

# Envelope solutions for cold storage facilities

SP2E X-PIR panels

System description

## INTRODUCTION

RUUKKI Cold storage system is based on high quality products for envelope and finalized details to ensure excellent thermal performance and airtightness. Products covers Ruukki SP2E X-PIR sandwich panels for walls and ceilings. Airtightness is especially important in chilled facilities. Ruukki has long experience on developing airtight energy panel solutions. Energy efficient structures guarantees top quality for cold constructions. With advanced panel details also moisture transfer through structures is minimized.

The application of special solutions with structural details ensures **excellent airtightness** and **energy efficiency**. Tested value of air permeability of the specimen of two panels and longitudinal seam between them is  $q_{50} < 0,003 \text{ m}^3/\text{m}^2\cdot\text{h}$  according to EN 12114.

SP2E X-PIR panels are watertight to 1200Pa (class A) according to EN 14509.

## AREAS OF APPLICATION

Definition and the name of the cold spaces are depending on the temperature and vary by the used source. In general cold store or storage is quite commonly used. Main division by temperature would roughly be:

- Frozen storage ( $-50\dots 0^\circ\text{C}$ , typically in food industry  $-25^\circ\text{C}$  in long term storing)
- Refrigerated storage ( $\sim -2\dots -4^\circ\text{C}$ ),
- Chilled storage ( $+2\dots +15^\circ\text{C}$ )

## DETAIL SOLUTION CATEGORIES:

1. Frozen storage: indoor temperature ranging between  $-50^\circ\text{C} < t < 0^\circ\text{C}$
2. Refrigerated and chilled storage: indoor temperature ranging between  $0^\circ\text{C} < t < +15^\circ\text{C}$

Ruukki SP2E X-PIR panels are intended for use in food processing and logistic buildings as cladding for walls and roofs of stationary cold storage facilities designed for indoor temperature ranging between  $-50^\circ\text{C} < t < +15^\circ\text{C}$ . Roof sections should be protected from sun exposure with additional covers (such as corrugated steel sheets or insulated roof structures). Space between the additional cover and the roof must be ventilated. The temperature on panel surface should not exceed  $+60^\circ\text{C}$ . Optimal thickness of Ruukki SP2E X-PIR panel, the facing and coating types are selected by the designer, depending on intended use, the facility operating conditions, possible impact of internal environmental factors and weather conditions.

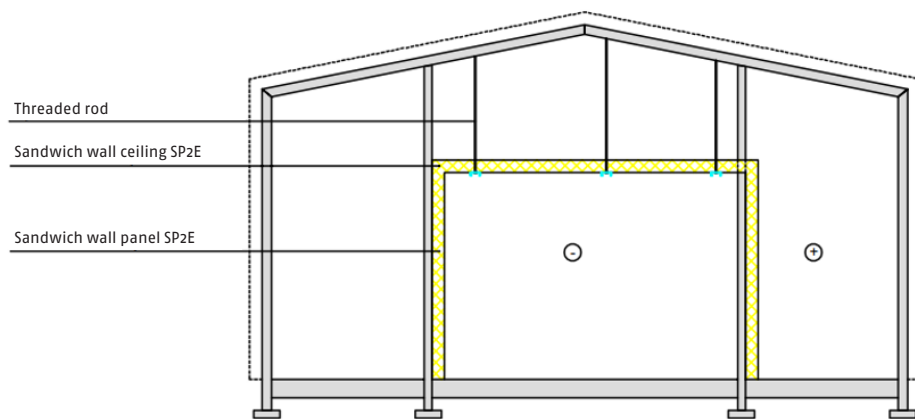
## STRUCTURAL SOLUTIONS FOR DIFFERENT APPLICATIONS

The panels are usually supported on a load bearing frame in cold rooms. Frame solutions depend on the intended use and the chosen structural solution. Figures 1–4 show the principle solutions, but in the implementation the final solutions are selected by the customer and the designers. The installation direction of the panels can be horizontal or vertical.

Typically, cold storages are built 'room-in-a-room' execution. The moisture stress rises when temperature difference over the panel rises, and this is the main reason why a 'room-in-a-room' solution is preferred. When the refrigerated storage panel is a part of the building envelope, it has to be analyzed properly and solar radiation has to be taken into account.

