SPUR®

# HARDEX®

## XPP FOAM

www.spur.cz

# ABOUT MANUFACTURER - SPUR A.S.

**Research, development and manufacturing of plastic products**

- Plastic processing company with modern technology founded in 1992.
- The high quality of products is guaranteed by a long-term professional research and development, experience, testing and production control.
- More than 70% of production is exported abroad.
- Own industrial facilities in Zlin with total area of 85 000 $m^2$.

## INTRODUCTION OF SPUR GROUP

The SPUR group was established through acquisition activities, enabled by more than thirty years of organic growth of the main company SPUR a.s., based in Zlín-Louky. In recent years, the company has acquired several companies doing business in the field of:

- **plastic production and processing**
- **recycling**
- **flexible food packaging manufacturing**
- **hydroponic vegetable cultivation farms**
- **a company employing workers with disabilites (sheltered workshop)**

By actively diversifying our product portfolio, today the company is presented in the spheres of economics, sales, and social responsibility by 3 +1 strategic parts:
PLASTICS, ENERGY, AGRO + SOCIAL AREA.

# A SUPPLIER WITH A CLOSED-LOOP SYSTEM

**A future-ready mono-material with upcycling potential and a low carbon footprint.**

In March 2024, SPUR a.s. significantly strengthened itś sustainability strategy through investing in a large-scale recycling facility with an annual capacity of 20,000 tonnes, primarily focused on polypropylene (PP). Operating under SPUR PLASTIC RECYCLING, this facility enhances recycling capabilities while creating new opportunities for expansion into injection moulding and other specialized applications tailored to business partners' needs.

## Upcycling PCR PP into sustainable solutions

It enables us to efficiently upcycle post-consumer recycled (PCR) PP, converting waste streams into high-quality materials, components, and structural solutions. By integrating recycling with downstream manufacturing, we are able to deliver innovative, sustainable products that support circular economy principles and respond to the increasing demand for environmentally responsible, closed-loop solutions.

## Closing the Loop with whole sandwich recycling

Whole Sandwich Recycling enables entire panels to be recycled without the need for prior separation of individual layers. The material is processed through grinding followed by extrusion regranulation, producing regranulate that can be reused in new applications, particularly in injection moulding. Based on this approach, we are able to implement practical closed-loop models for our customers, turning recycling from a concept into a fully operational and scalable solution.

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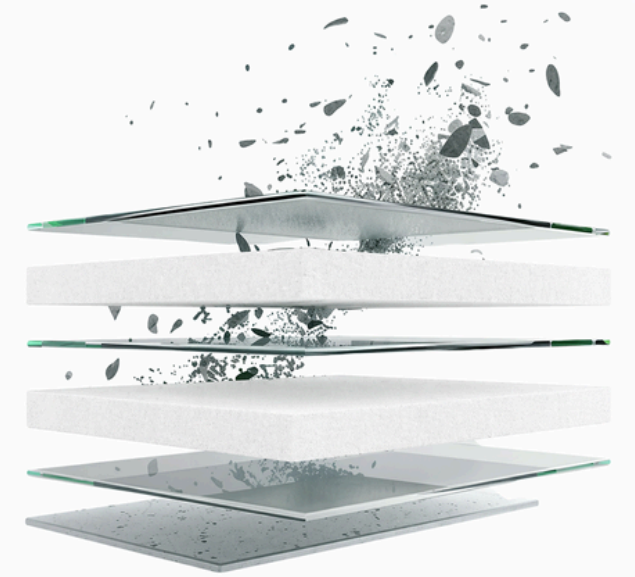
# WHAT PROBLEMS DID WE SET UP TO SOLVE



## Sustainability

Not only the product itself but also the overall design of the final sandwich. Current solutions are almost always non-recyclable, while HARDEX offers the simplest possible circularity. Cleaner working place - no glueing.

## Weight

We reduce the total weight of the core, which has two effects as a result - lower fuel consumption (eg for trucks, caravans, ships and planes) and greater weight of transported goods.

## Productivity

The price of human labour is expensive. HARDEX® can be processed using thermal lamination without the need for glues and vacuum tables, reducing the need for operators, glue and downtime.

# HARDEX® MATERIAL FOR A LIGHTER FUTURE

## OPTIMA

Less mechanical properties, but from the point of view of thermoformability it is ideal. Also, it has its limitation in thickness. Better in higher densities and smaller thicknesses.

## PERFORMANCE

It offers excellent mechanical properties in shear and compression, impact strength, and is resistant to fatigue stress. Great for sandwich panel industry, furniture, etc.

## PERFORMANCE EASY

An innovative solution for more efficient lamination – better surface, higher productivity, lower costs.

**SPUR a.s.** | trida Tomase Bati 299, Louky, 763 02 Zlin, CZ

# HARDEX® XPP OPTIMA

**SPUR HARDEX® XPP OPTIMA** is a lightweight, closed-cell polypropylene foam specifically engineered for thermoforming applications and cost-efficient thickness build-up.
The material features a more closed cellular structure, providing enhanced thermal insulation, low water absorption, and consistent thickness performance at reduced weight. It is particularly suitable for applications where high mechanical strength is not required, but thickness, cushioning, or insulation properties are essential.

**HARDEX® XPP OPTIMA** is supplied in rolls and enables efficient processing in continuous thermoforming operations. Available in thicknesses ranging from 4 mm to 40 mm.
Compared to traditional materials such as XPS or foamed PS, it offers improved recyclability, processability, and compatibility with mono-material PP solutions.

