


*Extremely light.*  
**Extremely strong.**

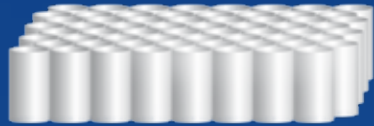
**TUBUS**  **WABEN**

*Processing instructions*

# Designs

## of Tubus honeycomb

Tubus honeycomb PP with open cells



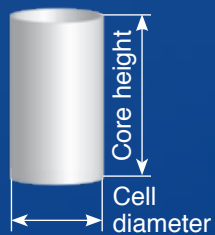
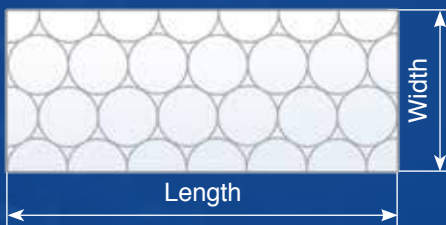
Tubus honeycomb PP laminated Polyester fleece on both sides



Tubus honeycomb PP laminated Polypropylene film on both sides  
Polyester fleece on both sides



### Structure of Tubus honeycomb



# Contents

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Tubus honeycombs are innovative cores for extremely light and highly stable lightweight products. They fulfil the highest requirements for precision and long life. Below we provide our recommendations for the optimal processing and handling of Tubus honeycombs.

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# Welding

cover layers and honeycomb mat

1

**TUBUS  WABEN**  
with open cells



2

## Welding

cover layers and honeycomb mat

Tubus honeycombs can be welded using heat and pressure in a continuous or discontinuous process. This is possible with or without additional materials. The materials to be welded are heated above their melting temperature and made liquid.

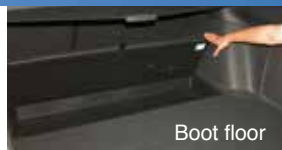
As this occurs at various temperatures for different plastics, only plastics of the same kind or with similar melting indices can be welded with each other.

Examples of processes:

- Laminating
- Hot gluing
- Hot pressing

3

Lightweight element



Boot floor

## Cover layers

Ideally fibre-matrix semi-finished products with a thermoplastic matrix are used. Fibre-matrix semi-finished products are understood as materials made from reinforcement fibres that are drenched in a plastic matrix.

Examples for cover layers:

- Textiles based on polyolefins
- Mats based on polyolefins
- Fleeces
- Fabric/cores based on polyolefins
- Hybrid fabrics with a polyolefin element

## Ability to deliver

Tubus honeycombs with open cells

Core density		60 - 120 kg/m <sup>3</sup>
Dimensions	Length*	1000 - 2900 mm
	Width*	850 - 1400 mm
	Core height	5 - 100 mm (every tenth)
Tolerances	Length/width	+/- 4.00 mm
	Core height	+/- 0.35 mm

\* Other dimensions available on request

# Gluing

cover layers and honeycomb mat

1

**TUBUS  WABEN**  
with polyester fleece



2

## Gluing

cover layers and honeycomb mat

The selection of adhesives is made mainly due to the adhesion to the cover layer. The adhesion in the fleece is purely mechanical. Air pockets in the adhesive should be avoided because these massively reduce the stability values and may result in bubbles when heating the honeycomb plate, e.g. sun radiation.

Examples of processes:

- Continuous and discontinuous processes
- Hot, cold and vacuum presses

Examples of adhesives:

- 1-K / 2-K polyurethane adhesive (PUR)
- Hot melt adhesive
- Reactive adhesive

3

Sandwich panel



## Cover layers

When gluing, the cover layers can be selected from thermoplastic, duroplastic or other materials.

### Examples for cover layers:

- Fibreglass reinforced plastic (GRP)
- Prepreg
- Fibreglass mats thermoplast (GMT)
- Metal (e.g. aluminium, steel, stainless steel)
- Wood, plywood, HPL, trim, stone,
- Anti-slip surface

## Ability to deliver of Tubus honeycombs with polyester fleece

Core density		60 - 120 kg/m <sup>3</sup>
Fleece weight		30 - 120 g/m <sup>2</sup>
Dimensions	Length*	800 - 3000 mm
	Width*	600 - 1500 mm
	Core height	5 - 65 mm (every tenth)
Tolerances	Length/width	+/- 4.00 mm
	Core height	+/- 0.15 mm

\* Other dimensions available on request

# Laminating

cover layers to the honeycomb mat

1

**TUBUS**  **WABEN**  
with film and fleece



Laminate cover layers on the honeycomb mat

Tubus honeycombs can be processed into sandwich components and pressed parts using various lamination processes. The cover layers are embedded in a resin matrix and connected with the honeycomb mat.

