

Glass Handbook 2014

Introduction

Solar Control



Thermal Insulation



Fire Protection



Noise Control



Safety / Security



Self-cleaning



Decoration



Glass Systems



Special Applications



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Introduction

General description

Our Glass Handbook has been designed to act as an easy-to-use reference document providing consistent information on our range of products for buildings that are distributed by Pilkington Polska and/or Pilkington IGP.

We have tried to highlight the benefits of the product as well as the technical specification to the user.

Our publication is not exhaustive, and therefore does not cover all products, combinations and applications. For additional information or advice, please get in contact with one of our NSG Group representatives (see: *Contact list* at the end of the book).

Pilkington Glass Handbook 2014 covers the range of products as it applied in May 2014.

Changes to the product range since then have not been incorporated.

Guide for Use:

Our Glass Handbook is organised into benefit-led categories. Please note that some of our products have multiple benefits and therefore may be found in more than one benefit-led category. If you are searching for a solution to a particular problem, you may need to consider products in more than one category.

Acknowledgements:

We wish to acknowledge the assistance of all those people throughout the NSG Group employees who have contributed to the compilation of our Glass Handbook.

Disclaimer:

This publication provides only a general description of the products. Further, more detailed information may be obtained from your local supplier of Pilkington products. It is the responsibility of the user to ensure that the use of any product is appropriate for any particular application and that such use complies with all relevant legislation, standards, code of practice and other requirements. To the fullest extent permitted by applicable laws, Nippon Sheet Glass Co. Ltd. and its subsidiary companies disclaim all liability for any error in or omission from this publication and for all consequences of relying on it.

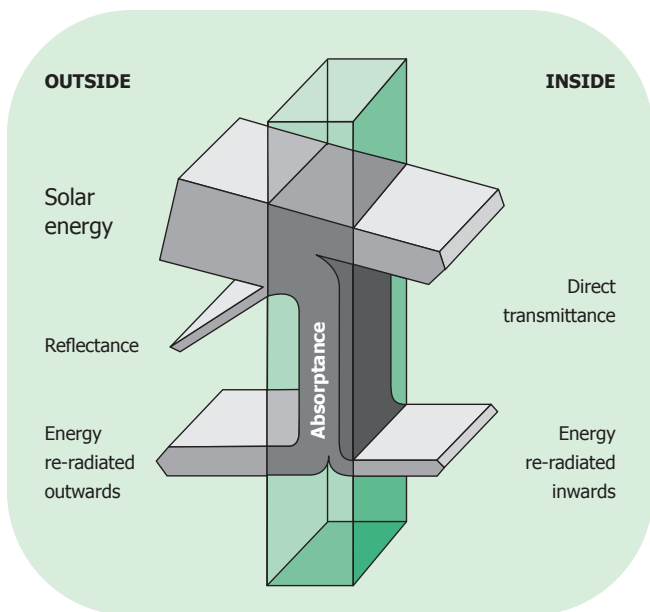


Figure 1. The solar control mechanism.

Visible light

Light Transmittance (LT) is the proportion of visible light at near normal incidence that is transmitted through the glass.

Light Reflectance (LR) is the proportion of visible light at near normal incidence that is reflected by the glass.

Colour Rendering Index (Ra) expresses the colour rendering properties of glass in transmission.

Solar energy

Glass transmits solar radiation from the sun by three mechanisms: reflection, transmission and absorption, which for solar control purposes are defined in terms of the following parameters:

Direct Solar Energy Transmittance (ET) is the proportion of solar radiation at near normal incidence that is transmitted directly through the glass.

Solar Energy Reflectance (ER) is the proportion of solar radiation at near normal incidence that is reflected by the glass back into the atmosphere.

Solar Energy Absorptance (EA) is the proportion of solar radiation at near normal incidence that is absorbed by the glass.

Total Solar Energy Transmittance (TET), also known as g value or solar factor, is the fraction of solar radiation at near normal incidence that is transferred through the glazing by all means. It is composed of the direct transmittance, also known as the short wave component, and the part of the absorptance dissipated inwards by longwave radiation and convection, known as the longwave component. The proportions of the absorbed energy that are dissipated either inside or outside depend on the glazing configuration and the external exposure conditions.

Selectivity index S: light to heat ratio ($S = LT/TET$).

The solar control mechanism is illustrated in Figure 1.

The solar radiant heat admission properties of glasses can be compared by their shading coefficients.

The Total Shading Coefficient (TSC) is derived by comparing the properties of any glass with a clear float glass having a total energy transmittance of 0,87 (such a glass would have a thickness of about 3 mm). It comprises a short wavelength and long wavelength shading coefficient.

The Short Wavelength Shading Coefficient (SWSC) is the direct energy transmittance divided by 0,87.

The Long Wavelength Shading Coefficient (LWSC) is the fraction of the absorptance released inwards, again divided by 0,87.

Thermal Insulation

Heat loss is quantified by the thermal transmittance or U-value (U). The U-value, usually expressed in S.I. units (Système Internationale d'Unités) of $\text{W/m}^2\text{K}$, is the heat flux density through a given structure divided by the difference in environmental temperatures on either side of the structure in steady state conditions. It is more generally referred to as the rate of loss of heat per square metre, under steady state conditions, for a temperature difference of one Kelvin (or degree Celsius) between the inner and outer environments separated by the glass, or other building element.

Performance data for Pilkington products

Performance data given in the following tables have been determined in accordance with European Standards (EN). Data for insulating glass units have been based on 90% argon filling unless otherwise stated, construction based on a 16 mm argon filled cavity, except for triple glazing where the cavities are 12 mm unless otherwise indicated.

(Note: U_g -values should be rounded to the nearest 0,1 in accordance with EN 673)

Light and solar energy technical data have been determined in accordance with EN 410.

Unless otherwise stated all the calculations are based on 4 mm glass thickness.

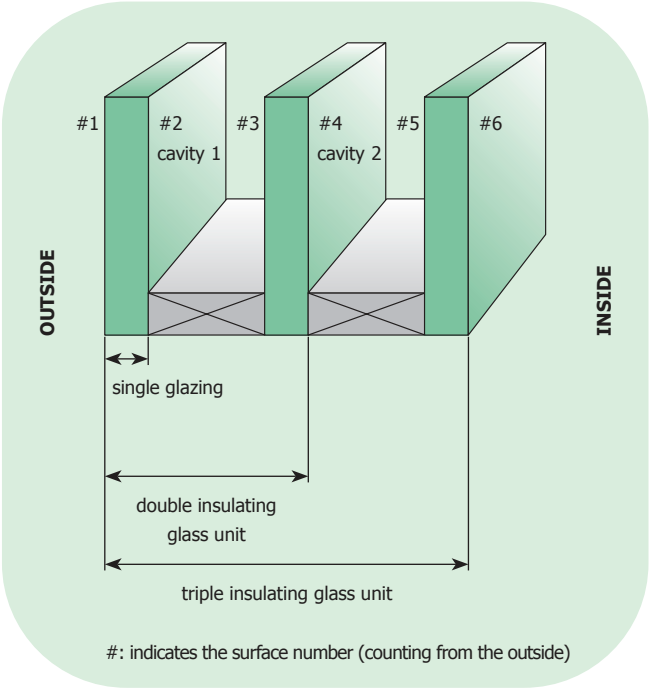


Figure 2. Glass surfaces.



1. Solar Control



Solar control is a key issue in terms of energy saving. In hot conditions or for buildings with high internal loads, solar control glass is used to minimise solar heat gain by rejecting solar radiation and help control glare. In more temperate conditions, it can be used to balance solar control with high levels of natural light.

The topic of air-conditioning is a major concern to building designers and architects. Often, more energy is used to operate air-conditioning systems during the summer months than to heat the building in winter thereby increasing the carbon footprint. It is therefore essential to improve the energy efficiency of buildings during the summer as well as in the winter.

In cold weather conditions, our low-emissivity glass reduces heat loss while allowing high levels of valuable free solar gain to heat buildings without significant loss in natural light. However, unless combined with solar control, in the summer it can become uncomfortably hot. The correct choice of glass can help to reduce the capital outlay, running costs and associated carbon emissions of a building throughout the year.

Given the variety of building designs and climatic conditions and the different levels of exposure to solar radiation during the year, the choice of glass must be able to protect the inside of the building to ensure maximum comfort, minimise energy consumption, guarantee safety and, not least, provide the optical and aesthetic qualities that satisfy the designer.



We are continually innovating and developing products that satisfy the full range of architectural requirements. Over the years we have developed a wide range of energy management solutions for large and small glazed areas on all types of building.

Our innovative solar control products cover the whole range:

- from the highest performing, off-line coated, solar control and low-emissivity products within the Pilkington **Suncool™** range;
- through on-line environmental control glasses that combine good performance solar control with low-emissivity such as Pilkington **Eclipse Advantage™**;
- to low-performance, body-tinted glass in the Pilkington **Optifloat™** Tint range;
- and even to solar control glass combined with the revolutionary, self-cleaning Pilkington **Activ™**.

In addition to the above ranges our solar control range can be used with many other Pilkington solutions, to achieve countless benefits in terms of safety, functionality and cost-efficiency.

How it works? – Glass controls solar heat radiation by the three mechanisms: reflection, transmission and absorption, which for solar control purposes are defined in terms of the following parameters:

- **Direct transmittance** – the proportion of solar radiation transmitted directly through the glass.
- **Reflectance** – the proportion of solar radiation reflected back into the atmosphere.
- **Absorptance** – the proportion of solar radiation absorbed by the glass.
- **Total transmittance** (also known as g value or solar factor) – the proportion of solar radiation transmitted through the glass by all means. This is composed of the direct transmittance and that which is absorbed by the glass and reradiated inwards.



Further parameters given to glass are as follows:

- **Light transmittance** – the proportion of the light that is transmitted by the glass.
- **Light reflectance** – the proportion of the light that is reflected by the glass.
- **Total Shading Coefficient** – the ratio between total solar heat transmittance of the glass and that of a single 3 mm thick clear float glass.

- **Shortwave Shading Coefficient**

$$SWSC = \frac{ET}{\text{total solar heat transmittance of standard glass}}$$

- **Longwave shading coefficient**

$$LWSC = TSC - SWSC$$

- **Total Shading Coefficient**

$$TSC = \frac{TET}{\text{total solar heat transmittance of standard glass}}$$

where:

SWSC – shortwave shading coefficient

LWSC – longwave shading coefficient

TSC – total shading coefficient

ET – direct solar heat transmittance

TET – total solar heat transmittance

Example for Pilkington **Optifloat™** Green 6 mm glass:

$$TSC = \frac{58}{87} = 0,67$$

The Total Shading Coefficient is not an absolute value. It is derived by comparing the properties of any glass with a 3 mm clear float glass having a total energy transmittance of 87%.

- **Selectivity index** – the ratio between light transmittance and total solar heat transmittance

$$S = \frac{LT}{g}$$

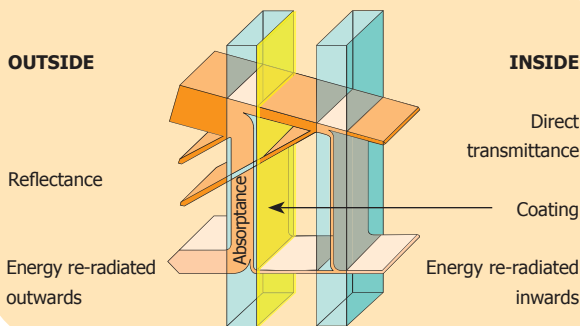


Figure 1.1. Insulating glass unit incorporating coated solar control glass.



Tinted solar control glass

Description

Pilkington **Arctic Blue**™ is a unique blue body-tinted float glass for high daylight transmittance, good solar control and cool comfortable colour without the use of a surface coating. Its solar control properties and colour densities vary with each available thickness so that glass with properties appropriate to a particular application can be chosen.

Applications

Pilkington **Arctic Blue**™ is ideally suited to climates or conditions where energy costs for cooling are a consideration.

Pilkington **Arctic Blue**™ can be specified as toughened or laminated glass. Due to its high solar heat absorptance, Pilkington **Arctic Blue**™ may be subject to thermal breakage. The risk of thermal breakage may occur on façades exposed to the sun, and in situations where high temperature differences across the glass pane are expected. In such cases it is advisable to specify toughened or heat strengthened glass.

Features and benefits

- Improved solar performance compared to traditional tinted float glass, reducing the need for air-conditioning.
- Solar control performance and colour density vary with the thickness.



Pilkington **Arctic Blue**™ – DAF showroom, Trzciana near Rzeszów, Poland



Pilkington **Arctic Blue™** – Call Center Poland, Góra Kalwaria, Poland

- Cool and distinctive rich blue colour, offering possibility for unique aesthetics and innovative design.
- High visibility properties providing a crisp, undistorted, natural view from the interior.
- High daylight transmittance, reducing the need for artificial lighting.
- Low internal and external reflection.
- Low UV transmittance.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- Easy to handle and process.
- No edge deletion required.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in monolithic form or incorporated in insulating glass units, and has an unlimited shelf-life.
- Available in 4, 6 and 10 mm thicknesses.



Pilkington Arctic Blue™													
glass		performance code			light			energy				S, UV	
I	monolithic glass	W/m²K	%	%	%	%	%	%	%	%	%	%	%
		U _g	LT	g	LT	g	LT	g	LT	g	LT	g	
		U _g value		light		energy							
4 mm		5,8	64	59	64	59	64	59	64	59	64	59	64
6 mm		5,7	54	50	54	50	54	50	54	50	54	50	54
8 mm		5,6	45	44	45	44	45	44	45	44	45	44	45
10 mm		5,6	38	40	38	40	38	40	38	40	38	40	38

Notes:

Maximum size: 6000 mm × 3210 mm.



PILKINGTON		Pilkington Arctic Blue™											
glass configuration			performance code		light			energy				S, UV	
II	II	II	W/m²K	%	%	%	%	%	%	%	%	—	%
II	II	II	U _g	LT	g	LT	g	LT	g	LT	g	LT	g
			U _g value					energy					
			insulating glass unit, Pilkington Optitherm ™ S3 #3					Ra colour rendering index					
			insulating glass unit, Pilkington Optitherm ™ S1 #3					LRI reflectance inside					
			insulating glass unit, Pilkington K Glass ™ N #3					LRO reflectance outside					
			insulating glass unit, primary product outside					LT transmittance					



Pyrolytic on-line coated solar control glasses with low-emissivity properties

Description

A range of good solar control performance pyrolytic on-line coated clear or body-tinted glass, with unique colour appearances, medium light transmittance, low, medium or high light reflectance and low-emissivity. The durable coating is applied pyrolytically during float glass manufacture to a variety of substrates giving a range of colours in reflection – Clear, Blue-Green, EverGreen, Bronze, Grey and Arctic Blue.

Pilkington **Eclipse Advantage**™ can be used in single glazing applications provided that the coating faces the interior of the building.



Pilkington **Eclipse Advantage**™ Arctic Blue
– Silver Center, Janki near Warsaw, Poland



Pilkington **Eclipse Advantage**™ Clear
and Pilkington **Eclipse Advantage**™ Bronze
– Kolporter, Kielce, Poland

Applications

Pilkington **Eclipse Advantage**™ provides a versatile and attractive solution to all applications where a brightly coloured glass is needed, with enhanced solar control performance. It is equally suited for all applications, from the small refurbishment to the largest prestige commercial development, where a comparatively low cost but high impact solution is demanded. Where a safety glass is required, Pilkington **Eclipse Advantage**™ can be specified as toughened or laminated glass. Due to its high solar heat absorptance, Pilkington **Eclipse Advantage**™ may be subject to thermal breakage. The risk of thermal breakage may occur on façades



exposed to the sun, and in situations where high temperature differences across the glass pane are expected. In such cases it is advisable to specify toughened or heat strengthened glass.

Features and benefits

- Good solar control performance with some low-emissivity properties, reducing the need for heating and cooling the building.
- Choice of colours, light transmittance, reflectivity and appearance, providing increased design flexibility.
- Less heat absorption compared to other tinted reflective glasses, eliminating the need for heat treat vision glass under normal glazing conditions.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- Durable pyrolytic on-line coating easy to handle and process, providing low cost solution with high visual impact.
- Can be laminated, toughened, bent and enamelled using standard techniques
- Can be used in monolithic form or incorporated in insulating glass units, and has unlimited shelf-life.
- No edge deletion required.
- Harmonising spandrel panels available.
- Available in 4 and 6 mm thicknesses.



Pilkington **Eclipse Advantage™** Blue-Green – Energa SA, Gdańsk, Poland

Notes:
Maximum size: 5180 mm × 3300 mm.



Pilkington Eclipse Advantage™ Clear			S, UV		energy		light		performance code		glass configuration	
	II	II	%	UV	%	TET	%	Ra	%	g	W/m²K	II
			—	S	—	EA	—	LRI	—	LT	U _g	II
				selectivity index		absorptance		reflectance inside		energy		insulating glass unit, Pilkington Optitherm™ S3 #3
						reflectance		reflectance outside		light		insulating glass unit, Pilkington Optitherm™ S1 #3
						direct transmittance		transmittance		U_g value		insulating glass unit, Pilkington K Glass™ N #3
												insulating glass unit, primary product outside #2

Notes:

- 1. Based on 6 mm glass thickness.
- 2. Based on 16 mm argon filled (90%) cavities.



Pilkington Eclipse Advantage™ Arctic Blue		S, UV	
PILKINGTON	glass	performance code	
		energy	
I	monolithic glass #2	light	
		S, UV	
4 mm	6 mm		UV transmittance
			S selectivity index
4 mm	6 mm		TSC total shading coefficient
			LSC longwave shading coefficient
4 mm	6 mm		SSC shortwave shading coefficient
			TET total transmittance
4 mm	6 mm	%	EA absorptance
			ER reflectance
4 mm	6 mm	%	ET direct transmittance
			Ra colour rendering index
4 mm	6 mm	%	LRI reflectance inside
			LRO reflectance outside
4 mm	6 mm	%	LT transmittance
			g energy
4 mm	6 mm	%	LT light
			U _g U _g value

Notes:

Maximum size: 5180 mm × 3300 mm.

1

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.



Pilkington Eclipse Advantage™ Blue-Green		S, UV	
PILKINGTON	glass	performance code	
		energy	
I	monolithic glass #2	light	
		S, UV	
4 mm	6 mm	I	UV transmittance
			S selectivity index
4 mm	6 mm	I	TSC total shading coefficient
			LSC longwave shading coefficient
4 mm	6 mm	I	SSC shortwave shading coefficient
			TET total transmittance
4 mm	6 mm	%	EA absorptance
			ER reflectance
4 mm	6 mm	%	ET direct transmittance
			Ra colour rendering index
4 mm	6 mm	%	LRI reflectance inside
			LRO reflectance outside
4 mm	6 mm	%	LT transmittance
			g energy
4 mm	6 mm	%	LT light
			U _g U _g value

Notes:

Maximum size: 5180 mm × 3300 mm.

1

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.

Notes:
Maximum size: 5180 mm × 3300 mm.

1

NOTES:

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.

Notes:
Maximum size: 5180 mm × 3300 mm.



Pilkington Eclipse Advantage™ EverGreen		S, UV		energy		light		performance code		glass configuration	
		%	UV	%	TET	%	Ra	%	g	II	insulating glass unit, Pilkington Optitherm™ S3 #3
		—	S	—	TSC	—	LRI	—	LT	II	insulating glass unit, Pilkington Optitherm™ S1 #3
					LSC		LRO		U _g	II	insulating glass unit, Pilkington K Glass™ N #3
					SSC		LT		U _g value	II	insulating glass unit, primary product outside #2
					EA						
					ER						
					ET						

Notes:

- 1. Based on 6 mm glass thickness.
- 2. Based on 16 mm argon filled (90%) cavities.



Pilkington Eclipse Advantage™ Grey		S, UV					
glass	I	performance code	light	energy	S, UV		
						W/m²K	%
4 mm	monolithic glass #2	U _g	U _g value	g	energy	UV	UV transmittance
		LT	light	LT	light	S	selectivity index
6 mm	monolithic glass #2			Ra	colour rendering index	TSC	total shading coefficient
				LRI	reflectance inside	LSC	longwave shading coefficient
				LRO	reflectance outside	SSC	shortwave shading coefficient
				LT	transmittance	TET	total transmittance
						EA	absorptance
						ER	reflectance
						ET	direct transmittance

Notes:

Maximum size: 5180 mm × 3300 mm.

1

NOTES:

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.



Tinted solar control glass

Description

Pilkington **EverGreen™** establishes new standards of quality, aesthetics and performance for green body-tinted glass.

Pilkington **EverGreen™** glass offers good solar control characteristics and responds to the demand for high light transmittance without the use of a surface coating. Its solar control properties and colour densities vary with each available thickness so that glass with properties appropriate to a particular application can be chosen.

Applications

Pilkington **EverGreen™** is ideally suited to climates or conditions where energy costs for cooling are a consideration.

Pilkington **EverGreen™** absorbs much of the sun's heat and UV rays while still letting through a high level of daylight. Where a safety glass is required, Pilkington **EverGreen™** can be specified as toughened or laminated glass.

Due to its high solar heat absorptance, Pilkington **EverGreen™** may be subject to thermal breakage. The risk of thermal breakage may occur on façades exposed to the sun, and in situations where high temperature differences across the glass pane are expected. In such cases it is advisable to specify toughened or heat strengthened glass.



Features and benefits

- Improved solar control performance compared to traditional tinted float glass, reducing the need for air-conditioning.
- Solar control performance and colour density vary with the thickness.
- Refreshing soft green colour, offering a crisp, clean view of the outside.
- High daylight transmittance, reducing the need for artificial lighting.
- Low internal and external reflection.
- Low UV transmittance.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- Easy to handle and process.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in monolithic form or incorporated in insulating glass units, and has an unlimited shelf-life.
- Available in 6 mm thickness.
- Satisfies the requirements for harmonised European Norm EN 572.



Pilkington **EverGreen™** – Sheraton Miramar Hotel, Viña del Mar, Chile

Notes:
Maximum size: 5180 mm × 3300 mm.



Pilkington EverGreen™		S, UV		energy		light		performance code		glass configuration	
		%	UV	%		%		%		II	II
		—	S	—		—		W/m²K	U _g	II	II
			UV transmittance								
			selectivity index								
			TSC								
			total shading coefficient								
			LSC								
			longwave shading coefficient								
			SSC								
			shortwave shading coefficient								
			TET								
			total transmittance								
			EA								
			absorptance								
			ER								
			reflectance								
			ET								
			direct transmittance								
			Ra								
			colour rendering index								
			LRI								
			reflectance inside								
			LRO								
			reflectance outside								
			LT								
			transmittance								
			g								
			energy								
			LT								
			light								
			U _g								
			U _g value								
			insulating glass unit, Pilkington Optitherm™ S3 #3								
			insulating glass unit, Pilkington Optitherm™ S1 #3								
			insulating glass unit, Pilkington K Glass™ N #3								
			insulating glass unit, primary product outside								

Notes:

- 1. Based on 6 mm glass thickness.
- 2. Based on 16 mm argon filled (90%) cavities.



Body tinted solar control glass

Description

A range of low solar control performance uncoated body-tinted glass, with low light reflection and high energy absorption.

Please note that in all body-tinted glass products, the properties and colour density vary with the thickness; this needs to be considered when designing façades where colour uniformity is aesthetically important. All of the body-tinted glasses can be toughened or laminated and/or incorporated into insulating glass units.



Pilkington **Optifloat™** Green – The lecture center of University of Technology, Poznań, Poland



Pilkington **Optifloat™** Grey – Mirbud SA head office, Skierniewice, Poland

Applications

Pilkington **Optifloat™** Tint glass products can be used wherever a coloured glass without surface coating is required for visual appeal or where a degree of solar control performance is necessary to improve or control the internal environment of the building. Where a safety glass is required, they can be specified as toughened or laminated glass.

Due to its high solar heat absorptance, Pilkington **Optifloat™** Tint may be subject to thermal breakage. The risk of thermal breakage may occur on façades exposed to the sun, and in situations where high temperature differences across the glass pane are expected. In such cases it is advisable to specify toughened or heat strengthened glass.

Designed to improve conditions within buildings by reducing glare, solar radiation and heat transfer into the building, they also reduce UV radiation and offer improved privacy, when compared with clear glass.



Pilkington **Optifloat™** Green – Parker Poland office, Czosnów, Poland



Pilkington **Optifloat™** Bronze – Buchalter office, Marki near Warsaw, Poland



Features and benefits

- Solar control performance, reducing the need for air-conditioning.
- Solar control performance and colour density vary with the thickness.
- Available in a choice of colours (Green, Blue-Green, Bronze and Grey), offering flexibility for original and innovative architectural design even where low reflection is required.
- Subdued colour range, complementing other building materials and natural surroundings.
- Low to high light transmission.
- Low internal and external reflection, reducing uncomfortable glare from the sun, and offering improved privacy compared to clear glass.
- Can reduce UV radiation.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in monolithic form or incorporated in insulating glass units, and has unlimited shelf-life.
- Available in a wide range of sizes from 3 to 10 mm (thickness depending on the colour).
- Satisfies the requirements for harmonised European Norm EN 572.

Notes:
Maximum size: 5180 mm x 3300 mm.



Pilkington Optifloat™ Blue-Green		S, UV		energy		light		performance code		glass configuration	
		%	UV	%	TET	%	Ra	%	g	II	insulating glass unit, Pilkington Optitherm™ S3 #3
		—	S	—	EA	%	LRI	%	LT	II	insulating glass unit, Pilkington Optitherm™ S1 #3
				—	ER	%	LRO	%	U _g	II	insulating glass unit, Pilkington K Glass™ N #3
				—	ET	%	LT	%	U _g	II	insulating glass unit, primary product outside
				—							
				—							
				—							
				—							
				—							
				—							
				—							
				—							

Notes:
1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.

Notes:
Maximum size: 6000 mm x 3210 mm.

1

NOTES:

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.



Pilkington Optifloat™ Green																	
glass	performance code	light				energy				S, UV							
I	W/m²K	U _g	LT	g	LT	LRo	LRI	Ra	ET	ER	EA	TET	SSC	LSC	TSC	S	UV
				energy					direct transmittance	reflectance	absorptance	total transmittance	shortwave shading coefficient	longwave shading coefficient	total shading coefficient	selectivity index	UV transmittance
4 mm		5,8	80	65	80	7	7	93	56	6	38	65	0,64	0,11	0,75	1,23	29
5 mm		5,7	78	61	78	7	7	92	51	6	43	61	0,59	0,11	0,70	1,28	25
6 mm		5,7	75	58	75	7	7	90	46	6	48	58	0,53	0,14	0,67	1,29	21
8 mm		5,6	71	53	71	7	7	87	40	5	55	53	0,46	0,15	0,61	1,34	17
10 mm		5,6	67	49	67	6	6	84	35	5	60	49	0,40	0,16	0,56	1,37	13

1

NOTES:

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.

Notes:
Maximum size: 6000 mm x 3210 mm.

1

1. Based on 6 mm glass thickness.
2. Based on 16 mm argon filled (90%) cavities.



Pyrolytic on-line coated reflective solar control glass

Description

A range of medium solar control performance on-line coated clear or body-tinted glass, with low light transmittance and medium light reflectance.

Pilkington **Reflite™** may be used in single glazing applications (with coating on surface #2), as well as in insulated glass units. They can also be laminated, heat strengthened, toughened and curved (or bent) using standard techniques.

Applications

Pilkington **Reflite™** can be used in a wide range of residential and commercial applications. Due to their high solar heat absorptance, Pilkington **Reflite™** may be subject to thermal breakage. The risk of thermal breakage may occur on façades exposed to the sun,



Pilkington **Reflite™** Emerald Green



Pilkington **Reflite™** Arctic Blue

and in situations where high temperature differences across the glass pane are expected. In such cases it is advisable to specify toughened or heat strengthened glass.



Features and benefits

- Medium solar control performance, reducing the need for air-conditioning.
- Attractive colours (Clear, Arctic Blue, Emerald Green and Bronze) providing a solution for a wide variety of design requirements.
- Colour stability whether toughened or annealed.
- Medium reflectivity providing privacy whilst still allowing a clear view to the outside.
- Durable pyrolytic on-line coating easy to handle and process, providing low cost solution with high visual impact.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in monolithic form or incorporated in insulating glass units, and has unlimited shelf-life.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- All colours available in 5 and 6 mm.¹
- Available in sizes 3210 mm × 2250 mm and 3048 mm × 2134 mm.
- Performance data has been determined in accordance with European Standards EN 1096 and EN 410 and quality requirements of the NSG Group.

¹ 8 mm glass may be available in the future on special request.



