BS EN 13022-2:2014

BSI Standards Publication

Glass in building — Structural sealant glazing

Part 2: Assembly rules

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National foreword

This British Standard is the UK implementation of EN 13022-2:2014. It supersedes BS EN 13022-2:2006+A1:2010 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/520/4, Properties and glazing methods.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 13022-2:2014) has been prepared by Technical Committee CEN/TC 129 “Glass in building”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by December 2014 and conflicting national standards shall be withdrawn at the latest by December 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13022-2:2006+A1:2010.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This part of EN 13022 is one of a series of interrelated standard parts dealing with:

— glass products for structural sealant glazing systems;

— installation of glass products in a structural manner on building façades;

— UV-resistant and structural sealant for use in structural sealant glazing.

The interrelated parts are:

— EN 13022-1: *Glass in building — Structural sealant glazing — Part 1: Glass products for structural sealant glazing systems for supported and unsupported monolithic and multiple glazing*

— EN 13022-2: *Glass in building — Structural sealant glazing — Part 2: Assembly rules*

— EN 15434: *Glass in building — Product standard for structural and/or ultra-violet resistant sealant (for use with structural sealant glazing and/or insulating glass units with exposed seals)*

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

1 Scope

This European Standard deals with the assembling and bonding of glass elements in a frame, window, door or curtain walling construction, or directly into the building by means of structural bonding of the glass element into or onto framework or directly into the building.

It gives information to the assembler to enable him to organize his work and comply with requirements regarding quality control.

Structural sealant glazing can be incorporated into the façades (curtain walls, doors and windows) or roofs as follows:

— either vertically; or

— up to 7° from the horizontal, i.e. 83° from the vertical.

This European Standard only deals with the bonding to glass surfaces, i.e. coated or uncoated or enamelled, and metallic surfaces, i.e. aluminium (anodised or coated), stainless steel, as considered in G.2 of EN 15434:2006+A1:2010.

2 Normative references

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

EN 13022-1:2014, *Glass in building — Structural sealant glazing — Part 1: Glass products for structural sealant glazing systems for supported and unsupported monolithic and multiple glazing*

EN 15434:2006+A1:2010, *Glass in building — Product standard for structural and/or ultra-violet resistant sealant (for use with structural sealant glazing and/or insulating glass units with exposed seals)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13022-1:2014, EN 15434:2006+A1:2010 and the following apply.

3.1
structural bonding
assembling of glass elements into or onto window, door or curtain walling framework by means of a structural seal

3.2
structural sealant
elastic sealant used for making a structural seal

4 Requirements

The assembling of the glass elements into or onto the window, door or curtain-walling framework or directly in the building or construction shall take place under the following controlled environmental conditions:

— temperature of the surface of the frame and of the glass and of the near environment shall be not less than 10 °C and not more than 35 °C;

— for a given temperature, the RH value shall be at least 5 % below the value corresponding to the dew point of the support to which the seal is being applied;

— environment in the vicinity of the assembling shall be dust free;

— glass elements are securely fixed until the full curing of the sealant has taken place.

It shall be ensured that the work is executed as foreseen by the design, so that in particular:

— curing of the various seals proceeds as foreseen by the design;

— after curing, the characteristic performances including durability are deemed to satisfy the design requirements.

NOTE For design guidance, refer to Annex B.

5 Assembling/bonding

The assembling manual shall be used for instruction of both the assembling and control and will be a part of the assembling control documentation.

The assembling manual shall make reference to the design of the work and detail the assembling procedures, in particular what is related to:

— list of characteristics claimed by the designer;

— component materials and products, and when appropriate trade name, generic type, marking and labelling;

— cleaning and preparation materials, trade name, generic type, marking and labelling;

— installations, equipment and tools for transport, storage, cleaning, use of primers, other preparation work of bonding surfaces, mixing sealant components, extrusion of sealant;

— cleaning process of the seal bonding surfaces;

— where applicable, process for use of primers;

— positioning of glass and framework before extrusion of sealant, inclusive the application of glazing blocks (see EN 13022-1), anti-adhesive film and backer rod;

— extrusion of sealant;

— waiting time to obtain initial cure and transport and storage conditions just after initial cure;

— waiting time to obtain further curing and final installation in the work;

— finishing processes such as removing temporarily fixing means and application of weather seals;

— information concerning the compatibility of various materials and components.

The assembling manual shall also contain control and testing requirements and conditions, which may be by full description or by reference to this European Standard.

