

SAFETY GLASSING FOR PROTECTION AGAINST THE IMPACT BY THROWN OBJECTS AND BURGLARY VIOLATION

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ABSTRACT

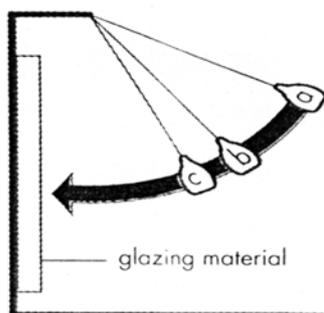
In this paper two kinds of safety glasses are considered: for protection against the impact by thrown objects and against the impact due to burglary violation. The methods were explained for testing the glass against the impact, the glass being divided into protection classes (A, B, C) in a connection with the tests results. Cited are main features of safety glassing of protection class A and B. Three kinds of glasses can be used as protective ones, according to the British Standard, and these are: laminated, quenched and wired glass.

Key words: safety glass, laminated glass, annealed glass

1. INTRODUCTION

In modern architecture the glass has a permanently increasing application as a construction material. Fable resistance to impacts, tension, heat and sound protection, then fire protection are only some of former features of a glass. The glass can be a source of the danger if it is crashed. Namely, in that case are formed the small parts with sharp rims. That is the reason why today the demands are greater, posed by the police and assurance companies, for undertaking the suitable preventive measures to protect the people and their proprieties. So that today the glasses are produced with an additional strength, which makes more complete this construction material. Produced are the glasses which found an application in any kind of safety. For the architecture very important is a new technology of the production of glass with high performances, which is used for the protection against the fire, but it provide too the safety against an impact.

2. DEFINITION OF THE SAFETY GLASS



Drop heights
Class A – 1219mm
Class B – 457mm
Class C – 305mm

The safety glass is defined as one which must be submitted to an impact test, where it must not crack or it may crack in a safe way. Three levels of impact exist, and that is the highest A, then the levels B and C (figure 1). The tested glass is submitted to the impact of a leather sack filled with 45 kg of lead balls (figure 2).

Figure 1. The impact levels by testing the safety glasses

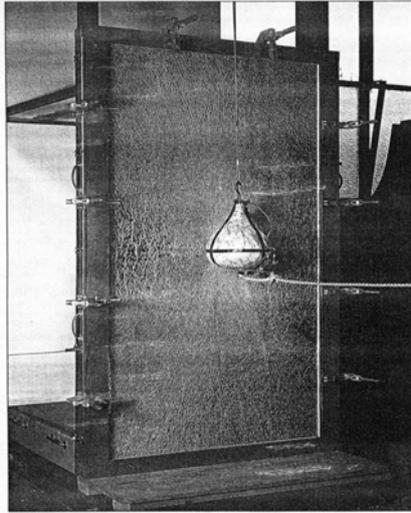


Figure 2. Proceeding by laboratory testing the resistance of the glass to the impact

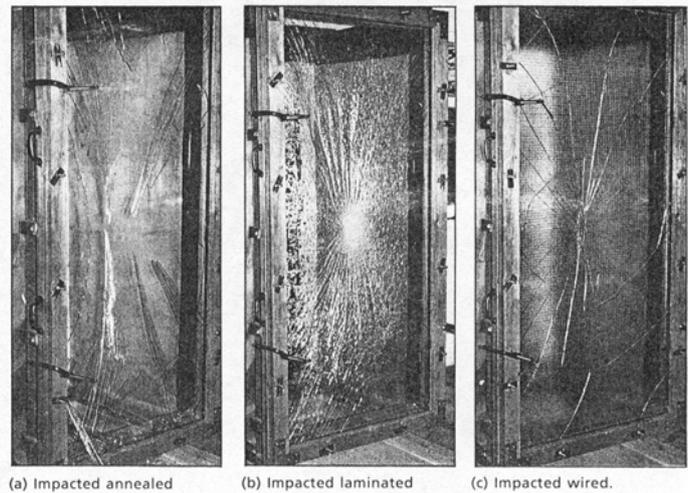


Figure 3. The appearance of annealed (a), laminated (b) and wired (c) glass after testing

Three main types of glasses, demanded by British Standard, are: laminated, annealed and wired glass. The appearance of cited glasses, after testing the resistance to impact, is shown on figure 3.

3. CLASSIFICATION OF SAFETY GLASSES

Depending on the level of safety which the glasses are supposed to stand, they are classified in following safety classes:

- Glasses for the protection against a human acting (vandalism and thrown object into the glass), the safety class of these glasses is A 1,2,3
- Anti-burglary (anti-crash) glasses, the safety class B 1,2,3
- Glasses against shooting from the firearms (armoured not breakable glasses), the safety class C 1,2,3,4,5
- Anti-explosion-effects glasses, the safety class D 1,2,3

According to BS 6206 the glasses have following designations: L – laminated, T – quenched, P – plastic, W – wired, SFB – covered by safety foil.

3.1 Safety glass for the protection against the impact of thrown objects (glassing in accord with the demands from DIN 52 290 T4) The safety Class A

The glassing for protection against the impact of a thrown object is applied for the objects in an urban milieu (A1), the industrial constructions out of urban area (A2) and for the constructions of greater importance and preciousness (A3). Related to the height from which an object is thrown, there are three protection degrees.