Pilkington Reflite™ Arctic Blue																						
glass	I	performance code			light			energy						S, UV								
		W/m²K	%	%	g	LT	LT	%	%	%	%	%	%	%	%							
5 mm 6 mm	monolithic glass #2	U _g	U _g value		g	energy		LT	light		LT	transmittance		LRo	reflectance outside		LRI	reflectance inside		Ra	colour rendering index	
		18	23	55	93	17	14	69	33	0,20	0,18	0,38	0,55	2	0,15	0,21	0,36	0,52	2	UV	UV transmittance	
		5,7	18	33		18	23	55	93	13	13	74	31	0,15	0,21	0,36	0,52	2	S	selectivity index		



Pilkington Reflite™ Arctic Blue																														
glass configuration			performance code		light			energy				S, UV																		
II	II	II	W/m²K	%	U _g	%	LT	%	LRo	%	LRi	%	Ra	%	ET	%	ER	%	EA	%	TET	%	SSC	%	LSC	%	TSC	%	S	UV
II	II	II																												



Pilkington Reflite™ Emerald Green		S, UV			
glass	I	performance code	light	energy	S, UV
5 mm	monolithic glass #2	U _g	U _g value		UV
		LT	light		UV transmittance
6 mm	monolithic glass #2	g	energy		S
		LT	light		selectivity index
				Ra	TSC
				colour rendering index	total shading coefficient
			LRI		LSC
			reflectance inside		longwave shading coefficient
			LRO		SSC
		reflectance outside		shortwave shading coefficient	
			LT		TET
		transmittance		total transmittance	
				EA	ER
				absorptance	reflectance
				ET	ET
				direct transmittance	direct transmittance

Notes:

Maximum size: 3302 mm × 2438 mm.



Pilkington Reflite™ Emerald Green																			
glass configuration				performance code			light			energy					S, UV				
II	II	II	II	W/m²K	%	%	%	%	%	%	%	%	%	%	%	%			
				U _g	LT	g	LT	LRo	LRi	Ra	ET	ER	EA	TET	SSC	LSC	TSC	S	UV
				U _g value															
				light															
				energy															
insulating glass unit, Pilkington Optitherm™ S3 #3				transmittance												UV transmittance			
insulating glass unit, Pilkington Optitherm™ S1 #3				reflectance outside												selectivity index			
insulating glass unit, Pilkington K Glass™ N #3				reflectance inside															
insulating glass unit, primary product outside #2				colour rendering index															
				2,6	19	19	19	21	48	89	10	11	79	19	0,11	0,11	0,22	1,00	1
				1,5	18	15	15	21	46	89	8	11	81	15	0,09	0,08	0,17	1,20	1
				1,0	17	11	11	21	48	88	7	11	82	11	0,08	0,05	0,13	1,55	1
				1,1	18	13	13	21	47	89	8	11	81	13	0,09	0,06	0,15	1,38	1

Notes:

- 1. Based on 6 mm glass thickness.
- 2. Based on 16 mm argon filled (90%) cavities.



Pyrolytic on-line coated solar control glass with low-emissivity properties

Description

A good solar control performance pyrolytic on-line coated glass with neutral appearance, medium light transmittance, low light reflectance and low-emissivity. Used in insulating glass unit the product provides colour-neutral aesthetics and reduces external glare.



Pilkington **Solar-E™** – Comarch SA head office, Cracow, Poland

Applications

Pilkington **Solar-E™** provides attractive solution to various applications where high light transmittance with enhanced solar control performance is required. Thanks to low exterior light reflectance the product is widely used for modern glass façades where high reflectance is prohibited or undesirable.

Pilkington **Solar-E™** can be toughened or laminated where a safety glass is required. Toughened or heat strengthened glass should also be specified in applications where Pilkington **Solar-E™** may be at risk of thermal breakage.



Pilkington **Solar-E™** – Harmony Office Center I,
Warsaw, Poland



Pilkington **Solar-E™** – Rondo Business Park,
Cracow, Poland

Features and benefits

- Good solar control performance with some low-emissivity, reducing the need for heating and cooling the building.
- Medium light transmittance and low light reflectance for undistorted, natural views.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- Durable pyrolytic on-line coating easy to handle and process, providing low cost solution with high visual impact.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in monolithic form or incorporated in insulating glass units, and has unlimited shelf-life.
- No edge deletion required.
- Available in 6 and 8 mm thickness.

Notes:

1. Coating on surface 2 (facing inside).
2. Maximum size: 5180 mm × 3300 mm.



Pilkington Solar-E™		S, UV		energy		light		performance code		glass configuration	
		%	UV	%		%		%		II	
		—	S	—		—		W/m²K	U _g	II	
			UV transmittance							II	
			selectivity index							II	
			TSC							II	
			total shading coefficient							II	
			LSC							II	
			longwave shading coefficient							II	
			SSC							II	
			shortwave shading coefficient							II	
			TET							II	
			total transmittance							II	
			EA							II	
			absorptance							II	
			ER							II	
			reflectance							II	
			ET							II	
			direct transmittance							II	
			Ra							II	
			colour rendering index							II	
			LRI							II	
			reflectance inside							II	
			LRO							II	
			reflectance outside							II	
			LT							II	
			transmittance							II	
			g							II	
			energy							II	
			LT							II	
			light							II	
			U _g							II	
			U _g value							II	
			insulating glass unit, Pilkington Optitherm™ S3 #3							II	
			insulating glass unit, Pilkington Optitherm™ S1 #3							II	
			insulating glass unit, Pilkington K Glass™ N #3							II	
			insulating glass unit, primary product outside #2							II	

Notes:

- 1. Based on 6 mm glass thickness.
- 2. Based on 16 mm argon filled (90%) cavities.



Superior solar control performance glass with outstanding thermal insulation

Description

A range of superior solar control performance off-line coated glass, with high light transmittance, low, medium or high light reflectance and outstanding thermal insulation.

The Light Transmittance and Total Solar Energy Transmittance are important parameters which distinguish the solar control glass. The ratio between these parameters defines the selectivity index.

The wide range of products is available in clear or neutral appearance and in two distinctive colours: blue and silver.

Table 1.1. The appearance of the Pilkington **Suncool™** product range.

Product	IGU construction (6 mm external pane – 16 mm – 4 mm Pilkington Optifloat™ Clear)		
	Appearance in reflection (external view)	Level of reflection ¹	Appearance in transmission (internal view)
Pilkington Suncool™ 70/40	neutral	low	neutral
Pilkington Suncool™ 70/35	neutral/blue	medium	neutral
Pilkington Suncool™ 66/33	neutral	medium	neutral
Pilkington Suncool™ 60/31	neutral	low	neutral
Pilkington Suncool™ 50/25	neutral/blue	medium	neutral
Pilkington Suncool™ Blue 50/27	blue	medium	neutral
Pilkington Suncool™ Silver 50/30	silver	high	neutral
Pilkington Suncool™ 40/22	neutral/blue	medium	neutral
Pilkington Suncool™ 30/17	neutral/blue	medium	neutral

¹ Level of reflection: low <15%, medium 15-25%, high >25%.



Pilkington **Suncool™** is a range of solar control off-line coated products used in insulating glass units. The coating is designed to reflect the short wave solar radiation. Thanks to a low-emissivity characteristics of the coating, the long wave radiation (generated by the heating, lighting and buildings' occupants) is reflected from the glass back into the building. Pilkington **Suncool™** effectively balances solar control with high levels of natural light.



Pilkington **Suncool™** Blue 50/27, Pilkington Spandrel Glass Coated E130
– Vorwerk Autotec Polska head office, Brodnica, Poland



Pilkington **Suncool™** 66/33 – Platinum Business Park, Warsaw, Poland



For additional thermal insulation, Pilkington **Suncool™** insulating glass units can be filled with an inert gas such as argon.

We have developed a range of Pilkington Spandrel Glass products for use with Pilkington **Suncool™** solar control glass, to ensure continuity in the aesthetic design of façades. Pilkington Spandrel Glass Coated products are available in thicknesses 6, 8 and 10 mm in toughened form.

Table 1.2. The Pilkington Spandrel Glass Coated product range and appearance.

Product	Appearance in reflection	Level of reflection ¹	Light reflection [%]
Pilkington Spandrel Glass Coated E200	neutral	medium	19
Pilkington Spandrel Glass Coated E140	neutral/blue	high	28
Pilkington Spandrel Glass Coated E120	silver	high	35

¹ Level of reflection: low <15%, medium 15-25%, high >25%.



Pilkington **Suncool™** Silver 50/30 – Kamea Residential Complex, Konstancin Jeziorna, Poland



Table 1.3. The full Pilkington **Suncool™** range and recommended off-line coated spandrels.

Product	Spandrel offering	Notes
Pilkington Suncool™ 70/40	—	Due to its low reflection, the appearance of Pilkington Suncool™ 70/40 is dominated by the transmission. However Pilkington Spandrel Glass Coated E200 can be offered as a spandrel solution for Pilkington Suncool™ 70/40 when the colour match is not expected to be perfect.
Pilkington Suncool™ 70/35	E200	Pilkington Spandrel Glass Coated E200 is the recommended solution for Pilkington Suncool™ 70/35, Pilkington Suncool™ 66/33 and Pilkington Suncool™ 60/31. Whilst not a perfect colour match this is the most harmonising offering in comparison to an enamelled spandrel solution.
Pilkington Suncool™ 66/33	E200	
Pilkington Suncool™ 60/31	E200	
Pilkington Suncool™ 50/25	E200	—
Pilkington Suncool™ Blue 50/27	—	—
Pilkington Suncool™ Silver 50/30	E120	—
Pilkington Suncool™ 40/22	E140	Pilkington Spandrel Glass Coated E140 is the recommended solution for Pilkington Suncool™ 40/22. Whilst not a perfect colour match this is the most harmonising offering in comparison to an enamelled spandrel solution.
Pilkington Suncool™ 30/17	E140	—

As with all spandrel constructions, it is strongly advised that the customer conducts a visual ‘mock-up’ test to ensure an acceptable match.



Applications

Pilkington **Suncool™** can only be used in insulating glass units. Designed to achieve optimum performance in large glazed areas, Pilkington **Suncool™** products are suitable for commercial and resi-



Pilkington **Suncool™** 50/25 – Holland Park, Warsaw, Poland



Pilkington **Suncool™** 66/33 – Wiśniowy Business Park, Warsaw, Poland



Pilkington **Suncool™** 50/25 – Aeropark Business Center (building A), Warsaw, Poland



dential applications that demand high light transmission properties. The high selectivity index (light-to-heat ratio) combined with outstanding thermal insulation makes the range ideally suited for large areas of glazing, where the need is to control solar gains without significantly reducing the internal light levels.

Where a safety glass is required, Pilkington **Suncool™** can be specified as toughened or laminated glass. Toughened or heat strengthened glass should also be specified in applications where Pilkington **Suncool™** may be at risk of thermal breakage.

Pilkington **Suncool™** products are available on Pilkington **Optiwhite™**, low-iron substrate which will offer higher light transmission and lower absorption than on standard float glass. The range of these products is called Pilkington **Suncool™** OW.



Pilkington **Suncool™** 70/40 OW – Renoma Shopping Center, Wrocław, Poland



Features and benefits

- Superior solar control performance with the highest level of thermal insulation (U_g -value down to 1,0 W/m²K in a double insulating glass unit with 90% argon filled), reducing the need for cooling and heating the building.
- High selectivity index (light transmittance divided by total solar heat transmittance), offering low solar gains without significantly reducing the internal light levels.
- Wide choice of colours and appearances, providing solutions for the most demanding designs.
- Range of light transmission and reflection.
- Can only be used in insulating glass units; argon gas filling can be used to achieve higher thermal insulation.
- Can be enhanced when combined with other Pilkington products to provide additional benefits such as self-cleaning, noise control, safety or security properties.
- Can also be combined with Pilkington **Optiwhite™** for improved light and solar transmittance properties.
- Harmonising spandrel panels available, allowing freedom in design of complete glass façades.
- Available in 6, 8 and 10 mm thickness in annealed and toughened form (4 mm available in some products, 12 mm may be available on special request).


1

1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
2. Based on argon gas-filled cavity (90%).
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.

Notes:

1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
2. Based on argon gas-filled cavity (90%).
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



Pilkington Suncool™ 70/35		S, UV		energy							light				performance code			glass configuration																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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Notes:

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1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
2. Based on argon gas-filled cavity (90%).
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.

Notes:

1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
2. Based on argon gas-filled cavity (90%).
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.




Pilkington Suncool™ 50/25		S, UV		energy		light		performance code		glass configuration	
		%	UV	%	UV	%	Ra	%	g	III	insulating glass unit, Pilkington Optitherm™ S3 #5
		—	S	—	S	—	LRI	—	LT	II	insulating glass unit, Pilkington Optitherm™ S3 #3
			TSC		TSC		LRO		U _g	II	insulating glass unit, Pilkington K Glass™ N #4
			LSC		LSC		LT		W/m²K	II	insulating glass unit, primary product outside #2
			SSC		SSC						
			TET		TET						
			EA		EA						
			ER		ER						
			ET		ET						

- Notes:
- 1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
 - 2. Based on argon gas-filled cavity (90%).
 - 3. The primary product shall only be used in insulating glass units.
 - 4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.


Notes:

1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
2. Based on argon gas-filled cavity (90%).
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



Pilkington Suncool™ Silver 50/30									
	glass configuration		performance code			light			
performance code		energy		S, UV		energy			
III		III		I		I			
II		II		I		I			
II		II		I		I			
II		II		I		I			
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Pilkington Suncool™ Silver 50/30 OW			S, UV		energy		light		performance code		glass configuration	
	III	II	%	UV	%	TET	%	Ra	%	g	III	insulating glass unit, Pilkington Optitherm™ S3 #5
			—	S	—	TSC	—	LRI	—	LT	II	insulating glass unit, Pilkington Optitherm™ S1 #3
	III	II	—	selectivity index	—	LSC	—	LRO	—	U _g	II	insulating glass unit, Pilkington K Glass™ N #4
			1,53	—	—	SSC	—	LT	—	1,0	↑	insulating glass unit, primary product outside #2
	III	II	—	—	—	total shading coefficient	—	—	—	—	—	—
			1,57	—	—	longwave shading coefficient	—	—	—	—	—	—
	III	II	—	—	—	shortwave shading coefficient	—	—	—	—	—	—
			0,39	—	—	total transmittance	—	—	—	—	—	—
	III	II	—	—	—	absorptance	—	—	—	—	—	—
			0,02	—	—	reflectance	—	—	—	—	—	—
	III	II	—	—	—	direct transmittance	—	—	—	—	—	—
			0,37	—	—	—	—	—	—	—	—	—

Notes:

- Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
- Based on argon gas-filled cavity (90%).
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Pilkington Suncool™ 40/22 OW																																	
glass configuration	performance code		light				energy							S, UV																			
	W/m²K	%	%	%	%	%	%	%	%	%	%	%	%	%																			
	II	II	III	g	energy	LT	light	U _g	U _g value	Ra	colour rendering index	LRI	reflectance inside	LRO	reflectance outside	LT	transmittance	ER	reflectance	EA	absorptance	TET	total transmittance	SSC	shortwave shading coefficient	LSC	longwave shading coefficient	TSC	total shading coefficient	S	selectivity index	UV	UV transmittance
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Pilkington Suncool™ 30/17		S, UV		energy		light		performance code		glass configuration	
		%	UV	%		%		%		III	insulating glass unit, Pilkington Optitherm™ S3 #5
		—	S	—	TSC	—	Ra	—	g	II	insulating glass unit, Pilkington Optitherm™ S3 #3
				—	LSC	—	LRI	—	LT	II	insulating glass unit, Pilkington K Glass™ N #4
				—	SSC	—	LRO	—	U _g	II	insulating glass unit, primary product outside #2
				%	TET	%	LT				
				%	EA	%					
				%	ER	%					
				%	ET	%					
		7	—	—	0,22	—	88	—	19	—	↕
		1,58	—	—	0,04	—	17	—	30	—	↕
		—	—	—	0,18	—	25	—	30	—	↕
		—	—	—	0,15	—	30	—	1,1	—	↕
		4	—	—	0,03	—	26	—	0,7	—	↕
		1,69	—	—	0,18	—	27	—		↕	

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Description

Pilkington **Suncool Optilam™** 65/59 is a laminated coated solar control glass with a coating laminated towards the PVB interlayer. It provides good solar control, high light transmittance and a neutral appearance. Depending on the coating position the glass can offer variable visual appearance with light reflectance of 8 or 17%.

Application

Laminated solar control glass dedicated to applications in curtain walls and double skin facades. The position of the coating in Pilkington **Suncool Optilam™** 65/59 allows the use of glass in single glass applications in the external skin of double skin facades as well as in the standard curtain walls.




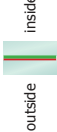
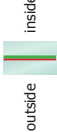



Pilkington **Suncool Optilam™** 65/59



Features and benefits

- Transparent solar control.
- Readily available in standard sizes in stock.
- Short lead time, endless shelf life, more flexibility.
- Alterable light reflectance coefficient (LR = 17% or 8%) depending on the glass position.
- All the benefits of double skin facades:
 - solar control glass is used as the external skin of double skin facade (as close to the sun as possible),
 - wind load occurs on the outer skin,
 - cavity between two skins provides additional and adjustable solar control,
 - effective noise control,
 - better ventilation of the building,
 - better energy performance (energy saving).



Pilkington Suncool Optilam™ 65/59						
 PILKINGTON	thickness	glass configuration		light	energy (%)	U_g (W/m ² K)
	12,8 mm	Pilkington Insulight™ Therm: 4 mm low-e glass – 16 mm argon – 4 mm Pilkington Optifloat™ Clear Pilkington Insulight™ Sun: 6 mm solar control glass – 16 mm argon – 4 mm Pilkington Optifloat™ Clear		transmittance	reflectance outside	reflectance inside
Pilkington Suncool Optilam™ 65/59				65	17	8
Pilkington Suncool Optilam™ 65/59 flipped				65	8	17
Pilkington Suncool Optilam™ 65/59		Pilkington Optitherm™ S3		53	23	18
Pilkington Suncool Optilam™ 65/59		Pilkington Suncool™ 70/35		46	24	21
Pilkington Suncool Optilam™ 65/59		Pilkington Suncool™ 50/25		33	25	22
Pilkington Suncool Optilam™ 65/59 flipped		Pilkington Optitherm™ S3		53	13	25
Pilkington Suncool Optilam™ 65/59 flipped		Pilkington Suncool™ 70/35		47	15	26
Pilkington Suncool Optilam™ 65/59 flipped		Pilkington Suncool™ 50/25		34	16	25

Notes : Performance data has been determined in accordance with EN 410 and EN 673.



Pilkington **Suncool™** Pro T is a range of toughenable off-line coated, energy management products that provide superior solar control and high thermal insulation when used as a component in Insulating Glass Units.

Pilkington **Suncool™** Pro T meets the requirements of the European Standard EN1096-3 Class C 'Glass in building – Coated glass' and when toughened will comply with EN 12150 'Thermally toughened soda lime silicate safety glass'.

Pilkington **Suncool™** Pro T can only be used in Insulating Glass Units. The coating for Pilkington **Suncool™** Pro T is designed to be on glass surface #2 (counting from the outside).

Pilkington **Suncool™** Pro T must be thermally toughened prior to Insulating Glass Unit fabrication to achieve desired solar control and low-emissivity performance and final appearance. After toughening, Pilkington **Suncool™** Pro T products are a colour match with their annealed Pilkington **Suncool™** counterparts.

Currently the range of Pilkington **Suncool™** Pro T includes the following glass types:

- Pilkington **Suncool™** 70/40 Pro T
- Pilkington **Suncool™** 70/35 Pro T
- Pilkington **Suncool™** 66/33 Pro T
- Pilkington **Suncool™** 50/25 Pro T

Pilkington **Suncool™** Pro T products are available on clear float substrate in jumbo and split sizes in 6, 8 and 10 mm thicknesses.

High performance solar control glass Pilkington **Suncool™** Pro T is available for glass processors and can be toughened by them in the most suitable formats (according to the individual order) and in the most suitable deadlines. Ultimately the processor receives toughened high performance solar control glass that combines high solar control performance with safety as well as high mechanical and thermal resistance.



Pilkington **Suncool™** 50/25 T – NoveKino cinema, Siedlce, Poland



Off-line coated reflective solar control glass

Description

Pilkington **SunShade™** Silver is a medium solar control performance off-line coated glass, with low light transmittance and high light reflectance. It offers the optimum solution for controlling intense sunlight and solar glare, which can be common problems for both commercial and residential buildings in hot and sunny climates.

Application

Pilkington **SunShade™** Silver is ideal for use in commercial façades as well as residential applications in hot climates with intense solar glare and sunlight. Where a safety glass is required, it can be specified as toughened or laminated glass.

Due to their high solar heat absorptance, Pilkington **SunShade™** Silver may be subject to thermal breakage. The risk of thermal breakage may occur on façades exposed to the sun, and in situations where high temperature differences across the glass pane are expected. In such cases it is advisable to specify toughened or heat strengthened glass. A thermal safety check is advisable for all applications.



Pilkington **SunShade™** Silver



Features and benefits

- Medium solar control performance with low light transmittance, thereby reducing the solar glare and heat entering the building.
- High reflectivity providing privacy whilst still allowing a clear view to the outside.
- Additional thermal insulation performance when combined in an insulating glass unit with a low-emissivity glass.
- Perfect colour match whether toughened or annealed.
- Can be cut, laminated, toughened, heat-strengthened, bent and made into insulating glass units using standard techniques.
- Has to be incorporated into an insulating glass unit.
- Available in 6 and 8 mm thicknesses.
- Maximum size 2250 mm × 3210 mm.

[illegible]

Notes:

1. Based on construction 6-16-4 (double glazed units) and 6-12-4-12-4 (triple glazed units).
2. Based on argon gas-filled cavity (90%).
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



2. Thermal Insulation



Low-emissivity

Advances in low-emissivity (low-e) glass technology have made windows an essential contributor to energy conservation and comfort, minimising heat loss and internal condensation.

The measure of heat loss is usually expressed in terms of U_g -value, which is the rate of heat loss in Watts per square metre per degree Kelvin temperature difference between inside and outside (expressed as W/m^2K). The lower the U_g -value, the better the insulation of the product.

How it works – Effectively, low-emissivity glass will reflect energy back into a building, to achieve much lower heat loss than ordinary float glass. Additionally, different types of low-emissivity glass allow different amounts of passive solar heat gain which helps reduce heating requirements and costs, especially in colder months.

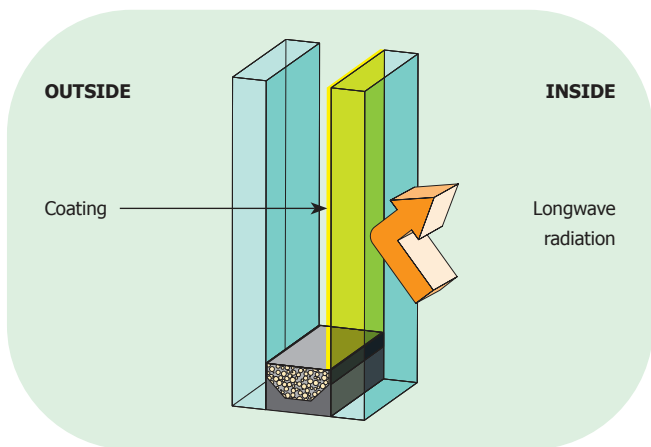


Figure 2.1. Insulating glass unit incorporating low-e glass.



Solar energy enters the building mainly as shortwave radiation but, once inside, it is reflected back by objects towards the glass as long-wave radiation. Low-emissivity glass has a coating that allows the transmission of the sun's shortwave radiation at a much higher rate than longwave radiation (from the heaters, electrical equipment and occupants in the room), providing an effective barrier to heat loss.

To maximise energy efficiency all year round, often the ideal glazing solution balances both solar control and low-emissivity performance. Our products offer two ways in which this can be achieved:

- by applying a single product which provides both solar control and low-emissivity in an insulating glass unit,
- by using both a solar control product and a separate low-emissivity product within an insulating glass unit.

Our low-emissivity range covers all levels of requirements:

- from on-line products such as Pilkington **K Glass™**,
- to extremely low U_g -value off-line solutions in the Pilkington **Optitherm™** range,
- through to Pilkington **Suncool™** and Pilkington **Eclipse Advantage™** which provide both low-emissivity and solar control properties in a single product.



High quality insulating glass units

Description

Pilkington insulating glass units called Pilkington **Insulight™** or Pilkington **Insulight™** Triple are technically advanced, dual sealed, double or triple glazed units.

They are designed to accommodate a variety of cavity widths. The dual seal design is able to withstand a wide temperature range and can be supplied with edge seals designed to withstand UV exposure as well as moisture vapour permeation.

Applications

Pilkington **Insulight™** offers a whole family of different variants, each one utilising a product from the specialist Pilkington glass range, to meet a particular requirement such as: safety, security, thermal insulation, solar control, noise control etc.



Pilkington **Insulight™** Sun – Królewska office center, Warsaw, Poland



Pilkington **Insulight™** Protect – Eko-Park Cameratta, Warsaw, Poland



Below you can find our complete range of Pilkington **Insulight™** products, which take their names from the main benefit provided by the glazing.

- Pilkington **Insulight Activ™** – self-cleaning units
- Pilkington **Insulight™** Sun – solar control units
- Pilkington **Insulight™** Phon – noise control units
- Pilkington **Insulight™** Protect – safety, security and fire protective units
- Pilkington **Insulight™** Décor – decorative units
- Pilkington **Insulight™** Therm – thermal insulation units

Features and benefits

- Wide range of technical performance options.
- Range of cavity widths from 6 to 27 mm (including traditional and warm edge spacers).
- Seal design is able to withstand a wide temperature range.
- Can be delivered with UV resistant seals for use in structural glazing.
- Standard 5 years warranty.
- Tested to European Standards EN 1279-2 and EN 1279-3 and satisfies the requirements of the product standard EN 1279-5.
- Available with Georgian bars.
- Maximum size 3000 mm × 6000 mm.
- Can be combined with an integrated blinds.



Pyrolytic on-line coated low-emissivity glass

Description

Pilkington **K Glass™** N is a durable, pyrolytic on-line coated, neutral coloured, low-emissivity glass, with high solar gain, which provides improved thermal insulation to multiple-glazed windows so reducing condensation and maximising comfort. A specially formulated, permanent, transparent low-emissivity coating is applied pyrolytically to one surface of clear float glass during glass manufacture. The coating allows the 'free' shortwave energy from the sun to enter the building, but acts as a barrier to the escape of expensive longwave energy from internal heat sources.



Pilkington **K Glass™** – Wiśniowy Business Park,
Warsaw, Poland



Pilkington **K Glass™** – Rodan Systems SA office,
Warsaw, Poland

Applications

Extremely versatile, Pilkington **K Glass™** N is recommended for new buildings and renovations/modernisations where high solar heat gain is beneficial.

Pilkington **K Glass™** N is suitable for surface #4 applications, therefore in addition to all the traditional benefits, such as energy efficiency, high solar heat gain, durability and processability Pilkington **K Glass™** N can help improve thermal performance further by utilizing the low-e #4 surface technology (IGU with low-e coatings on #2 and #4 has a lower centre-pane U_g -value, as compared to a standard unit with a low-e glass and a clear float).



2

Pilkington **K Glass™** – POL-MOT Holding office, Warsaw, Poland

By combining Pilkington **K Glass™** N on surface #4 of an IGU in combination with another glass with low-e coating (such as Pilkington **Optitherm™** S1 or Pilkington **Suncool™** 70/35) on surface #2, our research shows that a U_g -value as low as $0,9 \text{ W/m}^2\text{K}$ can be achieved.

Features and benefits

- Substantially improved thermal insulation compared to conventional double glazing; U_g -value of $1,5 \text{ W/m}^2\text{K}$ in 4-16-4 standard constructions with argon (90%), reducing the need for heating the building.
- High solar heat gain offering overall energy saving performance.
- Substantially reduced condensation.
- High light transmission, reducing the need for lighting the building.
- Neutral colour in transmission and reflection.
- Can be combined with a body-tinted or reflective solar control glass in an insulating glass unit to provide both thermal insulation and solar control.
- Durable pyrolytic on-line coating easy to handle and process, providing low cost solution with high visual impact.
- Can be laminated, toughened and bent using standard techniques.
- Can be used in monolithic form or incorporated in insulating glass units, and has unlimited shelf-life.
- No edge deletion required.
- Available in 4 and 6 mm.
- Achieves Class B to EN 1096 for coated glass.

Notes:

1. Coating on surface 2 (facing inside).
2. Maximum size: 6000 mm × 3210 mm.

Notes:

1. Based on 4 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



Description

A wide range of thicknesses of high quality clear float glass manufactured by the float process.

Applications

Pilkington **Optifloat™** Clear can be used in wide variety of applications, often representing a practical and stylish alternative to solid materials. It may be used in the exterior and interior of buildings to permit the transmission of daylight, thus reducing the cost of artificial lighting and allowing occupants to view their surroundings. In thicknesses above 6 mm, it can be used for a variety of commercial applications where superior strength, greater spans, reduced deflection, high daylight transmission and enhanced noise suppression are required. Where a safety glass is required, Pilkington **Optifloat™** Clear can be toughened or laminated.



Pilkington **Optifloat™** Clear – Luminar, Warsaw, Poland



Pilkington **Optifloat™** Clear T – Buchalter office,
Marki near Warsaw, Poland




Pilkington **Optifloat™** Clear T – Ataner
residential and commercial complex, Poznań,
Poland

2

Features and benefits

- High quality float glass.
- Very high light transmission.
- Extremely durable material.
- Maintenance-free and easily cleaned.
- Easily processed and fabricated.
- Can be used in insulating units in combination with other glasses.
- Can be toughened or laminated for safety and security.
- Manufactured in accordance with EN 572-2.
- Wide range of thicknesses – 2 to 19 mm.