The designer should specify that:

— sealant conforms to EN 15434 or has an ETA[1)] with the type of substrate used;

1) ETA: European Technical Agreement.

— glass products conform to the relevant product standard taking into account EN 13022-1.

For more details, refer to Annex A.

6 Assembling/bonding control

6.1 Assembling/bonding control requirements

6.1.1 General

An assembler operating under a (when required third party surveillance) Quality Assurance System according to EN ISO 9001:2008, in which the quality procedures refer to 6.2 of this European Standard, has the benefit of presumption to comply with this European Standard. If not, the following sub-clauses shall be applied.

6.1.2 Organization

6.1.2.1 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 need the organisational freedom and authority to:

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

b) identify and record any assembling conformity problems.

6.1.2.2 Management representative for assembling 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.

6.1.2.3 Management review

The assembling control system shall be reviewed at appropriate intervals by the manufacturer's management to ensure its continuing suitability and effectiveness. Records of such reviews shall be maintained.

6.1.3 Assembling – quality system

6.1.3.1 General

The manufacturer shall establish and maintain a documented system as a means of ensuring that the assembling conforms to this European Standard. The following requirements hereafter shall be fulfilled.

6.1.3.2 Personnel

The manufacturer shall appoint personnel for the inspections and assembling control tests that will be carried out before (e.g. incoming materials), during and after assembling.

6.1.3.3 Documentation

The manufacturer's documentation and procedures shall be relevant to the assembling and assembling control, and shall adequately describe in a manual:

a) aims and organizational structure, responsibilities and authorities of the management with regard to assembling/bonding conformity;

b) procedures for specifying and verifying the incoming materials (see also the assembling manual);

c) manufacturing (see the assembling manual), production control and other techniques, processes and systematic actions that will be used;

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

6.1.3.4 Test equipment

Calibration of test equipment necessary for assembling control shall be documented.

6.1.3.5 Inspection and testing

6.2 designates the inspections and tests by means of tables. The requirements and records are normative. The test methods are recommended and therefore only given as information. The frequencies are also recommended and therefore given as information, except when otherwise designated.

If another testing scheme is used, or if no testing scheme as described in the annexes is applicable, the testing scheme shall be described in detail in the quality manual.

Annexes A, C, D and E and 5.2 and 5.3 of EN 15434:2006+A1:2010 describe the tests referred to in 6.2 as recommendations.

6.1.3.6 Quality contracts

Inspections and tests on incoming materials (the material control section of the tables in 6.2) can be reduced on the basis of quality contracts between the supplier and the designer, on condition that the contract refers to the appropriate tables in 6.2.

Quality contracts shall include the possibility of an audit of the supplier.

Where contractually requested, quality records shall be made available by suppliers for evaluation by the customer's representative for an agreed period.

6.2 Inspection and testing tables for assembling glass elements into or onto framework with structural sealant

The tables consist of three sections:

— Section 1: Material control;

— Section 2: Assembling control;

— Section 3: Final control.

The tables do not pretend to be exhaustive. The designer or the assembler can complete them. The tables can require something that is inexistent in some design. In such a case, the inspection or test row shall be ignored.

When an assembling process is such that one or more of the listed inspections or tests are not applicable or physically not possible, the concerned inspection or test shall be ignored and an alternative shall be determined.

The inspections and/or tests on incoming materials and component products shall be carried as soon as possible. In case of non-conforming materials, action shall be taken that non-conforming assembling will not be performed.

The required records in the tables hereafter can be any document such as order documents, production documents, logbook, etc. as described in the quality procedures and associated documentation. However, records shall not indicate delivery or batch identification. When no record required, it is only valid if there is no negative result. In the case of a negative result, record shall always be made.

Adjustments of machinery and equipment used for assembling are periodically checked against defined parameters for optimal result.

The assembler shall fulfil the requirements of the Clause 4 of this European Standard.

