

**The more intelligent way to insulate.  
Plastic warm-edge spacers and bars for insulating glass.**



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**Thermix**<sup>®</sup>

by **ENSINGER** 

## **Thermix® – an essential for energy-efficient construction.**

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In comparison to insulating glazing with conventional spacers made of aluminium or steel, Thermix® plastic warm-edge spacers insulate more intelligently. Because Thermix® breaks the thermal bridge at the transition between the glass and the frame. Besides considerable heat savings, the danger of condensation and mould formation is minimized. Improved hygiene in dwellings and a healthy interior climate are the consequence.

The new German Regulation for Energy Saving (EnEV) specifies that thermal bridge losses at the glass edge should be taken into account when determining the characteristics of windows and facades.

The calculated thermal transmission coefficients of windows and facades ( $U_{w,f}$ ) clearly demonstrate the more favourable values for plastic spacers compared to those made of aluminium.

### **I The advantages of Thermix® profiles at a glance:**

- I Higher surface temperatures at the edge of the glass on the room side due to improved heat insulation ("warm-edge")
- I Virtually no danger of condensation formation leading to damage and mould, which can be a health risk
- I More favourable isothermal flow in windows and facades due to a thermal break at the edge bond of the glazing
- I Considerably better values for the thermal transmission coefficient  $U_{w,f}$
- I Less heating losses at windows, proven in the primary energy balance according to EnEV
- I Attractive design
- I Thermix® bar systems: complete solutions for every size of window
- I Can be built into all insulating glass products



## Design and effect of Thermix®.

### I Innovative plastic solutions with reliable properties.

Thermix® warm-edge spacers are made of high performance engineering plastic with an integrated metallic diffusion barrier made of steel or stainless steel. Thermix® bars consist of glass-fibre reinforced plastics.



High performance engineering plastics provide sturdy and reliable properties.

### I Proven safety with tested insulating glass technology.

During the manufacture of insulating glass, bent or push-fit spacer frames are filled with desiccant and processed in a double-sealed edge bond. The water vapour and gas tightness of the Thermix® edge bond has been demonstrated using valid standards.



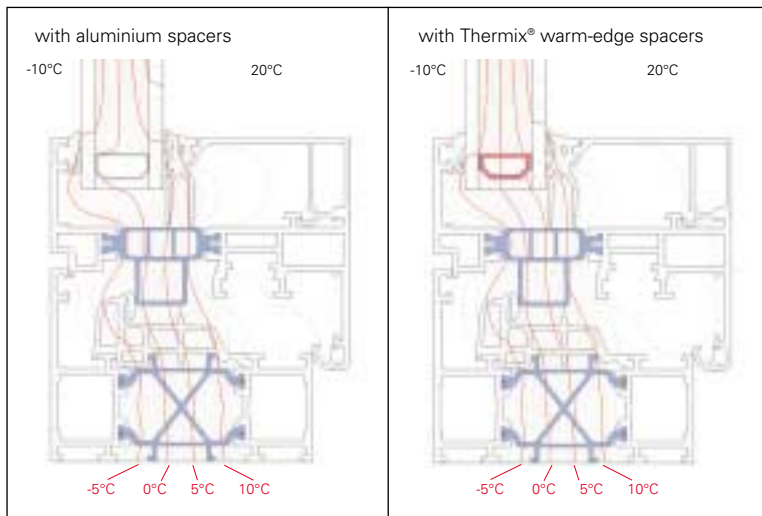
Thermix® warm-edge spacer: suitable for all insulating glazing.

### I Thermix® warm-edge spacers defuse the problem of condensation.

Thermix® warm-edge spacers keep the glass at the edge of the glazing warm – valuable heating warmth stays in the room. The danger of condensation forming at the glass edge is minimized, the window remains clean and dry and provides for a healthy climate in the room.



Thermix® warm-edge spacers break the thermal bridge in insulating glass. There is normally no formation of condensation or mould.



As a consequence of a continuous thermal separation, the window with the Thermix® spacers shows a more favourable isothermal flow.

## Reduction of edge losses by up to 55 %.



Calculation programmes available under [www.thermix.de](http://www.thermix.de)

The valid European standardisation not only takes into account the thermal losses through the glass and frame of a window, but also the heat losses through the edge bond of the insulating glass.