Pilkington Optifloat™ Clear																			
PILKINGTON 	glass configuration	performance code				light				energy								S, UV	
		W/m²K	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	S	UV
		U _g	LT	g	LT	LRO	LRI	Ra	ET	ER	EA	TET	SSC	LSC	TSC				
	2 mm	5,8	91	89	91	8	8	100	88	8	4	89	1,01	0,01	1,02	1,02	76	1,02	76
	3 mm	5,8	91	88	91	8	8	99	87	8	5	88	1,00	0,01	1,01	1,03	72	1,03	72
	4 mm	5,8	90	87	90	8	8	99	85	8	7	87	0,98	0,02	1,00	1,03	68	1,03	68
	5 mm	5,7	89	84	89	8	8	98	81	7	12	84	0,93	0,04	0,97	1,06	60	1,06	60
	6 mm	5,7	88	82	88	8	8	98	79	7	14	82	0,91	0,03	0,94	1,07	57	1,07	57
	8 mm	5,6	87	80	87	8	8	97	76	7	17	80	0,87	0,05	0,92	1,09	52	1,09	52
	10 mm	5,6	87	77	87	8	8	97	73	7	20	77	0,84	0,05	0,89	1,13	49	1,13	49
	12 mm	5,5	85	74	85	8	8	96	68	7	25	74	0,78	0,07	0,85	1,15	46	1,15	46
	15 mm	5,4	83	70	83	8	8	94	63	6	31	70	0,72	0,08	0,80	1,19	42	1,19	42
	19 mm	5,3	81	66	81	7	7	92	57	6	37	66	0,66	0,10	0,76	1,23	38	1,23	38

Notes:

Maximum size: 6000 mm × 3210 mm.

Notes:

1. Based on 4 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.



Off-line coated high performance low-emissivity glass

Description

Pilkington **Optitherm™** S1, Pilkington **Optitherm™** S3 and Pilkington **Optitherm™** GS are high quality clear glasses with specially formulated off-line low-emissivity coatings applied to one surface after glass manufacture. The effect of the low-emissivity coating is to reflect the long wavelength energy (generated by heating systems, lighting and building occupants) back into the building. However, the transparent coating still permits the transmission of short wavelength energy originating from the sun. This solar energy is absorbed by the internal surfaces of the building and re-radiated at the longer wavelengths that are then reflected by the coating into the building. The visual appearance of Pilkington **Optitherm™** S1, Pilkington **Optitherm™** S3 and Pilkington **Optitherm™** GS is almost identical to that of ordinary clear glass. As the coating is transparent and neutral in colour, its effect on light transmission and reflection is barely perceptible.



Pilkington **Optitherm™** – Lubicz office center, Cracow, Poland



Table 2.1. Sizes and thicknesses of low-e glass products.

Sizes [mm]	Thicknesses [mm]
Pilkington Optitherm™ S3	
6000 × 3210	3, 4, 6, 8, 10
3210 × 2250	4, 6, 8
Pilkington Optitherm™ S1	
6000 × 3210	3, 4, 6, 8
Pilkington Optitherm™ GS	
6000 × 3210	4, 6, 8

2



Pilkington **Optitherm™** – Metropolitan Building,
Warsaw, Poland



Pilkington **Optitherm™** – Private villa, Olkusz,
Poland

Applications

Pilkington **Optitherm™** S1, Pilkington **Optitherm™** S3 and Pilkington **Optitherm™** GS can only be used in insulating glass units. They are popular low-emissivity glasses because of their neutral colours, their high light transmissions and their excellent thermal insulation characteristics. They can be used from the smallest installation to the most prestigious curtain walling applications – anywhere where there is concern for reduced energy consumption and heat loss. Pilkington **Optitherm™** S1 has a higher performance low-emissivity coating than Pilkington **Optitherm™** S3, to further reduce heat loss through the unit for more demanding applications. They are often used in combination with other environmental



Pilkington **Optitherm**™ – Praktiker, Ząbki, Poland

control glasses. Pilkington **Optitherm**™ cannot be toughened or laminated after coating. However, where a safety glass is required, the coatings can be applied to toughened or laminated glass.

For safety applications, NSG Group offers Pilkington **Optitherm**™ S3 Pro T. This glass has to be toughened and its colour is matched to Pilkington **Optitherm**™ S3. After toughening the product has similar technical performance to Pilkington **Optitherm**™ S3.


Developed specifically for energy-optimised triple glazing, Pilkington **Optitherm**™ GS maximizes solar energy gain and reduces heat loss to increase the energy efficiency of houses, and ultimately cut down heating costs. Pilkington **Optitherm**™ GS exceeds the criteria for Passiv Haus glazing, achieving a total solar heat transmittance (g value) of up to 61% whilst still attaining a U_g -value of as low as $0,6 \text{ W/m}^2\text{K}$.



Features and benefits

- High to very high thermal insulation performance with U_g -values down to 1,0 W/m²K in 4-16-4 standard constructions with argon (90%), reducing the need for heating the building.
- Substantially reduced condensation.
- High light transmission, reducing the need for lighting the building.
- Neutral colour in transmission and reflection.
- Can only be used in insulating glass units (coating generally on surface #3); argon gas filling can be used to achieve higher thermal insulation.
- Can be combined in an insulating glass unit with solar control glass to improve both solar control and thermal insulation performance.
- Can be enhanced when combined with other Pilkington products to provide additional benefits such as self-cleaning, noise control, safety or security properties.
- Available in annealed, toughened and laminated form.
- Available in a "to be toughened" version – Pilkington **Optitherm**[™] S3 Pro T.
- Available in 3, 4, 6, 8 and 10 mm thicknesses.



Pilkington Optitherm™ GS		S, UV		energy		light		performance code		glass configuration	
	III	%	UV	%	TET	%	Ra	%	g	III	triple insulating glass unit, Pilkington Optitherm™ GS #2+5 (K)
		l	S	%	EA	%	LRI	%	LT	III	
				%	ER	%	LRe	%	U _g		
				%	ET	%	LT	%	U _g		
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Notes:

1. Based on 4 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm x 3210 mm.



PILKINGTON		Pilkington Optitherm™ S3										
glass configuration			performance code		light			energy			S, UV	
II	II	III	W/m²K	%	%	%	%	%	%	%	%	%

Notes:

1. Based on 4 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



Vacuum glazing

Description

Pilkington **Spacia™** is the world's first commercially available vacuum glazing. It offers the thermal performance of conventional double glazing in only the same thickness as single glass. Pilkington **Spacia™** is made up of 2 pieces of 3 mm glass one of which has a low emissivity coating. They are separated by the microspacer grid of small pillars. The gap between two panes is reduced to just 0,2 mm and the air between the panes is extracted, creating a vacuum.

A characteristic protection cap is placed in the corner of the pane. Pilkington **Spacia™** has low overall thickness (c.a. 6,2 mm) and the U_g value of 1,1 W/m²K.

2

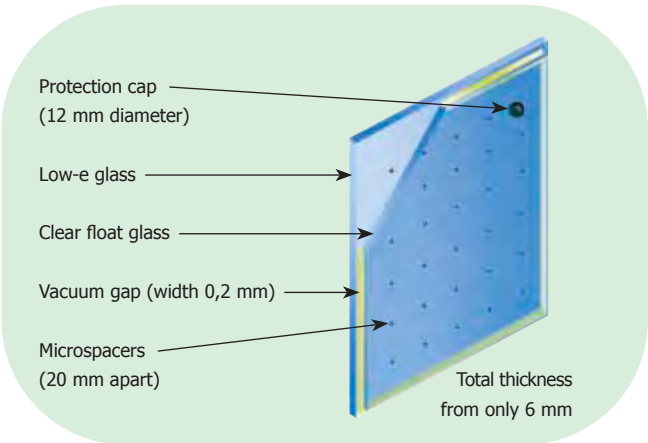


Figure 2.2. Pilkington **Spacia™** construction.

Applications

Pilkington **Spacia™** provides a real solution to the problems of balancing historical preservation with modern comfort and environmental requirements. Pilkington **Spacia™** has a low overall thickness as well as a good acoustic performance and is ideal for use in historic buildings, offering replacement windows more in keeping with the original design. It may even allow the use of the original frames if these are in a reasonable or repairable condition. Pilkington **Spacia™** is also suitable for other applications where



Pilkington **Spacia**™ – Hermitage, Amsterdam, The Netherlands

the use of thinner, low-weight glazing is desirable, for example in sliding box sashes or secondary glazing.

Features and benefits

- Thermal performance in the same thickness as single glass.
- Substantially improved thermal insulation and cost-effective method of improving the energy efficiency.
- Retaining the appearance of historic buildings and meeting the requirements for conservation areas.
- Also offers good acoustic performance for lower noise.
- Offers reduced levels of internal condensation compared to single glazing.
- Suitable as a replacement for single-glazing in old frames.
- Proven solution; successfully used in Japan for over a decade.
- Total thickness to 6 mm.
- Minimum size: 200 mm × 350 mm, maximum size: 1350 mm × 2400 mm.

Notes:

1. Based on 4 mm glass thickness, except for Pilkington **Spacia™** which has overall thickness of c.a. 6,2 mm.
2. Double glazed units are based on 12 mm argon filled (90%) cavities.
3. Triple glazed units are based on 10 mm argon filled (90%) cavities.
4. Minimum size of Pilkington **Spacia™** is 200 mm × 350 mm, maximum size is 6000 mm × 3210 mm.



3

3. Fire Protection



The wide range of modern functional glazings now available has opened up remarkable scope for creative design in today's architecture. Transparent design from façades and roofs right through to the core of the building is no longer a vision, it is a reality.

State-of-the-art glazing can now be used in high performance designs to provide a protected, yet comfortable and versatile building environment, founded on daylighting, brightness and clear vision, replacing solid roofs, doors and partitions which block out views and natural light. Our fire-resistant glasses, Pilkington **Pyrostop**® for superior level of insulation (EI), Pilkington **Pyrodur**® for enhanced integrity (EW), Pilkington **Pyroclear**® for basic integrity (E), and Pilkington **Pyroshield**™ 2 a wired glass for integrity-only (E) combine fire resistance and design flexibility, for peace of mind, elegant and functional buildings.

All our fire-resistant glass types are CE Marked building products and are labelled according to the actual CE Marking guidelines.

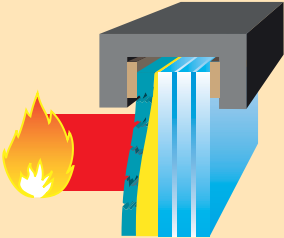
Why fire-resistant glass?

New and existing buildings according to regulations in force should provide suitable level of fire safety. The ordinary clear float glass widely used in buildings does not provide any fire resistance properties in case of fire. It tends to break at a temperature difference equal to about $\Delta T = 40^{\circ}\text{C}$. Ordinary laminated safety glass also has little resistance to fire – the glass breaks almost as quickly as clear float. Furthermore, at a temperature of about 250°C , when the PVB foil melts and fails to retain the glass fragments, the glass collapses and flames, smoke and hot gases can pass through the glazing. Whilst standard toughened glass is more resistant to high temperatures and temperature differences, it generally cannot survive temperature differences higher than about $300\text{--}350^{\circ}\text{C}$. All these glasses have, therefore, no reliable performance in fire.

That is why it was necessary to introduce glass products that could withstand typical high temperatures in fire of approx. 1000°C for a defined time (see also figure 3.3), and additionally in the event of fire, would be able to give people the maximum amount of time for safe escape. Pilkington **Pyrostop**® and Pilkington **Pyrodur**® meet these criteria at different levels.



Pilkington **Pyrostop**® for superior level of insulation



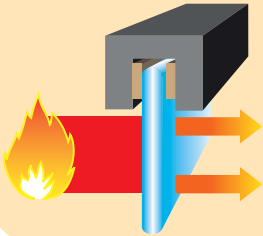
- Multi-layer intumescent laminated glass
- Full thermal insulation (Basic Integrity + Thermal Insulation) for up to 180 minutes

Pilkington **Pyrodur**® for enhanced integrity



- Multi-layer intumescent laminated glass
- Enhanced Integrity (Basic Integrity + Reduced Heat Radiation) for up to 60 minutes

Pilkington **Pyroclear**® for basic integrity



- Modified super toughened clear glass
- Basic Integrity (barrier against smoke, flames and fumes) for up to 60 minutes

Figure 3.1. The reaction of Pilkington **Pyrostop**®, Pilkington **Pyrodur**® and Pilkington **Pyroclear**® in case of fire.



How does it work?

Pilkington **Pyrostop**® and Pilkington **Pyrodur**® are clear, multi-layered fire-resistant glasses made of clear or extra clear float glass (Pilkington **Optifloat**™, Pilkington **Optiwhite**™), laminated with special transparent intumescent interlayers. When exposed to fire, the pane facing the flames fractures but remains in place, and the interlayer immediately foams up to form a thick, resilient and tough insulating shield that absorbs the energy of the blaze. This takes place at only modest temperatures of around 120°C, so that protection is provided right from the early stages of a fire. The resilient sandwich structure of Pilkington **Pyrostop**® and Pilkington **Pyrodur**® ensures that they stay in place and continue to act as an insulating fire-resistant wall for the required time periods, as defined in the relevant test standard.

Pilkington **Pyrostop**® and Pilkington **Pyrodur**® have successfully been tested in many fire doors, partitions and façade systems, covering vertical, horizontal and inclined glazing situations all over the world.

Pilkington **Pyroclear**® is a clear, monolithic fire-resistant and safety glass for up to 60 minutes basic integrity performance. It is also available in insulating glass unit form. Pilkington **Pyroshield**™ 2 is a range of monolithic fire-resistant wired glasses for 30 minutes basic integrity performance.

Definitions:

- **Integrity (class E)**

The ability of the system to keep back flames, smoke and fumes. No flaming on the non-fire side is permitted within the approved time classification.

- **Radiation (class EW)**

In addition to the integrity, the ability of fire-resistant systems to limit the radiant heat on the non-fire side to 15 kW/m² at a distance of 1 m to the surface, in order to prevent for example the ignition of goods on the protected side.

- **Insulation (class EI)**

In addition to the integrity, the ability of glazed screens or doors to limit the average temperature rise on the non-fire side to 140°C and the maximum temperature rise to 180°C above ambient temperature.



Resistance to fire

Classification according to EN 13501-2:

- **E...** = integrity (Pilkington **Pyroclear**®, Pilkington **Pyroshield**™ 2)
- **EW...** = integrity plus reduced heat radiation (Pilkington **Pyrodur**®)
- **EI...** = integrity and insulation (Pilkington **Pyrostop**®)

Pilkington **Pyrostop**® 60-101

1. number

60 Time of fire resistance or thermal insulation in minutes

1. digit of 2. number

0 Internal/external application (relevant only for Pilkington **Pyroclear**®)

1 Internal application

2 External application without coating

3 External application with coating

4 External application with coating for horizontal or sloped installation (Insulating glass unit)

5 Internal application for horizontal or sloped installation

2. digit of 2. number

0 Monolithic glass

2 Monolithic glass in combination with texture glass

5 Insulating glass unit in combination with float glass as outer pane

6 Insulating glass unit in combination with toughened safety glass as outer pane

7 Insulating glass unit in combination with acoustic laminated safety glass as outer pane

8 Insulating glass unit in combination with laminated safety glass as outer pane

digit of 2. number

0, 1... Index number of different product compositions (not relevant for some product compositions).

Figure 3.2. Description of product code for Pilkington **Pyrostop**®, Pilkington **Pyrodur**® and Pilkington **Pyroclear**®. An example presents Pilkington **Pyrostop**® for class EI.



Safety

Pilkington **Pyrostop**® and Pilkington **Pyrodur**® have been successfully tested for impact safety according to EN 12600 and provide safety up to the highest class for laminated safety glass 1(B)1. Pilkington **Pyroclear**® achieves class 1(C)1, the highest level for toughened glass.

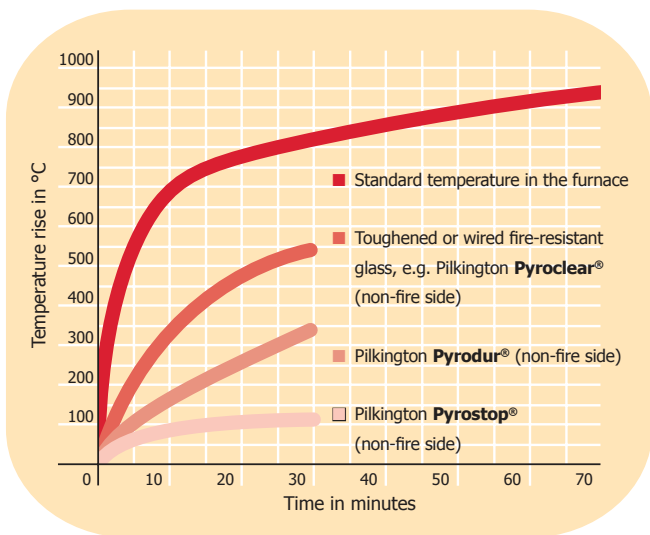


Figure 3.3. Typical temperature curves.
Summary data from standard fire tests.

Combinations

Pilkington **Pyrostop**® and Pilkington **Pyrodur**® are designed to be combined with the full range of Pilkington glasses in either insulating glass units or as monolithic glass for all glazing applications. Pilkington **Pyroclear**® – the latest development of clear transparent fire-resistant glasses – offers several solutions for modern applications for façades with different combinations of solar control and thermal insulation. This gives full scope to design glazing with thermal insulation, solar control, acoustic insulation, safety and security properties – all with built-in high fire resistance performance.



How to specify fire-resistant glass?

Subject to confirmation of: fire-resistance class/fire tested glazing system/safety requirement/thermal stress check/wind loading check (façades).

Please verify compliance with local regulations.

It is the installer's responsibility to ensure that the glasses are installed in fully tested and certified glazing systems, and that the assemblies meet local regulatory requirements.

All Pilkington **Pyrostop**®, Pilkington **Pyrodur**® and Pilkington **Pyroclear**® products have permanent marking on the glass surface.



Fire-resistant glass for basic integrity

Description

Pilkington **Pyroclear®** is a clear high performance monolithic fire-resistant and safety glass designed to provide basic integrity performance.

Applications

It is suitable for internal and external applications where basic integrity performance is required. Pilkington **Pyroclear®** has been approved in single and double glazed units for use with steel and aluminium systems. Pilkington **Pyroclear®** can be installed in doors, screens and partitions in line with national regulations as an effective barrier against fire, smoke and fumes.

Features and benefits

- Designed for fire-resistant glazing where basic integrity only is required.
- Permitting pragmatic framing edge cover from 10 mm up to 15 mm and therefore suitable for common fire-resistant glazing systems.
- Safe and consistent performance due to special edge strength providing high degree of resilience against thermal stress in case of fire.
- Uniquely designed edge technology for reliable fire-resistant performance.
- Special edge protection tape as a clear indicator for any damage to the glass edge.
- Available in monolithic form with up to 60 minutes integrity performance.
- Available in insulating glass units with 30 minutes integrity performance.
- High optical quality.
- Cost-effective product.



3

Pilkington **Pyroclear**® – University of Ecology and Management, Warsaw, Poland



Pilkington Pyroclear®									
Glass type	Fire resistance class	Supply form ^[1]	Nominal thickness [mm]	Thickness tolerance [mm]	Light transmittance [%]	Weight [kg/m²]	R _w -value ^[2] [dB]	U _g -value [W/m²K]	
Pilkington Pyroclear® 30-001 (integrity 30 min)	E 30	SGU	6	±0,2	88	15	32	5,7	
Pilkington Pyroclear® 30-002 (integrity 30 min)	E 30	SGU	8	±0,3	88	20	33	5,7	
Pilkington Pyroclear® 30-003 (integrity 30 min)	E 30	SGU	10	±0,3	87	25	34	5,6	
Pilkington Pyroclear® 60-002 (integrity 60 min)	E 60	SGU	8	±0,3	88	20	33	5,7	
Pilkington Pyroclear® 60-003 (integrity 60 min)	E 60	SGU	10	±0,3	87	25	34	5,6	
Pilkington Pyroclear® 30-361 with coated toughened glass (integrity 30 min)	E 30	DGU	20 (8 spacer) 24 (12 spacer) 28 (16 spacer)	±1,5	depends on coating ^[2]	30	32 (8 spacer) 33 (12 spacer) 33 (16 spacer)	depends on coating ^[2]	
Pilkington Pyroclear® 30-401 with coated toughened glass (integrity 30 min) inclined glazing	E 30	DGU	27 (12 spacer)	±1,5	76	36	38	1,3 ^[3]	

^[1] SGU – Single Glazed Unit; DGU – Double Glazed Unit

^[2] Insulating glass units may include various types of glass, i.e. Pilkington **Optitherm™** S3 or Pilkington **Suncool™**. They can provide additional functions such like thermal insulation (U_g value) solar control (g value), or change colour and reflection of the product.

Notes: Size tolerance of edge length: ≤2000 mm → ±2,5 mm
 >2000 - ≤3000 mm → ±3,0 mm
 >3000 mm → ±4,0 mm



Laminated fire protection glass for integrity only

Description

Pilkington **Pyrodur®** is a clear laminated fire-resistant and safety glass (in thickness from 9 mm) designed to provide integrity-only fire protection, but also offering a level of insulation against radiant heat transfer.

Applications

Suitable for internal and external applications where fire-resistant glasses are required to provide a prescribed level of integrity only, Pilkington **Pyrodur®** is available in single and double-glazed form, for use with steel, aluminium, softwood and hardwood timber frames. It can be combined with functional glasses to produce a wide range of products for numerous applications. Pilkington **Pyrodur®** is particularly suited to use in doors, screens and partitions where lightweight, narrow profiles are important and ease of glazing is a priority. Other applications include insulating glass units in façades and roof glazing.

Features and benefits

- Provides proven integrity for up to 60 minutes when used in a suitable, tested glazing system, restricting the spread of flames, smoke and hot gases.
- Special clear intumescent interlayers, reacting to form a rigid, opaque, visual barrier to flames, helping to reduce panic and fear during evacuation of the building.
- Added benefit of reducing the transmission of conductive and radiant heat from the fire.
- Lightweight.
- Totally clear, unobstructed vision.
- Can be used for internal or external applications.
- Provides effective noise control.
- Can provide impact safety performance, dependent upon thickness.
- Can be combined with other functional glasses for greater flexibility in applications.
- Available in monolithic or insulating glass unit form.




Pilkington **Pyrodur®** – Fatburen, Stockholm, Sweden



Pilkington Pyrodur® for internal use (class E)									
Glass type	Class	Thickness [mm]	Thickness tolerance [mm]	Light transm. LT [%]	Weight [kg/m²]	R _w -value [dB]	U _g -value [W/m²K]	Maximum tested size [mm]	
Pilkington Pyrodur® 30-10 (integrity 30 min)	E 30	7	±1	89	17	34	5,6	1200×2300	
Pilkington Pyrodur® 30-103 (integrity 30 min)	E 30	9	±1	88	22	35	5,5	1200×2600	
Pilkington Pyrodur® 60-10 (integrity 60 min)	E 60	10	±1	87	24	35	5,4	1200×2000	
Pilkington Pyrodur® 30-500 (integrity 30 min) inclined glazing	E 30	23	±2	83	53	40	4,9	1050×2000	

Notes:
Size tolerance ±1 mm/m lenght of edge.



Pilkington  PILKINGTON		Pilkington Pyrodur ® for external use (class E)							
Glass type	Class	Thickness [mm]	Thickness tolerance [mm]	Light transm. LT [%]	Weight [kg/m ²]	R _w -value [dB]	U _g -value [W/m ² K]	Maximum tested size [mm]	
Pilkington Pyrodur ® 30-201 (integrity 30 min)	E 30	10	±1	87	24	36	5,4	1200×2600	
Pilkington Pyrodur ® 30-251 IGU with 6 mm Pilkington Optifloat ™ (integrity 30 min)	E 30	24 to 32	±2	78	40	38	3,0	1400×2300	
Pilkington Pyrodur ® 30-351 IGU with coated glass (integrity 30 min)	E 30	24 to 32	±2	depends on coating ^[1]	40	38	down to 1,1	1400×2300	
Pilkington Pyrodur ® 60-20 (integrity 60 min)	E 60	13	±1	85	31	38	5,3	1200×2000	
Pilkington Pyrodur ® 60-36 IGU with coated glass (integrity 60 min)	E 60	25 to 29	±2	depends on coating ^[1]	46	38	down to 1,3	1200×2000	
Pilkington Pyrodur ® 30-401 (integrity 30 min) inclined glazing	E 30	40	±2	depends on coating ^[1]	67	40	down to 1,3	1050×2000	

^[1] Insulating glass units may include various types of coatings e.g. low-emissivity or Pilkington **Suncool™**. They can provide additional functions such like thermal insulation (U_g-value) solar control (g-value), or change colour and reflection of the product.

Notes:

Size tolerance ±1 mm/m length of edge.



Wired fire protection glass

Description

Pilkington **Pyroshield™ 2** is a fire resistant wired glass which, in the event of fire, provides an effective barrier to flame, smoke and hot gases. Available in Texture version, offering privacy, Pilkington **Pyroshield™ 2** can be used where there is a specific requirement for integrity-only fire protection.

Pilkington **Pyroshield™ 2** Safety is a monolithic safety wired glass for use where there is a specific requirement for both integrity-only fire protection and impact safety to class 3(B)3 according to EN 12600. Available in clear version, Pilkington **Pyroshield™ 2** Safety is a unique fire and impact resistant glass, combining a fire resistance rating of up to 30 minutes integrity with a consistent level of impact safety.

3



Pilkington **Pyroshield™ 2** – Agora`s printing house, Warsaw, Poland



Applications

Suitable for use with steel and timber frames, internally or externally, Pilkington **Pyroshield™ 2** is ideal for use in screens, partitions, doors, windows, fanlights and overhead glazing. Where there is also a requirement for safety, Pilkington **Pyroshield™ 2** Safety should be specified.

Features and benefits

- The most widely tested wired fire protection product in the world.
- Visually identifiable as fire resistant glass.
- Provides proven integrity for up to 30 minutes when used in a suitable, tested glazing system, restricting the spread of flames, smoke and hot gases.
- Maintains integrity even when fractured or sprayed with water.
- Pilkington **Pyroshield™ 2** Safety offers impact safety performance to class 3(B)3 according to EN 12600.
- Pilkington **Pyroshield™ 2** Safety Clear, in nominal 6 mm, offers distortion-free vision, and remain transparent throughout the fire period.
- Pilkington **Pyroshield™ 2** Texture, in nominal 7 mm, offers a degree of obscuration when privacy is required.
- Easily cut to size locally from stock sizes.
- Extremely cost-effective compared with other integrity fire protection glasses.



Pilkington Pyroshield™ 2 Texture																			
glass	I																		
performance code	W/m²K	%	%	light	%	%	%	energy	%	%	%	%	S, UV	%					
	U _g	U _g value	LT	LT	LT	LT	LT	g	g	energy	ET	ER	EA	TET	SSC	LSC	TSC	S	UV
											direct transmittance	reflectance	absorptance	total transmittance	shortwave shading coefficient	longwave shading coefficient	total shading coefficient	selectivity index	UV transmittance
7 mm	Texture	5,7	81	77	81	8	8	8	98	73	8	19	77	0,84	0,06	0,90	1,04	49	

Notes:

Maximum size: 3353 mm × 1829 mm.



Pilkington Pyroshield™ 2 Safety Clear																	
glass		performance code		light			energy			S, UV							
I	monolithic glass	W/m²K	%	%	%	%	%	%	%	—	%						
		U _g	LT	g	LT	g	ET	EA	TET	SSC	LSC						
		U _g value		light		energy		transmittance		reflectance							
								transmittance		reflectance							
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								transmittance		reflectance							
								transmittance		reflectance							
7 mm	Clear	5,7	81	77	81	9	9	98	73	8	19	77	0,84	0,05	0,89	1,05	49

Notes:

Maximum size: 3300 mm × 1980 mm.



Laminated fire protection glass for integrity and insulation

Description

A clear, laminated fully insulating fire-resistant and safety glass that offers the highest levels of fire protection, limiting the transmission of conductive and radiant heat, while maximising the available levels of natural light and visibility.



Pilkington **Pyrostop**® – Atrium Plaza office building, Warsaw, Poland



Pilkington **Pyrostop**® – Warszawa Spa & Resort Hotel, Augustów, Poland

3

Applications

Designed for interior and exterior use where thermal protection is officially required in the case of fire. Available for use with steel, aluminium and timber frames, and in single or double-glazed form, Pilkington **Pyrostop**® is ideal for use in transparent fire walls, windows, doors, screens, partitions, façades, roof glazing (special type) and horizontal glazing (special type).



