Warm-edge spacers

Increasing calls for energy saving from European environmentalists has boosted demand for Thermix® spacers. The 'warm edge' spacers improve the thermal insulation in the edge bond of double and triple glazings and minimize the risk of condensation. Their functioning and the European market for spacers, with emphasis on Germany, is looked at here.

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INTRODUCTION

Traditional metallic spacers act as a thermal bridge between two panes of insulating glass and a warm edge spacer reduces the heat loss through this "bridge". It must be considered as part of an up-to-date insulating window system, i.e. it would be of no value to use a warm edge spacer in a window made of aluminium or steel without thermal break which permits major heat transfer between the inside and outside of a building.

A EUROPEAN PERSPECTIVE

One reason for the recent focus on warm edge systems, which is one of the largest concerns in Europe particularly in Germany, is the saving of heating energy to reduce the emission of greenhouse gases like CO_2 and of other pollutants. On average, existing residences in Germany need 220 kWh/(m^2a) of heating energy per year. New regulations for energy saving in heated buildings in Europe require low-energy buildings as standard.

A future trend is to build passive houses. Compared with the average for existing buildings in Germany, these passive houses offer potential energy savings of more than 90 per cent.

Consuming 15 kWh instead of 220 kWh reduces CO_2 emissions by approximately 85 kilograms. For a living space of 100 m^2 this is a reduction of 8.5 metric tons of CO_2 emissions per year.

HEATING ENERGY PARAMETERS FOR RESIDENCES

Type of building	Description	Energy consumption kWh/m^2a	Litres per year of fuel oil for a living space of 100m^2
AVERAGE EXISTING BUILDINGS IN GERMANY	*Poor thermal insulation, standard double or single glazing*	*220*	*2,200 litres*
LOW ENERGY BUILDING	*Good thermal insulation, low-E double glazing, thermally improved window frames, conventional heating system*	*< 70*	*< 700 litres*
PASSIVE HOUSE BUILDING	*Highest thermal insulation low-E triple glazing in superframes, controlled air conditioning with heat regain, passively heated and cooled, no conventional heating system*	*< 15*	*< 150 litres*

HOW DOES "WARM EDGE" WORK?

Heat transmission through the centre of an IGU happens in three ways:

HEATING ENERGY AND CO_2 EMISSION

100 kWh heating energy	CO_2 emission
FUEL OIL	29 kg
NATURAL GAS	19 kg
ELECTRICAL CURRENT	83 kg
COAL	38 kg
AVERAGE	42.25 kg

- radiation - this transport mechanism can be reduced with low-E coatings;
- thermal conduction - this can be diminished by reducing the thermal conductivity of the gas fill, by the use of noble gas like Argon, Krypton or Xenon;
- convection is reduced to a minimum by optimization of the cavity.

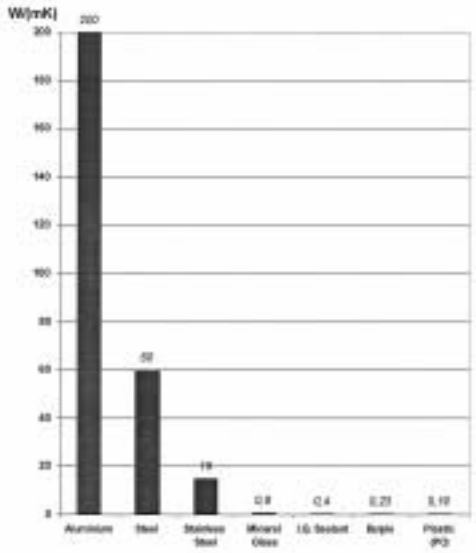
For a traditional IGU without low-E coating and gas fill, radiation is responsible for two thirds of the heat loss, due to the high emissivity of the uncoated glass pane. Thermal conduction and convection together contribute to the remaining one third of the heat loss.

The edge bond is different from the centre of an insulating glass unit, there heat is mainly lost by thermal conduction. Therefore, warm edge is not only a question of thermal conductivity, but also of design.

DESIGN

The design of a spacer influences the size and extent of the thermal bridge. Although a material might have a small thermal conductivity value - if the bridge is wide, it can have the same effect as a higher conducting material with a smaller cross-section. Therefore, to reduce a thermal bridge, drastic reduction in the thermal conductivity is necessary, as well as reduction of the wall thickness of the bridge in the direction of the heat flow.

THERMAL CONDUCTIVITY OF DOUBLE GLAZING CONSTRUCTION MATERIALS



SYSTEMS AVAILABLE IN EUROPE AND GERMANY

The certified testing institute in Rosenheim, Germany, has conducted a comparison of these systems, which are available in Germany and other European countries. All systems, except one, are hollow profiles with a diffusion barrier made of metal.

Systems without metallic diffusion barriers around the cavity for the desiccant do not pass the German insulating glass tests due to structural and long-term moisture resistance requirements. To be sold in Europe, the systems must pass severe insulating glass tests that rigidly test the long-term structural and moisture resistance integrity of the system. Before a new spacer system can be used for insulating glass in Germany, it has to pass severe insulating glass tests. Glazing which cannot provide certification

HEAT TRANSMISSION THROUGH A DOUBLE GLAZING

1 radiation
2 thermal conduction
3 convection

THE INFLUENCE OF DESIGN

Thermal conductivity	Width	Rate of heat transfer	Symbol
100	5	100 x 5 = 500	
50	10	50 x 10 = 500	

according to the German standard (DIN 1286), is not allowed in buildings and can incur legal penalties for the manufacturer. Drafts of new European standards for insulating glass tighten the requirements even more.

