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Glass in building - Laminated glass and laminated safety glass - Evaluation of conformity/Product standard

Verre dans la construction - Verre feuilleté et verre feuilleté de sécurité - Evaluation de la conformité/Norme de produit

Glas im Bauwesen - Verbundglas und Verbund-Sicherheitsglas - Konformitätsbewertung/Produktnorm

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This European Standard (EN 14449:2005) has been prepared by Technical Committee CEN/TC 129 “Glass in building”, the secretariat of which is held by IBN/BIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2005, and conflicting national standards shall be withdrawn at the latest by January 2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

No existing European Standard is superseded.

This European Standard stands alone.

This European Standard contains other aspects of importance of trade.

This European Standard includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard covers the evaluation of conformity and the factory production control of laminated glass and laminated safety glass for use in buildings.

NOTE 1 This also includes requirements subject to regulation.

NOTE 2 For glass products with electrical wiring or connections for, e.g. alarm or heating purposes, other directives, e.g. Low Voltage Directive, may apply.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 356, *Glass in building - Security glazing - Testing and classification of resistance against manual attack*

EN 410, *Glass in building - Determination of luminous and solar characteristics of glazing*

EN 572-1, *Glass in building - Basic soda lime silicate glass products - Part 1: Definitions and general physical and mechanical properties*

EN 673, *Glass in building – Determination of thermal transmittance (U value) – Calculation method*

EN 1063, *Glass in building - Security glazing - Testing and classification of resistance against bullet attack*

EN 1748-1-1, *Glass in building - Special basic products - Borosilicate glasses - Part 1-1: Definition and general physical and mechanical properties*

EN 1748-2-1, *Glass in building - Special basic products - Glass ceramics - Part 2-1: Definition and general physical and mechanical properties*

EN 1863-1, *Glass in building - Heat strengthened soda lime silicate glass - Part 1: Definition and description*

EN 12150-1, *Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description*

EN 12337-1, *Glass in building - Chemically strengthened soda lime silicate glass – Part 1: Definition and description*

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

EN 12758, *Glass in building - Glazing and airborne sound insulation - Product descriptions and determination of properties*

EN 12898, *Glass in building - Determination of the emissivity*

EN 13024-1, *Glass in building - Thermally toughened borosilicate safety glass - Part 1: Definition and description*

EN 13501-1, *Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests*

EN 13501-2, *Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services*

prEN 13501-5, *Fire classification of construction products and building elements - Part 5: Classification using test data from external fire exposure to roof tests*

EN 13541, *Glass in building - Security glazing - Testing and classification of resistance against explosion pressure*

EN 14178-1, *Glass in building – Basic alkaline earth silicate glass products - Part 1: Float glass*

prEN 14179-1, *Glass in building - Heat soaked thermally toughened soda lime silicate safety glass – Part 1: Definition and description*

prEN 14321-1, *Glass in building – Thermally toughened alkaline earth silicate safety glass - Part 1: Definition and description*

EN ISO 12543-1:1998, *Glass in building – Laminated glass and laminated safety glass - Part 1: Definitions and description of component parts (ISO 12543-1:1998)*

EN ISO 12543-2:1998, *Glass in building – Laminated glass and laminated safety glass - Part 2: Laminated safety glass (ISO 12543-2:1998)*

EN ISO 12543-3:1998, *Glass in building – Laminated glass and laminated safety glass - Part 3: Laminated glass (ISO 12543-3:1998)*

EN ISO 12543-4:1998, *Glass in building – Laminated glass and laminated safety glass - Part 4: Test methods for durability (ISO 12543-4:1998)*

EN ISO 12543-5:1998, *Glass in building – Laminated glass and laminated safety glass - Part 5: Dimensions and edge finishing (ISO 12543-5:1998)*

EN ISO 12543-6:1998, *Glass in building – Laminated glass and laminated safety glass - Part 6: Appearance (ISO 12543-6:1998)*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 12543:1998 Parts 1, 2, 3, 4, 5 and 6 and the following apply.

3.1 initial type testing
determination of the performance of a product (characteristic, durability), on the basis of either actual tests or other procedures (such as conventional, standardised, tabulated or general accepted values, standardised or recognised calculation methods, test reports when made available, …), in accordance with this European Standard that demonstrates compliance with this European Standard

3.2 test report
document that covers the results of tests undertaken on a representative sample of the product from production or on a prototype design of the product

3.3 product description
document that details the relevant parameters, e.g. process conditions, structure, etc., for defining a product that complies with the standard. It includes specific reference(s) to characteristics that are modified by the production process

3.4 significant change
variation in performance beyond the permitted tolerance for the characteristic

4 Requirements

4.1 Product description

For conformity purposes, the laminated/laminated safety glass manufacturer[1] is responsible for the preparation and maintenance of a product description. This description shall describe the product and/or product families.

Disclosure of the product description shall be at the discretion of the laminated/laminated safety glass manufacturer or his agent except in the case of regulatory requirements.

The description shall contain at least a normative part. The description may also contain an informative part, when the manufacturer foresees further development of the product.

The normative part of the description shall contain the following minimum information:

- A reference to EN ISO 12543 Parts 1 to 6 and all other standards with which the manufacturer claims compliance;
- Component parts:
  - Glass types and thicknesses (see 4.3.1.2),
  - Plastics glazing sheet materials types and thicknesses,
  - Interlayer types and thicknesses;
- The order of stacking of the components;
- Lamination process, e.g. folio, cast-in-place, etc.;
- Coatings if present and their position relative to an interlayer.

The interlayers may be listed either in full, i.e. chemical composition, or by a manufacturer's code.

The definition of product families shall be consistent with the normative part of the product description.

The substitution of materials and/or components shall maintain the conformity with the product description. The substituting materials and/or components can be added to the product family and also the product description when compliance has been demonstrated.

4.2 Conformity with the definition of laminated glass and laminated safety glass

4.2.1 General

Products shall conform with the manufacturer’s product description and fulfil the definition and requirements of laminated glass or laminated safety glass (see 4.2.2 and 4.2.3).

4.2.2 Conformity with definition of laminated glass

Products shall fulfil the definition and requirements for laminated glass as defined in EN ISO 12543-3.

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[1] The terms ‘manufacturer’ and ‘producer’ are understood as being synonyms (see CPD working document NB-CPD/02/019 – issued 24 April 2002 – page 1)

4.2.3 Conformity with definition of laminated safety glass

Products shall fulfil the definition and requirements for laminated safety glass as defined in EN ISO 12543-2.

4.3 Determination of the characteristic's performances

4.3.1 Characteristics of laminated glass and laminated safety glass

4.3.1.1 General

The characteristics of laminated glass and laminated safety glass are those of the glass panes used as components (see 4.3.1.2).

4.3.1.2 Characteristics of the glass panes used as components for the production of laminated and laminated safety glass

The glass types given in Table 1 can be used for the manufacture of laminated glass and laminated safety glass.

Table 1 - Glass types used as components for the production of laminated glass and laminated safety glass

Glass type	Reference
Basic soda lime silicate glass products	EN 572-1
Special basic glass products:	
- Borosilicate glasses	EN 1748-1-1
- Glass ceramics	EN 1748-2-1
Heat strengthened soda lime silicate glass	EN 1863-1
Thermally toughened soda lime silicate safety glass	EN 12150-1
Chemically strengthened soda lime silicate glass	EN 12337-1
Thermally toughened borosilicate safety glass	EN 13024-1
Alkaline earth silicate glass products	EN 14178-1
Heat soaked thermally toughened soda lime silicate safety glass	prEN 14179-1
Thermally toughened alkaline earth silicate safety glass	prEN 14321-1
NOTE For coated glass see EN 1096-4. Some characteristics of coated glass are similar to those of glass substrates.	

The characteristics of the glass components are listed in Table 2 and the values can be found in the appropriate product standards, e.g.; EN 572-1, EN 1748-1-1, etc.

For the characteristics listed in Table 2, for the glass pane types, generally accepted values or calculated values shall be used.

