



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 have opened up new avenues of design, which allows people to be protected from personal 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.

The classifications are summarised below.

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.

These classes of resistance are summarised below.

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



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).

These classes of resistance are summarised below.

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

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, 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 Optilam™ (safety glass)																									
 PILKINGTON <small>NSG Group, Flat Glass Business</small>	class according to EN 12600	class according to EN 356	performance code		light		energy							S, UV											
			W/m ² K	%	LT	%	LT	%	ET	%	ER	%	EA	%	TET	%	SSC	%	LSC	%	TSC	%	s	%	UV
I monolithic glass			U	g	Ra	ER	EA	TET	SSC	LSC	TSC	s	UV												
	4,4 mm		5,8	82	99	7	15	82	0,90	0,04	0,94	1,09	3												
	6,4 mm	3(B)3	5,8	79	98	7	19	79	0,85	0,06	0,91	1,11	3												
	6,8 mm	2(B)2	5,7	78	98	7	20	78	0,84	0,06	0,90	1,13	1												
	8,4 mm	1(B)1	5,7	77	97	7	22	77	0,82	0,07	0,89	1,13	3												
	8,8 mm	2(B)2	5,7	76	97	7	23	76	0,80	0,07	0,87	1,14	1												
12,4 mm	1(B)1	5,5	73	96	6	28	73	0,76	0,08	0,84	1,16	3													

Notes:

Above data are given for laminated glass made of 2 sheets of clear float glass and PVB interlayer 0,38 mm or 0,76 mm.



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 buildings such as 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

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 <small>NSG Group, Flat Glass Business</small>		Pilkington Optilam™ (security glass)																			
glass	class according to EN 1063	class according to EN 356	performance code			light			energy				S, UV								
			U W/m ² K	LT %	g %	LT %	LRo %	LRI %	Ra -	ET %	ER %	EA %	TET %	SSC -	LSC -	TSC -	s -	UV %			
I																					
monolithic glass																					
7,5 mm	—	P4A	5,7	88	77	88	8	—	71	7	22	77	0,82	0,07	0,89	1,14	0,1				
9,5 mm	—	P4A	5,6	87	75	87	8	—	69	7	24	75	0,79	0,07	0,86	1,16	0,1				
11,5 mm	BR1S	P4A	5,6	86	73	86	8	—	66	6	28	73	0,76	0,08	0,84	1,18	0,1				
13,5 mm	—	P4A	5,5	85	71	85	8	—	63	6	31	71	0,72	0,1	0,82	1,2	0,1				
19,5 mm	BR1S	P6B	5,3	82	66	82	8	—	56	6	38	66	0,64	0,12	0,76	1,24	0,1				
20,6 mm	BR2S	P6B	5,3	83	66	83	8	—	56	6	38	66	0,64	0,12	0,76	1,26	0,0				
27,5 mm	BR2S	P6B	5,1	79	61	79	7	—	49	6	45	61	0,56	0,14	0,70	1,3	0,1				
29,8 mm	BR3S	P7B	5,0	79	60	79	7	—	47	6	47	60	0,54	0,15	0,69	1,32	0,0				
39,0 mm	BR4S	P8B	4,8	74	55	74	7	—	41	5	54	55	0,47	0,16	0,63	1,35	0,0				

Notes:

1. 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.
2. Product thicknesses should be compared with most typical glass constructions.
3. Available in size 3210 mm × 2400 mm