## APPLICATIONS

### PACKAGING & THERMOFORMING

- Food packaging trays
- General thermoformed packaging
- Replacement of XPS in food and industrial packaging

### INSULATION & FUNCTIONAL LAYERS

- Thermal insulation layers
- Heat insulating panels (non-structural)
- Moisture-resistant insulating layers

### CONSTRUCTION & INDUSTRIAL (NON-LOAD-BEARING)

- Expansion joints for concrete floors and walls
- Void filling materials
- Thickness build-up layers
- Separation and insulation layers

### AUTOMOTIVE & TRANSPORT (INTERIOR, NON-STRUCTURAL)

- Headliners
- Sun visors
- Interior trim fillers
- Acoustic and insulation layers

### PROTECTIVE & CUSHIONING APPLICATIONS

- Protective packaging
- Cushioning layers
- Impact and energy-absorbing parts

### ACOUSTIC APPLICATIONS

- Sound-dampening layers
- Noise insulation components

### SPORT, LEISURE

- Protective and cushioning elements

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# HARDEX® XPP OPTIMA

## MECHANICAL PROPERTIES

| Type of test | | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | | **EN 1602** | **kg.m$^{-3}$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Length wise | Tensile Strength | ASTM C29 | MPa | 0.80 | 1.30 | 1.80 | 2.30 | 2.90 | 3.80 | 5.40 |
| | Tensile Modulus | | | 20 | 30 | 50 | 70 | 90 | 130 | 220 |
| Width wise | Tensile Strength | | | 0.70 | 1.00 | 1.50 | 1.90 | 2.40 | 3.20 | 4.60 |
| | Tensile Modulus | | | 10 | 20 | 25 | 40 | 50 | 75 | 120 |
| Thickness wise | Compressive Strength | ISO 844 method A (20 mm thickness) | MPa | 0.04 | 0.07 | 0.10 | 0.15 | 0.20 | 0.25 | 0.40 |
| | Compressive Modulus | | | 2 | 2.5 | 3.5 | 4 | 4.5 | 5 | 6 |
| Thickness wise | Compressive Strength | ISO 844 method B* | MPa | 0.04 | 0.07 | 0.10 | 0.15 | 0.20 | 0.25 | 0.40 |
| | Compressive Modulus | | | 4 | 5 | 7 | 8 | 9 | 10 | 12 |
| Length wise | Shear Strength | ISO 1922 | MPa | 0.20 | 0.30 | 0.45 | 0.55 | 0.70 | 0.80 | 1.10 |
| | Shear Modulus | | | 3 | 4 | 5.5 | 6.5 | 7 | 8 | 8.5 |
| Resistance to the axial withdrawal of screws | | EN 320 | N | 45 | 65 | 95 | 130 | 170 | 210 | 295 |
| Determination of withdrawal capacity of fasteners | | EN 13446 | N.mm$^{-2}$ | 1.20 | 1.70 | 2.30 | 2.90 | 3.50 | 4.30 | 5.80 |

*All values in tolerance ± 7,5 %. *Measured on optical camera ONE X SIGHT.*

## FIRE PROPERTIES

| Type of test | Standard | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Fire classification of buildings and constructions | EN 13501-1 | Class E, D, C | | | | | | |
| | DIN 4102-1 | Class B3, B2, B1 | | | | | | |
| | UL94 | Class HBF, HF1, HF2, V0, V1, V2 | | | | | | |

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# HARDEX® XPP OPTIMA

## THERMAL PROPERTIES

| Type of test | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m$^3$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Thermal conductivity | EN 12667 | W.m$^{-1}$.K$^{-1}$ | 0.043 | 0.043 | 0.042 | 0.041 | 0.04 | 0.04 | 0.04 |
| Coefficient of linear thermal expansion | ISO 11359-2 | $(10^{-5})$ K$^{-1}$ | 16 | 14 | 9.9 | 5.2 | 4.1 | 3.5 | 1.9 |
| Max. process temperature without thickness loss | - | °C | 155 | | | | | | |
| Short-time operating temperature | - | °C | from -40 to +130 | | | | | | |
| Continuous operating temperature | - | °C | from -30 to +110 | | | | | | |
| Laminating temperature * | - | °C | from +140** to +200 (recommended) | | | | | | |
| Thermoforming temperature * | - | °C | from +130 to +160 (for foam) | | | | | | |
| | | | up to +200*** (for sandwich type) | | | | | | |

** During the use of high temperatures above 160 °C, the thickness is losing depend on the lamination process setting and time and properties of the laminated layer.*
*** With using special lamination layer (upon inquiry).*
**** Upon inquiry.*

## OTHER PROPERTIES

| Type of test | Norm | Units | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg.m$^{-3}$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| **Type of structured foam** | | | | | | | | | |
| Closed cell content | EN 4590 | % | 95-98 | | | | | | |
| Diffusion for water vapor | EN 13469 | - | MU 2000 | | | | | | |