Table 2 - Example of characteristics for glass components

Characteristic	Symbol	Unit
Generally accepted values:		
- density	ρ	kg/m³
- hardness	$HK_{0,1/20}$	GPa
- Young's modulus	E	Pa
- Poisson's ratio	μ	Dimensionless
- Characteristic bending strength	$f_{g,k}$	Pa
- Resistance against sudden temperature changes and temperature differentials		K
- Specific heat capacity	c	J/(kg.K)
- Coefficient of linear expansion	α	K^{-1}
- Thermal conductivity (for *U*-value)	λ	W/(m.K)
- Mean refractive index to visible radiation	n	Dimensionless
- Emissivity	ε	Dimensionless
Measured values:		
- light transmittance	τ_v	Dimensionless
- solar direct transmittance	τ_e	Dimensionless
Calculated values:		
- total energy transmittance	g	Dimensionless

Since the majority of the characteristics of Table 2 are not changed significantly by the laminating process they shall be used for laminated/laminated safety glass.

4.3.2 Determination of characteristics of laminated glass and laminated safety glass

If the laminated glass and/or laminated safety glass manufacturer wishes to claim that any performance characteristic is independent of the production equipment used then the factory production control system shall be in accordance with this European Standard including his specific process control conditions.

4.3.2.1 Safety in the case of fire - Resistance to fire

Fire resistance shall be determined and classified in accordance with EN 13501-2.

NOTE EN 357 may be used as a classification reference specific to fire resistant glazed elements.

4.3.2.2 Safety in the case of fire - Reaction to fire

Reaction to fire shall be determined and classified in accordance with EN 13501-1.

4.3.2.3 Safety in the case of fire - External fire behaviour

Where the manufacturer wishes to declare external fire performance (e.g. when subject to regulatory requirements), the product shall be tested and classified in accordance with prEN 13501-5.

NOTE Compliance with this requirement is not possible until a version of prEN 13501-5 later than 2002 becomes available.

4.3.2.4 Safety in use - Bullet resistance: shatter properties and resistance to attack

Bullet resistance shall be determined and classified in accordance with EN 1063.

4.3.2.5 Safety in use - Explosion resistance: impact behaviour and resistance to impact

Explosion resistance shall be determined and classified in accordance with EN 13541.

4.3.2.6 Safety in use - Burglar resistance: shatter properties and resistance to attack

Burglar resistance shall be determined and classified in accordance with EN 356.

4.3.2.7 Safety in use - Pendulum body impact resistance: shatter properties (safe breakablity) and resistance to impact

Pendulum body impact resistance shall be determined and classified in accordance with EN 12600.

NOTE Laminated glass conforming with EN ISO 14543-3 (No EN 12600 classification) will be declared NPD.

4.3.2.8 Safety in use - Mechanical resistance: Resistance against sudden temperature changes and temperature differentials

The resistance against sudden temperature changes and temperature differentials is a generally accepted value. That value is given in the standards (see Table 1) for the appropriate glass substrate.

4.3.2.9 Safety in use - Mechanical resistance: Resistance against wind, snow, permanent load and/or imposed loads of the glass unit

The ordered assemblies of laminated glass or laminated safety glass (thickness and types of glass components or plastic glazing sheet materials – interlayers) shall ensure the resistance against wind, snow, permanent load, and other mechanical, (quasi-) static action, which shall be checked in accordance with design standards[2].

As long as on the concerned construction or building site no part of the design standards is applicable for the design then the current method of determining mechanical resistance in the country of destination shall be applied.

The manufactured or supplied thickness of laminated glass or laminated safety glass shall conform to the ordered thickness.

4.3.2.10 Protection against noise - Direct airborne sound reduction

The sound reduction indexes shall be determined in accordance with EN 12758.

4.3.2.11 Energy conservation and heat retention - Thermal properties

The thermal transmittance value (*U*-value) shall be determined by calculation in accordance with EN 673 with:

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[2] prEN 13474 series is currently being prepared.

— emissivity ε: the declared value of the manufacturer. If the information is not available, the emissivity shall be determined in accordance with EN 12898;

— nominal thickness of the glass panes.

4.3.2.12 Energy conservation and heat retention - Radiation properties: Light transmittance and reflectance

The light transmittance and reflectance shall be determined in accordance with EN 410.

4.3.2.13 Energy conservation and heat retention - Radiation properties: Solar energy characteristics

The solar energy transmittance and reflectance shall be determined in accordance with EN 410.

4.4 Durability

When products conform to the definition of laminated glass or laminated safety glass as 4.2 the characteristics' performances in 4.3.2 are ensured during an economically reasonable working life.

The durability of glass products, including their characteristics, shall be ensured by the following:

— Compliance with this European Standard;

— Compliance with instructions from the glass product manufacturer or supplier.

The manufacturer shall supply specific installation instructions or make reference to appropriate technical specifications.

NOTE The durability of glass products depends on:

-building and construction movements due to various actions;

-building and construction vibrations due to various actions;

-deflection and racking of the glass support due to various actions;

-glass support design (e.g. drainage of infiltrated water in the rebate, prevention of direct contact between glass support members and glass);

-accuracy of glass support and glass support member dimensions;

-quality of the assembling of glass support members up to a glass support;

-quality of installation of the glass support into or onto the buildings or constructions;

-glass support expansion due to adsorbed moisture from the air or other sources;

-the quality of installation of the glass product into or onto its support.

4.5 Dangerous substances

Materials used in products shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the Member State of destination.

5 Evaluation of conformity

5.1 General

Evaluation of conformity in accordance with this European Standard shall be as a result of Factory Production Control and Initial Type Testing in accordance with this European Standard:

1) Factory production control;

   This shall include the following:

   a) Inspection of samples taken at the factory in accordance with a prescribed test plan;

   b) Initial inspection of the factory and of factory production control;

   c) Continuous surveillance and assessment of the factory production control.

2) Initial type testing of the product;

NOTE There may be a need to involve a third party, with 1b, 1c, and/or 2, for the purpose of regulatory marking (see Annex ZA).

5.2 Initial type testing of the product (see 5.1, 2)

5.2.1 General

All the product's characteristics shall be initial type tested to verify they are in conformity with the requirements of this European Standard. In addition instead of performing any actual testing, initial type testing may make use of:

— generally accepted and/or conventional and/or standardised values, in the Clause 2 referenced standards, or in publications that are referred to in these standards;

— standardised calculation methods and recognised calculation methods in the Clause 2 referenced standards, or in publications that are referred to in these standards;

— test report(s) on the basis of 5.2.1.2 when made available except for the characteristics listed in 5.2.2.

— where components are used whose characteristics have already been determined, by the component manufacturer, on the basis of conformity with other product standards, these characteristics need not be reassessed providing they remain unchanged by the manufacturing process;

— release of dangerous substances may be assessed indirectly by controlling the content of the substance concerned;

— durability may be assessed indirectly by controlling the production processes according to this European Standard;

NOTE 1 Products CE marked in accordance with appropriate harmonised European specifications may be presumed to have the performances stated with the CE marking.

NOTE 2 There may be a need to involve a third party for the purpose of regulatory marking (see Annex ZA).

When actual testing is required then the Initial Type Testing (ITT) shall be undertaken on a sample representative of the product taken from direct production or a prototype, any plant and/ or line.

Whenever a change occurs in the raw material or the production process (subject to the definition of the family), which would change significantly one or more of the characteristics, the type tests shall be repeated for the appropriate characteristics (see Annex D).

5.2.1.1 Multiple lines/sites

If a manufacturer operates more than one line and/or site, the following can reduce the requirement for multiple Initial Type Testing (ITT):

a) The manufacturers' technical file for a product shall specifically covers all sites and/or lines of the same manufacturer[3];

b) The manufacturer shall establish a direct relationship between production control, initial type testing and on-going internal audit testing;

c) The manufacturer has a responsible individual designated to ensure product compliance based on:

— The operation of a consistent Factory Production Control system on all applicable sites and/or lines,

— The manufacturer having obtained evidence that shows the product to be consistent, with respect to both product characteristics and intended use characteristics,

— The manufacturer has in place an internal auditing scheme, including product consistency.

5.2.1.2 Historic Data

Tests previously performed in accordance with the provisions of this European Standard (same product, same characteristic(s), same or more onerous test method, sampling method and attestation of conformity) may be taken into account.

5.2.2 Initial type testing of laminated glass and laminated safety glass

5.2.2.1 General

To establish if a product conforms to the definition of laminated glass or laminated safety glass, initial type testing shall consist of:

— determining that the laminated safety glass material design conforms to EN ISO 12543-2.

— determining that the laminated glass material design conforms to EN ISO 12543-3.

5.2.2.2 Test specimens

The test specimens for the initial type test shall conform to the minimum specification(s) of the product family design for a specific intended use/characteristic (see 4.3.2.1 to 4.3.2.13).