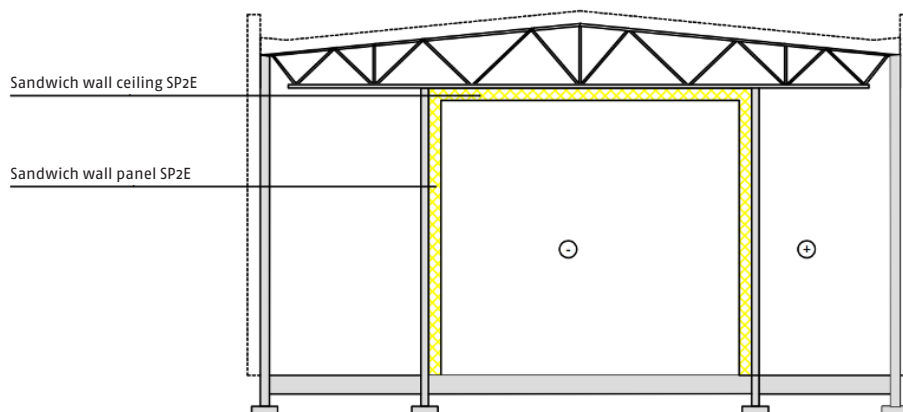
It is highly recommended to avoid frame penetrating the cold storage panels. In large storages it will however be difficult to avoid these, and in these cases special care should be taken in ensuring the air- and vapour-tightness and cold-bridge insulation. See also Ruukki details for cold storages.

- **Cold storages – all applications: indoor temperature ranging between  $-50^{\circ}\text{C} < t < +15^{\circ}\text{C}$**



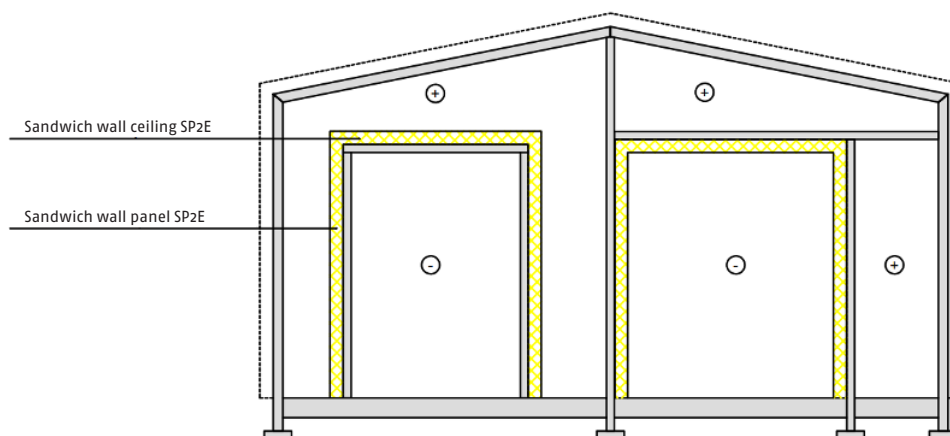
*fig. 1*

1.1 Columns outside (1.) or inside (2.) with cold bridge insulation, suspended ceiling.



*fig. 2*

1.2 Ceiling supported from the trusses. Walls can be installed vertically, without frame.

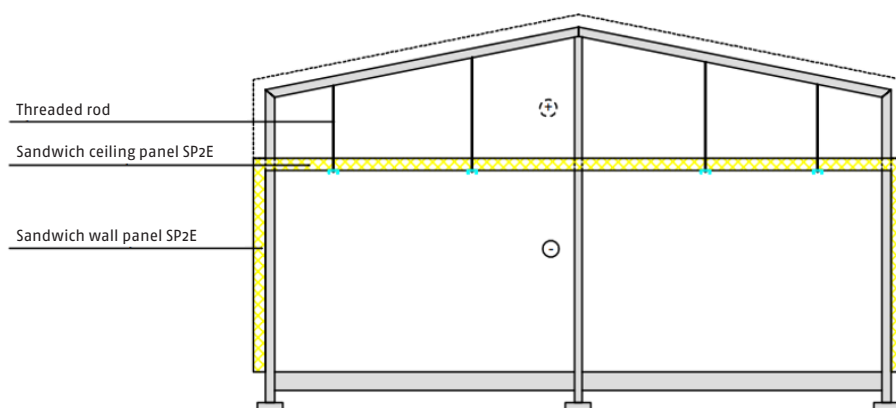


*fig. 3*

1.3 Own lightweight steel frame for panels inside cold storage (left). Room in a room external frame (columns and beams/trusses), suspended ceiling (attached to steel frame from below) (right))