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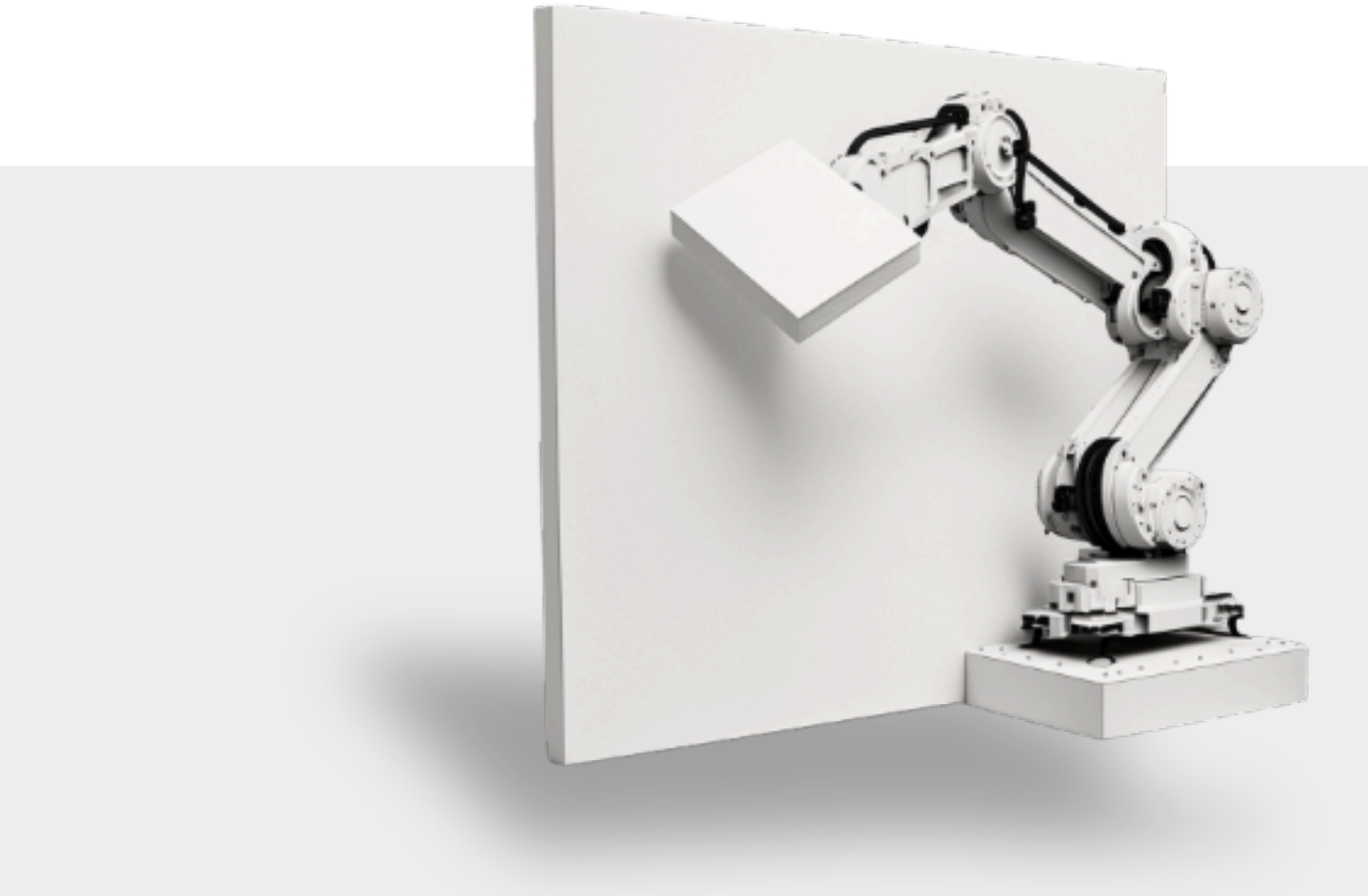
# HARDEX® XPP OPTIMA

## DIMENSIONS OF THE PRODUCT*

| Type of test | | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | | **EN 1602** | **kg/m$^3$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Length | | | mm | Roll** | | | | | | |
| Width | | | | (1000 – 1300) ± 10 | | | | | | |
| Thickness | Single layer sheet (mm) ±15% | | | 2 - 7 | 2 - 7 | 1,5 - 6 | 1,5 - 6 | 1,5 - 6 | 1 - 5 | 1 - 5 |
| | Multiple layer sheet (mm) ±15% | | | 30 | 25 | 20 | 15 | 15 | 10 | 10 |

* *At room temperature +23 °C.*
** *Roll length depends on thickness of product. Can be chopped to a format according to the customer´s requirement.*



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# HARDEX® XPP PERFORMANCE

**SPUR HARDEX® XPP PERFORMANCE** is a thermoplastic structured foam made of polypropylene (PP). The foam has a closed-cell structure that accounts for 95–98% of its composition. It offers excellent shear, compression, and impact strength. It is resistant to fatigue stress. The material exhibits excellent resist- ance to chemicals, water, and organic solvents, and meets health safety requirements. The foam can be produced with enhanced UV resistance, recycled content, or improved flame retardance. It also emits significantly lower toxic fumes when burned compared to other material. One major benefit of HARDEX® XPP PERFORMANCE is that the foam itself is easily recyclable, and the final sandwich structure can also be designed for complete recyclability.

**SPUR HARDEX® XPP PERFORMANCE** can be used as a core for a composite sandwich structure with excellent mechanical properties combined with low weight. It is used in applications that require a lightweight yet mechanically robust material, such as furniture boards, structural boards/profiles, construction, and automotive interior components (caravans, trucks, etc.). The foam can be processed and cut similarly to wooden materials and can be joined with screws, nails, and glues, by fusion welding and hot air welding. It can also be shaped by therm- oforming. Also, the material can be laminated with functional surface layers by reactive or hot-melt glues, or in case of good compatibility without glues by heat only.