Table 1. The conditions of testing the glasses of class safety A

Degree of charge	Height of fall (mm)	Degree of protection against thrown objects
		Must not brake the glass nor through it out of the frame
1	3500 ± 10	A1
2	6500 ± 10	A2
3	9500 ± 10	A3

From the table 1. it is evident that class A3 is most demanding concerning the resistance against the impact of thrown objects.

In the table 2. the features of safety class A glassing are presented.

Table 2. The features of safety class A glassing

Type Designation of the producer	Composition: out/inside	K	Ra	LT	LR	EA	σ _g	B – Shading coefficient	Safety class according DIN 52 290	Thickness	Masse	Max. length of the glass	Max. surface	Max. side dimension
	mm	W/m ² K	-	%	%	%	%	-	-	mm	kg/m ²	mm	m ²	-
A1- Iplus	9/10/4	1,5	96	74	12	30	64	51	A1	23	32	141/240	3,40	1:6
A2- Iplus	9,5/10/4	1,5	96	73	12	32	63	50	A2	24	33	141/240	3,40	1:6
A3- Iplus	10/10/4	1,5	96	73	12	34	63	50	A3	24	34	141/240	3,40	1:6

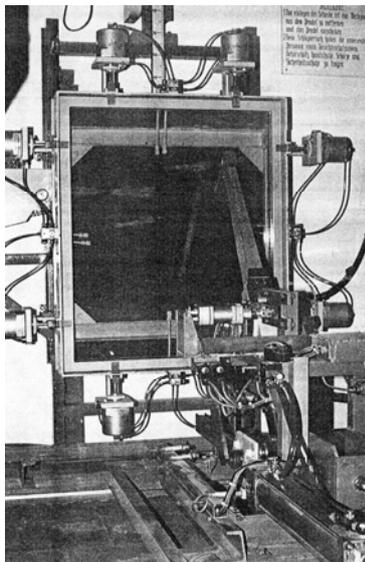
It is necessary to take in consideration that with augmenting the glass thickness it comes to a change of the glass coloration intensity toward yellow - green direction, which as a consequence has a decrease of the light and sun energy input in a premise.

3.2 Safety glasses for the protection against burglary violent impact – anti-breaking glasses (the glassing in accord with demand from DIN 52 290 T3) Class safety B

Considering the velocity of impact about 12,5 m/s, the power of impact about 350 N/m and the number of violent impact attempts, they are classified in following protection degrees:

- B1 – number of attempts 30 – 50
- B2 - number of attempts 51 – 70
- B3 - number of attempts over 79.

Mechanical characteristics of such a glass are checked with a machine water axe, which weight is 2,5 kg (figure 4).



The degree of protection is determined by number of impacts, which are necessary for cutting by the axe a cut 400 x 400 mm big in the sample of dimensions 110 x 90 cm. In the group B1 are the glasses which stand 30 to 50 impacts, in the group B2 the glasses stand 51 to 70 impacts, and in the group B3 they stand over 70 impacts. They are applied for the computer centres, pharmacies (B1), galleries, museums, antiquity shops and other important structures (B2) and for instance for goldsmith's shops (B3).

Figure 4. The impact axe

In the table 3. the features of safety class B glassing are presented

Table 3. The features of safety class B glassing

Type Designation of the producer	Composition: out/inside	K	Ra	LT	LR	EA	ge	B – Shading coefficient	Safety class according DIN 52 290	Thickness	Masse	Max. length of the glass	Max. surface	Max. side dimension
	mm	W/m ² K	dB	%	%	%	%	-	-	mm	kg/m ²	mm	m ²	-
B1- Iplus	17/10/6	1,5	-	69	10	44	56	45	B1-C1SA	33	56	252/400	8,00	1:6
B2- Iplus	22/10/6	1,5	-	67	10	50	53	42	B2-C2SA	38	68	252/400	7,35	1:6
B3- Iplus	28/10/6	1,5	-	65	9	54	50	40	B3-C3SA	44	82	252/400	6,10	1:6

4. CONCLUSION

Major part of European countries have prescribed, to protect the people and their properties, the use of safety glasses in the residential, business and the structures of special importance (goldsmith's shops, museums, galleries etc.). It is evident from this paper that the safety glasses are divided in 4 classes (A, B, C and D) related to the demand on them, of which in the paper are considered two classes A and B, respectively the safety glass for the protection against the impact by thrown objects (the safety class A) and the safety glass for the protection against burglary violent impact – anti – breaking glasses (the safety class B). Pertaining the safety glasses for the protection against impact by thrown objects, the most rigid demand is posed to the class A3 glasses, which must stand an impact of the sack filled with the 45 kg of lead balls, falling from the height of 9500 mm, what is importantly different from the class A1 which must stand an impact of same sack from the height of only 3500 mm. For the glasses against breaking the most exigent demand is posed to the class B3 glasses, which must stand over 70 impacts of the 2 kg weighing machine axe, and such glasses are used in the museums, goldsmith's shops etc.

5. REFERENCES

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