Pilkington **Pyrostop®** – Złote Tarasy, Multikino, Warsaw, Poland



Features and benefits

- Extensively tested clear fire protection.
- Provides proven integrity and insulation for up to 120 minutes when used in a suitable, tested glazing system, restricting the spread of flames, smoke and hot gases and limiting the transmission of conductive and radiant heat from the fire.
- Special clear intumescent interlayers, reacting to form a rigid, opaque, visual barrier to flames, helping to reduce panic and fear during evacuation of the building.
- Maximum light transmission for thicker versions that use Pilkington **Optiwhite**™ low iron glass.
- Totally clear, unobstructed vision.
- Impact safety.
- Provides effective noise control.
- Can be combined with other functional glasses for greater flexibility in applications.
- Available in different types for internal or external use.
- Available in monolithic or insulating glass unit form.




Pilkington Pyrostop® for internal use (class EI)								
Glass type	Class	Thickness [mm]	Thickness tolerance [mm]	Light transm. LT [%]	Weight [kg/m²]	R _w -value [dB]	U _g -value [W/m²K]	Maximum tested size [mm]
Pilkington Pyrostop® 30-10 (insulation 30 min, integrity 30 min)	EI 30	15	±1	86	35	38	5,1	1400×2500
Pilkington Pyrostop® 60-101 (insulation 60 min, integrity 60 min)	EI 60	23	±2	87	55	41	4,8	1400×3000
Pilkington Pyrostop® 90-102 (insulation 90 min, integrity 90 min)	EI 90	37	±2	84	86	44	4,2	1400×2500
Pilkington Pyrostop® 120-10 (insulation 120 min, integrity 120 min)	EI 120	58	±3	74	117	43	2,5	1150×2200
Pilkington Pyrostop® 120-106 (insulation 120 min., integrity 120 min.)	EI 120	55	±3	78	112	43	2,6	1150×2200
Pilkington Pyrostop® 30-500 (insulation 30 min, integrity 30 min) inclined glazing	EI 30	27	±2	81	63	41	4,8	1050×2000
Pilkington Pyrostop® 60-50 (insulation 60 min, integrity 60 min) inclined glazing	EI 60	33	±3	85	75	41	4,5	1050×2000

Notes:

Size tolerance ±1 mm/m length of edge.



Pilkington Pyrostop® for external use (class EI)									
 PILKINGTON	Glass type	Class	Thickness [mm]	Thickness tolerance [mm]	Light trans. LT [%]	Weight [kg/m²]	R _w -value [dB]	U _g -value [W/m²K]	Maximum tested size [mm]
	Pilkington Pyrostop® 30-20 (insulation 30 min, integrity 30 min)	EI 30	18	±1	85	42	38	5,0	1400×3000
	Pilkington Pyrostop® 30-25 IGU with 6 mm Pilkington Optifloat™ (insulation 30 min, integrity 30 min)	EI 30	32 to 36	±2	76	58	39 to 40	2,9 to 2,7	1400×3000
	Pilkington Pyrostop® 30-35 IGU with coated glass (insulation 30 min, integrity 30 min)	EI 30	32 to 36	±2	depends on coating ^[1]	58	39 to 40	down to 1,3	1400×3000
	Pilkington Pyrostop® 60-201 (insulation 60 min, integrity 60 min)	EI 60	27	±2	86	63	41	4,7	1400×2850
	Pilkington Pyrostop® 60-251 IGU with 6 mm Pilkington Optifloat™ (insulation 60 min, integrity 60 min)	EI 60	41 to 45	±2	77	77	41	2,7	1400×2850
	Pilkington Pyrostop® 60-351 IGU with coated glass (insulation 60 min, integrity 60 min)	EI 60	41 to 45	±2	depends on coating ^[1]	77	41	down to 1,3	1400×2850
	Pilkington Pyrostop® 90-201 (insulation 90 min, integrity 90 min)	EI 90	40	±2	83	93	44	4,1	1400×2500
	Pilkington Pyrostop® 120-380 (insulation 120 min, integrity 120 min)	EI 120	64	±2	depends on coating ^[1]	120	46	2,3	1100×2300
	Pilkington Pyrostop® 30-401 (insulation 30 min, integrity 30 min) inclined glazing	EI 30	44	±2	depends on coating ^[1]	77	40	down to 1,3	1050×2000

^[1] Insulating glass units may include various types of coatings e.g. low-emissivity or Pilkington **Suncool™**. They can provide additional functions such like thermal insulation (U_g-value) solar control (g-value), or change colour and reflection of the product.

Notes:
Size tolerance ±1 mm/m length of edge.



4. Noise Control



It could be a Sunday afternoon when you are indoors reading a good book, you could be tucked up in bed at night or seated at work trying to concentrate when you are disturbed by noisy neighbours, traffic or a variety of other unwanted noise. We all suffer from the intrusion of noise at some time or another.

With an increasing population density, factory production and transport, the noise seems to get worse with fewer opportunities to escape. Along with the increase in noise is a growing awareness of the effect on health due to the stress caused by everyday sounds intruding into once quiet environments. The trend for the future suggests that traffic and noise in general is going to get worse as living space declines. There is an increasing interest in ways to protect people from noise to avoid the considerable stress that it causes and in some cases serious illness.

A considerable amount of work has been done to control noise intrusion into a building and between adjoining areas, and whilst this is valuable we want to concentrate on the contribution that the careful selection of glass has to offer in managing the problem.



Figure 4.1. Sound spreads out in a similar manner to waves in water.



What is sound?

From a physical point of view, sound belongs in the field of wave physics/mechanical oscillations. Even 2000 years ago, a Roman architect engaged in the construction of amphitheatres used waves in water to improve his design.

For example, if we strike a tuning fork, we can hear the oscillations, but we cannot see them. These oscillations of the tuning fork are transmitted to air molecules, which then pass on their oscillations to other air molecules. This behaviour can be demonstrated in water. These oscillations are comparable to a wave in water, with the height of the wave being a measure of the volume of sound and the number of waves in time is the frequency of the sound i.e. the more waves, the higher the frequency. Frequency is defined as cycles per second or Hertz. Hertz is the correct way to describe the frequency or pitch of the sounds and is abbreviated to Hz.

4

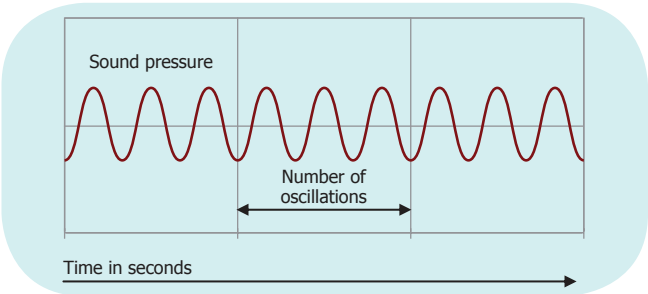


Figure 4.2. Definition of frequency.

In music, the note A (nearest A above middle C) has a frequency of 440 Hz or oscillations per second in concert tuning. If the frequency is doubled to 880 Hz, the note increases by an octave for equal tempered tuning.

The human ear of a young person can detect frequencies of 20 Hz up to 20,000 Hz and is capable of detecting sound pressures, or to be more precise pressure fluctuations, of between 10^{-5} Pascals (Pa) = 0,00001 (lower limit of hearing) and 10^2 Pa = 100 Pa (pain threshold) by passing these on to the brain as a sensation of volume.



With increased age the range of audible frequency diminishes from both ends of the scale naturally or from hearing damage.

The relationship between the quietest and the loudest noise is a ratio of 1 to 10 million. Since this is very unwieldy, in practice the sound-pressure level, or sound level *L* for short, is expressed as a logarithmic scale which represents a conversion of the sound pressure into a more convenient measure known as the decibel scale (dB). The normal range extends from 0 dB (hearing threshold) to around 130 dB (pain threshold). Figure 4.3 shows a few examples.

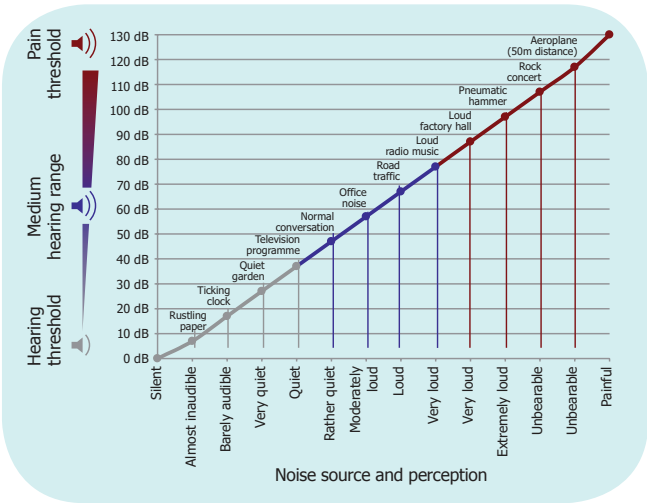


Figure 4.3. Noise source and perception (source: Kuraray, Troisdorf).

There are a variety of ways of creating noise and each noise can produce different volumes of sound at different frequencies. If we use aircraft as an example there is a clear difference in the sound made by propeller driven aircraft, modern fan jets and military aircraft. If the volume by frequency is plotted as a graph they would look distinctly different. When trying to defeat noise these variations can be taken into account and different glass types also work better at some frequencies than others. By matching the performance of the glass to the noise we can selectively reduce the most annoying sounds to get the maximum benefit. Anyone living next to a private airstrip with light aircraft has a very



different problem to a neighbour of a military base. The solution to the noise problem will be to use a different glass configuration.

Determining the noise level can be done in a number of ways. For large or difficult projects a site noise survey can be commissioned using acoustic consultants who use sensitive equipment to measure and average noise levels by frequency over a period. These surveys give precise data on the volume of noise at each frequency that needs to be attenuated. The information is often provided in reports that break the noise down into a table showing octave frequencies, e.g.:

Frequency [Hz]	125	250	500	1000	2000	4000
Sound pressure [dB]	30	36	42	44	48	50

4

The sound can be measured at the site, close to the noise source or a distance in between. Where site data is not provided an adjustment can be made to the sound to allow for distance. The further you are away from the source the less impact it has.

Example: Decay of noise with distance.

Road traffic noise decreases by approximately 3 dB with doubling of distance at right angles to the road. If, for example, L is the dB noise level at 5 meters, then the decay follows the pattern:

5 m	L	dB
10 m	(L-3)	dB
20 m	(L-6)	dB
40 m	(L-9)	dB
80 m	(L-12)	dB
160 m	(L-15)	dB

The noise level is often measured over a period and averaged to remove the disproportionate effect of isolated loud noise that is exceptional like a car horn sounding. A level of noise energy can be determined that is an A weighted long term average called the day-evening-night level (L_{den}). It is the L_{den} noise level that should be the basis of the design rather than isolated peaks in sound. Therefore the aim of the design should be to control the general noise rather



than exceptions otherwise the noise reduction criteria would become extreme. For some applications it may be appropriate to use only part of the three periods or a supplementary noise indicator for noise that only occurs for a short period of time.

There is sometimes an option with noise measuring equipment to record the data with an A weighting. Where interior noise limits are set they are often expressed in dB (A) or L_{Aeq} . The A weighting is an adjustment to the noise at each frequency that follows a standardised curve. The A weighting is a recognition that the human ear does not react to the same volume at each frequency equally i.e. some frequencies seem louder than others even though they are being delivered with the same energy. It is important that the human reaction to noise is considered rather than making decisions based upon the sensitive instruments that measure sound in an absolute way.

Where a survey is not carried out then there are examples of previous surveys that allow designers to assume typical noise levels from common sources of noise e.g. road traffic, music, speech, trains, aircraft etc.

Where third octave or octave band information is not provided there are a range of shorthand expressions used for the noise, typically the R_w and R_{tra} figures may be used to abbreviate the information. For glass performance the abbreviations are determined by taking plots on a graph of the sound attenuation by frequency and mathematically comparing standard curves to then until they are a good fit. The noise reduction at a fixed frequency on the standard curves provides the R_w and R_{tra} figures.

When the noise level is known the performance of the glass can be matched to get the required level of residual noise. It is important that the indices of measurement are matched or in the same scale to ensure that the calculation is correct.

For those who like to dig a little deeper

The measured values for 10 mm Pilkington **Optifloat**[™] – 16 mm air space – 9,1 mm Pilkington **Optiphon**^{™1} are shown in blue.

¹ Previously known as Pilkington **Optilam**[™] Phon.



The reference curve specified in EN 717 Section 4 is shown in red. This reference curve is now moved downwards in whole dB increments, until the sum of the deviations of the measured values from the shifted reference curve is maximised and less than 32 dB. Only those measured values that are less than the reference values are taken into account. The y-value of this shifted reference curve (green curve in Fig. 4.4) at a frequency of 500 Hz is the sought R_w -value, in this example 45 dB. Unfortunately, the above-mentioned relationship between the sound-pressure amplitude and the perceived volume is not as simple as scientists would like it to be because nature has made our hearing more sensitive to certain ranges than to others. This means that we perceive a thousand Hz tone as louder than a hundred Hz tone, even though the volume is the same. This property of the human ear is taken into account in the shape of the reference curve.

4

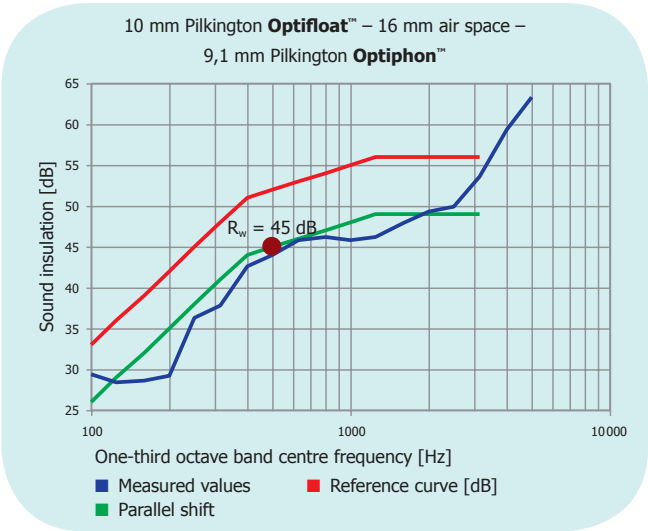


Figure 4.4. Determining the sound insulation value R_w .



Determining the sound insulation of types of glass

Since it would be time consuming and costly to measure every system on site, all sound insulation spectra are recorded under standardised conditions. As we see, sound insulation is very frequency-dependent. To avoid having to work with the complete data set this diagram can be reduced to a single value. The standardised procedure is described in the box below. The result is a single number – in this case $R_w = 45$ dB – which can be used in further calculations.

The disadvantage of such a single-value specification is that we can arrive at the same result with completely different curve shapes, as shown in Figure 4.5.

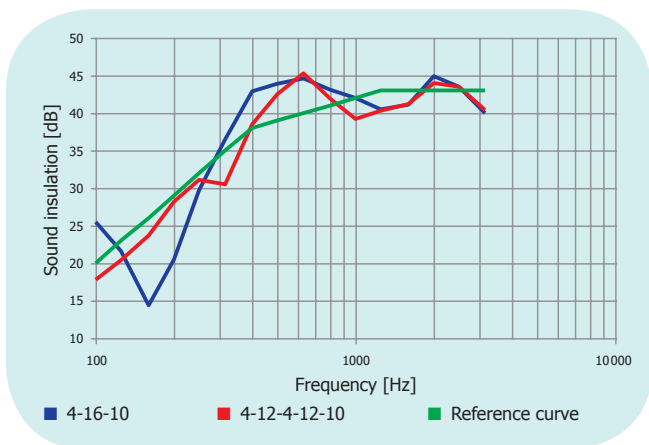


Figure 4.5. Comparison between two insulating glass structures where $R_w = 39$ dB.

We achieve more expressive single-value specifications if we use “custom-made” reference curves for specific requirements.

Such “special cases” are C and C_{tr} . They take into account the different frequency spectra of residential and traffic noises and thus make it possible to find adequate solutions to the problems in question in a simple manner.



The C-value takes into account the noise sources:

- residential activities (talking, music, radio, TV),
- children playing,
- rail traffic at average and high speed,
- motorway traffic > 80 km/h (50 mph),
- jet aeroplanes a short distance away,
- businesses that emit primarily medium- and high-frequency noise.

The C_{tr} -value takes into account noise sources such as:

- urban road traffic,
- low speed rail traffic,
- propeller aeroplanes,
- jet aeroplanes a long distance away,
- disco music,
- businesses that emit primarily low- and medium-frequency noise.

4

Thus, if the planned building is located in a city, right by a main road, the C_{tr} value is the most suitable. If a building is planned right next to a motorway, the C value is more appropriate.

Calculation rules

Although the use of the dB scale facilitates nice convenient numbers, it also gives rise to somewhat unusual “calculation rules”. If a noise source is duplicated then the overall dB value rises by only 3 dB. A ten-fold increase i.e. ten electric fans instead of one, leads to an increase of only twice as much noise i.e. 10 dB.

To complete the explanation, we should also mention that a halving of the noise level at the ear is not recognised as a halving of the volume. In general it is true that:

- a difference of 1 dB is not practically noticeable,
- a difference of 3 dB is just perceptible,
- a difference of 5 dB represents a clear difference,
- a difference of 10 dB halves / doubles the noise.



The different types of sound insulation

Mass

As mentioned above, sound spreads in waves by exciting the molecules of the medium in question so that they oscillate. Due to this means of transmission, the noise is subject to a natural damping – depending upon the mass in question. Expressed simply: the more mass put between transmitter and receiver, the greater the damping.

The simplest way of increasing the sound insulation of glass is therefore to use a lot of glass. Thus a 12 mm single pane has an R_w value of 34 dB, whereas the corresponding value for a 4 mm pane is only 29 dB.

Coincident frequency and asymmetry

If we compare the spectra of 4 mm, 8 mm and 12 mm float glass, we see that each of these spectra has a downturn in the right-hand section.

This fall off in performance at certain frequencies or coincident frequencies occurs at the frequency that matches the natural resonant frequency for the product. The so-called coincident frequency f_g is material specific and dependent upon thickness for glass. As a rule of thumb:

$$f_g = \frac{12000 \text{ Hz}}{d}$$

(where d = thickness of material)

According to this formula, f_g is 3000 Hz for 4 mm float glass, 1500 Hz for 8 mm float glass and 1000 Hz for 12 mm float glass, which corresponds very well with the spectra in Figure 4.6.

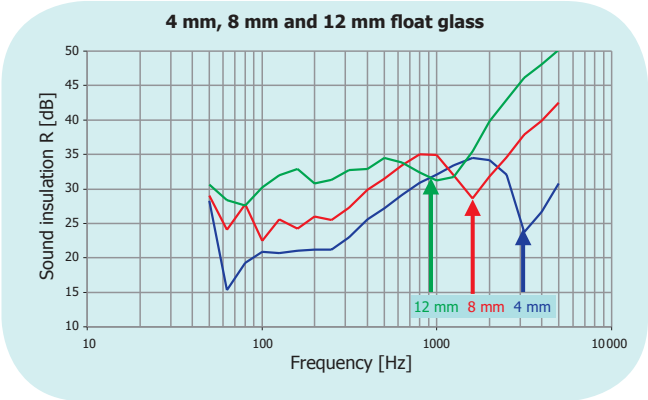


Figure 4.6. Influence of the pane thickness on the coincidence frequency.

To overcome this we can mix the thicknesses of glass panes in an insulating unit structure so that when one pane is at its coincident frequency the other is not and continues to defeat the sound. Such asymmetric structures can thus significantly reduce the downturn in the coincidence range, as shown in Figure 4.7. A 30% difference in thickness is desirable. Not only does this reduce the dip but it also shifts it up the scale which is beneficial as the higher the frequency, the more effective the glass becomes at reducing the overall noise level.

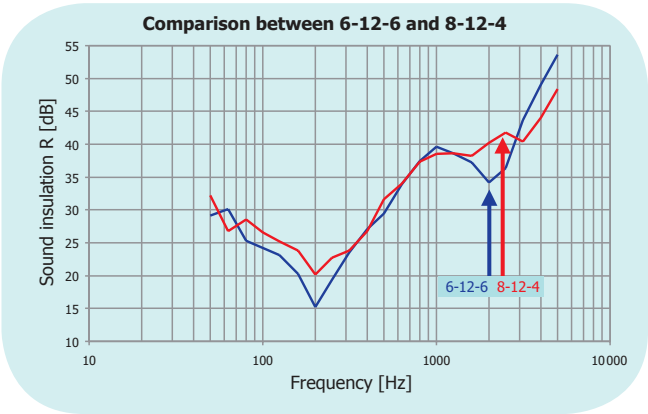


Figure 4.7. Asymmetric glass structure to reduce coincidence.



Gap between panes / gas fillings

Another method for controlling the transmission of noise is to vary the distance between the panes of glass. With conventional insulating glass units the gap between the panes is limited to maintain the optimal thermal performance and the size of the gap is not large enough to significantly improve the acoustic performance. With secondary glazing there is an opportunity to have relatively large gaps and an airspace of over 60 mm starts to provide real improvements in performance. The space between the panes can also be lined with acoustic tiles to enhance the benefit.

Gas filling the space between panes of an IGU has a marginal effect and there is no practical improvement in using argon gas. Due to the density of krypton a small benefit can be gained in acoustic performance of up to 1 dB. Sulphur hexafluoride (SF_6) could be used for sound insulation simply because it is so heavy, however, this gas has two disadvantages. Firstly it worsens the thermal insulation value and secondly this gas has a CO_2 equivalent of 22 800 and thus makes an extremely large contribution to the greenhouse effect. For these two reasons, the use of SF_6 gas is banned throughout large parts of Europe.

Decoupling / damping

We have said that the thickness of glass helps and varying the glass thicknesses in an insulating unit is a useful method of improving noise reduction. Adding mass to the product or having large air gaps may also be undesirable for reasons of weight and space. Fortunately there are ways of improving the noise reduction of relatively thin panes of glass by introducing a damping effect within the glass. By laminating the glass with ordinary PVB interlayer we can reduce the fall off in performance due to the coincident frequency and shift the frequency at which the downturn occurs. Adding a Pilkington **Optilam**[™] product to the construction can have a marked improvement particularly where the noise level would be high at the coincident frequency for a monolithic glass. Insulating glass units can provide very good results with a mixture of monolithic (Pilkington **Optilam**[™]) and Pilkington **Optilam**[™] glass types.

For higher specification requirements there is Pilkington **Optiphon**[™]. These products use special interlayers in a laminate that further decouple the two panes of glass whilst still providing the impact safety of laminated glass. If you look at the curve



profile for Pilkington **Optiphon™** you will see that the fall off in performance at what would have been a coincident frequency is almost eliminated. The correct grade of product can be chosen to match the sound profile to allow superior performance without dramatically increasing the glass thickness. This allows for greater flexibility in design without compromising other glazing functions.

In the left-hand part of the spectra (Fig. 4.7) we see a further downturn. This is the so-called resonant frequency. This is the frequency at which the component as a whole oscillates in resonance and thus transports the sound oscillations particularly well and insulates poorly.

The sound insulation can be improved by moving the resonant frequency of the component to another frequency (away from the nuisance frequency or to where the human ear can hear less well). This is achieved by “decoupling” the insulating glass unit, by making a pane of glass at the same time dense and soft. This can be achieved by joining two panes of glass either with special (soft) cast-in-place resins or with modern PVB interlayers developed specially for this application.

4

Important reminder

The object of selecting the right acoustic product is to make the internal environment comfortable and free from the stress associated with noise intrusion. The level of residual noise is not the same for all locations and national guidelines are produced for most environments. For instance, the background noise in a library should be around 30 dB. Zero noise is undesirable and tends only to be found in an echoic chambers usually reserved for testing. Zero noise can be an eerie experience as the ear tunes to other sounds that become distracting.

The equation as a first guide becomes:

$$\text{Noise Source} - \text{building attenuation} = \text{residual noise}$$

Note that the whole building needs to work and that glass alone will not solve all acoustic problems. Sound only needs a small entry way to get into a building unlike heat loss or gain, which tends to be proportional to the surface area. For a noise reduction of up to



35 dB provided by the glass the window frame without a ventilator should provide similar performance. Above this level, windows developed for noise reduction need to keep pace with the glass performance to ensure the combined product is functioning.

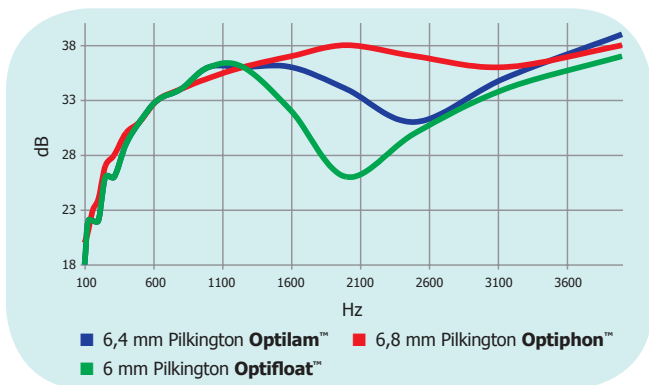


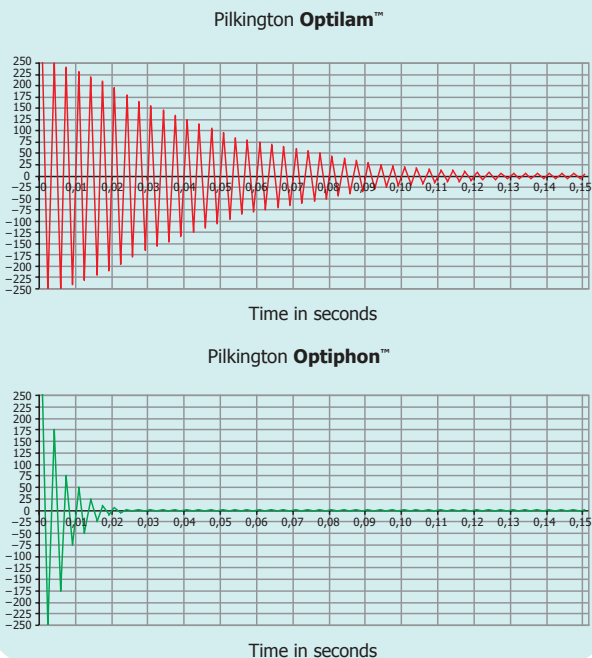
Figure 4.8. Sound reduction illustration.

To sum up

There are five factors that can be combined, which can positively influence the sound insulation of an insulating glass unit.

1. Glass mass.
2. Asymmetric structure.
3. Large gap between panes.
4. Use of alternative gases.
5. Use of Pilkington **Optiphon™** special laminated safety glasses or Cast In Place (CIP) products.

For the higher sound insulation requirements, modern sound insulating laminated safety glass products such as Pilkington **Optiphon™**, are becoming increasingly prevalent in comparison to the cast-in-place resin products because R_w values of even more than 50 dB can be achieved and they can be supplied in large sizes. The compatibility of PVB with other materials is well understood and safety benefits such as impact protection / safer overhead glazing can also be achieved.



4

Figure 4.9. The illustration shows the impressive damping differences between Pilkington **Optilam**[™] and Pilkington **Optiphon**[™] from the sound engineering point of view.



Insulating glass units with improved sound insulation

With increasing traffic on the road, rail and in the air, noise insulation has become a very important topic. It is not a question of it being a luxury anymore it is essential that noise reduction is considered in the specification of the glazing.

Pilkington **Insulight™** Phon is a proven and tested solution to the problem of noise control.

The enhanced sound insulation of Pilkington **Insulight™** Phon insulating glass units is made possible through the use of:

- panes of varied thickness – a 30 percent difference in thickness is recommended, e.g. 6 mm and 10 mm;
- Pilkington **Optilam™**, laminated glass, which is produced by combining two or more glass sheets with one or more PVB interlayers;
- Pilkington **Optiphon™** glass: laminated, sound absorbing glass with high acoustic insulation, which uses special foil to yield excellent noise attenuation parameters.

All above mentioned products can be combined with other functional products such as low-emissivity glass for improved thermal insulation or solar control glass for better solar control performance.




Pilkington **Insulight™** Phon – Air Traffic Control Centre, Warsaw, Poland




Pilkington **Insulight™** Phon – IO-1 office center, Warsaw, Poland



 PILKINGTON		Pilkington Insulight™ Phon													
type		acoustic performance data						light			energy				
		R _w (dB)	C (dB)	C _{tr} (dB)	C 100-5000 (dB)	C _{tr} 100-5000 (dB)	LT %	LR _o %	LR _i %	g %	ET %	ER %	EA %	TSC	
		EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	= g/87	
	4-16ar-4*	31	-2	-5	-1	-5	80	13	14	63	56	27	17	0,72	
	6-16ar-4*	34	-2	-5	-2	-5	79	13	14	59	53	23	24	0,68	
	6-16kr-4*	37	-2	-6	-1	-6	79	13	14	59	53	23	24	0,68	
	8-12kr-4*	37	-3	-6	-2	-6	78	12	14	57	51	21	28	0,66	
	8-16ar-4*	37	-2	-5	-1	-5	78	12	14	57	51	21	28	0,66	
	8-16ar-6*	36	-2	-6	-1	-6	77	12	14	57	49	21	30	0,66	
	8-20ar-4*	37	-2	-6	-1	-6	78	12	14	57	51	21	28	0,66	
	10-16ar-4*	38	-2	-6	-1	-6	77	12	14	56	49	19	32	0,64	
	10-16kr-4*	40	-4	-9	-3	-9	77	12	14	56	49	19	32	0,64	
	10-20ar-4*	39	-4	-8	-3	-8	77	12	14	56	49	19	32	0,64	
	10-16ar-6*	40	-2	-5	-1	-5	76	12	14	55	48	19	33	0,65	

Notes:
The performance data for insulating glass units have been determined with Pilkington **Optitherm™** S3 coating on glass marked with * and with argon (90%) or krypton (90%) gas filling. Letter L means that ordinary laminated glass Pilkington **Optilam™** has been used.