## APPLICATIONS

### CONSTRUCTION INDUSTRY

- Insulating materials - moisture-resistant boards; heat insulators
- Construction boards for walls
- Replacement of wooden materials
- Formworks for concrete structures
- Expansion joints for concrete floors and walls

### SPORT, LEISURE

- Pickleball

### HOME INTERIOR'S ELEMENTS

- Windowsills
- Doors
- Stairs and stair risers
- Floors
- Design tiles; wall coverings

### MARINE INDUSTRY

- Floats, paddleboards

### AUTOMOTIVE (CARAVANS, TRUCKS, PICKUPS)

- Exterior and interior walls, ceilings, headliners, roofs and floors
- Heat insulating walls
- Low weight furniture

### TRAINS, BOATS

- Exterior and interior walls, ceilings, roofs and floors

### FURNITURE INDUSTRY

- Furniture boards – cabinet cores; doors; supporting structures
- Kitchen worktops
- Outdoor furniture
- Furniture profiles

**And many other**

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# HARDEX® XPP PERFORMANCE

## MECHANICAL PROPERTIES

| Properties | Standard | Units | | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg.m$^{-3}$** | **Value** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Tensile Strength (max) – thickness wise | ISO 1926 | MPa | Average | 0.80 | 1.30 | 1.80 | 2.30 | 2.90 | 3.80 | 4.50 |
| | | | Minimum | 0.65 | 1.05 | 1.35 | 1.85 | 2.30 | 3.00 | 3.60 |
| Tensile Modulus – thickness wise | | | Average | 20 | 30 | 50 | 70 | 90 | 130 | 220 |
| | | | Minimum | 15 | 25 | 40 | 55 | 70 | 105 | 175 |
| Compressive Strength (max) – thickness wise | ISO 844 method B* | MPa | Average | 0.38 | 0.60 | 0.90 | 1.40 | 1.70 | 2.90 | 3.90 |
| | | | Minimum | 0.30 | 0.45 | 0.70 | 1.10 | 1.35 | 2.20 | 3.10 |
| Compressive Modulus at 25% of maximum strength – thickness wise | | | Average | 65 | 100 | 130 | 210 | 250 | 300 | 440 |
| | | | Minimum | 50 | 75 | 105 | 160 | 200 | 240 | 350 |
| Compressive Modulus – thickness wise, according to material thickness | ISO 844 method A | MPa | 5 mm Minimum | 3 | 4 | 5 | 10 | 12 | 12 | 12 |
| | | | 10 mm Minimum | 4 | 7 | 8 | 12 | 17 | 23 | 26 |
| | | | 20 mm Minimum | 7 | 13 | 14 | 22 | 28 | 40 | 45 |
| | | | 40 mm Minimum | 12 | 22 | 25 | 36 | 43 | 60 | 65 |
| | | | 80 mm Minimum | 21 | 32 | 39 | 50 | 58 | 78 | 90 |
| Shear Strength (max) – width / length-wise | ISO 1922 method B* | MPa | Average | 0.30 | 0.50 | 0.80 | 0.90 | 1.00 | 1.60 | 2.20 |
| | | | Minimum | 0.20 | 0.30 | 0.50 | 0.55 | 0.60 | 0.95 | 1.30 |
| Shear Modulus (max) – width wise | | | Average | 20 | 35 | 45 | 95 | 120 | 180 | 250 |
| | | | Minimum | 10 | 30 | 30 | 70 | 90 | 110 | 150 |
| Shear Modulus (max) – length wise | | | Average | 7 | 12 | 15 | 25 | 30 | 65 | 90 |
| | | | Minimum | 4 | 10 | 10 | 15 | 20 | 35 | 45 |
| Resistance to the axial withdrawal of screws | EN 320 | N | Average | 45 | 65 | 95 | 130 | 170 | 210 | 295 |
| Withdrawal capacity of fasteners | EN 13446 | N.mm$^{-2}$ | Average | 1.2 | 1.7 | 2.3 | 2.9 | 3.5 | 4.3 | 5.8 |

** Measured on optical camera ONE X SIGHT.*

# HARDEX® XPP PERFORMANCE

## MECHANICAL PROPERTIES

Indicative determination of Compressive modulus E ISO844 – method A (depends on thickness, density D):

**E = c · D**

Constant c represents the coefficient according to the thickness of the foam.

| Thickness of foam (mm) | Constant c (-) |
|---|---|
| 5 | 0,074 |
| 10 | 0,136 |
| 20 | 0, 243 |
| 40 | 0,380 |
| 80 | 0,564 |

*Example determination for a panel with thickness 20 mm and density 60 kg/m³: E = 0,243 · 60 = 15 MPa*