2

Examples of processes:

- Manual laying process (with vacuum presses)
- Injection fibres
- Vacuum infusion
- Light RTM

Examples of resins:

- Polyurethane resin
- Polyester resin
- Epoxy resin
- Phenol resin

3

Panel /  
moulded part





## Cover layers

Various materials combinations are possible for the cover laminates and these must harmonise with the honeycomb core.

In order to achieve the ideal result, an individual cover layer should be selected for each component.

Examples for cover layers:

- Fibreglass reinforced plastic (GRP)
- Metal (e.g. aluminium, steel, stainless steel)
- Wood, plywood, HPL, trim, stone
- Anti-slip surface

## Ability to deliver

Tubus honeycombs with film and fleece

Core density		60 - 120 kg/m <sup>3</sup>
Film thickness		75 µm and 140 µm
Fleece weight		30 - 120 g/m <sup>2</sup>
Dimensions	Length*	800 - 3000 mm
	Width*	600 - 1500 mm
	Core height	5 - 65 mm (every tenth)
Tolerances	Length/width	+/- 4.00 mm
	Core height	+/- 0.15 mm

\* Other dimensions available on request

# Cold moulding

of **TUBUS**  **WABEN**

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Tubus honeycombs with low thicknesses can be cold shaped in large radii at room temperature using pressure or vacuums as can resins or adhesives. For this the sandwich element must be placed and fixed into the shaping tool.

The new shape is retained after hardening the resin or adhesive.

## Laminate structure

The laminate layers are attached to the honeycomb mat using resin or adhesive.



## Shaping

Shaping the laminated honeycomb mat in a mould with a counter-mould or a mould under a vacuum.



## Hardening

After hardening the resin or adhesive, the mould can be removed and further processing can take place.

# Warm moulding

of **TUBUS**  **WABEN**

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Tubus honeycombs consist of a thermoplastic material that can be shaped in a particular temperature range. This process is reversible; i.e. it can be repeated by cooling and re-heating as often as required as long as so-called thermal decomposition is not caused in the material due to overheating.

## Heating

The honeycomb mat is heated e.g. using an oven, infra-red radiation or a heated mould.



## Shaping

The honeycomb mat receives a new contour in the mould.



## Cooling

The honeycomb mat is cooled at room temperature or in a cooled mould.

# Fixing options of **TUBUS** **WABEN**

## Fixing in the honeycomb

Plan the honeycomb cut-out in the position of the later fixing point.



- Use and adhere inserts, e.g. made of aluminium, plywood, ureol or special sandwich fixing element
- Alternatively fill the hollow space with resin
- Close with the cover layer

## Fixing on the honeycomb

Perforate the glass mat in the position of the later fixing point



- Screw special fixer (suitable for laminate) to the glass mat
- Insert the fixer into the laminate

## Fixing in the cover layer

Drill cover layer



- E.g. blind rivet, threaded insert, riveting nut or special sandwich fixing element
- Fix inserted element

# Design force guidance

for **TUBUS**  **WABEN**

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Special attention is required for designing force guides as it must be possible to guide loads directly into the cover layer.

Forces should be guided if possible as a shear load into the sandwich in the plane direction. Where the forces are guided the honeycomb core is filled, e.g. with a resin micro-ball mixture. Depending on the extent of the load the cover layers may need to be reinforced locally with additional cover layers.

When guiding moments or forces vertically to the sandwich level, in most cases an appropriate arrangement of frames, ribs or similar inserts is required.

For impact loads with various load directions, it has also proven to be favourable to replace the honeycomb sandwich where the force is applied with a reinforced cover layer.

# Mechanical strengths

## for sandwich constructions and plates

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A generally applicable formula for calculating the mechanical properties of sandwich plates is not possible.

The core material and cover layers are responsible for ensuring the mechanical stability of sandwich constructions, plates and panels. The ratio of the cover layers to the core material must be correct.

The basis for calculation from the literature only applies for defined relationships of total thickness, cover layer thickness, core material and cover layer material in particular ranges.

Technical application instructions and recommendations are neither binding nor guaranteed. They match the current state of our knowledge and do not release the user of Tubus honeycombs from the responsibility of checking that the products are suitable for the proposed use.

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