Pilkington  Pilkington Insulight™ Phon														
type	acoustic performance data						light			energy				
	R _w (dB)	C (dB)	C _{tr} (dB)	C 100-5000 (dB)	C _{tr} 100-5000 (dB)	LT %	LR _o %	LR _i %	g %	ET %	ER %	EA %	TSC	
	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	= g/87	
4*-16ar-8,L	38	-2	-6	-1	-6	77	14	12	59	49	28	23	0,68	
6*-14ar-8,L	39	-2	-6	-1	-6	77	14	12	57	47	25	28	0,66	
4*-16ar-9,5L	38	-2	-6	-1	-6	77	14	12	59	48	28	24	0,68	
4*-16ar-10,8L	38	-2	-6	-1	-6	77	14	12	59	47	28	25	0,68	
6*-16ar-10,8L	40	-2	-6	-1	-6	76	14	12	57	46	25	29	0,66	
8,4L-16ar-6*	37	-3	-7	-2	-7	77	12	14	55	48	19	33	0,63	
8,8L-16ar-8*	37	-3	-7	-2	-7	76	12	14	54	46	18	36	0,62	
12,8L-16ar-6*	41	-2	-5	-1	-5	75	12	14	51	44	15	41	0,59	
12,8L-16ar-8*	41	-2	-5	-1	-5	74	12	13	51	43	15	42	0,59	
16,8L-16ar-8*	41	-1	-4	0	-4	73	12	13	48	41	13	46	0,55	
4*-8kr-4-8kr-4*	31	-1	-4	0	-4	72	18	18	51	44	34	22	0,59	

Notes:

The performance data for insulating glass units have been determined with Pilkington **Optitherm™** S3 coating on glass marked with * and with argon (90%) or krypton (90%) gas filling. Letter L means that ordinary laminated glass Pilkington **Optilam™** has been used.



PILKINGTON 		Pilkington Insulight™ Phon												
type	acoustic performance data						light			energy				
	R _w (dB)	C (dB)	C _{tr} (dB)	C 100-5000 (dB)	C _{tr} 100-5000 (dB)	LT %	LR _o %	LR _i %	g %	ET %	ER %	EA %	TSC	
	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	= g/87	
4*-10kr-4-10kr-4*	32	-1	-5	0	-5	72	18	18	51	44	34	22	0,59	
4*-12ar-4-12ar-4*	32	-1	-5	0	-5	72	18	18	51	44	34	22	0,59	
4*-12kr-4-12kr-4*	33	-1	-5	0	-5	72	18	18	51	44	34	22	0,59	
4*-14ar-4-14ar-4*	32	-1	-4	0	-4	72	18	18	51	44	34	22	0,59	
4*-16ar-4-16ar-4*	32	-1	-5	0	-5	72	18	18	51	44	34	22	0,59	
6*-10kr-4-10kr-4*	36	-1	-5	0	-5	71	18	18	49	42	30	28	0,56	
6*-12ar-4-12ar-4*	36	-2	-6	-1	-6	71	18	18	49	42	30	28	0,56	
6*-12kr-4-12kr-4*	38	-2	-6	-1	-6	71	18	18	49	42	30	28	0,56	
8*-12ar-4-12ar-4*	37	-2	-7	-1	-7	70	17	18	48	41	27	32	0,55	
8*-12ar-4-12ar-6*	39	-2	-5	-1	-5	69	17	18	48	40	27	33	0,55	
8*-12kr-4-12kr-6*	39	-1	-5	0	-5	69	17	18	48	40	27	33	0,55	
8*-12ar-6-12ar-6*	38	-2	-6	-1	-6	68	17	17	47	38	26	36	0,54	

Notes:
The performance data for insulating glass units have been determined with Pilkington **Optitherm™** S3 coating on glass marked with * and with argon (90%) or krypton (90%) gas filling. Letter L means that ordinary laminated glass Pilkington **Optilam™** has been used.



Description

By using a special PVB (polyvinylbutyral) interlayer, Pilkington **Optiphon™** is a high quality acoustic laminated glass that offers excellent noise reduction without compromising on light transmittance or impact performance.

The desired acoustic performance can be achieved through combining various thicknesses of glass with a PVB interlayer. With a large variety of product combinations, Pilkington **Optiphon™** offers the opportunity to achieve specific noise reduction requirements.

Pilkington **Optiphon™** can be combined with other Pilkington products for a multi-functional noise-reduction monolithic glass or a multi-functional noise-reduction insulating glass unit providing additional benefits, such as thermal insulation, solar control or self-cleaning.

Applications

Pilkington **Optiphon™** is the ideal choice of glass in situations where there is excess noise from road, rail or air traffic, or other sources such as factories or nightclubs.



Pilkington **Optiphon™** – Metropolitan Building, Warsaw, Poland



Pilkington **Optiphon™** – Aeropark Business Center (building A), Warsaw, Poland




Pilkington **Optiphon™** – Marynarska Point office center, Warsaw, Poland

4

Benefits

- Provide a range of noise control levels.
- A thin and lightweight solution to noise problems.
- Achieve safety class 1(B)1 (EN 12600) and are available to meet security glass classifications in accordance with EN 356.
- In case of breakage remains intact, minimising the risk of injury.
- Widely tested.
- Easy to process, and can be incorporated into insulating glass units.
- Can be single, double or triple glazed.
- Can be combined with other Pilkington products for a multi-functional noise-reduction monolithic glass or a multi-functional noise-reduction insulating glass unit providing additional benefits, such as thermal insulation, solar control, or self-cleaning.
- Standard available sizes: 6000 mm × 3210 mm, 3210 mm × 2550 mm.
- Available thicknesses: 6,5; 6,8; 8,5; 8,8; 9,1; 10,5; 10,8; 12,5; 12,8; 13,1 mm.




Pilkington  Pilkington Optiphon™														
type	acoustic performance data						light			energy				
	R _w (dB)	C (dB)	C _{tr} (dB)	C 100-5000 (dB)	C _{tr} 100-5000 (dB)	LT %	LR _o %	LR _i %	g %	ET %	ER %	EA %	TSC	
	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	= g/87	
8,8	37	-1	-4	0	-4	87	8	8	76	70	7	23	0,87	
9,1	37	-1	-3	0	-3	87	8	8	75	69	7	24	0,86	
10,8	38	-1	-2	0	-2	86	8	8	73	67	7	26	0,84	
12,8	39	0	-2	1	-2	85	8	8	71	64	6	30	0,82	
13,1	40	0	-2	0	-2	85	8	8	71	64	6	30	0,82	
4*-16-8,8	39	-1	-5	0	-5	77	14	12	59	49	28	23	0,68	
5*-16-8,8	40	-3	-7	-2	-7	76	13	12	56	46	24	30	0,64	
6*-16-8,8	41	-3	-7	-2	-7	77	14	12	57	47	25	28	0,66	
6*-16-9,1	41	-2	-6	-1	-6	77	14	12	57	47	25	28	0,66	
6*-16-10,8	42	-3	-7	-2	-7	76	14	12	57	46	25	29	0,66	
6*-16-12,8	42	-3	-8	-2	-8	75	14	12	56	44	25	31	0,64	
6*-16-13,1	43	-1	-5	0	-5	75	14	12	56	44	25	31	0,64	
8*-16-8,8	42	-3	-7	-2	-7	76	14	12	55	46	23	31	0,63	

Notes:

The performance data for insulating glass units have been determined with Pilkington **Optitherm™** S3 coating on glass marked with * and with argon (90%) gas filling.



 PILKINGTON		Pilkington Optiphon™												
type		acoustic performance data					light			energy				
		R _w (dB)	C (dB)	C _{tr} (dB)	C 100-5000 (dB)	C _{tr} 100-5000 (dB)	LT %	LR _o %	LR _i %	g %	ET %	ER %	EA %	TSC
		EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	= g/87
	8*-16-9,1	43	-3	-7	-2	-7	76	14	12	55	46	23	31	0,63
	8*-16-10,8	43	-2	-6	-1	-6	75	13	12	55	44	23	33	0,63
	8*-16-12,8	43	-2	-7	-1	-7	74	13	12	55	43	23	34	0,63
	10*-16-8,8	44	-2	-6	-1	-6	75	13	12	53	44	21	35	0,61
	10*-16-9,1	45	-2	-5	-1	-5	75	13	12	53	44	21	35	0,61
	10*-16-10,8	44	-1	-5	0	-5	74	13	12	53	43	21	36	0,61
	10*-16-12,8	45	-2	-6	-1	-6	73	13	12	53	42	21	37	0,61
	6,5-16-4*	36	-1	-5	0	-5	78	12	14	57	51	20	29	0,66
	6,5-16-6*	39	-1	-5	0	-5	77	12	14	56	49	20	31	0,64
	8,5-16-4*	38	-1	-5	0	-5	77	12	14	55	49	18	33	0,63
	8,5-16-6*	41	-2	-6	-1	-6	77	12	14	55	48	18	34	0,63
	8,5-16-8*	42	-2	-6	-1	-6	76	12	14	55	46	18	36	0,63
	8,5-16-10*	45	-2	-6	-1	-6	75	12	13	55	45	18	37	0,63

Notes:
The performance data for insulating glass units have been determined with Pilkington **Optitherm™** S3 coating on glass marked with * and with argon (90%) gas filling.



Pilkington Optiphon™														
type	acoustic performance data						light			energy				
	R _w (dB)	C (dB)	C _{tr} (dB)	C 100-5000 (dB)	C _{tr} 100-5000 (dB)	LT %	LR _o %	LR _i %	g %	ET %	ER %	EA %	TSC	
	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN ISO 717-1	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	EN 410	= g/87	
8,5*-16-12,5	49	-3	-8	-2	-8	74	13	12	51	41	19	40	0,59	
8,5*-20-12,5	50	-3	-8	-2	-8	74	13	12	51	41	19	40	0,59	
8,8*-16-12,8	47	-2	-7	-1	-7	74	13	12	51	41	19	40	0,59	
9,1*-16-13,1	49	-3	-8	-2	-8	73	13	12	51	41	18	41	0,59	
9,1*-20-13,1	50	-3	-8	-2	-8	73	13	12	51	41	18	41	0,59	
10,5-16-8*	43	-2	-6	-1	-6	75	12	13	53	45	17	38	0,61	
10,5-16-10*	45	-1	-5	0	-5	74	12	13	53	43	17	40	0,61	
12,5-16-8*	43	-1	-5	0	-5	74	12	13	51	43	15	42	0,59	
12,5-16-10*	45	-1	-5	0	-5	73	12	13	51	42	15	43	0,59	
6*-12-4-12-9,1*	41	-2	-7	-1	-7	69	17	17	49	37	30	33	0,56	
13,1*-12-6-12-9,1*	49	-1	-6	0	-6	65	16	17	41	32	18	50	0,47	
13,1*-12kr-6-12kr-9,1*	50	-2	-7	-2	-7	65	16	17	41	32	18	50	0,47	

Notes:

The performance data for insulating glass units have been determined with Pilkington **Optitherm™** S3 coating on glass marked with * and with argon (90%) gas filling.



5. Safety/Security



Demanding safety legislation has highlighted the critical areas where modern safety glazing must comply with the relevant safety requirements. Innovations in the development of Safety/Security glass has opened up new avenues of design, which allows people to be protected from injury and, in the most extreme cases, protect buildings from various forms of attack.

With this in mind, we have developed a wide range of sophisticated products, in order to meet these ever increasing demands, without compromising on design criteria of natural light and visibility. We are always at the forefront in further developing the products and the industry standards, so that personal accident and serious injuries resulting from glass impact are further prevented or minimized.

What does "Safety" and "Security" mean?

Although Safety and Security are closely linked topics, it is important to understand the distinction between the two terms, to ensure the right glass is specified.

The term "Safety" is applied to glazing used to reduce the risk of accident by impact, fracture, shattering, or in a fire. The term "Security" is applied to glazing, which in addition to "Safety", is able to withstand a variety of deliberate attacks such as physical, armed or blast.

Using only the right type of glass is not enough to secure the necessary resistance to the severe loads. The glass, once impacted, behaves differently in different framing systems, it is therefore imperative to combine high performance glazing with high performance framing systems.



The standards

**EN 12600 Glass in building – Pendulum test –
Impact test method and classification for flat glass**

The pendulum impact test is the standard for classifying flat glass products by performance under impact and by mode of breakage. Similar in principle to previously used swing bag tests, EN 12600 utilises a dual rubber tyre impactor to strike the glass at three drop heights.

Table 5.1. Classification of safety glass in accordance with EN 12600 „Glass in building. Pendulum test. Impact test method and classification for flat glass“.

Classification	Mode of breakage types	Drop height [mm]
3	A, B, C	190
2	A, B, C	450
1	A, B, C	1200

The classification has three components:

- The first is the class (i.e. 1, 2 or 3) at which the glass has either not broken or broken safely.
- The second is the mode of breakage defined as:
Type A: numerous cracks appear forming separate fragments with sharp edges, some of which are large – typical of annealed glass.
Type B: numerous cracks appear, but the fragments hold together and do not separate – typical of laminated safety glass.
Type C: disintegration occurs, leading to a large number of small particles that are relatively harmless – typical of toughened glass.
- The third is the highest drop height (i.e. 1, 2 or 3) at which the product did not break (e.g. for toughened glass) or where it broke, but no shear or opening bigger than 76 mm in diameter appeared.



EN 356 Glass in building – Security glazing – Testing and classification of resistance against manual attack

This specifies the requirements and test methods for glass designed to be resistant to manual attack. The glass is subjected to impact from a hard body impactor of mass 4,11 kg for classes P1A to P5A and an axe for classes P6B to P8B.

Table 5.2. Classification of security glass in accordance with EN 356.

Class of resistance	Drop height [mm]	The number of strikes	Code designation of resistance class
P1A	1500	3 in a triangle	EN 356 P1A
P2A	3000	3 in a triangle	EN 356 P2A
P3A	6000	3 in a triangle	EN 356 P3A
P4A	9000	3 in a triangle	EN 356 P4A
P5A	9000	3×3 in a triangle	EN 356 P5A
P6B	—	from 30 to 50	EN 356 P6B
P7B	—	from 51 to 70	EN 356 P7B
P8B	—	more than 70	EN 356 P8B



Security glass test using an axe
Classes: P6B, P7B, P8B



EN 1063 Glass in building – Security glazing – Testing and classification of resistance against bullet attack

This specifies performance requirements and test methods for the classification of bullet resistant glass, based on attack by handguns, rifles and shotguns.

The test consists of 3 shots fired on the vertices of a 100 mm equilateral triangle glass sample with a weapon corresponding to the required class.

If the glass sample has not been pierced by the shots then the required class is achieved. Behind the glass sample is an aluminium witness sheet. If after the shots have been fired there are some perforations on it, then the resistance class must have the suffix S (splinters), otherwise it is classified NS (no splinters).



Bullet resistant glass



Table 5.3. Classification of bullet resistant glass in accordance with EN 1063 „Glass in building. Security Glazing. Testing and classification of resistance against bullet attack”.

Class of resistance	Calibre	Bullet mass [g]	Bullet velocity [m/s]	Test range [m]
BR1-S/BR1-NS	0,22 LR	2,6	360	10
BR2-S/BR2-NS	9 mm × 19	8,0	400	5
BR3-S/BR3-NS	0,357 Magnum	10,25	430	5
BR4-S/BR4-NS	0,44 Magnum	15,55	440	5
BR5-S/BR5-NS	5,56 × 45	4,0	950	10
BR6-S/BR6-NS	7,62 × 51	9,45	830	10
BR7-S/BR7-NS	7,62 × 51	9,72	820	10
SG1-S/SG1-NS	0,22 LR	2,6	360	10
SG2-S/SG2-NS	9 mm × 19	8,0	400	5



Description

Pilkington **Optilam**™ – is a laminated safety glass which consists of two or more panes of glass bonded together by heat and pressure with one or more sheets of flexible PVB (polyvinylbutyral) interlayer, sandwiched permanently between the glasses. The interlayers ensure the integrity of the glass, by holding the broken pieces in place should damage occur. In fact, glass fragments adhere strongly to the interlayer, while the resistant cushioning effect dissipates the energy. The performance of Pilkington **Optilam**™ can be influenced simply by changing the number and thickness of each layer of glass and PVB interlayer. By doing this, we can offer a wide range of products suitable for many applications.



Pilkington **Optilam**™ Therm 8,8 – Tulipan House office center, Warsaw, Poland

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Applications

Pilkington **Optilam**™ offers the specifier a wide choice of products fulfilling a multitude of functional requirements. For a given application, Pilkington **Optilam**™ can be specified to offer one or more of the following attributes: safety, security, noise control, solar control, bullet resistance, blast resistance, UV screening, privacy or decoration. The manufacturing method allows a wide variety of styles, shapes, colours and glass types to be incorporated.

Pilkington **Optilam**™ can be used wherever safety or security is important, in commercial, public and domestic applications. Recommended applications are skylights, full height windows, balustrades, low level glazing, tables and counter tops. It is particularly suited for use in hazardous situations, such as doors,



Pilkington **Optilam**[™] Therm – Mercedes showroom, Olsztyn, Poland

partitions, balconies, sloped glazing and other overhead glass applications.

When there is a risk of thermal stress, Pilkington **Optilam**[™] glass can be manufactured with heat strengthened or toughened glass.

Features and benefits

- Class 2(B)2 performance to EN 12600 achieved through Pilkington **Optilam**[™] 6,4, which is the most widely used thickness for protecting people against risk of accidental injury. Can achieve up to Class 1(B)1, dependent upon thickness.
- Available incorporating Pilkington **Optifloat**[™] Tint and Pilkington **Suncool**[™] range of glasses, or a tinted PVB interlayer (Pilkington **Optilam**[™] I) to provide both safety and solar control properties.
- Can be used with textured glass and polished wired glass.
- Available in combination with Pilkington **K Glass**[™] or Pilkington **Optitherm**[™] to enhance thermal insulation whilst providing safety.
- Reduced light transmission when made with a matt obscure interlayer.
- May be single glazed or incorporated in an insulating glass unit.
- Available in a wide range of thicknesses.



PILKINGTON			Pilkington Optilam™ (safety glass)																												
glass	class according to EN 12600	class according to EN 356	performance code		light				energy						S, UV																
I			W/m²K	%	%	%	%	—	%	%	%	%	%	—	—	%															
monolithic glass			U _g	L _T	g	LT	energy	LT	reflectance outside	LRI	reflectance inside	Ra	colour rendering index	ET	direct transmittance	ER	reflectance	EA	absorptance	TET	total transmittance	SSC	shortwave shading coefficient	LSC	longwave shading coefficient	TSC	total shading coefficient	S	selectivity index	UV	UV transmittance
	4,4 mm	3(B)3	5,7	89	81	89	8	8	99	78	7	15	81	0,90	0,03	0,93	1,10	3	1,13	1	1,13	3	0,89	0,07	0,89	1,13	3	1,14	1	1,18	3
	6,4 mm	2(B)2	5,7	88	79	88	8	8	98	74	7	19	79	0,85	0,06	0,91	1,11	3	1,13	1	1,13	3	0,85	0,06	0,91	1,11	3	1,14	1	1,18	3
	6,8 mm	1(B)1	5,7	88	78	88	8	8	98	73	7	20	78	0,84	0,06	0,90	1,13	1	1,13	1	1,13	3	0,84	0,06	0,90	1,13	1	1,14	1	1,18	3
	8,4 mm	2(B)2	5,6	87	77	87	8	8	97	71	7	22	77	0,82	0,07	0,89	1,13	3	1,13	3	1,13	3	0,82	0,07	0,89	1,13	3	1,14	1	1,18	3
8,8 mm	1(B)1	5,6	87	76	87	8	8	97	70	7	23	76	0,80	0,07	0,87	1,14	1	1,14	1	1,14	1	0,80	0,07	0,87	1,14	1	1,14	1	1,18	3	
12,4 mm	1(B)1	5,5	85	72	85	8	8	96	66	6	28	72	0,76	0,07	0,83	1,18	3	1,18	3	1,18	3	0,76	0,07	0,83	1,18	3	1,18	3	1,18	3	



Description

Pilkington **Optilam**™ (security glass) is produced by combining layers of glass with PVB interlayers to form sandwiches of material with specific design properties ensuring security in addition to its safety properties.

Applications

Pilkington **Optilam**™ (security glass) offers the specifier a wide choice of products fulfilling a multitude of functional requirements in applications such as buildings or shops which display valuable goods, banks, building societies, museums, as well as in hospitals and prisons. For a given application, Pilkington **Optilam**™ can be specified to offer one or more of the following attributes: safety, security, noise control, solar control, bullet resistance, blast resistance, UV screening, privacy or decoration.



Pilkington **Optilam**™ 9,5 – Warszawa Spa & Resort Hotel, Augustów, Poland



Pilkington **Optilam**™ – Renoir Residence,
Warsaw, Poland



Pilkington **Optilam**™ 9,5 – Eko-Park housing
estate, Warsaw, Poland

Features and benefits

- Conforms to security glazing standards (e.g. EN 356) in addition to safety glass requirements (EN 12600).
- Retains its overall integrity and continues to act as a barrier even if the glass breaks, protecting from vandalism, burglary or ballistic attack.
- Able to withstand repeated blows from heavy objects such as bricks, hammers or crowbars.
- Provides UV protection, which may help to reduce fading.



PILKINGTON		Pilkington Optilam [™] (security glass)																			
glass	class according to EN 1063	class according to EN 356	performance code			light			energy						S, UV						
I			W/m²K	%	%	U _g	LT	g	%	LRI	Ra	ET	ER	EA	TET	SSC	LSC	TSC	S	%	UV
monolithic glass																					
7,5 mm	—	P4A	5,6	88	76				88	8	8	71	7	22	76	0,82	0,05	0,87	1,16	0,1	
9,5 mm	—	P4A	5,6	87	74				87	8	8	69	7	24	74	0,79	0,06	0,85	1,18	0,1	
11,5 mm	BR1S	P4A	5,5	86	72				86	8	8	66	7	27	72	0,76	0,07	0,83	1,19	0,1	
13,5 mm	—	P4A	5,5	85	70				85	8	8	63	6	31	70	0,72	0,08	0,80	1,21	0,1	
19,5 mm	BR1S	P6B	5,3	82	65				82	8	8	56	6	38	65	0,64	0,11	0,75	1,26	0,1	
20,6 mm	BR2S	P6B	5,3	83	65				83	8	8	56	6	38	65	0,64	0,11	0,75	1,28	0,0	
27,5 mm	BR2S	P6B	5,1	79	60				79	7	7	49	6	45	60	0,56	0,13	0,69	1,32	0,1	
29,8 mm	BR3S	P7B	5,0	79	59				79	7	7	48	6	46	59	0,55	0,13	0,68	1,34	0,0	
39,0 mm	BR4S	P8B	4,8	74	54				74	7	7	41	5	54	54	0,47	0,15	0,62	1,37	0,0	

Notes:

Above data are given for laminated glass made of 2 or more sheets of clear float glass and PVB inter-layer 0,38 mm or its multiple versions.

Product thicknesses should be compared with most typical glass constructions.



Description

Pilkington Toughened Safety Glass is manufactured by subjecting the final glass size to a heating and cooling treatment which sets up high compressive stresses at the surface and balancing tensile stresses in the centre of the glass, which increases glass strength.

The high compressive surface stresses give Pilkington Toughened Safety Glass its increased resistance to mechanical and thermal stresses. It can, however, break under extreme loads or by severe impact. When broken, Pilkington Toughened Safety Glass shatters into small, blunt-edged fragments, reducing the risk of personal injury.



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Pilkington **Optifloat™** Clear T – Galeria Bałtycka shopping center, Gdańsk, Poland



Applications

Pilkington Toughened Safety Glass provides an economical and proven solution in any areas of particular hazard where national standards or Codes of Practice specifically require the use of safety glazing material.

Pilkington Toughened Safety Glass can be used, for example, along passageways and areas of high pedestrian traffic, in doors and adjacent panels, shower and bath enclosures, balconies, barriers, staircases and other structural glazing applications. It can be used to provide uninterrupted single or double glazed cladding for the whole building. Other applications include frameless shop fronts and entrances, internal partitions, furniture, canopies gymnasiums and sports arenas.

Features and benefits

- Achieves up to Class 1(C)1 according to EN 12600, dependent upon glass type and thickness.
- Up to 3-4 times stronger than ordinary glass of the same thickness, offering a proven solution to safety and strength concerns.
- Can be heat soaked for extra confidence in use.
- When broken, it shatters into small, relatively harmless pieces, reducing the risk of personal injury.
- Reduces the risk of thermal stress breakage of glass exposed to solar radiation.
- Conforms to all the requirements of EN 12150-1 and is CE marked in accordance with EN 12150-2.
- Available in a wide range of sizes and thicknesses.



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Pilkington **Optifloat™** Clear T – Solpark educational and sport complex, Kleszczów, Poland



Glass sizes

Thickness [mm]	Maximum size [mm]	Minimum size [mm]
4	1500×2500	200×350
5	2000×3000	200×350
6-19	2800×6000	200×350

Technical data

hardness	6 on Mohs Scale according to EN 572-1:2009
density	2500 kg/m ³ according to EN 572-1:2009
resistance to temperature	DT 200 K according to EN 12150-1:2002
U-value	5,7-5,8 W/m ² K according to EN 673:2011
bending strength	120 N/mm ² according to EN 12150-1:2002

Pilkington Toughened Safety Glass products can be easily identified by the simple use of the letter 'T' after the product brand name; whereas heat strengthened glass can be identified by the descriptor 'HN'. In order to distinguish heat soaked glass from standard toughened glass, 'HS' is used as a descriptor after the letter 'T'. Examples are given below.

Pilkington Optifloat™ T	toughened Pilkington Optifloat™
Pilkington Optiwhite™ T	toughened Pilkington Optiwhite™
Pilkington K Glass™ T	toughened Pilkington K Glass™
Pilkington Activ™ T	toughened Pilkington Activ™
Pilkington Optifloat™ Grey T	toughened Pilkington Optifloat™ Grey
Pilkington Suncool™ 70/40 T	toughened Pilkington Suncool™ 70/40
Pilkington Optitherm™ S3 T	toughened Pilkington Optitherm™ S3
Pilkington Optifloat™ THS	heat soaked toughened Pilkington Optifloat™
Pilkington Optifloat™ HN	heat strengthened Pilkington Optifloat™



6. Self-cleaning



NSG Group made a significant step in the glass industry with the development of Pilkington **Activ**™ the first dual-action self-cleaning glass. The unique dual-action of the Pilkington **Activ**™ coating uses the forces of nature to help keep the glass free from dirt, giving not only the practical benefit of less cleaning, but also clearer, better-looking windows. The Pilkington **Activ**™ coating, located on surface #1 of the glass, works in two stages. Firstly, it reacts with natural daylight to break down and loosen organic dirt. Secondly, when it rains, instead of forming droplets, the water spreads evenly over the surface of the glass, forming a thin film and helping to wash any dirt away, preventing the formation of drying spots and streaks, and helping the glass to dry very quickly. In installations where condensation is a problem, it reduces its visibility and helps it to evaporate more quickly.

The Pilkington **Activ**™ coating works also on cloudy days and during the night. During dry spells the glass can be cleaned by simply hosing it down.

Glass used today in commercial buildings and offices, has to provide multiple functions. A technical profile of large glazed areas must meet requirements related to solar control, thermal insulation and noise control, as well as strict safety regulations. These requirements can now be combined with self-cleaning properties. Availability of dual coated products and laminating possibilities allow the manufacture of the glass products that ensure aesthetics, safety, comfort and cost-effective operation of modern buildings, allowing best cost effective management of buildings.

Dual coating technology is used to combine self-cleaning and solar control properties in one product, ensuring a highly cost effective glass combination. Pilkington **Activ Suncool**™ is manufactured with a Pilkington **Activ**™ coating on the outside (i.e. on surface #1) and a Pilkington **Suncool**™ coating on the inside (i.e. coating on surface #2). It is used in insulating glass units to enable cost effective building management literally from both sides.



In the commercial sector the glass often needs to provide additional protection features. To meet these requirements, NSG Group offers two product lines of laminated safety glass. Using laminated Pilkington **Activ**™ glass for façade elements and on glazed roof and sloping areas which are difficult to access, both safety and self-cleaning can be assured.

The same applies to the combination of the self-cleaning properties with noise control of the façade. Functional glass, such as Pilkington **Activ Optiphon**™ allows a significant decrease in costs of window cleaning, and at the same time, it has an increased sound reduction index (R_w).