- **Refrigerated and chilled storages: indoor temperature ranging between  $0^{\circ}\text{C} < t < +15^{\circ}\text{C}$**



*Kuva 4.*

*2.1 Wall panel part of envelope, suspended ceiling, only for spaces  $> 0^{\circ}\text{C}$ .*

## **RUUKKI SP2E PANELS**

Ruukki SP2E X-PIR are intended for use in food processing and logistic buildings as cladding for walls and roofs of stationary cold storage facilities. Ruukki SP2E X-PIR panels are featured with high values of heat resistance, guaranteeing excellent thermal insulating power of walls and roofs. Thanks to that, the panels may be twice as thin as the panels with other cores, offering a considerable reduction of freight and installation costs. Harmonized standard for panels is EN 14509:2013.

## **INSULATION CORE**

The core of SP2E sandwich panel is made of rigid, HCFC-free, self-extinguishing and sustainable polyisocyanurate foam (PIR). Its **excellent thermal insulation properties** allow for the decrease of panel thickness.

Produced in a continuous process, the polyisocyanurate core is highly homogenous thus providing excellent and repeatable thermal and mechanical properties on a consistent basis. The foam's density is of  $37 \pm 3 \text{ kg/m}^3$ , whereas its design thermal conductivity ratio  $\lambda_{\text{calc}} = 0.022 \text{ W/m}\cdot\text{K}$  in temp.  $0^{\circ}\text{C}$ .

## **MAIN TECHNICAL SPECIFICATIONS FOR SP2E PANELS**

Main technical properties for PIR-panels are shown in tables 1–5. The thickness of the panel is selected according to the operating environment and other requirements.

Panel type	Ext. facing (mm)	Int. facing (mm)	Modular panel width (mm)	Max. panel length L (mm)	Panel weight (kg/m <sup>2</sup> )	U-value* (W/m <sup>2</sup> K)	Sound insulation Rw (dB)	Reaction to fire
SP2 E X-PIR 120	0.50	0.50	1100	18500	13.1	0.18	24	B-s1, do
SP2 E X-PIR 140	0.50	0.50	1100	18500	13.9	0.16	24	B-s1, do
SP2 E X-PIR 160	0.50	0.50	1100	18500	14.6	0.14	24	B-s1, do
SP2 E X-PIR 180	0.50	0.50	1100	18500	15.4	0.12	24	B-s1, do
SP2 E X-PIR 200	0.50	0.50	1100	18500	16.2	0.11	24	B-s1, do

\* the heat transmittance value U was calculated for the  $\lambda_{calc}$  value of 0.022 [W/m.K] and includes impact of linear thermal bridge on panel joint

Panel type	Heat resistance [m <sup>2</sup> ·K/W]	Minimum internal temperature $t_w$ [°C]	Temperature difference $\Delta t^*$ [K]
SP2 E X-PIR 120	5.884	-10	50
SP2 E X-PIR 140	6.836	-20	60
SP2 E X-PIR 160	7.789	-30	70
SP2 E X-PIR 180	8.741	-40	80
SP2 E X-PIR 200	9.694	-50	90

Notice:

$t_{external\ calculation} = 0.4 t_{monthly\ average} + 0.6 t_{max}$  – where ( $t_{monthly\ average}$ ) denotes the average temperature in the hottest month of the year while ( $t_{max}$ ) denotes the maximum temperature of outdoor air in the area of facility.

\* difference between internal temperature ( $t_w$ ) and the computational outdoor temperature ( $t_{external\ calculation}$ ) in the aimed area.

## FIRE PERFORMANCE

Ruukki SP2E X-PIR panel claddings with polyisocyanurate foam (PIR) cores are classified in terms of:

- fire resistance
- reaction to fire

Ratings based on results of fire tests carried out on polyisocyanurate foam (PIR) core Ruukki SP2E X-PIR panel walls are listed in Table 3 and for ceilings in Table 4.