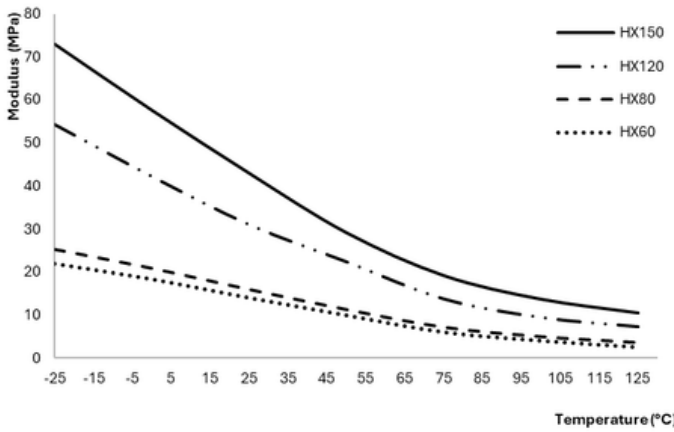
## THERMAL PROPERTIES

| Properties | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m³** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Thermal conductivity*** | EN 12667 | $W.m^{-1}.K^{-1}$ | 0.059 | 0.058 | 0.056 | 0.055 | 0.055 | 0.055 | 0.055 |
| Coefficient of linear thermal expansion | ISO 11359-2 | $(10^{-5})\ K^{-1}$ | 16 | 14 | 9.9 | 5.2 | 4.1 | 3.5 | 1.9 |
| Max. process temperature without thickness loss | - | °C | 155 | | | | | | |
| Short-time operating temperature | - | | from -40 to +130 | | | | | | |
| Continuous operating temperature | - | | from -30 to +110 | | | | | | |
| Laminating temperature * | - | | 155 ± 15 °C | | | | | | |
| Thermoforming temperature ** | - | | from +130 to +160 (for foam)<br>up to +200 (for sandwich type) | | | | | | |

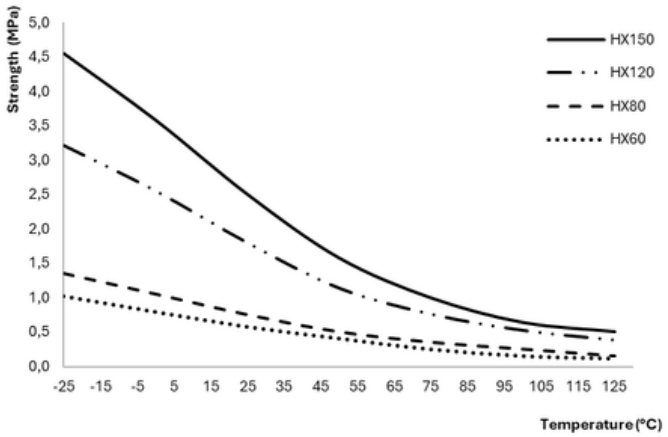
*** With the use of a special lamination layer.* *** Lower thermal conductivity upon inquiry.*

*Laminating temperature depends on the melting temperature of the foam core, adhesive, and reinforcing skin. At lower laminating temperatures, reduced adhesion between layers may occur. At temperatures above 160 °C, the thickness of foam core loss depends on process settings, exposure time, and the properties of the lamination layer.*

**Compressive modulus depend on temperature**




**Compressive strength depend on temperature**




*Compressive mechanical properties depend on temperature (thickness-wise). The sample was conditioned for 60 minutes according to the norm: ISO 844 method A, for a thickness of 20 mm.*

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# HARDEX® XPP PERFORMANCE

## FIRE PROPERTIES

| Properties | Standard | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Fire classification for buildings and constructions | EN 13501-1 | Class E, D, C | | | | | | |
| | DIN 4102-1 | Class B3, B2, B1 | | | | | | |
| | UL94 | Class HBF, HF1, HF2, V0, V1, V2 | | | | | | |

## OTHER PROPERTIES

| Properties | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m$^3$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Closed cell content | EN 4590 | % | 95-98 | | | | | | |
| Diffusion for water vapor | EN 13469 | - | MU 2000 | | | | | | |

## DIMENSIONS OF THE PRODUCT*

| Properties | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m$^3$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Length | - | mm | Standard 2440 ± 10 Up to 3000** ± 10 | | | | | | |
| Width | | | 1200 ± 10 | | | | | | |
| Thickness | | | (3 – 100) ± 0,5 | | | | | | |

Panels may exhibit colour and transparency inhomogeneity, including stripes, without affecting the declared properties in this document. For specific applications, panels with a more visually homogeneous appearance are available upon inquiry.

** At room temperature +23°C.* *** Upon inquiry.*

# HARDEX® XPP PERFORMANCE EASY

## SUPERIOR SURFACE QUALITY

Achieve a smooth and uniform finish without defects or distortions.

## MINIMAL FOAM THICKNESS LOSS

Maintains original foam structure, even under higher loads.

## HIGHER LAMINATION SPEED

Faster processing increases productivity and shortens production cycles.

## SIMPLIFIED LAMINATION OF LIGHTWEIGHT SKINS ON LIGHTWEIGHT CORES

Ideal for modern, weight-sensitive constructions.

## LOWER LAMINATION TEMPERATURE

Reduced temperatures cut energy consumption and operational costs.

## SIMPLIFIED LAMINATION OF HEAVYWEIGHT SKINS ON HEAVYWEIGHT CORES

Ideal for robust, load-bearing constructions.

## STRONGER ADHESION FOR A WIDER SKIN THICKNESS RANGE

Ensures reliable bonding even with challenging materials.

## SIGNIFICANT ENERGY SAVINGS

Efficient thermal management leads to lower overall costs.

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# HARDEX® XPP PERFORMANCE EASY

The correct use of HARDEX® Performance Easy XPP core is based on the following conditions:

**Suitable reinforcing layers**

- The reinforcement can be of any composition. However, to ensure mono-material recyclability, the use of PP-based, PP/GF, or aluminum layers is recommended. As a rule, the layer material should exhibit high temperature resistance, typically 160–170°C or higher. For all polypropylene-based layers, the melting point should be at least 160°C.
- It is necessary that the reinforcing layer is originally provided on the back by the supplier with a thermoadhesive layer 10-200microns thick on a PP basis with a melting point in the range of 135-145°C. In special cases, it may be lower. Adhesion can also be promoted by other suitable adhesion promoters, e.g. primers, but the PP adhesive film is the preferred option.
- If the reinforcing layer is not provided with a thermoadhesive or promotional layer, it is recommended to apply such a layer to the reinforcing layer prior to lamination with HARDEX® Performance Easy, for example by hot lamination of a PP film, powder, or web. The bond strength of the thermolaminated layer must be sufficiently high to prevent delamination of the layers.
- The thermoadhesive or promoting layer should be always an integral part of the reinforcing layer. Using a thermoadhesive film loosely placed between the reinforcing layer and the XPP core is not recommended, except in special cases that should be discussed with the manufacturer. of HARDEX® Performance Easy.