Pilkington **Optitherm**™ S3 low-emissivity coating, usually used on surface #3 in insulating glass units, is sometimes difficult or impossible to apply on some glass types. However, dual coated Pilkington **Activ Optitherm**™ S3 provides self-cleaning and good thermal insulation for insulating glass units with thick bullet-resistant or textured glass.

Table 6.1. Pilkington **Activ**™ product combinations.

Function	Product and combination
Self-cleaning	Pilkington Activ ™ monolithic, single-coated, used as single or in insulating glass units.
Plus solar control	Pilkington Activ Suncool ™ monolithic, dual-coated, used in insulating glass units.
Plus safety	Pilkington Activ Optilam ™ laminated safety glass, coated, used as single or in insulating glass units.
Plus noise control	Pilkington Activ Optiphon ™ sound insulating laminated safety glass, coated, used as single or in insulating glass units.
Plus thermal insulation	Pilkington Activ Optitherm ™ S3 monolithic, dual-coated, used in insulating glass units.

Apart from the above-mentioned combinations, other configurations are possible (e.g. Pilkington **Activ Suncool Optilam**™).



Self-cleaning solar control glass

Description

Pilkington **Activ™** Blue is a pyrolytic on-line coated body-tinted, self-cleaning and medium performance solar control glass, with an attractive blue colour. Its surface #1 self-cleaning coating has photo-catalytic and hydrophilic properties. The unique blue colour helps to keep internal temperatures cool whilst still maintaining excellent light transmittance, low light reflection and high energy absorption. For optimum self-cleaning and thermal performance, Pilkington **Activ™** Blue can be combined with Pilkington **K Glass™** or Pilkington **Optitherm™** in an insulating glass unit.

Applications

Specially designed for the optimum roof unit, Pilkington **Activ™** Blue is perfect for use in conservatories and winter gardens. Its self-cleaning properties make it ideal for use in hard to reach places that are difficult to clean.



Pilkington **Activ™** Blue – BorgWarner office, Jasionka, Poland



Pilkington **Activ™** Blue must always be processed, installed and maintained in accordance with our specialist Handling and Processing instructions for Pilkington **Activ™**.

Features and benefits

- Self-cleaning properties reduce the need for manual cleaning, saving water and eliminating potentially harmful run-off from expensive detergents, also increasing personal safety.
- Additional medium performance solar control properties, reducing solar heat entering the building, enhancing comfort and reducing the need for cooling the building.
- Attractive blue colour of the glass is perfect for roof glazing, enhancing the view from inside to outside.
- Good light transmission.
- Low exterior reflection, improving aesthetics of the building.
- Works even on cloudy days and during the night.
- Highly durable pyrolytic on-line coating that lasts the lifetime of the glass, easy to handle and process.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in its monolithic form or incorporated into insulating glass units (coating on surface #1), and has an unlimited shelf-life.
- Can be combined in an insulating glass unit with low-emissivity glass such as Pilkington **K Glass™** or Pilkington **Optitherm™** for additional thermal insulation properties.
- Available in a range of different sizes and thicknesses (4, 6 and 10 mm).

Notes:
Maximum size: 6000 mm x 3210 mm.



Pilkington Activ™ Blue																				
glass configuration		performance code			light			energy			S, UV									
II	II	II	II	W/m²K	%	%	%	%	%	%	—	UV								
				U _g	LT	g	LT	LT	LT	LT	ET	ER	EA	TET	SSC	LSC	TSC	S	UV transmittance	selectivity index



Self-cleaning glass

Description

An pyrolytic on-line coated self-cleaning glass with photo-catalytic and hydrophilic properties.

Applications

Pilkington **Activ™** Clear is the perfect choice for situations where cleaning is difficult or costly, such as high-rise buildings, glass roof structures or conservatories and atria, or in housing for use by elderly residents. It is also ideal where good visibility is important, for example, in sports stadiums, commentary boxes, airports and external walkways.



Pilkington **Activ™** Clear – Faculty of Management and Social Communication
of the Jagiellonian University, Cracow, Poland



Pilkington **Activ**™ Clear – Olimp shopping center, Mińsk Mazowiecki, Poland


Pilkington **Activ**™ Clear must always be processed, installed and maintained in accordance with our specialist Handling and Processing instructions for Pilkington **Activ**™.

Features and benefits

- Self-cleaning properties reduce the need for manual cleaning, saving water and eliminating potentially harmful run-off from expensive detergents, also increasing personal safety.
- Works even on cloudy days and during the night.
- Highly durable pyrolytic on-line coating that lasts the lifetime of the glass, easy to handle and process.
- Can be laminated, toughened, bent and enamelled using standard techniques.
- Can be used in its monolithic form or incorporated in insulating glass units (coating on surface #1), and has an unlimited shelf-life.
- Available in combination with Pilkington **Optilam**™ for impact resistance or increased security, Pilkington **Optiphon**™ for improved noise reduction, Pilkington **Optitherm**™ S3 for additional thermal insulation properties.
- Can be combined in an insulating glass unit with a low-emissivity glass such as Pilkington **K Glass**™ or Pilkington **Optitherm**™ for additional thermal insulation properties.
- Available in a range of different sizes and thicknesses (4, 6, 8 and 10 mm).

Notes:
Maximum size: 6000 mm × 3210 mm.



Pilkington Activ™ Clear		S, UV		energy							light				performance code			glass configuration																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
	II	II	II	insulating glass unit, Pilkington Optitherm™ S3 #3	insulating glass unit, Pilkington Optitherm™ S1 #3	insulating glass unit, Pilkington K Glass™ N #3	insulating glass unit, primary product outside #1	W/m²K	U _g	U _g value	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	g	energy	%	LT	light	%	



Neutral self-cleaning solar control glass

Description

A self-cleaning and medium performance solar control dual coated glass with a neutral colour:

- surface #1 self-cleaning on-line coating with photo-catalytic and hydrophilic properties,
- surface #2 off-line solar control coating, with medium light transmittance and high light reflectance.

Its unique solar control coating also helps keep internal temperatures cool whilst still maintaining excellent, neutral light transmittance.



Pilkington **Activ SunShade™** Neutral

Applications

Specially designed for conservatories and large glazed areas, Pilkington **Activ SunShade™** Neutral is perfect for use in both the roof and verticals for domestic or commercial applications.

Pilkington **Activ SunShade™** Neutral must always be processed, installed and maintained in accordance with our specialist Handling and Processing instructions for Pilkington **Activ™**.



Features and benefits

- Self-cleaning properties reduce the need for manual cleaning, saving water and eliminating potentially harmful run-off from expensive detergents, also increasing personal safety.
- Additional medium solar control performance properties, reducing solar heat entering the building, enhancing comfort and reducing the need for cooling the building.
- Works even on cloudy days and during the night.
- Neutral appearance in transmission and reflection, offering attractive aesthetics and making it ideal for use in roof or vertical glazing applications.
- Good light transmission.
- Durable dual coatings coating that last the lifetime of the glass, easy to handle and process.
- Can be laminated, toughened, and bent using standard techniques.
- Has to be incorporated into insulating glass units (self-cleaning coating on surface #1 / solar control coating on surface #2).
- Can be combined in an insulating glass unit with a low-emissivity glass such as Pilkington **K Glass™** or Pilkington **Optitherm™** for additional thermal insulation properties.
- Available in a range of different sizes and thicknesses (4, 6 and 8 mm).

Notes:
Maximum size: 6000 mm × 3210 mm.



Pilkington Activ SunShade™ Neutral		S, UV		energy		light		performance code		glass configuration	
		%	UV	%	TET	%	Ra	%	g	II	insulating glass unit, Pilkington Optitherm™ S3 #3
		—	S	—	TSC	—	LRI	—	LT	II	insulating glass unit, Pilkington Optitherm™ S1 #3
					LSC		LRO		U _g	II	insulating glass unit, Pilkington K Glass™ N #3
					SSC		LT		U _g value	II	insulating glass unit, primary product outside #1
					EA						
					ER						
					ET						

Notes:

- 1. Based on 4 mm glass thickness.
- 2. Based on 16 mm argon filled (90%) cavities.



Self-cleaning high performance solar control and low-emissivity glass

Description

A range of self-cleaning, superior solar control and thermal insulation performance dual coated glass:

- surface #1 self-cleaning on-line coating with photo-catalytic and hydrophilic properties;
- surface #2 superior off-line solar control and low-emissivity coating, with high light transmittance, low, medium or high light reflectance and outstanding U_g -value (down to 1,0 W/m²K) in an double insulating glass unit.

Pilkington **Activ Suncool™** is available in a wide range of clear or neutral appearances and in two distinctive colours: blue and silver.

Table 6.2. The appearance of the Pilkington **Activ Suncool™** range.

Product	Appearance in reflection (external view)	Level of reflection ^[1]	Appearance in transmission (internal view)
Insulating glass unit construction (6 mm external pane–16 mm–4 mm Pilkington Optifloat™ Clear)			
Pilkington Activ Suncool™ 70/40	neutral	medium	neutral
Pilkington Activ Suncool™ 70/35	neutral/blue	medium	neutral
Pilkington Activ Suncool™ 66/33	neutral/blue	medium	neutral
Pilkington Activ Suncool™ 60/31	neutral/blue	medium	neutral
Pilkington Activ Suncool™ 50/25	neutral/blue	medium	neutral
Pilkington Activ Suncool™ Blue 50/27	blue	medium	neutral
Pilkington Activ Suncool™ Silver 50/30	silver	high	neutral
Pilkington Activ Suncool™ 40/22	neutral/blue	medium	neutral
Pilkington Activ Suncool™ 30/17	neutral/blue	high	neutral

^[1] Level of reflection: low < 15%, medium 15-25%, high > 25%.



Pilkington **Activ Suncool™** is a range of dual coated products incorporating self-cleaning, solar control and thermal insulation properties. The external self-cleaning coating breaks down the organic dirt, and rain water washes any loosened dirt away. The internal solar control and low-emissivity coating reflects short wavelength solar radiation out of the building, as well as long wavelength heat radiation (generated by heating systems, lighting and building's occupants) back into the building.

Pilkington **Activ Suncool™** effectively reduces solar heat gain, at the same time providing high level of light transmittance and aesthetic appearance.

We have developed a range of Pilkington Spandrel Glass products for use with Pilkington **Activ Suncool™** solar control glass to ensure continuity in the aesthetic design of façades. Pilkington Spandrel Glass Coated is available in thicknesses 6, 8 and 10 mm in toughened form. Maximum size of such spandrels is 2500 mm × 4500 mm.

Table 6.3. The Pilkington Spandrel Glass Coated product range and appearance.

Product	Appearance in reflection	Level of reflection ^[1]	Light reflection [%]
Pilkington Spandrel Glass Coated A200	neutral/blue	medium	24
Pilkington Spandrel Glass Coated A140	neutral/blue	high	29
Pilkington Spandrel Glass Coated A120	silver	high	37

^[1] Level of reflection: low < 15%, medium 15-25%, high > 25%.



Table 6.4. The full Pilkington **Activ Suncool™** range and recommended off-line coated spandrels.

Product	Spandrel offering	Notes
Pilkington Activ Suncool™ 70/40	—	Due to its low reflection, the appearance of Pilkington Activ Suncool™ 70/40 is dominated by the transmission. However Pilkington Spandrel Glass Coated A200 can be offered as a spandrel solution for Pilkington Activ Suncool™ 70/40 when the colour match is not expected to be perfect.
Pilkington Activ Suncool™ 70/35	A200	Pilkington Spandrel Glass Coated A200 is the recommended solution for Pilkington Activ Suncool™ 70/35, Pilkington Activ Suncool™ 66/33 and Pilkington Activ Suncool™ 60/31 . Whilst not a perfect colour match this is the most harmonising offering in comparison to an enamelled spandrel solution.
Pilkington Activ Suncool™ 66/33	A200	
Pilkington Activ Suncool™ 60/31	A200	
Pilkington Activ Suncool™ 50/25	A200	—
Pilkington Activ Suncool™ Blue 50/27	—	—
Pilkington Activ Suncool™ Silver 50/30	A120	—
Pilkington Activ Suncool™ 40/22	A140	Pilkington Spandrel Glass Coated A140 is the recommended solution for Pilkington Activ Suncool™ 40/22. Whilst not a perfect colour match this is the most harmonising offering in comparison to an enamelled spandrel solution.
Pilkington Activ Suncool™ 30/17	A140	—

As with all spandrel constructions, it is strongly advised that the customer conducts a visual ‘mock-up’ test to ensure an acceptable match.



Applications

Pilkington **Activ Suncool™** can only be used in insulating glass units. Designed to achieve optimum performance in large glazed areas, Pilkington **Activ Suncool™** is suitable for commercial and residential applications that demand high light transmission properties. Where a safety glass is required, Pilkington **Activ Suncool™** can be specified as toughened or laminated glass. Toughened or heat strengthened glass should also be specified in applications where Pilkington **Activ Suncool™** may be at risk of thermal breakage.



Pilkington **Activ Suncool™** 70/40 – Villa, Airiston Lumous, Finland



Features and benefits

- Self-cleaning properties reduce the need for manual cleaning, saving water and eliminating potentially harmful run-off from expensive detergents, also increasing personal safety.
- Additional superior solar control property, reducing the need for cooling the inside of the building.
- Range of light transmission and reflection, reducing the need for lighting the inside of the building.
- Wide range of appearance and performance options, providing a solution for the most demanding designs.
- Superior low-emissivity, with U_g -values down to 1,0 W/m²K in 6-16-4 standard constructions with argon (90%), making the products highly energy efficient, through reduced need for heating.
- Works even on cloudy days and during the night.
- Highly durable self-cleaning coating lasts the lifetime of the glass.
- Can only be used in insulating glass units (self-cleaning coating on surface #1 / solar control coating on surface #2), with argon gas for even better thermal insulation.
- Available in combination with Pilkington **Optilam™**, for impact resistance or increased security, or Pilkington **Optiphon™**, for improved noise reduction.
- Available in annealed, toughened and laminated forms.
- Selection of harmonising spandrel panels available, allowing freedom in design of complete glass façades.
- Available in a range of different sizes and thicknesses (generally available in 6 and 8 mm (10 mm is available on special request)).

6

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm x 3210 mm.

6

Notes:

1. Based on 6 mm glass thickness.
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6

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



Pilkington		Pilkington Activ Suncool™ Blue 50/27									
glass configuration		performance code		light		energy		S, UV			
II	II	W/m²K	%	%	%	%	%	%	%	%	%
II	III										

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.

6

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



Pilkington Activ Suncool™ 40/22		S, UV		energy							light			performance code			glass configuration		
		%	UV	UV transmittance	6														
			S	selectivity index	1,76														
				TSC	total shading coefficient	0,24													
				LSC	longwave shading coefficient	0,02													
				SSC	shortwave shading coefficient	0,22													
			%	TET	total transmittance	21													
			%	EA	absorptance	37													
			%	ER	reflectance	44													
			%	ET	direct transmittance	19													

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.

6

Notes:

1. Based on 6 mm glass thickness.
2. Based on 16 mm (double glazed units) and 12 mm (triple glazed units) argon filled (90%) cavities.
3. The primary product shall only be used in insulating glass units.
4. Maximum size of primary monolithic product is 6000 mm × 3210 mm.



7. Decoration



Our decoration glass is very versatile; it allows total freedom in design and can be customised to fulfil any requirements. Various technologies can be used to create the finished products, whether it is patterned or colour glass. We can also influence the glass surface's transparency as well as its light transmittance of (i.e. be translucent).

Our range of decorative products comprises transparent or translucent glass such as screen printed glass, laminated glass with tinted or white translucent interlayer, sand blasted or acid etched glass, texture glass, or fully opaque products such like enamelled glass, mirrors, and reflective spandrel panels.

Using decorative glass you can create surroundings with a strong individual identity. In this section you will find our most popular decorative products. However, additional decorative glass can be manufactured on request to meet individual requirements of architects and specifiers.



Acid-etched translucent glass

Description

An acid-etched glass suitable for internal or external use, Pilkington **Optifloat™** Opal creates an attractive finish for windows, partition walls, glass doors, furniture, shelving, wall cladding and many more applications. Whilst they can look stunning and create a beautiful effect, many of the semi-opaque glasses on the market have proved difficult to stock, handle and process until now.

Pilkington **Optifloat™** Opal offers all the diffused natural light of a translucent glass, but with none of the drawbacks. The real beauty is that it can be stored and processed in the same way as standard float glass, is readily available from stock in a range of sizes and thicknesses and can be easily toughened, laminated or screen-printed.

Applications

Pilkington **Optifloat™** Opal is versatile and easy to handle and process, therefore it can be used in any internal or external applications for decoration purposes such as windows, partition walls, glass doors and furniture (including shelves, cabinets and display cases), working surfaces, wall cladding and balustrades.



Pilkington **Optifloat™** Opal



Pilkington **Optifloat™** Opal

Features and benefits

- High light transmittance (of typically 87% in 4 mm), allowing privacy and uniform, natural design whilst still diffusing light.
- 'Velvet smooth' and durable surface; high perceived value in any application.
- Anti-reflectivity of the etched surface.
- Can be toughened, laminated and screen-printed using standard techniques.
- Available in a 4, 6 and 8 mm thicknesses.



Acid-etched translucent extra clear glass

Description

An acid-etched extra clear glass suitable for internal or external use, Pilkington **Optiwhite™** Opal creates an attractive finish for windows, partition walls, glass doors, furniture, shelving, wall cladding and many more applications. The glass is practically colourless, and the green cast inherent to ordinary an acid-etched glass, which is particularly noticeable in thicker glasses, is virtually eliminated. Whilst they can look stunning and create a beautiful effect, many of the semi-opaque glasses on the market have proved difficult to stock, handle and process until now.

Pilkington **Optiwhite™** Opal offers all the diffused natural light of a translucent glass, but with none of the drawbacks. The real beauty is that it can be stored and processed in the same way as standard float glass, is readily available from stock in a range of sizes and thicknesses and can be easily toughened, laminated or screen-printed.



Pilkington **Optiwhite™** Opal



Applications

Pilkington **Optiwhite™** Opal is versatile and easy to handle and process, therefore it can be used in any internal or external applications for decoration purposes such as windows, partition walls, glass doors and furniture (including shelves, cabinets and display cases), working surfaces, wall cladding and balustrades. The colour neutrality of Pilkington **Optiwhite™** Opal is mostly noticeable in applications where the edges of the glass are exposed, for example in shelving or table tops.

Features and benefits

- Acid etched glass
- Practicallary colourless and the green cast inherent to other glasses is not present
- Diffuses light to give a uniform natural look
- 'Velvet smooth' and durable surface
- Can be used internally and externally
- Etched surface has low reflection



Description

A range of toughened safety glass mostly used in non-vision area of the façade, it includes Pilkington Spandrel Glass Enamelled, Pilkington Spandrel Glass Silicone, Pilkington Spandrel Glass Coated and Pilkington Spandrel Glass Laminated.

Pilkington Spandrel Glass Enamelled

Pilkington Spandrel Glass Enamelled is produced by depositing special ceramic paint on the glass, and subsequently being toughened, a process which also fires ceramic paint into the glass surface.



Pilkington Spandrel Glass Enamelled
– PGK office center, Poznań, Poland



Pilkington Spandrel Glass Enamelled
– Manhattan shopping center, Gdańsk, Poland

Pilkington Spandrel Glass Enamelled is offered in 10 standard colours: white RAL 9016, light grey RAL 7046, grey RAL 7012, dark grey RAL 7021, bronze RAL 8017, green RAL 6032, dark green RAL 6012, blue RAL 5024, dark blue RAL 5010 and black RAL 9011. A wider range of RAL colours is available upon request, but minimum quantity ordered should be 200 m².
Maximum size: 1800 mm × 4500 mm.



Pilkington Spandrel Glass Silicone

Pilkington Spandrel Glass Silicone is a toughened glass covered with silicon coating, which makes the glass non-transparent. Pilkington Spandrel Glass Silicone, in standard offer, is available in Blue Grey tint. On special request, the glass is also offered in following tints: Warsaw Grey, Traffic Grey, Primary White and Harmony Blue. Maximum size: 1800 mm × 4500 mm.



Pilkington Spandrel Glass Silicone – Wrocław
University of Technology, Wrocław, Poland



Pilkington Spandrel Glass Silicone
– Toyota showroom, Rzgów, Poland

Pilkington Spandrel Glass Coated

Pilkington Spandrel Glass Coated is a toughened glass, coated with special metallic coating, developed for Pilkington **Suncool™** glass range (type E200, E120, E140) and Pilkington **Activ Suncool™** (type A200, A120, A140).

Maximum size: 2500 mm × 4500 mm.

Pilkington Spandrel Glass Coated (E200, E120, E140) is also available in a toughenable version Pilkington Spandrel Glass Coated Pro T. Maximum size: 6000 mm × 3210 mm



Pilkington Spandrel Glass Coated E120 – Jutrzenki Business Park, Warsaw, Poland





Pilkington Spandrel Glass Laminated

Pilkington Spandrel Glass Laminated is a laminated glass coated with metallic coating laminated towards PVB interlayer. It is an opaque glass panel composed of an extra clear Pilkington **Optiwhite™** glass coated with metallic coating and a clear float. The fact that the coating is laminated towards PVB interlayer protects it against any damage that may happen during processing or installation. The risk of thermal breakage is reduced to a minimum thanks to an application of extra clear low-iron float glass as a substrate of coated glass.

Currently the range of laminated coated spandrel glass includes:

- Pilkington Spandrel Glass Laminated L120 (colour adjusted to high performance solar control glass Pilkington **Suncool™** Silver 50/30),
- Pilkington Spandrel Glass Laminated L140 (colour adjusted to high performance solar control glass Pilkington **Suncool™** 30/17),
- Pilkington Spandrel Glass Laminated L200 (colour adjusted to high performance solar control glass Pilkington **Suncool™** 50/25).

Pilkington Spandrel Glass Laminated is a universal product that can be used in many types of curtain walls, both ventilated and non-ventilated (insulation material in the direct contact with glass).



Pilkington Spandrel Glass Laminated L200 - Parkhaus Weserbahnhof, Bremen, Germany



Pilkington Spandrel Glass Coated E130 – Vorwerk Autotec Polska head office, Brodnica, Poland

Our wide range of Pilkington Spandrel Glass offers a number of options for use with curtain wall applications allowing the entire building exterior to be fully glazed. Its primary function is to cover the construction elements in non-vision areas, such as hung ceilings or the edges of floor slabs. Spandrel glass can be incorporated into insulating glass units, and when used in combination with the same adjacent vision glass, it can either complement or contrast depending on the coating or colour of the external glass. Spandrel glass can be insulated with a variety of materials to meet even the most exacting of standards.

Applications

Pilkington Spandrel Glass is used for curtain wall applications, either to match the non-vision spandrel panels to the vision area of glazing or to provide a contrast to the vision area glazing.



Pilkington Spandrel Glass Enamelled is also used for interior design and furniture.

Features and benefits

- Meets the requirements for toughened safety glass.
- No colour fading.
- Wide range of colours of enamelled glass, allowing a wide range of visual effects.
- Provides uniformity of curtain walling appearance, and total concealment of internal structure or services.
- Can be subjected to additional heat soak treatment, where required.
- Available in a wide range of sizes and thicknesses.



Description

A rolled patterned glass, one surface of which has a specific pattern or design impressed into the surface, Pilkington Texture Glass provides obscuration and decoration. The patterned glass allows the passage of light but depending on the depth and configuration of the pattern, varying degrees of obscuration are obtained. All patterns are classified according to their obscuration in relation to each other, the gradation being from 1 (least obscuring) to 5 (most obscuring).

Applications

The designs give scope for combining functional suitability with decorative effect, whilst emphasising the natural light-enhancing properties of glass. The glasses can be supplied in toughened or laminated form for safety and incorporated into insulating glass units for thermal insulation or noise control.



Pilkington Texture Glass **Taffeta™**

Pilkington Texture Glass is translucent, with diffused light transmitted but privacy maintained. It offers a wide selection of alternatives, meeting both functional and aesthetic requirements and may be used for privacy in commercial, industrial and residential buildings. It may also be used for decorative purposes in applications such as doors, partitions and balustrades.



Features and benefits

- Provide different degrees of obscuration for privacy of decoration purposes.
- Extensive range of designs and finishes.
- Available with wired glass, and therefore suitable for glazing resistant to fire.
- Available in toughened and laminated forms (depending on design) for safety and security performance.
- Can be single glazed or incorporated in an insulating glass unit for additional properties.
- Available in a wide range of sizes and thicknesses (3, 4, 6, 8 and 10 mm) depending on design.



Pilkington Texture Glass **Stippolyte™**



Pilkington Texture Glass		S, UV		energy		light		performance code		glass
PILKINGTON	I	%		%		%		%		monolithic glass
		UV	UV transmittance							
		S	selectivity index							
		TSC	total shading coefficient							
		LSC	longwave shading coefficient							
		SSC	shortwave shading coefficient							
		TET	total transmittance							
		EA	absorptance							
		ER	reflectance							
		ET	direct transmittance							
		Ra	colour rendering index							
		LRI	reflectance inside							
		LRO	reflectance outside							
		LT	transmittance							
		g	energy							
		LT	light							
		U _g	U _g value							
		3 mm								
		4 mm								
		6 mm								
		10 mm								

Notes:

Maximum size: 2140 mm × 1320 mm (except for rough cast available in 2700 mm × 1320 mm).



Description

A clear or tinted float glass, which has been printed with ceramic ink designs and subsequently toughened. Pilkington Screen Printed Glass is available in wide range of colours and designs that fully or partially cover the surface of the glass. Pilkington Screen Printed Glass gives strength, safety, privacy, decoration and solar control in one product. Ceramic coverage on the screen printed glass helps to control heat and light transmission. The shading coefficient of clear and body-tinted glass is reduced, thus allowing greater flexibility of choice and design.



Pilkington Screen Printed Glass – Mondrian House, Warsaw, Poland

Applications

Pilkington Screen Printed Glass can be used in wide variety of applications including doors, bus shelters, telephone kiosks, display signs etc., in addition to the more traditional glazing of partitions, windows and façades.



Pilkington Screen Printed Glass – Król Maciuś I Kindergarten, Warsaw, Poland



Features and benefits

- Available in a wide range of designs.
- Meets the requirements for toughened safety glass.
- High durability of ceramic ink.
- No colour fading.
- Can be single or double glazed.
- Can be subjected to additional heat soak treatment, where required.
- Available in a wide range of sizes and thicknesses.



Pilkington Screen Printed Glass – Institute of Oceanography, Gdynia, Poland

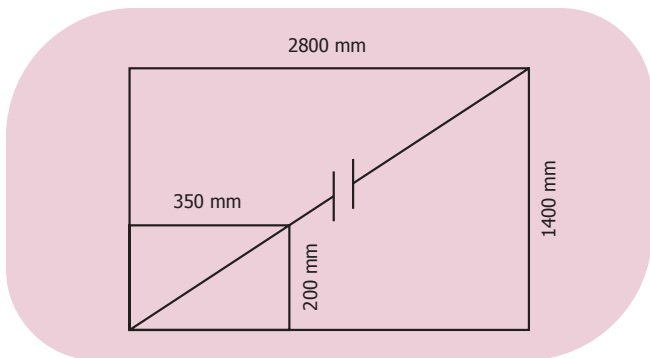
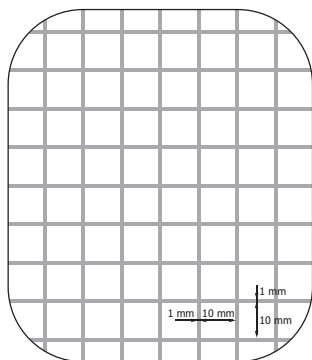
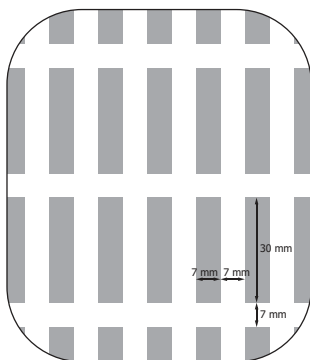


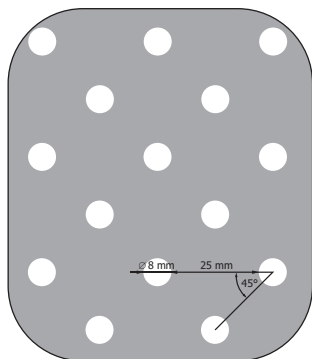
Figure 7.1. Pilkington Screen Printed Glass. Minimum and maximum size of glass subjected to screen printing.



QR10-1

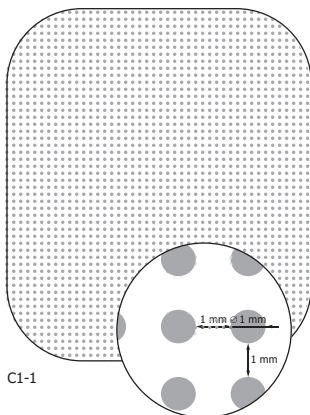


R7-30-7V



45CR8-25

 Ceramic enamel



C1-1

Figure 7.2. Pilkington Screen Printed Glass. Standard designs.



8. Glass Systems



Glass can be used to create building interiors which connect occupants with the external environment, combining unbroken views of the surrounding nature and high level of natural light with the comfort and safety of the internal environment.