NOTE 1 When the intended uses comprises bullet resistance, explosion resistance and/or burglar resistance, and the product is to be defined as a laminated safety glass then the classification according to EN 12600 can be undertaken on test specimens that consist of two glasses, thickness 3 mm nominal, separated by an interlayer, thickness 0,76 mm nominal. When for a type of glass no 3 mm nominal exists, the nearest thickness should be used. When for a type of interlayer no 0,76 mm nominal exist, the nearest thickness should be used.

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[3] The terms 'manufacturer' and 'producer' are understood as being synonyms (see CPD working document NB-CPD/02/019-issued 24 April 2002 – page1)

The test specimens for the radiation test (see Clause 6 of EN ISO 12543-4:1998) shall conform to the minimum specification of the product family related to interlayer type.

NOTE 2 The undertaking of a radiation test can be unnecessary if test reports are supplied by interlayer supplier.

5.2.3 Initial type testing (ITT) of characteristic's performances

All characteristics in 4.3.2 shall be subject to initial type testing in accordance with 5.2.1.

NOTE Annex D includes information on those changes that may require a new ITT

5.3 Factory production control (FPC) and inspection of samples in accordance with a prescribed test plan (see 5.1, 1a and b)

Factory production control means the permanent internal control of production exercised by the manufacturer.

All elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This production control system documentation shall ensure a common understanding of quality assurance and enable the achievement of the required product characteristics and the effective operation of the production control system to be checked.

Factory production control shall be according to Annex A of this European Standard.

NOTE 1 A factory production control system similar to EN ISO 9001 made product specific to this European Standard is deemed to satisfy the requirements of this clause.

NOTE 2 There may be a need to involve a third party for the purpose of regulatory marking (see Annex ZA).

Annex A of this European Standard also summarizes the tests to be carried out by the manufacturer as part of the production control in the factory, and as further testing of samples taken at the factory in accordance with a prescribed test plan.

5.4 Initial inspection of factory and of factory production control (see 5.1, 1c)

The initial inspection of the factory and of the factory production control shall cover the parameters listed in Table 3 in conjunction with Annex A.

NOTE There may be a need to involve a third party for the purpose of regulatory marking (see Annex ZA).

Table 3 - Characteristics of interest for the Factory Production Control

Nr	Characteristic	Interested parameter related to the characteristic	For details, refer to
A	Resistance to fire Reaction to fire External fire behaviour	- checking incoming materials - the use of appropriate interlayer material - process control - product control after lamination - labelling outgoing glass product	Annex A
B	Release of dangerous substances	- checking incoming materials	Annex A
C	Bullet resistance Explosion resistance Burglar resistance Pendulum body impact resistance Resistance against sudden temperature changes and temperature differentials Wind, snow, permanent and imposed load resistance of the glass unit	- checking incoming materials - the use of appropriate interlayer material - process control - product control after lamination - labelling outgoing glass product	Annex A
D	Direct airborne sound reduction Thermal properties Radiation properties: – light transmittance and reflection – solar energy characteristic	- checking incoming materials the use of appropriate interlayer material process control - product control after lamination - labeling outgoing glass product	Annex A

5.5 Continuous surveillance and assessment of the factory production control (see 5.1, 1c)

The continuous surveillance and assessment of the factory production control shall cover the parameters listed in Table 3 in conjunction with Annex A.

NOTE There may be a need to involve a third party for the purpose of regulatory marking (see Annex ZA).

The frequency of production surveillance shall be twice per year for new production facilities or for facilities that do not already have an established factory production control system in accordance with this European Standard.

When assessment of FPC fails to identify major non-conformances during four successive assessments, the frequency can be reduced to once a year.

When a major non-conformance is recorded, the inspection shall be repeated within two months. The frequency of production surveillance shall return to, or remain at twice a year. When the repeated inspection also results in a major non-conformance, then the production shall be subject within two months to a repeated initial inspection of the factory and of the factory production control together with a surveillance inspection. When this repeated initial inspection and surveillance inspection also results in a major non-conformance then the products are considered as no longer conforming to this European Standard.

6 Marking and/or labelling

6.1 General

All voluntary marking and/or labelling shall comply with Annex E.3.

Care shall be taken to ensure that any voluntary marking and/or labelling does not cause confusion with respect to the mandatory requirements.

NOTE All marking and/or labelling of product to demonstrate compliance with the regulatory requirement is detailed in Annex ZA.

6.2 Product marking

There is no requirement to mark laminated glass or laminated safety glass products.

6.3 Product characteristics

The manufacturer or his agent shall organise a system of references that allows for the following:

— the identification of exactly which characteristics have to be assessed (see 4.3.2);

— those characteristics that will be assessed;

— the values, classes, categories, etc. that have been determined for those characteristics.

This system shall be documented as part of the evaluation of conformity.

6.4 “Characteristics/performance identification paper”

The manufacturer shall prepare a “characteristics/performance identification paper” based on the information collected on the product characteristics (see 6.3). This document shall be part of the manufacturer’s technical file and is the basis for the accompanying information as required for regulatory purposes.

The "characteristics/performance identification paper" can be a catalogue in any media format (paper, disk, website, etc.), always identifiable by the reference that accompanies the marking with the product. The catalogue shall contain the values or classes of the characteristics for which a performance is declared. If no performance is declared, an indication of no performance determined (NPD) shall be made.

NOTE 1 The conditions of use of NPD are given in Annex ZA.

NOTE 2 The catalogue should not contain any information other than that relevant to the “characteristics/performance identification paper”.

Annex A
(normative)

Factory production control

A.1 Factory Production Control Requirements

A.1.1 General

The factory production control system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control [raw and other] incoming materials or components, equipment, the production process and the product.

NOTE An FPC system conforming with the requirements of EN ISO 9001 and made specific to the requirements of this European Standard is deemed to satisfy the requirements of this European Standard

A.1.2 Organisation

A.1.2.1 Responsibility and authority

The responsibility, authority and the interrelation of all personnel who manage, perform and verify work affecting conformity shall be defined, particularly for personnel who have the organizational freedom and authority to:

a) initiate action to prevent the occurrence of product non-conformity;

b) identify and record any product non-conformances.

A.1.2.2 Management representative for factory production control

The manufacturer shall appoint a management representative who, irrespective of other responsibilities, shall have defined authority and responsibility for ensuring that the requirements of this European Standard are implemented and maintained.

A.1.2.3 Management review

The production control system shall be reviewed by the manufacturer's management at appropriate intervals in accordance with the manufacturer's documented control system to ensure its continuing suitability and effectiveness. Records of such reviews shall be maintained for a minimum period of 5 years.

A.1.3 Control system

A.1.3.1 General

The manufacturer shall establish and maintain a documented system as a means of ensuring that the product conforms to EN ISO 12543-2 or EN ISO 12543-3 as appropriate. The following requirements shall be fulfilled.

A.1.3.2 Personnel

The manufacturer shall use appropriately trained personnel for the operation and inspection of all production and inspection equipment.

A.1.3.3 Documentation

The manufacturer's documentation and procedures shall be relevant to the production and process control of the laminated glass and laminated safety glass, and shall be adequately described in a manual which shall include:

a) The organizational structure, responsibilities and authorities of the management with regard to product conformity.

b) The procedures for specifying and verifying the incoming materials.

c) The manufacturing, production control and other techniques, processes and systematic actions that will be used.

d) The inspections that will be carried out before production, the inspections and tests during and after production, and the frequency at which they will be carried out.

e) Required records of inspections, tests and assessments.

f) Records of non-conformity situations requiring corrective actions and the actions taken.

g) Unless otherwise indicated in national regulations records shall be kept for a minimum of one year after manufacturing the product.

A.1.3.4 Test equipment

Calibration of test equipment necessary for factory production control shall be documented.

NOTE The precision of calibration required is implied by the accuracy of the test method and tolerances specified.

A.1.3.5 Inspection and testing

Clause A.3 designates the inspections and tests by means of tables. The requirements and records shall be normative.

Frequencies shall be regarded as a minimum frequency.

A.2 Marking

The manufacturer shall establish, document and maintain procedures for marking of the products. The product shall be marked in accordance with the established documents.

For tracing purposes, the manufacturer shall establish and maintain the records required in Clause A.3.