## PRELIMINARY PROCESSING CONDITIONS

| **Adhesive system HARDEX® Easy** | **Maximum operating temperature of sandwich (°C)** | **Fusing temperature (°C)** | **Fusing pressure (kPa)** | **Minimal fusing time (second)** | | | |
|---|---|---|---|---|---|---|---|
| | | | | PP/glass Organosheet | | | Aluminum (0,5-1,5 mm) |
| | | | | 2 UD (0,66 g/m²) | 4 UD (1,35 g/m²) | 8 UD (2,65 g/m²) | |
| High temp | 115 | 145 | 10-50 | 20 | 30 | 60 | 30 |
| | | 150 | | 20 | 20 | 30 | 20 |
| Mid temp | 100 | 140 | | 20 | 30 | 30 | 30 |
| | | 145 | | 20 | 20 | 20 | 20 |

# HARDEX® XPP PERFORMANCE EASY

## MECHANICAL PROPERTIES

| Properties | Standard | Units | | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg.m$^{-3}$** | **Value** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Tensile Strength (max) – thickness wise | ISO 1926 | MPa | Average | 0.80 | 1.30 | 1.80 | 2.30 | 2.90 | 3.80 | 4.50 |
| | | | Minimum | 0.65 | 1.05 | 1.35 | 1.85 | 2.30 | 3.00 | 3.60 |
| Tensile Modulus – thickness wise | | | Average | 20 | 30 | 50 | 70 | 90 | 130 | 220 |
| | | | Minimum | 15 | 25 | 40 | 55 | 70 | 105 | 175 |
| Compressive Strength (max) – thickness wise | ISO 844 method B* | MPa | Average | 0.38 | 0.60 | 0.90 | 1.40 | 1.70 | 2.90 | 3.90 |
| | | | Minimum | 0.30 | 0.45 | 0.70 | 1.10 | 1.35 | 2.20 | 3.10 |
| Compressive Modulus at 25% of maximum strength – thickness wise | | | Average | 65 | 100 | 130 | 210 | 250 | 300 | 440 |
| | | | Minimum | 50 | 75 | 105 | 160 | 200 | 240 | 350 |
| Compressive Modulus – thickness wise, according to material thickness | ISO 844 method A | MPa | 5 mm Minimum | 3 | 4 | 5 | 10 | 12 | 12 | 12 |
| | | | 10 mm Minimum | 4 | 7 | 8 | 12 | 17 | 23 | 26 |
| | | | 20 mm Minimum | 7 | 13 | 14 | 22 | 28 | 40 | 45 |
| | | | 40 mm Minimum | 12 | 22 | 25 | 36 | 43 | 60 | 65 |
| | | | 80 mm Minimum | 21 | 32 | 39 | 50 | 58 | 78 | 90 |
| Shear Strength (max) – width / length-wise | ISO 1922 method B* | MPa | Average | 0.30 | 0.50 | 0.80 | 0.90 | 1.00 | 1.60 | 2.20 |
| | | | Minimum | 0.20 | 0.30 | 0.50 | 0.55 | 0.60 | 0.95 | 1.30 |
| Shear Modulus (max) – width wise | | | Average | 20 | 35 | 45 | 95 | 120 | 180 | 250 |
| | | | Minimum | 10 | 30 | 30 | 70 | 90 | 110 | 150 |
| Shear Modulus (max) – length wise | | | Average | 7 | 12 | 15 | 25 | 30 | 65 | 90 |
| | | | Minimum | 4 | 10 | 10 | 15 | 20 | 35 | 45 |
| Resistance to the axial withdrawal of screws | EN 320 | N | Average | 45 | 65 | 95 | 130 | 170 | 210 | 295 |
| Withdrawal capacity of fasteners | EN 13446 | N.mm$^{-2}$ | Average | 1.2 | 1.7 | 2.3 | 2.9 | 3.5 | 4.3 | 5.8 |

** Measured on optical camera ONE X SIGHT.*

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# HARDEX® XPP PERFORMANCE EASY

## MECHANICAL PROPERTIES

Indicative determination of Compressive modulus E ISO844 – method A (depends on thickness, density D):

**E = c · D**

Constant c represents the coefficient according to the thickness of the foam.

| Thickness of foam (mm) | Constant c (-) |
|---|---|
| 5 | 0,074 |
| 10 | 0,136 |
| 20 | 0, 243 |
| 40 | 0,380 |
| 80 | 0,564 |

*Example determination for a panel with thickness 20 mm and density 60 kg/m³: E = 0,243 · 60 = 15 MPa*