Table 3. Wall fire properties, Max span in horizontal/vertical orientation (m)								
	El 15	El 15 (stainless steel)	El 30	El 30 (stainless steel)	El 60	EW 30	EW 30 (stainless steel)	Reaction to fire
SP2 E X-PIR 120	7.5 / 7.5	7.5 / 7.5	7.5 / 7.5	- / 7.5	-	7.5 / 7.5	7.5 / 7.5	B-s1, do
SP2 E X-PIR 140	7.5 / 7.5	7.5 / 7.5	7.5 / 7.5	- / 7.5	-	7.5 / 7.5	7.5 / 7.5	B-s1, do
SP2 E X-PIR 160	7.5 / 7.5	7.5 / 7.5	7.5 / 7.5	- / 7.5	-	7.5 / 7.5	7.5 / 7.5	B-s1, do
SP2 E X-PIR 180	7.5 / 7.5	7.5 / 7.5	7.5 / 7.5	- / 7.5	-	7.5 / 7.5	7.5 / 7.5	B-s1, do
SP2 E X-PIR 200	7.5 / 7.5	7.5 / 7.5	7.5 / 7.5	- / 7.5	6.0 / 4.0*	7.5 / 7.5	7.5 / 7.5	B-s1, do

\* stitched joints on both sides and fire resistant silicone applied to female joints

Table 4. Ceiling fire properties, Max span lengths (m)			
	El 15 (inside)	El 30 (inside)	Reaction to fire
SP2 E X-PIR 120	2.0	2.0	B-s1, do
SP2 E X-PIR 140	2.0	2.0	B-s1, do
SP2 E X-PIR 160	2.0	2.0	B-s1, do
SP2 E X-PIR 180	2.0	2.0	B-s1, do
SP2 E X-PIR 200	2.0	2.0	B-s1, do

\* stitched joints on upper facing

Symbols related to fire resistance performance:

I – insulation

E – integrity

El – insulation and integrity

W – radiation

Detailed information regarding the application of fire resistance ratings can be obtained from Ruukki Sales.

**All properties are declared in accordance with EN 14509 and related standards.**

## STRUCTURAL PERFORMANCE

Depending on load bearing capacity and rigidity, Ruukki SP2E X-PIR sandwich panels may be applied as single- and multi-span wall and roof covering elements. Recommended maximum panel lengths are shown in Table 6.

Dimensioning and span length shall be determined according to TrayPan software – <https://designtools.ruukki.com/>

**Table 5. Recommended Maximum span lengths and internal temperature [°C] of Ruukki SP2E X-PIR panels used as wall elements of cold storage and refrigerated warehouse in a single and multi-span system**

Panel type	0°C	-5°C	-10°C	-15°C	-20°C	-25°C	-30°C	-40°C
SP2 E X-PIR 120	5.60	4.70	3.90	3.40	•	•	•	•
SP2 E X-PIR 140	6.20	5.00	4.20	3.60	•	•	•	•
SP2 E X-PIR 160	6.90	5.40	4.50	3.90	3.50	3.20	3.00	•
SP2 E X-PIR 180	7.30	5.60	4.70	4.10	3.70	3.40	3.10	2.80
SP2 E X-PIR 200	8.10	6.10	5.10	4.50	4.10	3.70	3.50	3.10

Notice:

This table concerns panels with external light and very light coloured facings. Or covered panels.

Maximum wind characteristic load is 0.75 kN/m<sup>2</sup> (check by designer)

## MATERIALS AND COATINGS

Ruukki SP2E X-PIR panels are composed of two external facings made of steel sheets and a structural insulation core of rigid polyisocyanurate foam.

Panel facings are made of metal sheet galvanized on both sides. Facing parameters comply with the parameters of steel grades S280GD with metallic coatings according to the European standard EN 10346.

Steel facings are coated with organic coatings according to the table 5. In case of facilities with extra hygiene requirements like food production/storage, panel facings may be coated with laminate (FoodSafe 120 µm) or produced with stainless steel 1.4301 and 1.4404. Protection film is added on both sides to protect panels against physical damage during loading, unloading, storage and installation.