This section presents two of our attractive and practical glass systems, which will allow you, for example, to transform yards into cosy interiors, enclose private and public outdoor areas under glass roofs and build stunning glass façades.

Our two major glass systems, Pilkington **Planar™** and Pilkington **Profilite™** are developed for use in glass façades, walls or roofs, and also for internal glazing applications.

Our specialists and accredited installers can provide all the support that architects and designers require during their planning and design process.



The ultimate structural glazing system

Description

A structural glazing system that provides a flush glass surface, by utilising stainless steel fittings housed in countersunk holes to fix the glass façade back to the structure, instead of using the more conventional framed systems. The result is a fully engineered system with the minimum of structure and the maximum visual clarity. The exterior glass used in all Pilkington **Planar**™ systems is normally 10, 12, 15 or 19 mm thick Pilkington **Optifloat**™ heat soaked toughened glass. A silicone seal between adjacent panels provides weatherproofing. Pilkington Architectural has been at the forefront of structural glass testing and design for over 40 years. The fixture holes are a critical feature, subject to constant investigation and testing because of the stresses induced locally by wind or snow loading, or by the weight of the façade. Positive and negative wind loads as well as snow loads must be resisted by the system and transferred through the fixing locations. The system





uses a combination of thickness of glass, panel size and number of fixings to accommodate for a variety of loads. Pilkington **Planar**™ system has given architects the freedom to create the stunning glass buildings and canopies that are such a feature of modern cityscapes.

Glass types used within Pilkington **Planar**™ systems:

- Single glass – flat and curved.
- Single laminated safety glass.
- Pilkington **Planar**™ Integral.
- Insulating glass units.
- Laminated insulating glass units.
- Triple insulating glass units – Pilkington **Planar**™ Triple.



Pilkington **Planar**™ – Zaulek Piękna, Warsaw, Poland



Pilkington **Planar**™ – Federal Court Building, Washington, USA

Latest developments

Pilkington **Planar**™ Triple

The world's first triple glazed frameless bolted system, offering improved thermal insulation, design flexibility and multiple glass combinations for better solar performance or noise control.

- U_g values of $0,8 \text{ W/m}^2\text{K}$ achievable
- Acoustic performance of $R_w > 42 \text{ dB}$ achievable
- Maximised load capacity for larger design modules
- Building transparency increased by larger vision areas



Pilkington **Planar**™ – Crown Point office center, Warsaw, Poland

Pilkington **Planar**™ Integral

By using a bolt fixing incorporated into the glass rather than an exterior fastener, this revolutionary method of securing laminated panels allows the use of a greater variety of glass types:

- no holes in external glass surface;
- flush exterior for easier maintenance;
- wider choice of glass improves design flexibility.

Pilkington **Planar**™ Heavy Duty

Constant improvement in Pilkington **Planar**™ bolt fittings has increased capacity to such an extent that larger and heavier Insulating Glass Units (IGUs) can now be easily accommodated:

- larger modules available for units, even up to 600 kg;
- increased load capacity allows high wind load applications.



Pilkington Laminated Glass Fins (Mullions)

The latest development in mullions, or fins, is composite glass mullions made from laminated glass, offering the designer greater design versatility:

- vertical and horizontal applications possible;
- enhanced structural durability – offering design solutions for ever more demanding markets and applications;
- offers the opportunity to reduce mullion depth and need for lateral bracing.

Planar™ | SentryGlas® System

The **Planar**™ | SentryGlas® System was born from a unique collaboration between Pilkington Architectural engineers and the scientists at DuPont. This high performance laminated system offers:

- increased strength and durability;
- reduced weight of glass and structure;
- longer spans with reduced fixings;
- spectacular post glass breakage security;
- visibly improved clarity, particularly when combined with Pilkington **Optiwhite**™ low-iron glass;
- structural glass fin and beam applications;
- the opportunity to specify glass for horizontal installations when access may be required for maintenance.



Planar™ | SentryGlas® System – Times office centre, Wrocław, Poland



Pilkington **Planar**™ Intrafix System

Fixing securely to the inner structural glass component of an insulated unit, the Intrafix System offers a thermally efficient facade in which the external glass surface is not penetrated with fittings.

- No holes in the external glass surface.
- An increased range of coated and coloured glass.

Glass Types

Pilkington **Planar**™ Laminated Safety Glass

For greater confidence in vertical, horizontal or inclined applications, Pilkington Architectural have developed a range of toughened (or heat strengthened) laminated glass for incorporation into the Pilkington **Planar**™ system. The design process can use a combination of materials to maintain panel integrity in post breakage situations. Furthermore the Pilkington **Planar**™ system, comprising laminated safety glass, has been used in many applications including high wind load, snow load, seismic movements, blast resistance hurricane and impact resistance.

Pilkington **Planar**™ Insulating Glass Units

Pilkington **Planar**™ Insulating Glass Units are technically advanced, dual sealed units offering excellent in-service reliability, consistently high quality manufacture and optimum thermal performance. They incorporate a patented custom spacer bar designed to accommodate high levels of flexibility and building movement. They can also incorporate Pilkington Laminated Safety Glass and a range of other Pilkington glass types, including Pilkington **Activ**™ self-cleaning glass.

Pilkington **Optifloat**™ Clear

High quality clear float glass, from the world leaders and inventors of the float glass process.

Pilkington **Optiwhite**™

Pilkington **Planar**™ incorporating Pilkington **Optiwhite**™ increases the amount of visible light that can pass through the glass by reducing the iron content during the float glass manufacturing process.



Pilkington **Planar**™ – Crown Tower office centre,
Warsaw, Poland



Pilkington **Planar**™ – Elmar office centre,
Jędrzejów, Poland

Pilkington **Optifloat**™ Tint and Pilkington **Arctic Blue**™ body-tinted glass

Pilkington **Optifloat**™ Green, Grey, Bronze and Pilkington **Arctic Blue**™ offer excellent solar control, enhancing the interior environment.

Pilkington **K Glass**™ and Pilkington **Optitherm**™

A unique low-emissivity coating on the surface of Pilkington **Optifloat**™ gives it superb energy management properties. Insulating units incorporating Pilkington **K Glass**™ offer up to 30 percent better insulation than conventional units. Pilkington **Optitherm**™ is a super neutral, off-line coated, low-emissivity glass for use in Insulating Glass Units offering excellent thermal insulation.

Pilkington **Planar**™ Suncoated

This range offers an exciting selection of energy management glass, for insulation and combating solar gain, in a variety of subtle colours which can be used in Pilkington **Planar**™ Insulating Glass Units. This allows the specifier maximum flexibility in choosing the level of performance that suits the project's needs.

Pilkington Decorative Glass

Choose from a selection of screen printed glass, to achieve a range of stunning visual effects.



Pilkington **Planar Activ**™

This product combines Pilkington **Planar**™ with Pilkington **Activ**™ allowing designers to create the first ever self-cleaning frameless structural glazing systems. Collaboration between Pilkington Architectural engineers and scientists at the sealant companies allowed the creation of a revolutionary sealant product compatible with Pilkington **Activ**™.

Pilkington **Planar**™ fittings

The fittings in the Pilkington **Planar**™ system offer the ideal balance between durability and appearance. All are manufactured from 316 grade stainless steel and some of the most durable engineering plastics currently available. Highly engineered and tested components allow Pilkington Architectural to offer the smallest, most aesthetically pleasing fittings available, without compromising performance. Specially customised fittings are available subject to design assessment and approval.

The 902 fitting

Connects indirectly to the secondary structure by means of Pilkington **Planar**™ spring plate brackets or castings. The 902 can accommodate any angle of slope, making it ideal for roofs and canopies.

The 905J fitting

The most popular Pilkington **Planar**™ fitting. Eliminates the need for spring plates and allows absorption of live loads and thermal expansion by rotation around a stainless steel rod connected to the back up structure.

Seismic casting

Accommodates large lateral movements by the use of adjustable arms while maintaining an extremely flat profile.

Four and two point castings

Just some of the many types of stainless steel connectors designed to connect the glass fitting to the back up structure whether structural steel or glass mullion.



905J fitting to a glass mullion



Glass mullion splice connection



905J single glazed fitting to steelwork



902 glass mullion splice connection



Customised casting



Four point casting

Types of structures

Various forms of steel structures can be used to support a Pilkington **Planar**™ façade. The versatility of Pilkington **Planar**™ connections enables almost any type of structure to be used.

The compatible support systems are:

- Steel structures: basic mullions, trusses, tension structures.
- Aluminium purlins.
- Glass mullions systems.

Glass Fin (Mullion) Systems

The use of Pilkington **Planar**™ in combination with a glass fin system creates the ultimate in transparency.

Glass fins are used to transfer wind loading to the structure. Pilkington Architectural have led the way in the development and testing of this design technology.



Structures of this type can be either supported at the base (ground based) or suspended (hung) from above depending upon the height of the façade. The façade glass panels are fastened to the fins by Pilkington **Planar**™ fittings. This means the weight of both the panels and the fins is carried by the connection at the head or base of each fin. This allows the design of very high façades that don't exert large in-plane loads on the Pilkington **Planar**™ panels.



Pilkington **Planar**™ – Lubicz office centre, Cracow, Poland

In places of high seismic activity, glass fin projects must be suspended. Pilkington **Planar**™ has an enviable pedigree in seismic activity areas, as its excellent performance in the San Francisco Bay, Kobe and Taiwan earthquakes testifies.

Steel structures

Various forms of steel structures can be used to support a Pilkington **Planar**™ façade. The design of these structures can be varied and either simple, in the form of mullions, or intricate in the form of trusses. The versatility of the Pilkington **Planar**™ connections enables almost any type of structure to be used.

Pilkington **Planar**™ T.S. System (**Tension Structures**)

Pilkington Architectural has been at the forefront of structural glass testing and design for over 40 years. The Pilkington **Planar**™ T.S. System has combined the back up structure and the glass into one sole source of sytem supply.



A proven performance

Pilkington **Planar**™ T.S. has already met performance requirements for seismic loads, live and dead loads and wind loading up to tropical storm level. We also offer a full technical design service, starting with the basic design concept and leading through to 2D and 3D analysis, full performance specifications, design drawings and, via a network of specialist subcontractors, budgets leading



Pilkington **Planar**™ – KDG office, Warsaw, Poland



Pilkington **Planar**™ – Hayden Planetarium, American Museum of Natural History, New York, USA



to the bid process. In addition, there are many examples of Pilkington **Planar**™ T.S. in acclaimed projects around the world. These include: Procter & Gamble, Surrey, UK; Stadhalle, Germany; Hayden Planetarium, New York, the University of Connecticut, Stamford, USA, and Rolex, Geneva.

Pilkington **Planar**™ T.S. – design concepts

Three forms of tension assisted glass wall systems form the basis of the standardised Pilkington **Planar**™ T.S. system.

Series 1. Primary truss with secondary rigging system:

- most conventional truss fabrication;
- most rigid;
- most economical.

Series 2. Bow string truss:

- transmits no tension forces into boundary structure;
- erects quickly;
- middle range of transparency;
- middle range of pricing.

Series 3. Cable truss:

- generates highest tensile load into boundary structure;
- requires increased support stiffness;
- lightweight;
- maximum transparency.

The drawings show are representations of each series and are not to be limiting in any way.



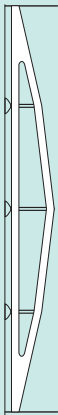
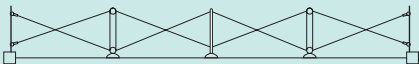
Series 1

Primary truss with secondary rigging system.

Vertical section
at truss



Plan



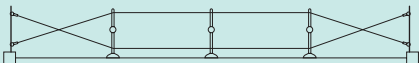
Series 2

Bow string truss.

Vertical
section



Plan

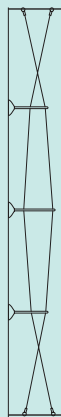




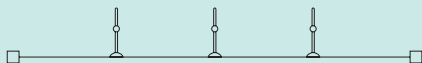
Series 3 Cable truss.



Vertical section



Plan



The perfect system for skylights and canopies

The design flexibility of Pilkington **Planar**™ and its elimination of metal framing makes it the perfect choice for horizontal and overhead glazing.



Pilkington **Planar**™ – Fox Plaza, Century City,
California, USA



Pilkington **Planar**™ – Muni Metro,
San Francisco, USA



Pilkington Architectural has extensive experience in the supply of glazing for canopies and skylights and the Pilkington **Planar**™ system can be specified with confidence for such applications. The extensive seismic, bomb blast, impact, wind load and durability testing procedure which has been carried out on the system has been undertaken to provide this confidence and to support the design process.



Pilkington **Planar**™ – POL-MOT Holding office, Warsaw, Poland

Technical considerations

- The back up structure is required to carry snow loads and resists negative wind pressure through the fixing locations.
- Large spans are possible if underlying purloins are reinforced with cable tensioned rod-rigging.
- Pilkington **Planar**™ requires only a 3 degree slope to eliminate ponding on the glass.



Planar™ | SentryGlas® System

Pilkington Architectural and DuPont, world leaders in structural glass systems and laminate interlayers, have joined forces to create the ultimate in strength, safety, durability and appearance in laminated structural glass – the **Planar**™ | SentryGlas® System: a revolution in terms of frameless laminated glazing.

Applications of the **Planar**™ | SentryGlas® System are not just confined to complex projects. Significant benefits can be realised on any project in which increased strength or enhanced appearance are considered to be of importance. The versatility of the **Planar**™ | SentryGlas® System can now match the demands of projects on all levels.



Figure 8.1. Performance comparison of Pilkington **Planar**™ using SentryGlas® versus PVB interlayers.

Benefits

Stronger

The laminated glass in the **Planar**™ | SentryGlas® System is substantially stronger than traditional PVB laminated systems. Therefore, while the system still offers the same high levels of performance synonymous with Pilkington **Planar**™, it can be made with a thinner glass.

DuPont™ and SentryGlas® are registered trademarks or trademarks of E.I. DuPont De Nemours & Co. or its affiliates and are used with the permission of the trademark owner.



Lighter

The use of custom-designed Pilkington **Planar**™ fittings in combination with stronger laminated glass panels results in a **Planar**™ | SentryGlas® System typically being much lighter than its more conventional PVB counterpart. This can result in longer panels, a reduced number of support fixings and lighter weight support structures – reducing their visual impact, as well as providing cost savings.

More durable

SentryGlas® is manufactured by DuPont; the leader in glass interlayers, and has been subjected to intensive testing to ensure its long-term stability.

Safer

Tests have proven that the **Planar**™ | SentryGlas® System has residual strength, even with both glass components broken. This brings greater peace of mind in locations subject to typhoons or hurricanes, and makes it possible to specify laminated glass for canopies and skylights with limited access for maintenance.

More applications

The **Planar**™ | SentryGlas® System can be supplied using the revolutionary Pilkington **Planar**™ Integral System, allowing a much wider choice of glass than traditional structural laminates.

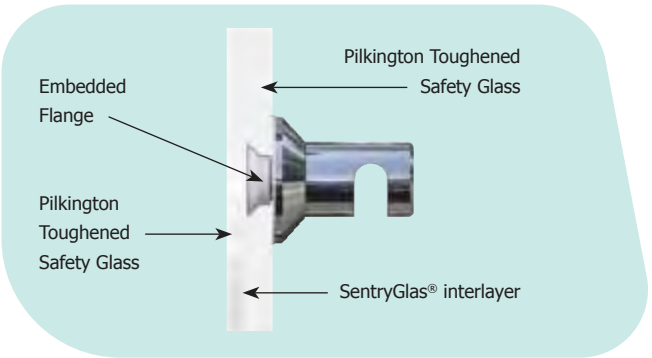


Figure 8.2. Detail of Pilkington **Planar**™ Integral.



Maximum clarity

The SentryGlas® structural interlayer is significantly clearer than traditional interlayers. When used with Pilkington **Optiwhite**™ exceptional clarity is achieved, even in a laminated glass.

What makes the Planar™ | SentryGlas® System **so efficient?**

Load sharing

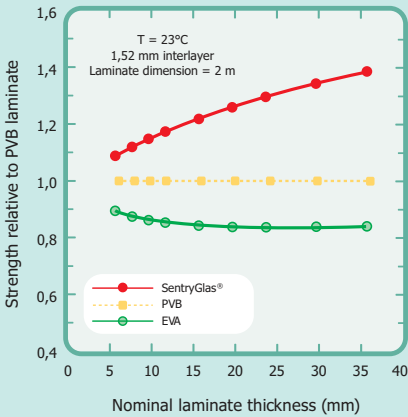
Specially developed Pilkington **Planar**™ fittings combined with the much higher modulus of the structural interlayer (compared with traditional interlayers) allows the **Planar**™ | SentryGlas® System to share applied loads between both glass components of the laminate. The fittings are designed to interlock with the interlayer to develop maximum strength and structural efficiency, giving a significant increase in load bearing capacity while at the same time reducing the thickness required.

Low deflection

The **Planar**™ | SentryGlas® System fully utilises the increased stiffness of the SentryGlas® interlayer (in some cases 100 times that of PVB) to reduce deflections under wind, snow and dead loads – often a limiting factor when designing structural glazing installations.

High & low temperatures

SentryGlas® has a higher Glass Transition temperature (T_g) than other interlayers which means enhanced mechanical properties can be utilised over a much greater range of temperatures. Pilkington Architectural engineers allow for temperature variations and all load combinations when designing **Planar**™ | SentryGlas® System installations, using techniques developed by DuPont and Pilkington Architectural and more recently being reflected in international design standards.



Relative Strength (Bending)

- SentryGlas® laminates show superior strength properties.
- Up to 65% stronger than EVA laminates.
- Good opportunities to reduce glass thickness, particularly for thicker glass.

Figure 8.3. Load shared between both panels of the laminate.

Durability

SentryGlas® is a DuPont engineered polymer containing no plasticisers, resulting in unrivalled edge stability. Edge Stability Numbers (ESN) with SentryGlas® interlayers remain zero at all known installations, including seven year test panels exposed to severe Florida heat and humidity. Pilkington Architectural and DuPont together with the sealant suppliers have also tested for compatibility and approved a wide range of weather seals for use in the **Planar**™ | SentryGlas® System.



Pilkington **Planar**™ – most tested, most trusted

Pilkington **Planar**™ is subject to on-going testing by our in-house team of dedicated product development engineers in a laboratory environment at Pilkington European Research and Development Centre. The system has also been subject to extensive performance testing at a wide range of independently accredited test laboratories. This includes the prestigious British Board of Agreement (assessment of products for construction), designated by Government to issue European Technical Approval. Agreement Certificate No 97/3360 covers the "Planar Mechanically Fastened Structural Glazing System". It has been also tested by Smith Emery in the USA, Taywood Engineering, BRE, Salford University (acoustic laboratory), National Physics Laboratory and BSI in the UK, CSTB in France, Germany's Otto Graff Institute and NSG of Japan.

Specific results for everything from bomb blast loading to seismic performance are used by Pilkington Architectural engineers in project design. In addition, we are prepared to carry out full scale tests on an unprecedented scale to prove Pilkington **Planar**™ can meet the required specification.

The knowledge we have acquired over 40 years of testing has allowed us to develop a Code of Practice for structural glass façades. Every part of every Pilkington **Planar**™ solution is designed in accordance with its criteria.



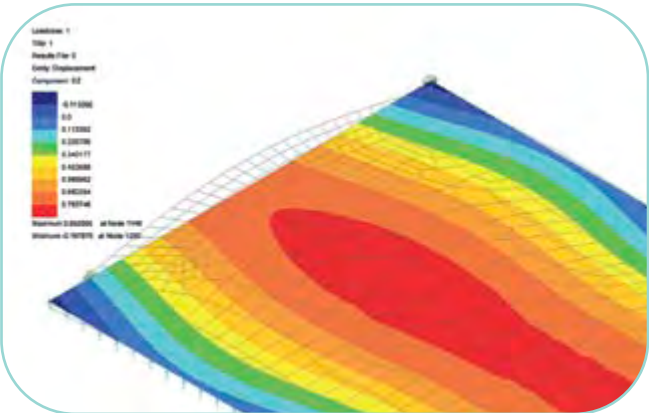
Hole stress evaluation test



Plus, Pilkington **Planar**™ is never sold as a glass or hardware alone, but always as a complete system; the design of which remains the responsibility of Pilkington Architectural. Giving you absolute reassurance.

The highest quality and the widest range of glass

Structural glass façades depend on the quality of the glass for their performance and aesthetic effect. With Pilkington glass this is assured. All toughened glass will be supplied heat soaked to, or in excess of international specifications, e.g. EN 14179-1. This ensure a higher quality product which is much less susceptible to breakage. Our expertise in glass manufacture means we can also place a vast array of glass types at your disposal. This gives you total flexibility of performance, appearance and transparency; and allows you to meet all requirements, functional or aesthetic.





Pilkington **Planar**[™] – Hector Training Centre,
Warsaw, Poland



Pilkington **Planar**[™] – Focus office centre,
Warsaw, Poland

Features and benefits


- Offers maximum freedom in design.
- Flush external surface.
- Engineered to permit glazing in any plane: vertical, horizontal or sloping.
- High quality and appearance of materials.
- Most widely tested structural glazing system.
- 12 years warranty.



Pilkington Planar™ Single Glazed								
Pilkington Toughened and Heat Soaked Glass (THS)	Thickness	Light transmittance, LT	Light reflectance, LR	Total solar radiant heat transmittance, g	Total shading coefficient	U _g	R _w	
	mm	%	%	%	—	W/m²K	dB	
Pilkington Optifloat™ Clear	10	87	8	77	0,89	5,6	34	
Pilkington Optifloat™ Clear	12	85	8	74	0,85	5,5	35	
Pilkington Optifloat™ Clear	15	83	8	70	0,80	5,4	36	
Pilkington Optifloat™ Clear	19	81	7	66	0,76	5,3	40	
Pilkington Optifloat™ Bronze	10	32	5	44	0,51	5,6	34	
Pilkington Optifloat™ Grey	10	26	5	44	0,51	5,6	34	
Pilkington Optifloat™ Green	10	67	7	49	0,56	5,6	34	
Pilkington Optiwhite™	10	90	8	89	1,02	5,6	34	
Pilkington Optiwhite™	12	90	8	88	1,01	5,5	35	
Pilkington Optiwhite™	15	90	8	87	1,00	5,4	36	
Pilkington Optiwhite™	19	89	8	85	0,99	5,3	40	
Pilkington Arctic Blue™	10	38	5	40	0,46	5,6	34	
Pilkington Activ™ Clear	10	81	14	74	0,85	5,6	34	
Pilkington Activ™ Blue	10	35	13	36	0,41	5,6	34	

Notes:
Technical data has been calculated according to EN 410 and EN 673.



<div>  PILKINGTON </div>		Single Pilkington Planar™ Laminated Safety Glass Performance of typical combinations with clear interlayer					
Pilkington Toughened and Heat Soaked Glass (THS) outer leaf	Pilkington Heat Strengthened Glass (HN) or Toughened and Heat Soaked Glass (THS) inner leaf	Light transmittance, LT	Light reflectance, LR	Total solar radiant heat transmittance, g	Total shading coefficient	U _g	R _w
		%	%	%	—	W/m²K	dB
Pilkington Optifloat™ Clear	Pilkington Optifloat™ Clear						
10 mm	6 mm	82	8	67	0,77	5,3	39
12 mm	6 mm	81	7	65	0,75	5,3	39
15 mm	6 mm	79	7	62	0,71	5,2	40
19 mm	6 mm	77	7	58	0,67	5,1	—
Pilkington Optiwhite™	Pilkington Optiwhite™						
10 mm	6 mm	88	8	81	0,93	5,3	39
12 mm	6 mm	88	8	81	0,93	5,3	39
15 mm	6 mm	87	8	80	0,92	5,2	40
19 mm	6 mm	86	8	78	0,90	5,1	—
Pilkington Activ™ Clear	Pilkington Optifloat™ Clear						
10 mm	6 mm	77	14	63	0,72	5,3	39
Pilkington Activ™ Blue	Pilkington Optifloat™ Clear						
10 mm	6 mm	34	12	35	0,40	5,3	39
Pilkington Arctic Blue™	Pilkington Optifloat™ Clear						
10 mm	6 mm	36	5	38	0,44	5,3	39

Notes:

Technical data has been calculated according to EN 410 and EN 673. R_w value is indicative for PVB interlayer product only and will be subject to minor variations dependent upon the size of the glass panels and the number of fittings required.

Pilkington Planar™ Integral Laminated Safety Glass Performance of typical combinations with clear interlayer								
Pilkington Toughened and Heat Soaked Glass (THS) outer leaf	Pilkington Heat Strengthened Glass (HN) or Toughened and Heat Soaked Glass (THS) inner leaf	Light transmittance, LT	Light reflectance, LR	Total solar radiant heat transmittance, g	Total shading coefficient	U _g	R _w	
		%	%	%	—	W/m²K	dB	
Pilkington Optifloat™ Clear	Pilkington Optifloat™ Clear							
6 mm	10 mm	82	8	67	0,77	5,3	39	
6 mm	12 mm	81	7	65	0,75	5,3	39	
Pilkington Optiwhite™	Pilkington Optiwhite™				0,71	5,2	40	
6 mm	10 mm	88	8	81	0,93	5,3	39	
6 mm	12 mm	88	8	81	0,93	5,3	39	
Pilkington Activ™ Clear	Pilkington Optifloat™ Clear				0,93	5,3	39	
6 mm	10 mm	77	14	63	0,72	5,3	39	
Pilkington Activ™ Blue	Pilkington Optifloat™ Clear				0,92	5,2	40	
6 mm	10 mm	47	12	42	0,48	5,3	39	
Pilkington Arctic Blue™	Pilkington Optifloat™ Clear							
6 mm	10 mm	50	6	45	0,52	5,3	39	

Notes:

Technical data has been calculated according to EN 410 and EN 673. R_w value is indicative for PVB interlayer product only and will be subject to minor variations dependent upon the size of the glass panels and the number of fittings required.



Pilkington Planar [™] Insulating Glass Units (IGUs)							
Outer pane: Pilkington Toughened and Heat Soaked Glass (THS)	Outer pane thickness	Light transmittance, LT	Light reflectance, LR	Total solar radiant heat transmittance, g	Total shading coefficient	U _g	R _w
	mm	%	%	%	—	W/m²K	dB
Inner pane: 6 mm Pilkington Optifloat [™] Clear THS							
Pilkington Optifloat [™] Clear	10	77	14	67	0,77	2,7	38
Pilkington Optifloat [™] Clear	12	76	14	64	0,74	2,7	38
Pilkington Optifloat [™] Clear	15	74	13	60	0,69	2,6	40
* Pilkington Planar [™] Sun 73/42	10	69	10	40	0,46	1,4	38
* Pilkington Planar [™] Sun 70/39	10	67	12	37	0,43	1,3	38
* Pilkington Planar [™] Sun 69/37	10	66	11	35	0,40	1,3	38
* Pilkington Planar [™] Sun 62/29	10	58	9	29	0,33	1,3	38
* Pilkington Planar [™] Sun 50/27	10	48	10	26	0,30	1,3	38
* Pilkington Planar [™] Sun 30/17	10	29	24	19	0,22	1,3	38
Inner pane: 6 mm Pilkington K Glass [™] THS							
Pilkington Optifloat [™] Clear	10	72	16	63	0,72	1,7	38
Pilkington Optifloat [™] Clear	12	70	16	60	0,69	1,7	38
Pilkington Optifloat [™] Clear	15	68	16	56	0,64	1,7	40

Notes:


Technical data has been calculated according to EN 410 and EN 673.



Inner pane: 6 mm Pilkington Optitherm™ S3 Pro T (toughened)							
Pilkington Optifloat™ Clear	10	76	12	55	0,63	1,4	38
Pilkington Optifloat™ Clear	12	75	12	53	0,61	1,4	38
Pilkington Optifloat™ Clear	15	73	12	50	0,57	1,3	40
Pilkington Optiwhite™	10	80	13	64	0,74	1,4	38
Pilkington Optiwhite™	12	79	13	63	0,72	1,4	38
Pilkington Optiwhite™	15	79	13	63	0,72	1,3	40
Inner pane: 6 mm Pilkington Optiwhite™ THS							
Pilkington Optiwhite™	10	83	15	81	0,93	2,7	38
Pilkington Optiwhite™	12	82	15	80	0,92	2,7	38
Pilkington Optiwhite™	15	82	15	79	0,91	2,6	40
*Pilkington Planar™ Sun OW 73/42	10	74	11	43	0,49	1,4	38
*Pilkington Planar™ Sun OW 69/37	10	70	12	38	0,44	1,3	38
*Pilkington Planar™ Sun OW 62/29	10	63	10	30	0,34	1,3	38
*Pilkington Planar™ Sun OW 50/27	10	51	10	28	0,32	1,3	38
Inner pane: 6 mm Pilkington K Glass™ OW THS							
Pilkington Optiwhite™	10	77	17	76	0,87	1,7	38
Pilkington Optiwhite™	12	76	17	76	0,87	1,7	38
Pilkington Optiwhite™	15	76	17	75	0,86	1,7	40

* Please note that these are a selection of solar control glasses within the range and the performance data supplied is indicative only and can vary subject to the substrate used. It is strongly recommended that indicative 6/12/6 colour samples are viewed and approved as the basis for colour selection. It should be noted that although the performance data of some of the products are very similar there may still be colour differences.