A.3 Inspection and testing tables of laminated glass and laminated safety glass product production

A.3.1 General

The tables consist of three parts:

— section 1: Material control

— section 2: Production Control

— section 3 : Product control

When a manufacturing process is such that one or more of the listed inspections or tests are not applicable or physically not practical the concerned inspection or test may be ignored.

The inspections and/or tests on incoming materials shall be carried out before use.

In case of non-conforming materials, action shall be taken so that:

— non-conforming raw materials can not be used

— non-conforming products can not be delivered.

The required records in Tables A.1, A.2 and A.3 may be any document, e.g. order documents, production documents, logbook, etc, as described in the FPC procedures and associated documentation.

For those criteria where no record is required this situation shall only apply until a complaint regarding that criterion is received. Records shall subsequently be kept to show that corrective action has been successful.

The machinery and equipment used for manufacturing the products shall be checked at periods consistent with the manufacturers' documented process control against defined parameters, maintained and adjusted for optimal results.

A.3.2 Use of proxy testing

A manufacturer may employ a test method/method of evaluation other than those referred to in the Tables A.1, A.2 and A.3. However, it shall be the manufacturer's responsibility to prepare suitable documentation describing such tests and their correlation with the recommended method to ensure that the appropriate characteristic is as declared.

Table A.1 - Inspection and test table for laminated glass and laminated safety glass: Interlayer - folio/sheets

Section 1: Material control					
Ref.	Material, inspection or test	Recommended method (decision to be made by the manufacturer) [e)]	Requirement	Recommended minimum frequency	Record
1.1	Incoming materials: all glass				
1.1.1	Type/tint/thickness etc.: identification, including packaging and label	Visual	See purchase specification	Each delivery	Yes
1.1.2	CE Mark; labelling inc. accompanying documentation	Visual	See purchase specification	Each delivery	Yes
1.2	Incoming materials: thermally treated glass[a)]				
1.2.1	Flatness[b)]	Measurement	See purchase specification	Each delivery and thickness, one sample	Yes
1.2.2	Dimensions, shapes, holes, notches, etc.	Measurement	See purchase specification	Each delivery and thickness, one sample	Yes
1.2.3	Edgework	Visual	See purchase specification	Each delivery and thickness, one sample	Yes
1.3	Incoming materials: plastics glazing sheet materials				
1.3.1	Type/tint etc.: identification, including packaging and label	Visual	See purchase specification	Each delivery	Yes
1.4	Incoming materials: interlayer materials				
1.4.1	Plastic interlayer folio/sheet	Visual	See purchase specification	Each delivery	Yes

[a)] Refers to glass products complying with EN 1863, EN 12150, EN 13024, prEN 14179, prEN 14321.

[b)] To enable acceptable laminated/laminated safety glass to be manufactured from thermally treated glasses then the flatness tolerance required may be tighter than that specified in the appropriate product standards (see [a)]).

(continued)

Table A.1 - Inspection and test table for laminated glass and laminated safety glass: Interlayer – folio/sheets *(continued)*

Section 2: Production control					
Ref.	Material, inspection or test	Recommended method (decision to be made by manufacturer) [e)]	Requirement	Recommended minimum frequency	Record
2.1	Process control				
2.1.1	Temperature and/or relative humidity in storage, assembly and laminating area	Measurement	See production instructions	Continuously[c)]	Yes
2.1.2	Process parameters of production line	See manual instruction	See production instructions	Continuously[c)]	Yes
2.1.3	In the case of coated or enamelled glass: identification of the position of the coating or enamel	Visual	See production instructions	When required	No
[c)] Continuously means a frequency based on an assessment of the requirements of the process used by the manufacturer that will give assurance that product characteristics will comply with the initial type test.					

(continued)

Table A.1- Inspection and test table for laminated glass and laminated safety glass: Interlayer – folio/sheets (*concluded*)

Section 3: Product control					
Ref.	Inspection or test	Recommended method (decision to be made by manufacturer)[e)]	Requirement	Recommended minimum frequency	Record
3.1	Finished product				
3.1.1	Dimensions	Measurement	See EN ISO 12543-5 or customer order	1 test per day[d)]	Yes
3.1.2	Composition and construction design	Visual	See order specifications	At least 1 pane per design and per order	Yes
3.1.3	Visual appearance	Visual	See EN ISO 12543-6	1 test per day	No
3.1.4	Edge work (of cut sizes, if important for fire resistance)	Visual	See production instructions	Each pane	Yes
3.1.5	Test for ensuring conformity	See Annex B	See Annex B	See Annex B	Yes

[d)] The test shall be undertaken to ensure that all glass types and thicknesses manufactured in one week are tested during that week.

[e)] It is the manufacturer of the laminated glass and/or the laminated safety glass that is intended.

Table A.2 - Inspection and test table for laminated glass and laminated safety glass: Interlayer – cast in place interlayer

Section 1: Material control					
Ref.	Material, inspection or test	Recommended method (decision to be made by the manufacturer) [e)]	Requirement	Recommended minimum frequency	Record
1.1	Incoming materials: all glass				
1.1.1	Type/tint/thickness etc.: identification, including packaging and label	Visual	See purchase specification	Each delivery	Yes
1.1.2	CE Mark; labelling inc. accompanying documentation	Visual	See purchase specification	Each delivery	Yes
1.2	Incoming materials: thermally treated glass[a)]				
1.2.1	Flatness[b)]	Measurement	See purchase specification	Each delivery and thickness, one sample:	Yes
1.2.2	Dimensions, shapes, holes, notches, etc	Measurement	See purchase specification	Each delivery and thickness, one sample:	Yes
1.2.3	Edgework	Visual	See purchase specification	Each delivery and thickness, one sample:	Yes
1.3	Incoming materials: plastics glazing sheet materials				
1.3.1	Type/tint etc.: identification, including packaging and label	Visual	See purchase specification	Each delivery	Yes
1.4	Incoming materials: Interlayer materials				
1.4.1	Resin; type/colour, packaging and labelling	Visual	See purchase specification	Each delivery	Yes
1.4.2	Closing, spacing and retaining materials	Visual	See purchase specification	Each delivery	Yes

[a)] Refers to glass products complying with EN 1863, EN 12150, EN 13024, prEN 14179, prEN 14321.

[b)] To enable acceptable laminated/laminated safety glass to be manufactured from thermally treated glasses then the flatness tolerance required may be tighter than that specified in the appropriate product standards (see [b)]).

(continued)

Table A.2 - Inspection and test table for laminated glass and laminated safety glass: Interlayer – cast in place interlayer
(*continued*)

Section 2: Production control					
Ref.	Material, inspection or test	Recommended method (decision to be made by manufacturer) [e)]	Requirement	Recommended minimum frequency	Record
2.1	Process control				
2.1.1	Temperature and/or relative humidity in laminating area	Measurement	No condensation on glass	Continuously[c)]	Yes
2.1.2	Process parameters of production line	See manual instruction	See production instructions	Continuously[c)]	Yes
2.1.3	In the case of coated or enamelled glass: identification of the position of the coating or enamel	Visual	See production instructions	When required	Yes
c) Continuously means a frequency based on an assessment of the requirements of the process used by the manufacturer that will give assurance that product characteristics will comply with the initial type test.					

(continued)

Table A.2 - Inspection and test table for laminated and laminated safety glass: Interlayer – cast in place interlayer *(concluded)*

Section 3: Product control					
Ref.	Inspection or test	Recommended method (decision to be made by manufacturer)[e)]	Requirement	Recommended minimum frequency	Record
3.1	Finished product				
3.1.1	Dimensions	Measurement	see EN ISO 12543-5 or customer order	1 test per day [d)]	Yes
3.1.2	Composition and construction design	Visual	See order specifications	At least 1 pane per design and per order	Yes
3.1.3	visual appearance	Visual	Refer to EN ISO 12543-6	1 test per day	No
3.1.4	Edge work (of cut sizes, if important for fire resistance)	Visual	See production instructions	Each pane	Yes
3.1.5	Test for ensuring conformity	See Annex B	See Annex B	See Annex B	Yes

[d)] The test shall be undertaken to ensure that all glass types and thicknesses manufactured in one week are tested during that week

[e)] It is the manufacturer of the laminated glass and/or the laminated safety glass that is intended.