Table 6. Recommended coatings				
Facing	Coating	Corrosivity category	UV resistance	Colours
External	Green coat HIARC MAX	C4	Ruv4	RAL7035, RAL9006, RAL9007
External	Polyester	C3	Ruv2-3	RAL1015, RAL3009, RAL3013, RAL5005, RAL6011, RAL7015, RAL7016, RAL7035, RAL9002, RAL9006, RAL9007, RAL9010
Internal	Polyester	C3	–	RAL9002, RAL9010
Internal	FoodSafe laminate*	C4	–	White

Facing	Corrosivity category
External	Stainless steel* C5-M
Internal	Stainless steel* C5-M

\*) optional material

UV resistance describes how well the coating is able to keep its original colour and gloss levels in accordance with EN10169. The higher the class, the better the resistance.

Corrosivity categories describe the outdoor climate conditions in accordance with EN12944. The higher the category, the more corrosive environment.



## CORROSIVITY CATEGORIES AND EXAMPLES OF TYPICAL ENVIRONMENTS IN ACCORDANCE WITH EN ISO 12944-2

### Corrosivity category C1 (very low):

Interior – heated building with clean atmospheres, e.g. offices, shops, schools, hotels.

### Corrosivity category C2 (low):

Exterior – atmospheres with low level of pollution. Mostly rural areas.

Interior – unheated buildings where condensations may occur, e.g. depots, sports halls.

### Corrosivity category C3 (medium):

Exterior – urban and industrial atmospheres, moderate sulfur dioxide pollution, coastal areas with low salinity.

Interior – production rooms with high humidity and some air pollution, e.g. food-processing plants, laundries, breweries, dairies.

### Corrosivity category C4 (high):

Exterior – industrial and coastal areas with medium salinity.

Interior – chemical plants, swimming pools, coastal ship- and boatyards.

### Corrosivity category C5-I (very high – industrial):

Exterior – industrial areas with high humidity and aggressive atmosphere.

Interior – buildings or areas with almost permanent condensation and with high pollution.

### Corrosivity category C5-M (very high – marine):

Exterior – coastal and offshore areas with high salinity.

Interior – buildings or areas with almost permanent condensation and with high pollution.

Panel surface profiling options are shown in Table 7.

Modular width	Facing	Profile options
1100	External	L, M
1100	Internal	L, M

L25 available only for panel thicknesses 120,140,160 mm. For freeze rooms only F / inside.  
For stainless steel only L profiling is available.

## PROFILE OPTIONS



Linear L



Micro M

## LONG TERM FEATURES

The panels are featured with good mechanical properties stemming from the properties of polyisocyanurate itself and from durable and reliable joint between the core and steel facings. Polyisocyanurate is resistant to chemical agents and biological corrosion. It is not attacked either by mould, fungi, rodents or insects.

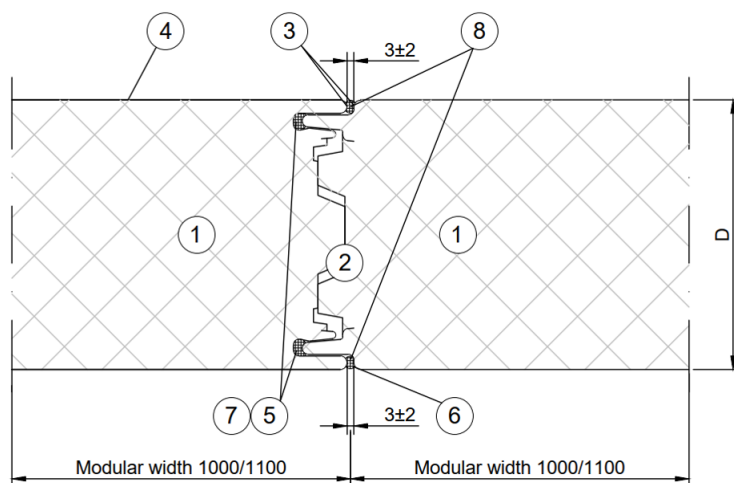
## PANEL JOINTS

At the moment of leaving the production line, Ruukki SP2E X-PIR panels are ready to install. Precise tongue-and-groove system makes assembly easier and faster. Ruukki SP2E X-PIR panels are installed on the load-bearing structure with use of special sets of fasteners.