Table 1 — Inspection and test table for structural assembling in accordance with this European Standard

Ref.	Material, inspection or test	Recommended method (decision to be made by assembler)	Normative requirement	Recommended frequency (decision to be made by designer or assembler)	Record normative
Section 1: Material control					
1.1	**Framework**				
1.1.1	packaging and label	Visual	See purchase specification	Each delivery	No
1.1.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.2	**Glass products**				
1.2.1	packaging and label	Visual	See purchase specification	Each delivery	No
1.2.2	identification (according to relevant standards)	Visual	See purchase specification	Each delivery	Yes
1.2.3	Dimensions	Measurement	See purchase specification	Each package and thickness	No
1.3	**Structural sealant**				
1.3.1	Packaging, label and quality control report of the sealant supplier	Visual	See purchase specification	Each delivery	No
1.3.2	shelf life	Visual	Suppliers' specification	Each delivery	Yes
1.3.3	**Convenience test** adhesion test when no delivery information [a] on the sealant from the sealant supplier available shall be carried out together)	Annex A and Annex C Peel test only accepted	Annex A Rupture 100 % cohesive failure	Each delivery of sealant, glass or framework [b]	Yes
1.4	**Bond breaker material**				
1.4.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.4.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.5	**Spacer material**				
1.5.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.5.2	Identification	Visual	See purchase specification	Each delivery	Yes

Ref.	Material, inspection or test	Recommended method (decision to be made by assembler)	Normative requirement	Recommended frequency (decision to be made by designer or assembler)	Record normative
1.6	**Weather sealant**				
1.6.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.6.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.7	**Finishing material**				
1.7.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.7.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.8	**Retaining devices**				
1.8.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.8.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.9	**Retaining clips**				
1.9.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.9.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.10	**Cleaning products**				
1.10.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.10.2	Identification	Visual	See purchase specification	Each delivery	Yes
1.11	**Primer**				
1.11.1	packaging and labelling	Visual	See purchase specification	Each delivery	No
1.11.2	Identification	Visual	See purchase specification	Each delivery	Yes

Ref.	Material, inspection or test	Recommended method (decision to be made by assembler)	Normative requirement	Recommended frequency (decision to be made by designer or assembler)	Record normative
Section 2: Assembling control					
2.0	**Control of the temperature and RH of the location**				
2.0.1	Temperature and RH	Measurement	Clause 4	Every day	Yes
2.1	**Component preparation**				
2.1.1	dry and clean framework surface	Visual	No visible contamination	Continually	No
2.1.2	dry and clean glass surface	Visual	No visible contamination	Continually	No
2.2	**Structural sealant application**				
2.2.1	preparation (including application primer) and positioning glass elements and/or framework	Visual	Assembling manual	Continually	No
2.2.2	extrusion of structural sealant and application retaining clips	Visual	Assembling manual	Continually	No
2.2.3	storage after initial cure	Visual	Assembling manual	Continually	No
2.2.4	installation on building with retaining devices (if relevant)	Visual	Assembling manual	Continually	No
2.2.5	finishing work	Visual	Assembling manual	Continually	No
2.2.6	application weather sealant (if relevant)	Visual	Assembling manual	Continually	No
2.3	**Structural sealant**				
2.3.1	Adhesion on relevant substrates	Annex C C.3 Method 1	Annex C	(2 × per working day): 2 specimens	Yes
2.3.2	mixing ratio	See equipment and sealant specifications	See sealant specification	See assembling control manual	Yes
2.3.3	thoroughness of mixing	Mixing check (Annex D)	No marbling	Each working day: 1	Yes

Ref.	Material, inspection or test	Recommended method (decision to be made by assembler)	Normative requirement	Recommended frequency (decision to be made by designer or assembler)	Record normative
2.3.4	air inclusions (during 2.3.3 thoroughness of mixing)	Visual	No air inclusions	Together with 2.3.3	No
2.3.5	Hardness	Hardness test (Annex E)	See sealant specification	Each working day: 2 specimens	Yes
2.3.6	Pot life	[Text to be sent by TP]	See sealant specification	Each working day: 2 specimens	No
2.3.7	Contamination	Visual	See purchase specification	Each drum	No
Section 3: Final assembling control					
3	**Final assembling**				
3.1	where applicable, storage conditions	Visual	See assembling control manual	Once per shift	No
3.2	dimensions and positioning structural seal	Measurement	See design specification	See designers specification	Yes
3.3	control of the visible surface of the sealant	Visual	See design specification	See designers specification	Yes
3.4	positioning glass element versus framework	Measurement	See design specification	See designers specification	Yes
3.5	positioning of the retainer devices if relevant	Measurement	See design specification	See designers specification	Yes
3.6	application of weather seal if relevant	Measurement	See design specification	See designers specification	Yes
3.7	general aspect of window, door or curtain-walling	Visual	See design specification	Randomly five times per shift	No

[a] Results available 6 months maximum.