The insulating glass manufacturer has to run daily audits and be certified annually by an independent organization.

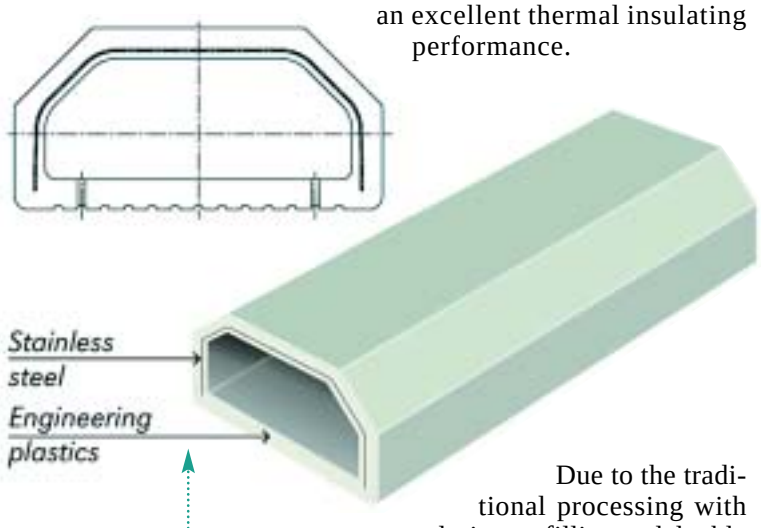
This expenditure of time and money is necessary to guarantee an expected service life for windows of more than 20 years.

The calculated linear thermal transmission coefficients, the ψ–values, do not show a clear separation between warm and cold edge, but a constant improvement of thermal performance.

Thermix® spacers are made of a high quality engineering plastic, containing an extremely thin layer of stainless steel foil which acts as a diffusion barrier.

INSULATING PERFORMANCE

The plastic material, a modified polycarbonate, will not outgas, has excellent rigidity over a wide range of temperatures and enhanced UV stability. Due to the stainless steel foil, the coefficient of linear thermal expansion does not exceed that of an aluminum spacer. Thermix® spacers can be processed on most of the existing insulating glass lines that use traditional metallic spacers. Specific equipment is only necessary for bending corners. Modified polycarbonate has a thermal conductivity of 0.19 W/(mK), which is 1,052 times less than the thermal conductivity of aluminum. Stainless steel contributes 15 W/(m²K), which is still 13.3 times less than aluminium. Because the stainless steel film in the Thermix® spacers is very thin, U-shaped, and is completely insulated by the plastic material, the profiles have an excellent thermal insulating performance.



The design of Thermix® warm edge spacers

Due to the traditional processing with desiccant filling and double sealing, Thermix® spacers provide the safety and durability of a traditional insulating glass edge bond.Thermix® profiles provide the best Uw-values, i.e. thermal transmission coefficients for windows according to prEN ISO 10077 - reducing the thermal bridge loss coefficient by more than 50 per cent. Also the export markets are becoming increasingly important.

Thermix® spacers improve the thermal insulation in the edge bond of double and triple glazings. The roomside glass edge is warmer than with conventional spacers made of aluminium. This minimizes the risk of condensation.

Thermix® profiles are available in black

LINEAR THERMAL TRANSMISSION COEFFICIENTS Ψ in W/(mK)

Spacer system/ manufacturer	Double glazing 4/16/4			Triple glazing 4/12/4/12/4		
	Frame material			Frame material		
	Wood	PVC	WPG	Wood	PVC	WPG
Aluminium spacer	0.068	0.067	0.108	0.074	0.070	0.111
Stainless steel	0.050	0.050	0.070	0.051	0.049	0.065
Flachglas/TIS	0.048	0.048	0.068	0.049	0.046	0.062
St. Gobain/Swisspacer	0.043	0.043	0.060	0.043	0.041	0.055
Henkel-Teroson/TPS	0.042	0.042	0.054	0.042	0.042	0.049
Chemetall/TPS	0.041	0.041	0.053	0.041	0.041	0.048
Thermix	0.040	0.040	0.053	0.040	0.039	0.048

and grey colours and in a variety of sizes (8 mm and 20 mm). They are bendable and have a full line of accessories, i.e. corner keys, straight connectors, gas plugs and tubes, muntin connectors and cruciforms. From October 2000, a new size, Thermix® spacer 27 mm, will be available for special applications. The Thermix® bar systems are becoming more and more popular. They allow the window manufacturer to integrate thermally not conductive Thermix® bars inside the air space, made of engineering plastics, and matching to the warm edge. The Thermix® bar programme is continuously extended, to make all possibilities available and to fulfill all requirements.

CONCLUSION

European (and in particular, German) standards for insulating glass units demand a warm edge spacer designed to meet long-term structural and performance standards.

The ideal spacer to meet these requirements is non-metallic, hollow, and contains a thin metallic (preferably stainless steel) diffusion barrier. One such spacer, Thermix®, provides excellent thermal performance while meeting these long-term requirements.

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