Longitudinal profiled edges of panels creating tongue-and-groove system with double scarf joint on the outside and inside and Ruukki SP2E X-PIR panels are equipped with factory-installed EPDM gasket on both panel female joints, guarantee joint tightness, even if there are heavy temperature or moisture differences on both sides of the partition wall made of Ruukki SP2E X-PIR panels.

## PANEL JOINT DESCRIPTION

1. Rigid, HCFC-free and self-extinguishing environmentally and ozone friendly polyisocyanurate foam core of excellent thermal insulation.
2. Properly milled core improves longitudinal joint tightness.
3. Large bend radii on facings ensure that none of the protective coat properties is lost.
4. Facing profile conforming with the standards applicable to cooling and food industries ensures uniform facade appearance.
5. Double scarf joint from outer and inner sides increases fire-tightness and facilitates assembly.
6. 3 mm gap enables additional joint closure with durably elastic mass.
7. Factory installed sealing strip eliminates air and moisture penetration.
8. Durably elastic sealing compound (compulsory for ceilings, optional for walls), applied at building site.



Ruukki SP2E X-PIR panel joint is fixed to the structure with use of a set of self-drilling fasteners made of stainless steel.

## ENVIRONMENTAL

We support you in sustainable development through advances in our technology and processes. Greener, smarter solutions are increasing in popularity, and our commitment to ongoing new product and service development allows us to be at the forefront of sustainable building innovation. For us, environmental transparency is the norm.

Environmental product declaration for products: <https://www.ruukki.com/building-envelopes/services-support/sandwich-panel-support/environmental-product-declaration-for-sandwich-panels>

## SAFETY

All of our products are designed for safe manufacturing, installation and end-use. Our intention is to grow with our partners and be the world leader in safety.

## NOTICE

Detailed solutions introduced here are recommended by Ruukki, but the final decision related to the particular solution is taken by designer.

## GENERAL PANEL ASSEMBLY GUIDELINES

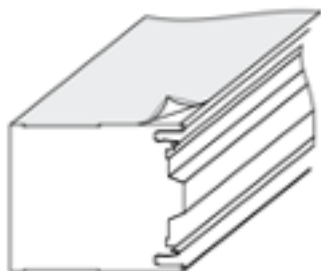


Fig. 1. Removing protective film from panel facing.



Fig. 2. Cutting of the panels.

- Details of the principle of installation work are presented on Ruukki's website, that can be applied in project-specific instructions\*
- Before assembly, check structure for compliance with design specifications and construction accuracy.
- Prior to assembly, remove protective film from internal panel facings. Film on external facings should be removed soon after assembly, however, not later than 2 months after panel purchase (Fig. 1). *attention:* Ruukki SP2E wall panels are covered with blue film that comes on the internal of structure.
- Panels and flashings should be cut on stands covered with a soft material (such as felt or polystyrene) to protect coating from damaging.
- It is recommended to cut panels with fine-toothed blades and to cut flashings with snips. Do not use angle grinder (Fig. nr 2)!
- During assembly, press panels into place with fixing tool 1410 (made by Ruukki Polska) – the tool helps to ensure proper piece joining without risking any damage.
- Panels should be fixed to structures with fasteners recommended by sandwich panels manufacturer. Any other fasteners should be pre-approved by the manufacturer.
- If wind speed exceeds 9m/s do not install panels during or in heavy fog.
- All swarf and dirt produced during plate assembly should be removed immediately.
- It is recommended to follow the detailed instructions provided in "Assembly instruction for sandwich panels" brochure.
- Elevation/outer side of Ruukki SP2E panels made of facings in the same colours and the same profiles is marked with overprint on panel side: "elewacja↓outside↓ a a ". Arrows indicate external facing of panel.
- Assembly inconsistent with marking will cause loss of warranty!

\*Final structural details by main structural designer

## CONSTRUCTION DETAILS

Technical performance of the Ruukki cold storage envelope solution is guaranteed with high-quality products and careful installation according to recommended construction details.

You can find principal details: <https://www.ruukki.com/building-envelopes/services-support/sandwich-panel-support/detail-drawings-for-sandwich-panels>

## ACCESSORIES

Standard panel accessories are presented in Accessory description.

We make steel-based products for walls and roofs, for both commercial buildings and private homes. We're a supplier of high-quality products, systems and solutions, developed sustainably and to live up to the highest demands on durability in harsh conditions.

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