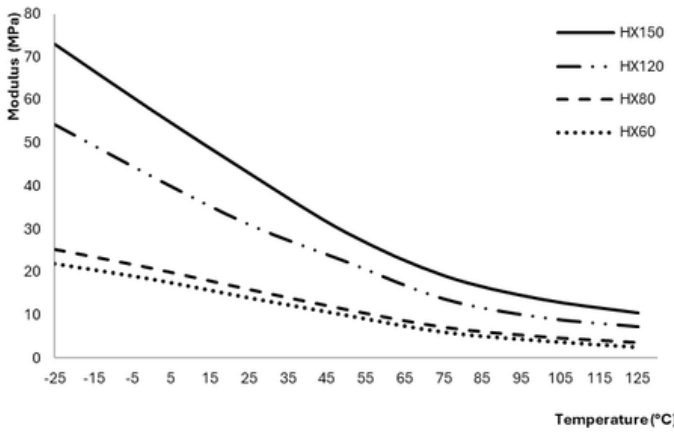
## THERMAL PROPERTIES

| Properties | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m³** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Thermal conductivity*** | EN 12667 | $W.m^{-1}.K^{-1}$ | 0.059 | 0.058 | 0.056 | 0.055 | 0.055 | 0.055 | 0.055 |
| Coefficient of linear thermal expansion | ISO 11359-2 | $(10^{-5})\ K^{-1}$ | 16 | 14 | 9.9 | 5.2 | 4.1 | 3.5 | 1.9 |
| Max. process temperature without thickness loss | - | °C | 155 | | | | | | |
| Short-time operating temperature | - | | from -40 to +130 | | | | | | |
| Continuous operating temperature | - | | from -30 to +110 | | | | | | |
| Laminating temperature * | - | | 155 ± 15 °C | | | | | | |
| Thermoforming temperature ** | - | | from +130 to +160 (for foam)<br>up to +200 (for sandwich type) | | | | | | |

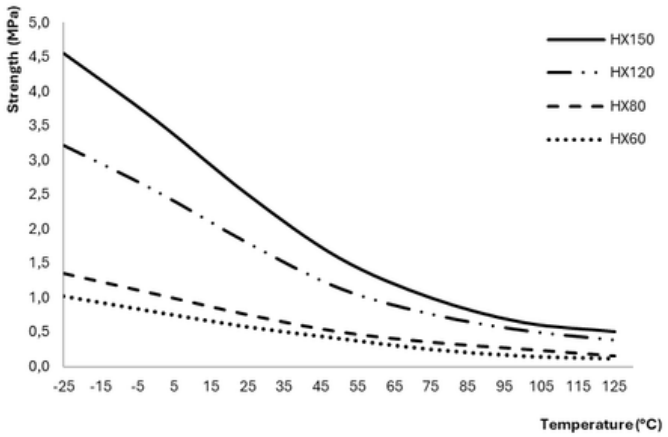
*** With the use of a special lamination layer.* *** Lower thermal conductivity upon inquiry.*

*Laminating temperature depends on the melting temperature of the foam core, adhesive, and reinforcing skin. At lower laminating temperatures, reduced adhesion between layers may occur. At temperatures above 160 °C, the thickness of foam core loss depends on process settings, exposure time, and the properties of the lamination layer.*

**Compressive modulus depend on temperature**




**Compressive strength depend on temperature**




*Compressive mechanical properties depend on temperature (thickness-wise). The sample was conditioned for 60 minutes according to the norm: ISO 844 method A, for a thickness of 20 mm.*

**SPUR a.s.** | trida Tomase Bati 299, Louky, 763 02 Zlin, CZ

# HARDEX® XPP PERFORMANCE EASY

## FIRE PROPERTIES

| Properties | Standard | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Fire classification for buildings and constructions | EN 13501-1 | Class E, D, C | | | | | | |
| | DIN 4102-1 | Class B3, B2, B1 | | | | | | |
| | UL94 | Class HBF, HF1, HF2, V0, V1, V2 | | | | | | |

## OTHER PROPERTIES

| Properties | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m$^3$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Closed cell content | EN 4590 | % | 95-98 | | | | | | |
| Diffusion for water vapor | EN 13469 | - | MU 2000 | | | | | | |

## DIMENSIONS OF THE PRODUCT*

| Properties | Standard | Units | Measurements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bulk Density** | **EN 1602** | **kg/m$^3$** | **40** | **60** | **80** | **100** | **120** | **150** | **200** |
| Length | - | mm | Standard 2440 ± 10 Up to 3000** ± 10 | | | | | | |
| Width | | | 1200 ± 10 | | | | | | |
| Thickness | | | (3 – 100) ± 0,5 | | | | | | |

Panels may exhibit colour and transparency inhomogeneity, including stripes, without affecting the declared properties in this document. For specific applications, panels with a more visually homogeneous appearance are available upon inquiry.