Table A.3 - Inspection and test table for laminated and laminated safety glass: Interlayer - intumescent

Section 1: Material control					
Ref.	Material, inspection or test	Recommended method (decision to be made by the manufacturer) [e]	Requirement	Recommended minimum frequency	Record
1.1	Incoming materials: all glass				
1.1.1	Type/tint/thickness etc.: identification, including packaging and label	Visual	See purchase specification	Each delivery	Yes
1.1.2	CE Mark; labelling inc. accompanying documentation	Visual	See purchase specification	Each delivery	Yes
1.2	Incoming materials: thermally treated glass[a]				
1.2.1	Flatness [b]	Measurement	See purchase specification	Each delivery and thickness, one sample:	Yes
1.2.2	Dimensions, shapes, holes, notches, etc	Measurement	See purchase specification	Each delivery and thickness, one sample:	Yes
1.2.3	Edgework	Visual	See purchase specification	Each delivery and thickness, one sample:	Yes
1.3	Incoming materials: plastics glazing sheet materials				
1.3.1	Type/tint etc.: identification, including packaging and label	Visual	See purchase specification	Each delivery	Yes
1.4	Incoming materials: Interlayer materials				
1.4.1	Interlayer material (type, colour, packaging, labelling)	Visual	See purchase specification	Each delivery	Yes
1.4.2	Interlayer material; composition	Measurement	See purchase specification	Each batch	Yes
1.4.3	Closing, spacing and retaining material	Visual	See purchase specification	Each delivery	Yes

[a] Refers to glass products complying with EN 1863, EN 12150, EN 13024, prEN 14179, prEN 14321.

[b] To enable acceptable laminated/laminated safety glass to be manufactured from thermally treated glasses then the flatness tolerance required may be tighter than that specified in the appropriate product standards (see [a]).

(continued)

Table A.3 - Inspection and test table for laminated glass and laminated safety glass: Interlayer - intumescent *(continued)*

Section 2: Production control					
Ref.	Material, inspection or test	Recommended method (decision to be made by manufacturer) [e)]	Requirement	Recommended minimum frequency	Record
2.1.	Prior to laminating – All				
2.1.1	Glass: thickness, dimensions	Visual	See purchase specification	Each delivery, package and thickness:	No
2.1.2	Glass: edge work	Visual	See purchase specification	Each delivery, package and thickness	No
2.1.3	In the case of coated or enamelled glass: identification of the position of the coating or enamel	Visual	See purchase specification	When required	No
2.2	Prior to laminating – Cut sizes				
2.2.1	Glass: thickness, dimensions, shapes, holes, notches	Measurement	See purchase specification	Each delivery, package and thickness:	Yes
2.2.2	Glass: edge work	See production instructions	See production instructions	One specimen per week	Yes
2.3	Process control				
2.3.1	Relevant process conditions of production line and area	For control methods, requirements, frequencies and records, see production and process instructions			Yes
2.3.2	Temperature and/or relative humidity in laminating area	Measurement	See manufacturing instructions	Continuously [c)]	Yes
c) Continuously means a frequency based on an assessment of the requirements of the process used by the manufacturer that will give assurance that product characteristics will comply with the initial type test.					

(*continued*)

Table A.3 - Inspection and test table for laminated glass and laminated safety glass: Interlayers - intumescent (*concluded*)

Section 3: Product control					
Ref.	Inspection or test	Recommended method (decision to be made by manufacturer) [e)]	Requirement	Recommended minimum frequency	Record
3.1	Finished product (stock sizes)				
3.1.1	Dimensions	Measurement	See EN ISO 12543-5	1 pane per shift per design	Yes
3.1.2	Construction design	Visual	See order specifications	1 pane per shift per design	Yes
3.1.3	Visual appearance	Visual	Refer to manufacturer's specification	1 pane per shift	No
3.2	Finished product (cut sizes only)				
3.2.1	Dimensions	Measurement	See customers order	Each pane	Yes
3.2.2	Construction design	Visual	See customers order	Each pane	Yes
3.2.3	Visual appearance	Visual	Refer to EN ISO 12543-6	At least 1 pane per design and per order	No
3.2.4	Edge work	Visual	See production instructions	Each pane	Yes
3.3	Finished product				
3.3.1	Test for ensuring conformity	See Annex B	See Annex B	See Annex B	Yes

[e)] It is the manufacturer of the laminated glass and/or the laminated safety glass that is intended.

Annex B
(informative)

Tests for ensuring conformity

B.1 General

During production testing of the laminated glass/laminated safety glass should be undertaken to ensure that the product is durable. These tests are detailed in B.2.

The manufacturer should also submit the production to a regular testing to check conformity of the product with the samples submitted for Initial Type Testing. These tests are detailed in B.3.

B.2 Production durability check

The purpose of the check is to determine if the laminating process has been successfully performed.

The specific test undertaken will be dependant on the following:

a) Whether the product is a laminated glass or a laminated safety glass

b) The interlayer type

c) The intended use of the product

See Table B.1

Table B.1 - Production durability tests for laminated glass and laminated safety glass

Glass Type	Interlayer Type	Test methods for the Intended Uses (see 4.3.2)		
		Safety in Case of Fire	Safety in Use	Others
Laminated glass	Folio/sheet	A		A
	Cast in place resin	A		A
	Intumescent	B		
Laminated safety glass	Folio/sheet	A	A	
	Cast in place resin	A	A	
	Intumescent	B	B	
A High temperature test B Short high humidity test without condensation				

B.3 Regular conformity check of the product

The purpose of the check is to determine if the product continues to conform to the ITT.

The specific test undertaken will be dependant on the following:

a) Whether the product is a laminated glass or a laminated safety glass;

b) The interlayer type;

c) The intended use of the product.

See Table B.2.

Table B.2 - Conformity check of the laminated glass and laminated safety glass

Glass Type	Interlayer Type	Test methods for the Intended Uses (see 4.3.2)		
		Safety in Case of Fire	Safety in Use	Others
Laminated glass	Folio/sheet	C		C
	Cast in place resin	C		C
	Intumescent	D		
Laminated safety glass	Folio/sheet	C	C	
	Cast in place resin	C	C	
	Intumescent	D	D	
C High humidity test with condensation D High humidity test without condensation				

B.4 Details of test methods

B.4.1 General

B.4.1.1 Introduction

The test methods have been taken either from EN ISO 12543-4 or have been developed especially. They will enable a manufacturer to check that his process control has been successful and that the products comply.

Details of the test methods are given in Table B.3.

Table B.3 - Details of the test methods for laminated glass and laminated safety glass

Test method	Details of test methods	
	Test method reference	Test method title
A	EN ISO 12543 –4:1998 Clause 4	High temperature test
B	EN ISO 12543 –4:1998 5.3.2	Short High humidity test without condensation
C	EN ISO 12543 –4 :1998 5.3.1	High humidity test with condensation
D	EN ISO 12543 –4 :1998 5.3.2	High humidity test without condensation
NOTE Test B has been modified from that given in 5.3.2 of EN ISO 12543-4:1998 to give faster results (see B.4.1.3)		

B.4.1.2 Details of test method A

The specimen should be in accordance with 4.2 of EN ISO 12543-4:1998.

The test should be carried out according to 4.3 of EN ISO 12543-4:1998.

The results should be expressed according to 4.4. of EN ISO 12543-4:1998.

The results should be interpreted as the following:

- Laminated glass in accordance with 4.1 of EN ISO 12543-3:1998.
- Laminated safety glass in accordance with 4.1 of EN ISO 12543-2:1998.

B.4.1.3 Details of test method B

The specimen should be in accordance with 5.2 of EN ISO 12543-4:1998.

The test should be carried out according to 5.3.2 of EN ISO 12543-4:1998 subject to the following modifications:

— Temperature 80 $^{+2}_{0}$ ^{0}C;

— Duration of test 24 h

The results should be expressed according to 5.4 of EN ISO 12543-4:1998.

The results should be interpreted as the following:

- Laminated glass in accordance with Clause 5 of EN ISO 12543-3:1998.
- Laminated safety glass in accordance with Clause 5 of EN ISO 12543-2:1998.

B.4.1.4 Details of test method C

The specimen should be in accordance with 5.2 of EN ISO 12543-4:1998.

The test should be carried out according to 5.3.1 of EN ISO 12543-4:1998.

The results should be expressed according to 5.4. of EN ISO 12543-4:1998.

The results should be interpreted as the following:

- Laminated glass in accordance with 4.2 of EN ISO 12543-3:1998.
- Laminated safety glass in accordance with 4.2 of EN ISO 12543-2:1998.