The characteristics of different types of frame were determined in an extensive study using the insulating glass edge bond systems Thermix® and Thermix®-LX [ebök, 2002\*] and the values were compared with aluminium spacers.

The transmission heat losses were calculated on the frames and edge bonds according to E DIN EN ISO 10077-2. In this way the linear thermal transmission coefficient  $\Psi$  and the frame U-value  $U_f$  were determined.

The  $U_w$ -values of the window are obtained according to DIN EN ISO 10077-1 as follows:

$$U_w = \frac{A_g \cdot U_g + A_f \cdot U_f + L_g \cdot \Psi}{A_g + A_f}$$

$U_w$	Thermal transmission coefficient of the window [W/(m <sup>2</sup> K)]
$U_g$	Thermal transmission coefficient of the glazing [W/(m <sup>2</sup> K)]
$U_f$	Thermal transmission coefficient of the frame [W/(m <sup>2</sup> K)]
$\Psi$	Linear thermal transmission coefficient as a consequence of the combined influence of the spacer, glass and frame [W/(mK)]
$A_f, A_w, A_g$	Area of frame, window and glass
$L_g$	Surrounding boundary length of $A_g$ [m]

### I Comparison of the linear thermal transmission coefficients $\Psi$ .

	$U_f$ [W/(m <sup>2</sup> K)]	$\Psi$ [W/(mK)]			Improvement in $\Psi$ compared to aluminium (%)	
		Aluminium	Thermix®-LX	Thermix®	Thermix®-LX	Thermix®
IV68 Standard wooden window	1.46	0.076	0.053	0.044	31%	42%
Five chamber plastic window	1.38	0.065	0.047	0.040	28%	39%
Metal framed window thermally broken	2.06	0.094	0.062	0.050	34%	47%
Passive house window	0.69	0.060	0.036	0.027	40%	55%

\* The full report from Ingenieurbüro ebök is available under [www.thermix.de](http://www.thermix.de)

Thermix®: Stainless steel diffusion barrier  
Thermix®-LX: Steel diffusion barrier

## I Improvement of the window U-value $U_w$ for the test window size 1.23 m x 1.48 m.

*) $U_g = 1,1 \text{ W/(m}^2\text{K)}$	$U_w$ for 1,23 m x 1,48 m [W/(m <sup>2</sup> K)]			Improvement of $U_w$ compared to aluminium [%]	
	Aluminium	Thermix®-LX	Thermix®	Thermix®-LX	Thermix®
IV 68 Standard wooden window *)	1.40	1.35	1.32	4%	6%
Five chamber plastic window *)	1.35	1.30	1.29	3%	5%
Metal framed window thermally broken *)	1.60	1.51	1.48	5%	7%
Passive house window **)	0.84	0.78	0.76	7%	9%

Considerable energy savings can be achieved with Thermix® warm-edge spacers. In terms of the whole window, the use of the Thermix® edge bond leads to a distinct reduction of heat losses from the window.

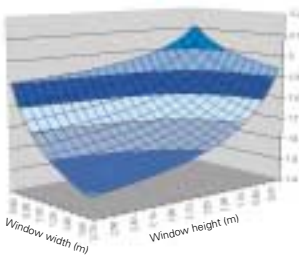
## I Thermix® defuses the problem of condensation.

*) $U_g = 1.1 \text{ W/(m}^2\text{K)}$	$T_{\min}$ [°C] for $R_{Si}$ (0,20)			Temperature increase $\Delta T$ compared to aluminium [K]	
	Aluminium	Thermix®-LX	Thermix®	Thermix®-LX	Thermix®
IV 68 Standard wooden window *)	5.7	8.1	9.1	2.4	3.4
Five chamber plastic window *)	7.0	8.9	9.7	1.9	2.7
Metal framed window thermally broken *)	6.2	8.7	9.6	2.5	3.4
Passive house window **)	10.3	12.3	13.0	2.0	2.7

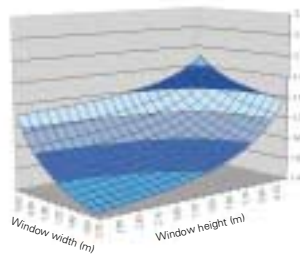
Minimum temperatures at the glass edge using higher transition resistances  $R_{Si} = 0.20 \text{ m}^2\text{K/W}$

Thermix® minimizes the thermal bridge effect. The glass edge on the room side does not cool down so much. No condensation will form under normal conditions. With Thermix® the minimum temperatures at the glass edge are considerably higher compared to conventional aluminium spacers.