 PILKINGTON	Pilkington Planar™ Laminated Insulating Glass Units Performance of typical combinations with clear interlayer							R_w dB
	Pilkington Toughened and Heat Soaked Glass (THS) outer leaf	Pilkington Heat Strengthened Glass (HN) Laminated inner leaf	Light transmit- tance, LT %	Light reflect- ance, LR %	Total solar radiant heat transmit- tance, g %	Total shading coefficient	U_g W/m ² K	
Pilkington Optifloat™ Clear 10 mm 12 mm 15 mm	Pilkington Optifloat™ Clear	Pilkington Optifloat™ Clear				—		
		6 mm + 6 mm	73	14	63	0,72	2,6	41
		6 mm + 6 mm	72	13	60	0,69	2,6	42
Pilkington Optifloat™ Clear	Pilkington K Glass™ i Pilkington Optifloat™ Clear	6 mm + 6 mm	70	13	57	0,66	2,6	43
Pilkington Optifloat™ Clear 10 mm 12 mm 15 mm	Pilkington Optifloat™ Clear	6 mm + 6 mm	68	16	62	0,71	1,7	41
		6 mm + 6 mm	67	16	59	0,68	1,7	42
		6 mm + 6 mm	65	15	55	0,63	1,7	43

Notes:

Technical data has been calculated according to EN 410 and EN 673. R_w value is indicative for PVB interlayer product only and will be subject to minor variations dependent upon the size of the glass panels and the number of fittings required.



Pilkington Optiwhite™	Pilkington Optiwhite™						
10 mm	6 mm + 6 mm	81	15	78	0,90	2,6	41
12 mm	6 mm + 6 mm	80	15	77	0,89	2,6	42
15 mm	6 mm + 6 mm	80	15	76	0,87	2,6	43
10 mm Pilkington Planar™ Sun 73/42 OW	6 mm + 6 mm	73	10	43	0,49	1,3	41
10 mm Pilkington Planar™ Sun 69/37 OW	6 mm + 6 mm	69	12	38	0,44	1,3	41
10 mm Pilkington Planar™ Sun 62/29 OW	6 mm + 6 mm	61	10	30	0,34	1,3	41
10 mm Pilkington Planar™ Sun 50/27 OW	6 mm + 6 mm	50	10	28	0,32	1,3	41
Pilkington Optiwhite™	Pilkington K Glass™ OW i Pilkington Optiwhite™						
10 mm	6 mm + 6 mm	75	17	75	0,86	1,7	41
12 mm	6 mm + 6 mm	74	17	75	0,86	1,7	42
15 mm	6 mm + 6 mm	74	17	74	0,85	1,7	43
	Pilkington Optiwhite™						
* 10 mm Pilkington Planar™ Sun 73/42	6 mm + 6 mm	66	10	39	0,45	1,3	41
* 10 mm Pilkington Planar™ Sun 70/39	6 mm + 6 mm	63	11	37	0,43	1,3	41
* 10 mm Pilkington Planar™ Sun 69/37	6 mm + 6 mm	62	11	35	0,40	1,3	41
* 10 mm Pilkington Planar™ Sun 62/29	6 mm + 6 mm	55	9	29	0,33	1,3	41
* 10 mm Pilkington Planar™ Sun 50/27	6 mm + 6 mm	45	9	26	0,30	1,3	41
* 10 mm Pilkington Planar™ Sun 30/17	6 mm + 6 mm	28	24	18	0,21	1,3	41

* Please note that these are a selection of solar control glasses within the range and the performance data supplied is indicative only and can vary subject to the substrate used.

Pilkington Planar™ Triple



Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	Pilkington Optitherm™ S3	68	16	47	0,54	0,8
Pilkington Planar™ Sun 73/42	Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	61	13	35	0,40	0,8
Pilkington Planar™ Sun 70/39	Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	59	14	33	0,38	0,7
Pilkington Planar™ Sun 69/37	Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	58	14	31	0,36	0,7
Pilkington Planar™ Sun 62/29	Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	52	11	26	0,30	0,7
Pilkington Planar™ Sun 50/27	Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	42	11	23	0,26	0,7
Pilkington Planar™ Sun 30/17	Pilkington Optifloat™ Clear	Pilkington Optitherm™ S3	26	25	16	0,18	0,7
Pilkington Optiwhite™	Pilkington Optiwhite™	Pilkington Optiwhite™	76	21	74	0,85	1,8
Pilkington Planar™ Sun 73/42	Pilkington Optiwhite™	Pilkington Optiwhite™	68	15	40	0,46	1,1
Pilkington Planar™ Sun 69/37	Pilkington Optiwhite™	Pilkington Optiwhite™	65	16	35	0,40	1,0
Pilkington Planar™ Sun 62/29	Pilkington Optiwhite™	Pilkington Optiwhite™	57	13	27	0,31	1,0
Pilkington Planar™ Sun 50/27	Pilkington Optiwhite™	Pilkington Optiwhite™	47	12	25	0,29	1,0
Pilkington Optiwhite™	Pilkington K Glass™ OW	Pilkington K Glass™ OW	66	24	66	0,76	1,0
Pilkington Planar™ Sun 73/42	Pilkington Optiwhite™	Pilkington K Glass™ OW	63	17	39	0,45	0,9
Pilkington Planar™ Sun 69/37	Pilkington Optiwhite™	Pilkington K Glass™ OW	60	18	34	0,39	0,8
Pilkington Planar™ Sun 62/29	Pilkington Optiwhite™	Pilkington K Glass™ OW	53	14	26	0,30	0,8
Pilkington Planar™ Sun 50/27	Pilkington Optiwhite™	Pilkington K Glass™ OW	43	13	24	0,28	0,8

R_w value is indicative for PVB interlayer product only and will be subject to minor variations dependent upon the size of the glass panels and the number of fittings required.

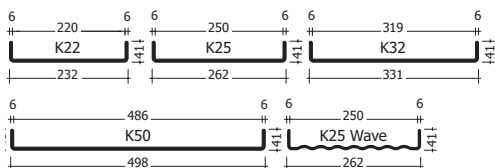


Description

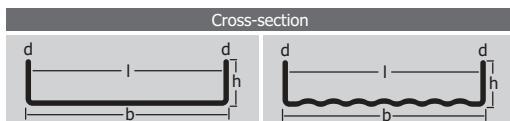
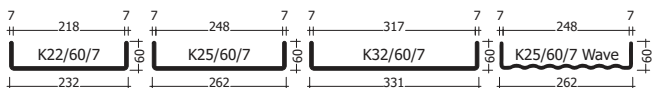
Pilkington **Profilit™** is an alkali cast glass in U-shape, which is produced according to EN 572, Part 7, using the machine rolling process. It is translucent, but not transparent, with a patterned surface on the outside (pattern 504) and has the quality features of cast glass.

Available in several basic widths: 232, 262, 331 and 498 mm and two glass thicknesses and flange heights:

- Glass thickness 6 mm, flange height 41 mm



- Glass thickness 7 mm, flange height 60 mm

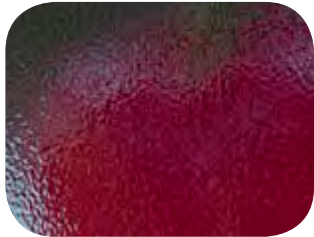


Tolerances: $b \pm 2,0$ mm; $d \pm 0,2$ mm; $h \pm 1,0$ mm. Cutting tolerances of $\pm 3,0$ mm are allowed. Tolerances according to EN 572-7. Dimensions are nominal.



Products

Pilkington **Profilit™** Amethyst – textured profiled glass with a blue coating.



Pilkington **Profilit™** Amethyst

Pilkington **Profilit™** Plus 1,7 with thermal insulation coating.



Pilkington **Profilit™** Plus 1,7

Pilkington **Profilit™** Antisol – textured profiled glass with solar control coating. Although the coating is bronze in colour, high visible light transmittance can be maintained.



Pilkington **Profilit™** Antisol

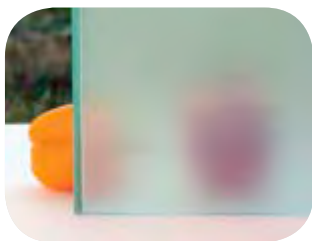


Pilkington **Profilit™** Clear – profiled glass without any texture. As a design profiled glass without any ornamental structure on its outer face, Pilkington **Profilit™** Clear is an alternative option to all translucent types of Pilkington **Profilit™** glass. The transparency of this profiled glass permits its virtually undistorted and largely colour-neutral visual penetration. Optical deviations as compared with the visual penetration of flat glass are attributable to minor variations in surface flatness. These are due to the process applied and are typical of cast glass products.



Pilkington **Profilit™** Clear

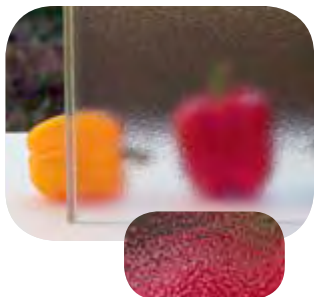
Pilkington **Profilit™** Opal – gets its soft, velvety, milky look from the defined, sandblasted processing of the inner surface of the profiled glass. Despite its high level of light permeability, this design product elegantly obscures closer views of all persons and objects on the other side of the glass. They are only perceptible in a shadowy, diffuse manner thanks to the opal effect - contours and colours merge into soft, cloudy patches. Also available as texture glass with extremely smooth surface.



Pilkington **Profilit™** Opal



Pilkington **Profilit™** OW – profiled low iron extra clear glass is a design product that has extremely little intrinsic colouring due to the use of raw materials with low iron oxide content during glass production. The look of it and view through it have a clean, pure charm. The colour neutrality of this profiled glass is transferred to all the objects, persons and areas behind the glass – they are perceived in their „natural“ colouring despite the ornamental diffusion typical of the product. Also available in a sandblasted version as Pilkington **Profilit™** Opal OW.



Pilkington **Profilit™** OW



Pilkington **Profilit™** OW Opal

Pilkington **Profilit™** Macro – profiled textured glass with an ornament in a form of netted screen structure. Its symmetrical point structure which is clearly visible close up gives the design product its special visual character. Seen from distance, the point structure breaks down into fine, slightly broken, horizontal lines, giving the glass both a dynamic and structured look. This textured, optically diffuse effect is transferred to the objects behind the glass when observed through it.



Pilkington **Profilit™** Macro



Pilkington **Profilit™** Slim Line – profiled textured glass with an ornament in a form of thin, linear grooves. The fine, undulating surface creates a gentle yet dynamic sense of motion as soon as the observer changes the view perspective. The elegantly lined structure is transferred to the optical perception of objects located behind the glass providing for their 'alienated' yet clearly contoured view.



Pilkington **Profilit™** Slim Line

Pilkington **Profilit™** T thermally toughened Pilkington **Profilit™** available with Heat Soak Test upon request.

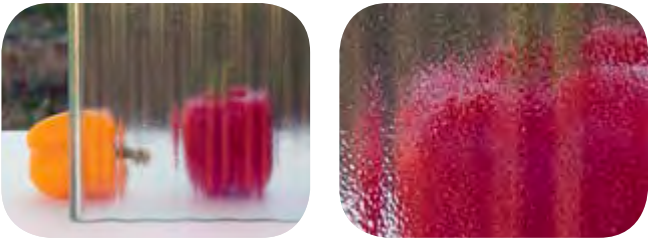
Pilkington **Profilit™** T Color thermally toughened and coloured enamelled Pilkington **Profilit™** available with Heat Soak Test upon request.



Pilkington **Profilit™** T Color

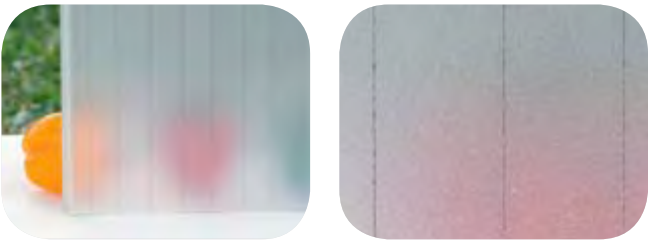


Pilkington **Profilit**™ Wave, the first wave-shaped channel glass. In the facade as well as in the interior, the symmetric wave-shaped surface of Pilkington **Profilit**™ Wave gives rise to a fine structure. From a distance too, it gives buildings and building elements greater depth and structure. Additionally, colour-changing effects are created that, depending on the exposure of light, light intensity and viewing angle result in interesting optical variations on the glass surface. Delivery and installation lengths of Pilkington **Profilit**™ Wave are the same as the familiar values of the standard products. The same applies to the static and energetic properties that vary only slightly as a result of the variation in the surface geometry. Pilkington **Profilit**™ Wave is manufactured according to EN 527-7.



Pilkington **Profilit**™ Wave

Most of profiled glass types such as Pilkington **Profilit**™ Wave, Pilkington **Profilit**™ Plus 1,7, Pilkington **Profilit**™ Amethyst, Pilkington **Profilit**™ Antisol are available as wired glass. New texture types Pilkington **Profilit**™ Macro and Pilkington **Profilit**™ Slim Line are also available in Opal finish.



Pilkington **Profilit**™ Wired OW Opal



Applications

Thermal insulation

Pilkington **Profilit**™ Plus 1,7 is a low-e coated glass with a U_g -value of 1,8 W/m²K when double glazed. Please note that Pilkington **Profilit**™ Plus has to be assembled according to our guidelines. For more information, please contact your local sales representative.



Pilkington **Profilit**™ Clear and Pilkington **Profilit**™ Clear Plus 1,7 – International Education Centre of University of Information Technology and Management, Kielnarowa, Poland

Solar control

Pilkington **Profilit**™ Antisol reduces the total solar energy transmittance (g-value) of the glazing.

- Protects sensitive products against UV rays.
- Reduces solar transmittance.

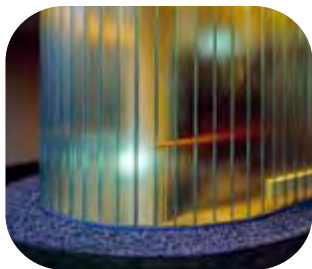


Pilkington **Profilit**™ – Zawisza Residences, Spichlerz apartments, Gliwice, Poland



Safety

Thermally toughened profiled glass Pilkington **Profilit**™ T is specially designed to satisfy increased safety requirements within common areas of public buildings. This product variant provides greater mechanical strength compared to its annealed version, allowing the creation of large surfaces that are bright whilst also meeting all safety requirements. In addition it allows for longer installation lengths in comparison with standard Pilkington **Profilit**™. Heat soaked thermally toughened glass is available upon request.



Pilkington **Profilit**™ – Mondrian House, Warsaw, Poland

Decoration

Thermally toughened and colour coated Pilkington **Profilit**™ T Color is a profiled enamelled glass available in a wide range of colours, that gives architects new design possibilities. As the glass is toughened, it also meets higher safety requirements.

Noise control

Noise ranks among the most unpleasant emissions. The psychological and physical strain resulting from noise is a continuous hazard to human health.

The use of Pilkington **Profilit**™ glass reduces the level of external noise to a level that is safe for the human ear. A double glazed installation with the padding profiles no. 165 and 166 achieves a sound reduction of 38-41 dB. Triple glazing can be used to achieve a sound reduction of 55 dB.



Sports centre applications

For sports centre glazing subject to ball impact, a double skin special profile Pilkington **Profilit**™ K22/60/7, K25/60/7 or K32/60/7 construction should be selected, as permitted for ball impact glazing in accordance with DIN 18032, Part 3. The profile should be used without wires. Please consider special application requirements.




Pilkington **Profilit**™ – Sport Centre, Jasło, Poland



Table 8.1. Range of Pilkington **Profilit™** products.

Product	Description
Pilkington Profilit™	Standard with ornament 504 and uncoated
Pilkington Profilit™ Wired	With longitudinal wire inlays
Pilkington Profilit™ Plus 1,7	Thermal insulation
Pilkington Profilit™ Antisol	Solar control
Pilkington Profilit™ Amethyst	Blue
Pilkington Profilit™ Clear	Without ornament
Pilkington Profilit™ Wave	Wave-shaped surface with ornament 504
Pilkington Profilit™ OW	Extra clear
Pilkington Profilit™ Opal	Sand blasted
Pilkington Profilit™ Macro	Ornament Macro
Pilkington Profilit™ Slim Line	Ornament Slim Line
Pilkington Profilit™ T	Thermally toughened <i>also available with Heat Soak Test</i>
Pilkington Profilit™ T Color	Thermally toughened and coloured enamelled <i>also available with Heat Soak Test</i>





PILKINGTON

Pilkington **Profilit™** glass types

Width	w [mm]	K 22(*)	K 25	K 32	K 50	K 22/60/7	K 25/60/7	K 32/60/7
Flange height	h [mm]	41	41	41	41	60	60	60
Weight (single glazing)	t [mm]	6	6	6	6	7	7	7
Weight (single glazing)	[kg/m²]	19,5	19,0	18,2	17,0	25,5	24,5	22,5
Max. length supplied (not max. installation length)		6000	6000	6000	5000	7000	7000	7000
Number of longitudinal wires		7(*)	8	10	16(*)	7	8	10
With 16 longitudinal wires (meshing function)		—	16	—	—	—	16	—
For façades ^[2]		—	—	—	—	—	8+2 ^[1]	—
Pilkington Profilit™ Plus 1,7		—	S	S	S	S	S	S
Pilkington Profilit™ Plus 1,7 wired		—	S	S	—	—	S	S
Pilkington Profilit™ Antisol		—	S	S	S	S	S	—
Pilkington Profilit™ Antisol wired		—	S	S	—	—	S	—
Pilkington Profilit™ Amethyst (blue)		—	S	S	—	—	S	—
Pilkington Profilit™ Amethyst wired		—	S	—	—	—	S	—
Pilkington Profilit™ Clear (without ornamentation)		—	S(*)	—	S(*)	—	S(*)	—
Pilkington Profilit™ Clear wired (without ornamentation)		—	S	—	—	—	—	—
Light transmittance (mean value)		single glazing: 86%			double glazing: 75%			
Thermal transmittance	U [W/m²K]	SG: 5,6			SG: 5,52			
Sound insulation value (in range 100-3200 Hz)	R _w [dB]	SG: 22			SG: 25			

Pilkington **Profilit™** T and Pilkington **Profilit™** T Color thermally toughened profiled glass can be heat soaked upon request. The supply lengths and maximum installation lengths provided in this document do not apply for Pilkington **Profilit™** T and Pilkington **Profilit™** T Color.

[1] One wire per flange.

[2] For Pilkington **Profilit™** façades, please consult our technical advisory service prior to use.

[3] Glass installation using Pilkington **Profilit™** gaskets nos. 165 and 166.

Notes:

R_w value for eg. for K22 = 36 dB without padding, 38 dB with padding.

SG – single glazing / DG – double glazing

S = special production – for production-related reasons these products are only manufactured on a per-order basis and are not kept in stock.

(*) = sale from stock providing there are sufficient stocks available or from next production run.

We would be pleased to examine the possibility of supplying any product combination not mentioned above upon request.



9. Special Applications



Our special applications section includes products with specific properties.

Pilkington **Optiwhite™** – is an extra clear low iron float glass which can be used as a final product, in insulating glass units or as a by-product for manufacture of other special glass products. It is also used in the fast developing solar energy sector.

Pilkington **Mirropane™** is used as a one-way vision mirror for undetected surveillance. This type of glass is used in areas which need to be observed or where people need to be prevented from looking in, for example in police stations, customs halls, hospitals, warehouses, computer installations and banks.

Our product range includes also insulating glass units with integrated blinds systems Pilkington **Insulight™** with ScreenLine®. This is an ideal choice for external façades and internal partitions.

NSG **TEC™** is a range of low-emissivity glasses with an electric conductive coating of special qualities. NSG **TEC™** is also used in white goods applications such as fridge and oven doors, where high insulation is required. In its toughened version, it is used for direct electrical heating, which uses an electric current passing through the coating. Because the coating conducts electricity, static electricity is conducted from the coated side. We manufacture various types of NSG **TEC™** with different resistance levels. The glass is neutral and transparent like conventional float glass and has high light transmission. It can be curved, toughened and screen printed.

If you are interested to know more about these products please contact our Technical Advisor.



Description

Pilkington **Insulight™** with ScreenLine® is a system, where the blind (venetian, pleated or roller) is encapsulated within two glass panes, i.e. in a double glazing unit. The exclusive characteristics ensure total protection against dirt, dust or weather conditions, and therefore blinds do not require any maintenance.

Pilkington **Insulight™** with ScreenLine® integral blinds system combines high thermal insulation with benefits provided by blinds i.e. shade light and reduce heat from direct sunlight. In summer,



Pilkington **Insulight™** with ScreenLine®

solar heat gain can be controlled by tilting the slats to achieve total or partial screening. In winter, raising the slats or keeping them open maximises solar gain, while the inclusion of either Pilkington **K Glass™** or Pilkington **Optitherm™** in the unit provides improved thermal insulation. In addition a range of solar control coated options can be incorporated to optimise performance.



The movement of the blind, for manual or motorised systems, does not compromise the insulating properties of the double glazing unit and is performed in a totally sealed environment.



Cord-operated external magnetic device



External motor



Internal motor control

Application

The versatile nature of Pilkington **Insulight™** with ScreenLine® makes it ideal for many applications. Superior protection against solar radiation, light control and privacy makes them ideal for external façades, windows and indoor glazing. Their slim fit and ease to maintain make them the ideal choice for glazed internal partitions. The blind slats stay clean, making them suitable for places where hygiene is of prime importance. With no casing, Pilkington **Insulight™** with ScreenLine® blinds not only blends



Pilkington **Insulight™** with ScreenLine®

in well with contemporary design, but also offers a significant saving of space in comparison with standard blinds. By tilting and raising the slats, you can manage sun shading, solar heat gain and light control within a single product. The wide product choice and versatility of operation make Pilkington **Insulight™** with ScreenLine® blind systems suitable for all types of framing systems.



Pilkington **Insulight™** with ScreenLine® blinds are ideal for a range of environments including:

- offices,
- hospitals/nursing homes,
- schools,
- banks,
- police stations,
- laboratories,
- high traffic public areas,
- houses and residences.

Features and benefits

- Excellent light and solar control characteristics.
- Space saving.
- The integral blinds are fully adjustable, and can be tilted or raised on certain models to achieve varying levels of privacy.
- Clean for life.
- As the blinds are sealed within the unit itself, they remain well protected from day-to-day damage. This not only means they retain their appearance but can also reduce maintenance costs.
- Comprehensive tests carried out in order to determine the durability of the product showed that Pilkington **Insulight™** with ScreenLine® blinds can withstand regular use over several decades.
- The rotational frontal magnet control does not compromise the unit seal and guarantees perfect integrity of the double glazed unit.
- Variable operating methods.
- A 5-year guarantee on all models.



Description

An on-line coated glass product developed for use as a one-way mirror where total clear vision is required and specific lighting conditions can be achieved. Under specified lighting conditions it offers an effective means of providing undetected surveillance and high quality one-way vision to achieve complete privacy.

In order to maintain privacy in the observing area, the ratio of illumination levels between public and private side, or observed and observing side, must be 8:1. It is also advisable, if absolute privacy is essential, to have dark furnishings, to wear dark clothing in the area from which observation is taken place, and to ensure the lights on the observed side are not directed at the glass.



Pilkington **Mirropane™**

Applications

Pilkington **Mirropane™** is the ideal choice for supermarkets, computer rooms, banks or cash offices, where areas need to be kept under observation or hidden from public scrutiny. It is also appropriate for patient monitoring in hospitals or residential care establishments. Pilkington **Mirropane™** is available in 6 mm annealed form.



Pilkington **Mirropane™** is normally only used for internal applications. In such cases, since neither side of the mirror will be exposed to the weather, glazing materials such as adhesive cotton based strips, plastics or rubber channels can be used in a suitable frame. The glass must be installed with the coating on the observer's side. In such situation glass on the observer's side appears like a normal mirror and helps to hide the fact that the glass is used for surveillance purposes. In addition such position of the coating avoids a risk of finger prints, scratches etc. on the higher traffic side of the glass (e.g. in shops). When used within an insulating glass unit, the coating should face the cavity, and the Pilkington **Mirropane™** glass should be on the observer's side.

If you would like to use Pilkington **Mirropane™** in external applications, please contact your local NSG Group representative.

Features and benefits

- Allows privacy with clear vision into observed space.
- High reflectivity and light transmission, in the controlled lightning conditions it may look like a typical mirror.
- Ideal choice for hospitals, police stations and residential care establishments.
- Mostly used for indoor glazing.



Pilkington Mirropane™ Grey		S, UV		energy		light		performance code		glass configuration	
		%	UV	%	UV	%	Ra	%	g	III	triple insulating glass unit, Pilkington Optitherm™ S3 #5
		—	S	—	TSC	—	LRI	—	LT	II	insulating glass unit, Pilkington Optitherm™ S3 #3
			selectivity index		LSC		LRO		U _g	II	insulating glass unit, Pilkington K Glass™ N #3
					SSC		LT			I	insulating glass unit, primary product outside #2
					TET						primary product, monolithic #2
					EA						
					ER						
					ET						

Notes:
Maximum size: 5180 mm × 3300 mm.



Extra clear low iron float glass

Description

The glass is practically colourless, and the green cast inherent to ordinary clear float glass, which is particularly noticeable in thicker glasses, is virtually eliminated. Pilkington **Optiwhite™** offers the highest level of light and solar energy transmittance.



Pilkington **Optiwhite™** – Balustrades on The Fields of Grunwald, Poland

Applications

Pilkington **Optiwhite™** is recommended for applications that require high light transmission or for which a glass of neutral colour is desired. These include clear fire protection glazing, laminated security glazing, insulating glass units, photovoltaic modules, solar collectors, projection room windows, shop fronts, demonstration counters, shelving, showcases, table tops and other frameless glazing applications. Pilkington **Optiwhite™** is also ideal for glass which is to be ceramically decorated, as the true colours of the decoration will show through the glass. The colour neutrality of Pilkington **Optiwhite™** is mostly noticeable in applications where the edges of the glass are exposed, for example in shelving or table tops.

Features and benefits

- Practically colourless compared to ordinary clear float glass, ideal for applications where the glass edges are visible or when a neutral colour is desired.



Pilkington **Optiwhite™** – The Glass Pavilion™ at the Toledo Museum of Art, Toledo, Ohio, USA

- Highest light transmittance (1% higher than clear float glass in 3 mm thickness – 6% higher in 15 mm thickness), offering outstanding visual clarity when unrestricted view is required.
- High solar heat transmittance (4% higher than clear float glass in 3 mm thickness), allowing more heat through the glass, thus reducing the need for heating the building.
- Available in annealed or toughened form.
- Can be combined with other Pilkington products to offer additional benefits such as solar control, noise reduction or fire protection.
- Available in a wide range of thicknesses, from 2 to 19 mm.



Pilkington **Optiwhite™** – Fira de Barcelona, Spain



Pilkington Optiwhite™																	
I	glass configuration	performance code				light				energy						S, UV	
		W/m ² K	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
		U _g	LT	g	LT	LRo	LRI	Ra	ET	ER	EA	TET	SSC	LSC	TSC	S	UV
	2 mm	5,8	92	91	92	8	8	100	91	8	1	91	1,05	0,00	1,05	1,00	88
	3 mm	5,8	92	91	92	8	8	100	91	8	1	91	1,05	0,00	1,05	1,00	87
	4 mm	5,8	92	91	92	8	8	100	91	8	1	91	1,05	0,00	1,05	1,01	86
	5 mm	5,7	91	90	91	8	8	100	90	8	2	90	1,03	0,00	1,03	1,01	84
	6 mm	5,7	91	90	91	8	8	100	90	8	2	90	1,03	0,00	1,03	1,01	83
	8 mm	5,6	91	90	91	8	8	100	89	8	3	90	1,02	0,01	1,03	1,01	81
	10 mm	5,6	91	89	91	8	8	99	88	8	4	89	1,01	0,01	1,02	1,02	79
	12 mm	5,5	91	89	91	8	8	99	88	8	4	89	1,01	0,01	1,02	1,02	77
	15 mm	5,4	90	88	90	8	8	99	87	8	5	88	1,00	0,01	1,01	1,02	75
	19 mm	5,3	90	87	90	8	8	99	86	8	6	87	0,99	0,01	1,00	1,03	72

Notes:

Special extra clear low iron float glass.

Maximum size: 6000 mm × 3210 mm.

Contact list

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Tel.: +48 29 760 45 32
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Contact details for Sales Enquiries in other European countries

For **primary products** (e.g. clear float, low-e glass, solar control glass, laminated glass etc.) enquiries:

Pilkington Polska Sp. z o.o.
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For **processed products** (e.g. insulating glass units, toughened glass, enamelled glass, screen printed glass etc.) enquiries:

Denmark, Sweden, Norway, Finland

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Notes

Notes



CE marking confirms that a product complies with its relevant harmonised European Norm. The CE marking label for each product, including declared values, can be found at www.pilkington.com/CE



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