B.4.1.5 Details of test method D

The specimen should be in accordance with 5.2 of EN ISO 12543–4:1998.

The test should be carried out according to 5.3.2 of EN ISO 12543–4:1998.

The results should be expressed according to 5.4 of EN ISO 12543-4:1998.

The results should be interpreted as the following:

- Laminated glass in accordance with Clause 5 of EN ISO 12543-3:1998.

- Laminated safety glass in accordance with Clause 5 of EN ISO 12543-2:1998.

B.5 Testing protocol

B.5.1 Frequency

B.5.1.1 Test method A

A minimum of one specimen per day should be tested.

NOTE One specimen per production cycle may be more realistic.

B.5.1.2 Test method B

A minimum of one specimen per day should be tested.

B.5.1.3 Test method C

A minimum of three specimen should be tested every two weeks.

B.5.1.4 Test method D

A minimum of three specimen should be tested every six months.

B.5.2 Specimen selection

B 5.2.1 General

The test specimens should, where applicable, conform to the minimum specification(s) of the product family design for a specific intended use/characteristic (see 4.3.2.1 to 4.3.2.13).

B.5.2.2 Test method A

The test should be undertaken on a selection of specimens chosen to ensure that the range of glass types and interlayer types used to manufacture the laminated/laminated safety glass are covered.

NOTE 1 Glass types includes different compositions, different products, e.g. float, patterned, coated, etc.

NOTE 2 Interlayer types includes material, curing system, manufacturer, etc.

B.5.2.3 Test method B

The test specimens should be chosen to ensure that, where practical, the full range of products are covered (see B.3.2.1). Both products for indoor and outdoor use should be tested.

B.5.2.4 Test method C

The specimens should be taken from three separate production runs. Where practical the specimens should ensure that the full range of manufactured products are covered (see B.3.2.2).

B.5.2.5 Test method D

The specimens should be taken from three separate production runs.

The test specimens should be chosen to ensure that, where practical, the full range of products are covered (see B.3.2.1). Both products for indoor and outdoor use should be tested.

B.6 Outcome of testing

B.6.1 General

The results of the testing to test methods A and B will enable the manufacturer to decide if the product can be regarded as non-conforming. The action by the manufacturer in the result of a failure will depend on the glass type and intended use.

B.6.2 Test method A

If the test specimen has failed the test then the production run should be quarantined.

Three further specimens should be tested according to B.4.1.2. If they pass the test then the production can be cleared for delivery. However, a further failure will condemn the production run.

B.6.3 Test method B

If the test specimen has failed the test then the production run should be quarantined.

Three further specimens should be tested according to B.4.1.3. If they pass the test then the production can be cleared for delivery. However, a further failure will condemn the production run.

B.6.4 Test method C

If the test specimen has failed the test then the system of FPC should be reviewed.

B.6.5 Test method D

If the test specimen has failed the test then the system of FPC should be reviewed.

B.7 Other testing

The tests covered by B.2 and B.3 are a means of ensuring on-going compliance of the factory production control. However, none of the tests check the mechanical performance of the laminated safety glass.

Therefore at least once per week a minimum of 3 test specimens should subjected to a mechanical performance test.

NOTE Annex C lists a number of test methods that a manufacturer could employ to demonstrate on-going mechanical performance.

Annex C
(informative)

Laminated safety glass: Mechanical resistance tests

C.1 General

The tests for ensuring conformity given in Annex B do not always act as a good indicator of the future mechanical behaviour, i.e. safety in use performance resistance.

The tests, in Annex B, give an insight into the effectiveness of the laminating process. However, the mechanical behaviour of the assembly is as a result of the inherent properties of the interlayer, sometimes referred to as tenacity, and the adhesion of the interlayer to the other components of the assembly.

A number of mechanical tests have been used to check that the laminated safety glass will offer the expected performance.

C.2 Ball drop test

C.2.1 Requirement

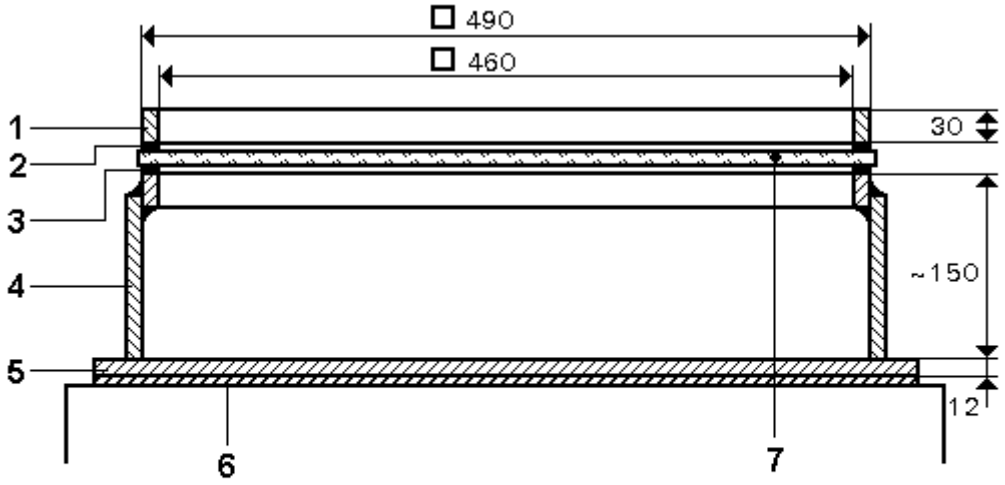
The ball should not penetrate the test specimen within 5 s after impact.

C.2.2 Equipment

A steel ball with a diameter of 63,50 mm (mass approximately 1030 g) can be held, e.g. by means of an electric magnet, at 4 m (for the 3.3.1 composition) above a sample. For other compositions the manufacturer must specify the drop height and/or mass of the steel ball. From the desired height, the ball will be released in such a way that only gravity acts on the ball. The ball should fall within a circle of 100 mm diameter in the centre of the sample, which is positioned in accordance with Figure C.1.

The positioning equipment consists out two steel frames, type of steel 37.2. The centred edges should have a width of 15 mm, and should be covered with rubber strips, 15 mm width and 3 mm thick, hardness (40±10) IHRD. The upper frame will have a mass of approximately 7 kg. The equipment is mounted on a 12 mm thick steel base plate. Between the base plate and the solid support, a 3 mm rubber mat, hardness (40±10) IHRD should be used.

Dimensions in millimetres



Key

1 Upper frame
2 Rubber
3 Rubber
4 Lower frame
5 Base plate
6 Rubber interlayer
7 Test specimen

Figure C.1 - Positioning of the test sample in ball drop test

C.2.3 Test specimen

Test specimens should conform to the minimum specification of the product design or to the minimum specification manufactured in that production run. Length and width are equal to 500 mm ± 5 mm.

C.2.4 Procedure

The test specimen should be stored at least four hours at test temperature, preferably (23±5) °C. After placing a test specimen in the supporting equipment the ball will be positioned at the required height, and released.

C.3 Pendulum impact test

C.3.1 Requirement

The impactor should not produce an opening in the test specimen through which a 76 mm diameter steel sphere can pass.

C.3.2 Test equipment

This can be either an EN 12600 test rig or similar. The impactor can be either the twin-tyre according to EN 12600 or similar.

C.3.3 Test specimens

Test specimens should conform to the minimum specification of the product design or to the minimum specification manufactured in that production run. The specimen size according to EN 12600.

C.3.4 Procedure

The test specimen should be stored at least four hours at test temperature, preferably (23±5) °C. After placing a test specimen in the test rig the impactor will be raised to the drop height for the claimed performance of the specimen, and released.

C.4 Others

C.4.1 General

There is not yet a fully defined test method for determining the tenacity of the interlayer or the adhesion of the interlayer.

The following are reference to articles on this subject:

C.4.2 Compressive shear test (see bibliography [5] and [6])

Compressive shear adhesion is a measure of the bond strength between the interlayer and the glass. The laminate bond strength must be controlled to avoid problems of de-lamination at low adhesion and impact failure at high adhesion.

C.4.3 Pummel test (see bibliography [7] and [8])

Pummel adhesion is a measure of the bond strength between the interlayer and the glass. The laminate bond strength must be controlled to avoid problems of de-lamination at low adhesion and impact failure at high adhesion

C.4.4 Tenacity and adhesion test for determination of link between product and impact performance, i.e. EN 356, EN 12600. (see bibliography [9])

The performance of a laminated glass under impact, i.e. EN 356, EN 12600, is influenced by the adhesion and tenacity of the interlayer. Adhesion is related to the inherent properties of the folio interlayer and the processing parameters. Tenacity is a basic characteristic of the folio interlayer. This method allows a manufacturer to determine the appropriate parameters that will ensure the product performance is maintained.

