operation, the fans should not be started before the circulation of the refrigerant fluid in the evaporator pack is completed. If the refrigerating system is equipped with more than one fan, these should be turned on in sequence and not all at the same time.

D.4 Maintenance and cleaning of the walk-in cold room

D.4.1 General

The metal faces of sandwich panels used for walk-in cold rooms are normally covered by a protective film that is removed after installation is completed. In order to avoid damage and excessive adhesion to the metal surface, the protective film should be protected from UV rays and high temperatures during storage prior to installation.

D.4.2 Cleaning of the external side of panels

For the cleaning of the metal faces of panels the following products should not be used: cellulose thinners, solvents containing chlorine, aromatic solvents, ammonia, or abrasives. There are products specifically designed for the cleaning of painted metal; therefore, before using a cleaning product the operator should check if it is compatible with the type of material and paint.

The residues of cutting operations should be removed in order to avoid the appearance of traces of rust; in case of need, the rust can be eliminated by using, specific products, suitable for cleaning of painted surfaces.

D.4.3 Cleaning of the internal side of panels

Given the importance of cleanliness and hygiene within a walk-in cold room, it is recommended to prepare a hygiene plan taking into account the panels' resistance to aggressive agents, the risk of corrosion, the gasket ability to seal, the impermeability of the joints and of the single critical points.

The walk-in cold room working at temperature $T \leq 0$ °C should not be cleaned using plenty of water; any residual washing water should be eliminated through the front door or by using a vacuum machine. It is good practice to carefully follow the instructions of the manufacturer of the product used for cleaning and, in general, the following criteria:

— pH between 4 and 9;

— respect of the concentration levels;

— temperature $T \leq 30$ °C;

— contact time < 30 min;

— adequate rinsing;

— pressure at the base ≤ 4 bar.

The choice of the cleaning product is determined by both the degree of dirt to be removed and the material to be treated, in order to avoid corrosion; it is normally recommended not to use products containing chlorine.

Before using a new cleaning product, check the product data sheet, the chemical composition, pH, concentration, and the conditions of use (temperature, application method and frequency).

D.4.4 Recommended procedure for cleaning

D.4.4.1 General

The cleaning procedure should be adapted to the actual needs, in particular:

— ***on a very dirty surface:***

a) perform a pre-wash of the walls using a spear and warm water at low pressure (2 to 3 bar);

b) clean with a soap solution applied with a spray doser; the time of application of the foam ranges from 15 to 30 min, it is important not to let it dry;

c) rinse with low pressure spear;

d) disinfect with a proper foam and leave it work for at least 20 min;

e) remove the detergent disinfectant with water.

— ***on a bit dirty surface:***

a) perform a pre-wash of the walls using a spear and warm water at low pressure (2 to 3 bar);

b) clean with a soap solution applied with a spray doser; the time of application of the foam should be of at least 20 min, it is important not to let it dry:

c) rinse the detergent disinfectant with low pressure spear (2 to 3 bar).

D.4.4.2 Recommended procedure for cleaning: PVC coating

In general, for the cleaning of the contaminated surface, a mild soap and water mixture should be used. It is recommended to use a soft cloth, taking care to rinse and dry thoroughly. Products containing abrasives should not be used.

For the removal of small surface stains mineral spirits or denatured alcohol may be used. Stains caused by absorption of substances by the PVC film cannot be removed.

It is possible the formation of halos or spots in the contact zone with fresh tomatoes and coffee.

It is recommended to avoid the use of solvents such as acetone, toluene and similar products as they have an aggressive action against PVC.

D.4.4.3 Recommended procedure for cleaning: stainless steel

The cleaning using cleaning products, provided that they do not contain chlorine, followed by a thorough rinsing with water is generally enough to guarantee the removal of dirt.

Proceed as follows:

— perform a pre-wash of the walls with a jet of hot water at low pressure (2 to 3 bar);

— clean and disinfect with a chlorine-free foam solution applied with a spray doser; the time of application of the solution should be of at least 20 min;

— rinse the detergent disinfectant with a jet of water at low pressure (2 to 3 bar).

It is forbidden the use of hard brushes, steel wool or metal scouring pads or fine grain abrasive products, as they can scratch the material. The use of polishing products that leave a film of grease on surfaces should be avoided.

For drying it is recommended the use of rubber strips, such as those used for glass surfaces.

D.4.5 Maintenance of pressure relief devices

The air duct of the pressure relief device should be cleaned at least twice a year, with a jet of compressed air. In case the electric resistance appears to be burned it is mandatory to replace the pressure relief device.

D.4.6 Maintenance, repair and replacement of elements and components

D.4.6.1 General

The interventions of repair or replacement of elements and components can be of various types, and in particular they can be distinguished in.

D.4.6.2 Repair of scratched or smeared panels

When, during handling and installation or normal use of the walk-in cold room, a panel is scratched or damaged with local removal of the organic coating of the metal faces, it is possible to restore it using a fine brush and a coloured paint. For deeper scratches, use filler metal before retouching the panel.

D.4.6.3 Replacing a damaged or not recoverable panel

Depending on the position of the panel, the operation can be more or less complicated, but to perform the replacement in safety, it is necessary to disassemble the entire walk-in cold room; therefore, the panel should be replaced by qualified personnel following in reverse the assembly instructions.

D.4.6.4 Replacing damaged door accessories

It may happen that some ancillaries of the door need replacing, such as hinges, handles, heating cable, door sills and gaskets. For these replacement operations it is preferable to call qualified personnel.

In extreme cases, it may be necessary to replace the door leaf, this should be done by qualified personnel only.

Bibliography

[1] ETAG 21, Cold storage premises kits – Part 1: Cold storage room kits

[2] ISO 12491, *Statistical methods for quality control of building materials and components*

[3] EN ISO 9001, *Quality management systems - Requirements (ISO 9001)*

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