** At room temperature +23°C.* *** Upon inquiry.*

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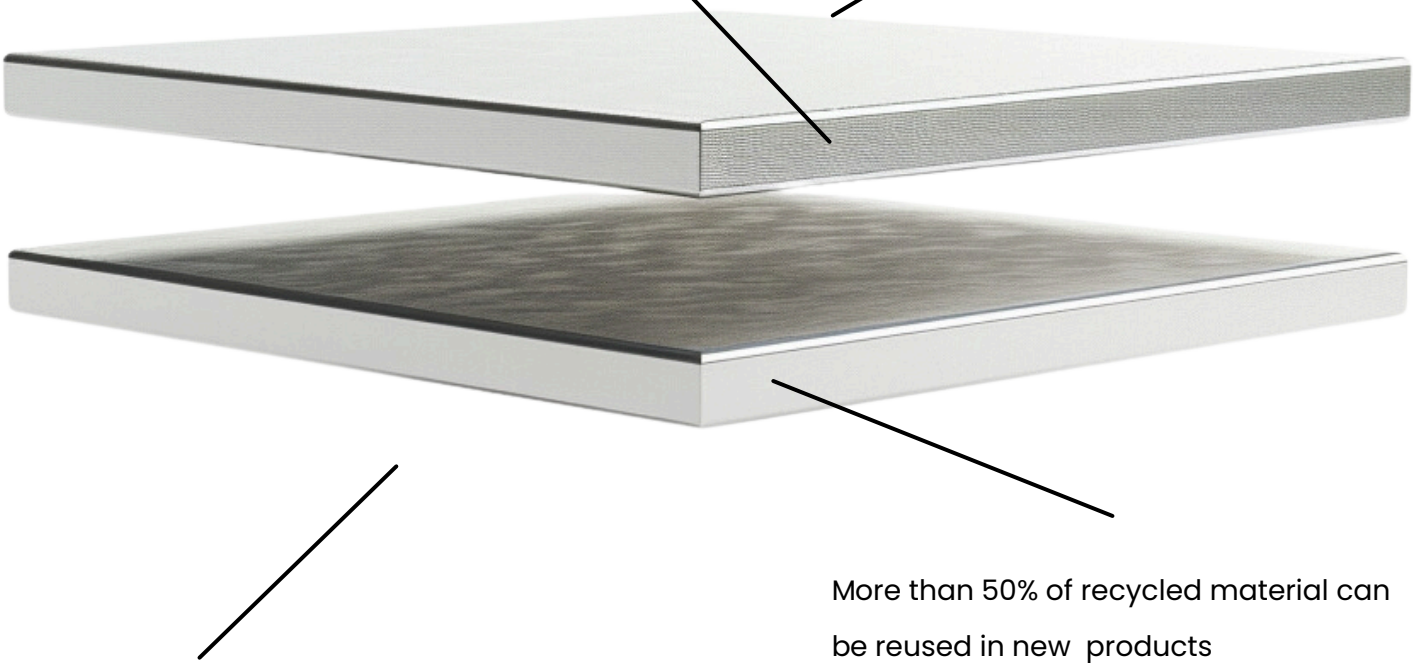
HARDEX®

# ENGINEERED FOR FULL RECYCLABILITY

Zero waste in the recycling process

The sandwich design is engineered for complete mechanical recyclability



More than 50% of recycled material can be reused in new products

Remaining recycled material suitable for other applications

**SPUR a.s.** | trida Tomase Bati 299, Louky, 763 02 Zlin, CZ

HARDEX®

# ALREADY IN PRODUCTION

## Better Shelter

- Swedish company Better Shelter chose PP based panels (PP-based skins + XPP HARDEX) to the UNHCR
- There is improved recyclability, UV and fire retardancy.

## Thermoforming

- SPUR produce, laminate and thermoform about 2 million panels per year.

## Trucking business


- With our lamination partners, we started to supply one of the biggest market players in jumbos and box trailers in NL and DE.
- Our design is crucial for future electromobility due to the lightweightness.

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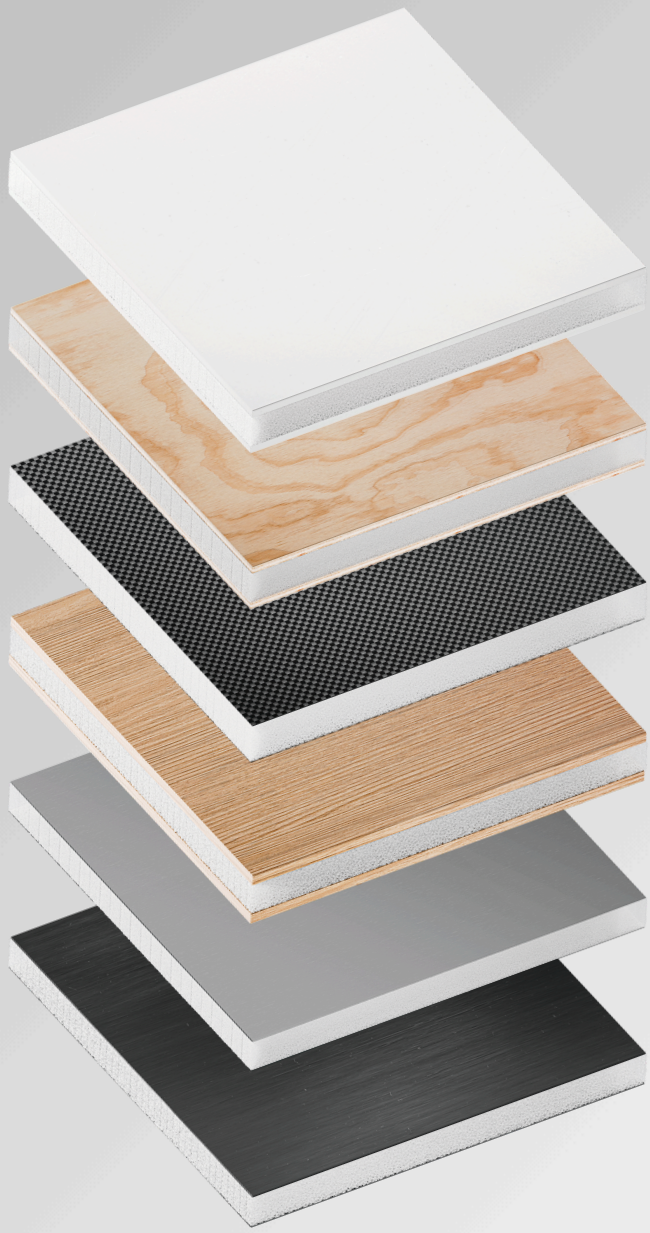
# HARDEX®

## XPP FOAM



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