Annex D
(informative)

Criteria for deciding if a change within an assembly requires a new initial type test

D.1 General

5.2.3 discusses the requirement for initial type testing the characteristics of the laminated glass and laminated safety glass. The general rules for initial type testing are given in 5.2.1 [4)] .

However, there will be circumstances when due to changes in the material design, e.g. change of components, changes in thickness, alteration of the stacking order, etc., that the 'new' design is outside the product description/product families and will require being a new initial type test. Table D.1 offers advice as to those alterations that require consideration of a new initial type test. The advice in Table D.1 relates to specific intended uses/characteristics.

4) 5.2.1 details the use of generally accepted values, calculated values etc., that should be considered before undertaking any actual testing.

Table D.1 - Requirements for new initial type testing

Intended use / Characteristic	Alterations to material design that are outside product description/product families					
	Glass			Interlayer		Stacking order
	Composition	Float, patterned, coated, thermally treated, etc.	Thickness	Type	Thickness	
Resistance to fire	YES	YES	YES	YES	YES	YES
Reaction to fire		YES		YES	YES	
External fire behaviour	YES		YES	YES	YES	YES
Bullet resistance	YES	YES	YES	YES	YES	YES
Explosion resistance	YES	YES	YES	YES	YES	YES
Burglar resistance	YES	YES	YES	YES	YES	YES
Pendulum impact	YES	YES	YES	YES	YES	YES
Resistance to T change	YES		YES			
Resistange to wind etc.		YES	YES			YES
Sound reduction			YES	YES	YES	YES
Thermal properties		YES				
Light transmittance	YES	YES	YES	YES	YES	YES
Solar energy	YES	YES	YES	YES	YES	YES

Annex E
(informative)

Provisions for voluntary involvement of third party(ies)

E.1 General

A manufacturer may employ third party(ies) for conformity assessment, which may involve a combination of initial type testing, inspection of factory production control, continuous surveillance and auditing of the product. The results of the conformity assessment by the bodies acting for regulators may be used by third party(ies) in carrying out their assigned tasks.

E.2 Voluntary tasks for third parties

A third party may be voluntarily contracted to perform the initial type testing, inspection of factory production control, continuous surveillance and auditing of the product.

Where a third party is voluntarily involved in the evaluation of conformity of the laminated glass and laminated safety glass products covered by this European Standard then the assessment should be in accordance with Clause 5, Evaluation of Conformity in this European Standard.

A manufacturer may also voluntarily involve a third party in the control of characteristics, e.g. visual aspects, colour, etc., that are over and above the characteristics required for regulatory purposes.

E.3 Marking and labelling

The format of the label and position should be agreed between the body involved and the manufacturer.

All marks and/or labels of a voluntary nature should be so affixed as not to be confused with those marks and/or labels that are required for regulatory purposes.

In order to prevent confusion with any regulatory marking and/or labelling then any marking and/or labelling associated with the involvement of third party(ies) on a voluntary basis should be accompanied with the following warning: "This marking/labelling has no relationship with any product characteristic covered by any legal marking and/or labelling".

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under a mandate M/135 “Flat glass, profiled glass and glass block products” given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European standard shown in this Annex meet the requirements of mandate M/135 given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the laminated and laminated safety glass product characteristics covered by this annex for the intended uses herein; reference shall be made to the information accompanying the CE marking.

WARNING: Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to the laminated and laminated safety glass falling within the scope of this European Standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this Standard, there may be other requirements applicable to products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (CREATE, accessed through http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm).

This annex has the same scope as Clause 1 of this standard with regard to the products covered. It establishes the conditions for the CE marking of laminated and laminated safety glass intended for the use indicated below and shows the relevant clauses applicable (see Table ZA.1).

Construction Product: Laminated glass and laminated safety glass

Intended uses: In buildings and construction works

The requirement on a certain characteristic is not applicable in those Member States where there are no regulatory requirements on that characteristic for the intended end use of the product. In this case, manufacturers placing their products on the market of these Member States are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

Table ZA.1 – Relevant clauses for laminated glass and/or laminated safety glass and intended use in buildings and construction works

Product: Laminated glass or laminated safety glass as covered under the scope of this standard Intended use: In buildings and construction works			
Essential Characteristics	Requirements in this and other European Standard(s)	Mandated Levels and/or classes	Notes
Safety in the case of fire –			
Resistance to fire (for glass for use in a glazed assembly intended specifically for fire resistance)	4.2, 4.3.1 and 4.3.2.1	All	Minutes
Reaction to fire	4.2, 4.3.1 and 4.3.2.2	Any	Euroclasses
External fire performance (for roof coverings only)	4.2, 4.3.1 and 4.3.2.3	Any	Euroclasses
Safety in Use –			
Bullet resistance: Shatter properties and resistance to attack	4.2, 4.3.1 and 4.3.2.4	-	Classes of convenience
Explosion resistance: Impact behaviour and resistance to attack	4.2, 4.3.1 and 4.3.2.5	-	Classes of convenience
Burglar resistance: Shatter properties and resistance to attack	4.2, 4.3.1 and 4.3.2.6	-	Classes of convenience
Pendulum body impact resistance: Shatter properties(safe breakability) and resistance to impact	4.2, 4.3.1 and 4.3.2.7	-	Classes of convenience
Mechanical resistance: Resistance against sudden temperature changes and temperature differentials	4.2, 4.3.1 and 4.3.2.8	-	K and/or °C
Mechanical resistance: Resistance against wind, snow, permanent and imposed load and/or imposed loads of the glass unit	4.2, 4.3.1 and 4.3.2.9	-	mm
Protection against noise:-Direct airborne sound reduction	4.2, 4.3.1 and 4.3.2.10	-	dB

Energy conservation and heat retention: –			
Thermal properties	4.2, 4.3.1 and 4.3.2.11	-	W/(m².K)
Radiation properties:			
- light transmittance and reflectance	4.2, 4.3.1 and 4.3.2.12	-	Fractions or %
- solar energy characteristics	4.2, 4.3.1 and 4.3.2.13	-	Fractions or %

ZA.2 Procedure(s) for the attestation of conformity of laminated glass and laminated safety glass products

ZA.2.1 System(s) of attestation of conformity

The systems of conformity for laminated and laminated safety glass indicated in Table ZA.1, are in accordance with the Decision of the Commission 2000/245/EC of 2000-02-02 as amended by 01/596/EC and as given in Annex III of the mandate for “Flat glass, profiled glass and glass block products”, is shown in Table ZA.2 for the indicated intended use(s) and relevant level(s) or classes:

Table ZA.2 – System(s) of attestation of conformity

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Laminated and laminated safety glass	For used in a glazed assembly intended specifically to provide fire resistance	Any	1
	For uses subject to reaction to fire regulations	Euroclasses A1, A2, B, C, D, E --- Euroclasses A1*, F	3 --- 4
	For uses subject to external fire performance regulations	products requiring testing --- products "deemed to satisfy" without testing	3 --- 4
	For use as anti-bullet, or anti-explosion glazing --- For other uses liable to present "safety-in-use" risks and subject to such regulations	- --- -	1 --- 3
	For uses relating to energy conservation and/or noise reduction	-	3
	For uses other than those specified above	-	4

System 1: see Directive 89/106/EEC (CPD) Annex III.2.(i), without audit-testing of samples.

System 3: see Directive 89/106/EEC (CPD) Annex III.2.(ii), Second possibility.

System 4: see Directive 89/106/EEC (CPD) Annex III.2.(ii), Third possibility

***** Products/materials that do not require to be tested for reaction to fire (e. g. Products/materials of Classes A1 according to Commission Decision 96/603/EC, as amended 2000/605/EC)

The attestation of conformity of the laminated glass and laminated safety glass in Tables ZA.1 shall be based on the evaluation of conformity procedures indicated in Tables ZA.3.1 to ZA.3.3 resulting from the application of the clauses of this or other European Standard indicated therein.

Where more than one table applies for the product, i.e. because its intended use makes different characteristics relevant, Table ZA.3.1 has to be read in conjunction with subsequent tables in order to determine which characteristics assigned by the manufacturer in Table ZA.3.1 are type tested by a notified test lab (system 3) and which by the manufacturer (system 4).