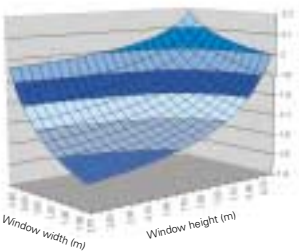
## I Influence of window size on the $U_w$ -value.



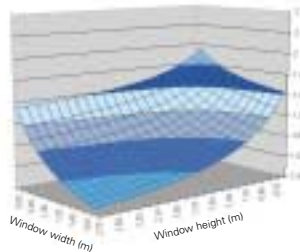
Single winged metal window with aluminium edge bond



Single winged metal window with Thermix® edge bond



Single winged metal window with aluminium edge bond and crossed aluminium glazing bars



Single winged metal window with Thermix® edge bond and crossed Thermix® glazing bars

Tests on different window sizes and formats have shown: heat losses from windows using the Thermix® edge bond are considerably lower than with the aluminium edge bond. The higher the proportion of the frame, the greater the improving effect of Thermix®.

Thermix® bars are clearly better from a heat technology point of view than aluminium bars.



1.5-storey single-family home with 144 m<sup>2</sup> heated living area in low-energy building standard

## Thermix®: economic and intelligent.

In order to make the potential savings achieved with Thermix® more transparent, a typical new show building for the single-family home segment was calculated according to the German Regulation for Energy Saving. [ebök, 2002\*]

The result: Depending on the type of frame, up to 4.1% heating energy (2.8 % primary energy) was saved using the Thermix® edge bond compared to the use of a standard aluminium edge bond.

### I Results of the calculation according to the German Regulation for Energy Saving monthly procedure.

Type of window	Edge bond	Ø U <sub>w</sub> [W/(m <sup>2</sup> K)]	Monthly procedure EnEV		Energy savings compared to aluminium-spacers	
			Q <sub>h</sub> " [kWh/(m <sup>2</sup> a)]	Q <sub>p</sub> " [kWh/(m <sup>2</sup> a)]	ΔQ <sub>h</sub> " [%]	ΔQ <sub>p</sub> " [%]
IV68 Standard wooden window	Aluminium	1.42	42.7	74.6	0.0	0.0
	Thermix®-LX	1.36	41.6	73.4	2.5	1.6
	Thermix®	1.34	41.2	72.9	3.4	2.2
Five chamber plastic window	Aluminium	1.35	40.4	71.7	0.0	0.0
	Thermix®-LX	1.30	39.6	70.8	2.1	1.3
	Thermix®	1.28	39.2	70.4	2.9	1.8
Metal framed window thermally broken	Aluminium	1.69	48.0	80.7	0.0	0.0
	Thermix®-LX	1.61	46.5	79.1	3.0	2.0
	Thermix®	1.58	46.0	78.5	4.1	2.8

Ø U<sub>w</sub> Average U-value for all windows of the show building  
 Q<sub>h</sub>" Heating energy requirement according to energy savings regulation  
 Q<sub>p</sub>" Primary energy requirement according to energy savings regulation

In order to achieve the same savings as with Thermix®, for example, the exterior wall insulation of the show building would have to be increased by 6 cm (IV68 wooden window and aluminium spacers).

\* The full report from Ingenieurbüro ebök is available under [www.thermix.de](http://www.thermix.de)

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ENERGON Ulm: The administration building of the Software AG foundation is the largest office building in the world built to the passive house standard. Thermix® warm-edge spacers are built into the windows and the facade.  
 Architects: oehler + arch kom



The Burse student hall of residence in Wuppertal is the largest residential building in Germany to be extensively renovated and achieve the passive house standard.  
 Architektur Contor Müller Schlüter



Energy savings in private residences by lower heating losses through windows. Thermix® used in a detached one-family house in Feldkirch.



Energy-conserving construction using Thermix® is clearly demonstrated at the ecological training centre of the Adult Education Centre in Munich.



Energy efficiency in modern industrial buildings: For the insulating glazing in the Mölk-Presssegrosso Osnabrück plastic Thermix® warm-edge spacers were used.



Thermix® combines efficiency with attractive design: Modern steel facade at the Cinema Centre "Die Burg" in Ravensburg.

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