Table ZA.3.1 – Assignment of evaluation of conformity tasks for laminated glass and laminated safety glass under system 1

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the manufacturer	Factory production control (F.P.C.)	Parameters related to all relevant characteristics of Table ZA.1	5.3
	Further testing of samples taken at factory	All relevant characteristics of table ZA.1	Annex A
	Initial type testing	All relevant characteristics of Table ZA.1, except: Resistance to fire, Anti-bullet Anti-explosion	5.2
Tasks for the notified body	Initial type testing	Resistance to fire, Anti-bullet Anti-explosion	5.2
	Initial inspection of factory and F.P.C.	Parameters related to all the characteristics of Table ZA.1 relevant for the intended uses, in particular: Resistance to fire Anti-bullet Anti-explosion	5.4
	Continuous surveillance, assessment and approval of F.P.C.	Parameters related to all relevant characteristics of Table ZA.1, in particular: Resistance to fire Anti-bullet Anti-explosion	5.5

Table ZA.3.2 – Assignment of evaluation of conformity tasks for laminated glass and laminated safety glass under system 3

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the manufacturer	Factory production control (F.P.C.)	Parameters related to all relevant characteristics of Table ZA.1	5.3
	Initial type testing	All other relevant characteristics of Table ZA.1 other than those shown below	5.2
Tasks for the notified body	Initial type testing	Reaction to fire (Classes A1, A2, B, C, D, E) External fire performance Burglar resistance Pendulum body impact resistance Direct airborne sound insulation Thermal properties Radiation properties: – light transmittance and reflection – solar energy characteristics	5.2

Table ZA.3.3 – Assignment of evaluation of conformity tasks for laminated glass and laminated safety glass under system 4

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the manufacturer	Factory production control (F.P.C.)	Parameters related to all relevant characteristics of Table ZA.1	5.3
	Initial type testing	All relevant characteristics of Table ZA.1, i.e. Reaction to fire (Classes A1*, F) External fire performance	5.2

ZA.2.2 EC Certificate and Declaration of conformity

In case of products with system 1: When compliance with the conditions of this Annex is achieved, the certification body shall draw up a certificate of conformity (EC Certificate of conformity), which entitles the manufacturer to affix the CE marking. This certificate shall include:

– name, address and identification number of the certification body;

– name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

– description of the product (type, identification, use, …),

– provisions to which the product conforms (i.e. Annex ZA of this standard)

– particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

– the number of the certificate;

– conditions and period of validity of the certificate, where applicable;

– name of, and position held by, the person empowered to sign the certificate.

In addition, the manufacturer shall draw up a declaration of conformity (EC Declaration of conformity) including the following:

- name and address of the manufacturer, or his authorised representative established in the EEA;

- name and address of the certification body;

- description of the product (type, identification, use, ...), and a copy of the information accompanying the CE marking;

- provisions to which the product conforms (i.e. Annex ZA of this standard);

- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

- number of the accompanying EC Certificate of conformity;

- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

In case of products under system 3: When compliance with the conditions of this Annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

- name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

- description of the product (type, identification, use,...), and a copy of the information accompanying the CE marking;

- provisions to which the product conforms (i.e. Annex ZA of this standard)

- particular conditions applicable to the use of the product, (e.g. provisions for use under certain conditions, etc);

- name and address of the notified laboratory(ies);

- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

In case of products under system 4: When compliance with this Annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

- name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

- description of the product (type, identification, use,...), and a copy of the information accompanying the CE marking;

- provisions to which the product conforms (i.e. Annex ZA of this standard);

- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

NOTE Duplication of information between the declaration and certificate shall be avoided. To avoid duplication of information, cross-reference between documents may be made when one contains more information than the other.

The above mentioned declaration and certificate shall be presented in the official language or languages of the Member State in which the product is to be used.

ZA.3 CE marking and labelling

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the laminated and laminated safety glass (or when not possible it may be on the accompanying label, the packaging or on the accompanying commercial documents e.g. a delivery note). The following information shall accompany the CE marking symbol:

- identification number of the certification body (only for products under systems 1);

- name or identifying mark and registered address of the producer;

- the last two digits of the year in which the marking is affixed;

- number of the EC Certificate of conformity or factory production control certificate (if relevant);

- reference to this European Standard;

- description of the product: generic name, material, dimensions, … and intended use;

- information on those relevant essential characteristics listed in Table ZA.1 which are to be declared presented as:

- declared values and, where relevant, level or class (including “pass” for pass/fail requirements, where necessary) to declare for each essential characteristic as indicated in "Notes" in Table ZA.1;

- as an alternative, standard designation(s) alone or in combination with declared values as above, and;

- “No performance determined” for characteristics where this is relevant.

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of the information to be given on the product, label, packaging and/or commercial documents.

CE	*CE conformity marking, consisting of the "CE"-symbol given in directive 93/68/EEC.*
AnyCo Ltd, PO Box 21, B-1050	*Name or identifying mark and registered address of the producer*
05	*Last two digits of the year in which the marking was affixed*
EN 14449	*No. of European standard*
Laminated glass, intended to be used in buildings and construction works	*Description of product*
Characteristics	*And*
	information on regulated characteristics
Resistance to fire **NPD**	
Reaction to fire **B**	
External fire performance **NPD**	
Bullet resistance **NPD**	
Explosion resistance **NPD**	
Burglar resistance **NPD**	
Pendulum body impact resistance **NPD**	
Resistance against sudden temperature changes and temperature differentials **40K**	
Wind, snow, permanent and imposed load resistance **7,0 mm**	
Direct airborne sound insulation **32 –1 -3 dB**	

Thermal properties	**5,6 W/(m^2·K)**
Radiation properties:	
- **light transmission and reflection**	**0,70/0,13**
- **solar energy characteristics**	**0,55/0,11**

Figure ZA.1 - Example CE marking information (Laminated glass) for system 3

CE 01234	*CE conformity marking, consisting of the* *"CE"-symbol given in directive 93/68/EEC.* *Identification number of the certification body (where relevant)*
AnyCo Ltd, PO Box 21, B-1050	*Name or identifying mark and registered address of the producer*
05	*Last two digits of the year in which the marking was affixed*
01234-CPD-00234	*Certificate number (where relevant)*
EN 14449	*No. of European standard*
Laminated safety glass, intended to be used in buildings and construction works	*Description of product* *and* *information on regulated characteristics*
Characteristics	
Resistance to fire	**E30**
Reaction to fire	**B**
External fire performance	**NPD**
Bullet resistance	**NPD**
Explosion resistance	**NPD**
Burglar resistance	**NPD**
Pendulum body impact resistance	**2(B)2**
Resistance against sudden temperature changes and temperature differentials	**40K**
Wind, snow, permanent and imposed load resistance	**10 mm**

Direct airborne sound insulation	**34 -1 -3 dB**
Thermal properties	**5,5 W/(m^2·K)**
Radiation properties:	
- **light transmission and reflection**	**0,70/0,13**
- **solar energy characteristics**	**0,55/0,11**

In addition to any specific information relating to dangerous substances shown above, the product shall also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE European legislation without national derogations need not be mentioned.

Figure ZA.2 - Example CE marking information (Laminated safety glass) for system 1

Bibliography

[1] EN 357, *Glass in Building - Fire resistant glazed elements with transparent or translucent glass products – Classification of fire resistance*

[2] EN 1096-4, *Glass in building – Coated glass – Part 4 Evaluation of conformity/Product standard*

[3] EN 1288-3, *Glass in building - Determination of bending strength of glass - Part 3: Test with specimen supported at two points (four point bending)*

[4] prEN 13474 (all parts), *Glass in building – Design of glass panes*

[5] EN ISO 9001, *Quality management systems - Requirements (ISO 9001:2000)*

[6] Solutia; Louvain-la-Neuve Applications Laboratory: Test procedure - Compressive Shear Adhesion

[7] HT Troplast AG; Troisdorf : 6c.- Compressive shear test

[8] Solutia; Louvain-la-Neuve Applications Laboratory: Test procedure - Pummel Adhesion

[9] HT Troplast AG; Troisdorf: Pummeltest fű r Verbundsicherheitsglas

[10] Saint-Gobain Glass; Tenacity and adhesion test for determination of link between product and impact performance, i.e. EN 356, EN 12600.

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