[b] One delivery of anodised aluminium: group of anodised aluminium profile in the same bath, at the same time for 1 working shift.
One delivery of coated aluminium is a production done from a same colour, same gloss, same finish, same powder, from a same supplier from a single coater.
One delivery of stainless steel: means one day production.

Annex A
(normative)

Dynamic tensile and peel test on structural sealant

A.1 Purpose

A.1.1 General

This annex gives possible methods to evaluate the constancy of the cohesive strength of the structural sealant and of the adherence to materials as defined in EN 15434:2006+A1:2010, Annex G. The description of the test methods given below is intended to help sealant suppliers as well as sealant users. Every effort has been made to keep these methods as simple as possible without detracting from the achievement of consistency of quality in the manufactured products.

Three levels are considered:

A.1.2 Project Test

Test performs on one sample representative of the surface tested according to EN 15434:2006+A1:2010, Annex G.

This test should be only be performed when the structural sealant manufacturer has not made available this information with the sealant shipped to the purchaser

A.1.3 Convenience test

Test performs according to 6.2, Table 1 – Section Material control – line 1.3.3

This test should be only be performed when the structural sealant manufacturer has not made available this information with the sealant shipped to the purchaser

A.1.4 Factory production control test

Test performs according to 6.2, Table 1 – Section Assembling control – line 2.3.1

A.2 Test specimens

A.2.1 Tensile test

Eight test standard specimens shall be prepared and cured in accordance with EN 15434:2006+A1:2010, 5.3.2, and following the sealant manufacturer's recommendations.

A.2.2 Peel test

Height test standard specimens shall be prepared and cured in accordance with C.3.1 of this European Standard and in accordance with the sealant’s manufacturer's recommendations.

A.3 Conditioning of test specimens

Condition the eight test standard specimens for the selected test (tensile or peel) and ensure that they conform to the selected alternative conditioning. The various conditioning requirements are described in more detail below:

a) initial, or room temperature conditioning:

3 test standard specimens, storage 7 d in air at (23 ± 2) °C and (50 ± 5) % relative humidity in accordance with EN ISO 8339 and one hour in water at (23 ± 2) °C;

b) high temperature conditioning:

3 test standard specimens, storage in air 7 d at (100 ± 2) °C and (50 ± 5) % relative humidity subsequently conditioned in air for (24 ± 2) h at (23 ± 2) °C and (50 ± 5) % relative humidity;

c) water immersion and room temperature conditioning:

3 test standard specimens, 7 d immersion in water of (23 ± 2) °C, subsequently conditioned in air for (24 ± 2) h to (48 ± 2) h at (23 ± 2) °C and (50 ± 5) % relative humidity.

d) warm water immersion and room temperature conditioning:

3 test standard specimens, 7 d immersion in water of (23 ± 2) °C, subsequently seven days in immersion water of (55 ± 2) °C, subsequently conditioned in air for (48 ± 2) h at (23 ± 2) °C and (50 ± 5) % relative humidity.

Table A.1 — Level of control

Type of surface	**Project test**	**Convenience test**	**Assembling control**
Anodised aluminium	Conditioning d	Conditioning b and c	Conditioning a
Coated aluminium	Conditioning d	Conditioning c and d	Conditioning a

A.4 Test procedure

A.4.1 In the case of tensile test

All eight test specimens should be subject to tensile rupture with a separation speed of (5 ± 0,5) mm/min at a temperature of (23 ± 2) °C.

A.4.2 In the case of peel test

All eight test specimens should be subject to the peel test in accordance with C.3.3 of this European Standard.

A.5 Observation

After the four conditioning periods have been applied:

— type of breakage shall be 100 % cohesive;

— breaking values shall comply with the sealant manufacturer's declaration.

After the conditioning period: the minimum elongation value shall be ≥ 50 % and Ru_5 ≥ 0,50 MPa.

A.6 Report

The report should include:

— selected alternative possibility;

— pass or fail of each test specimen;

— designation and lot number of the sealant;

— information to identify the glass and framework;

— date of test;

— any deviation from the test described above.

Annex B
(informative)

Design guidance

B.1 Characteristics

Within the multitude of design aspects for windows, doors and curtain walling, the following characteristics should have particular attention:

— safety in the case of fire:

  — resistance to fire;

  — reaction to fire;

  — fire propagation;

  — external fire behaviour;

— health:

  — water tightness;

  — dangerous substances;

— safety in use:

  — bullet resistance;

  — explosion resistance;

  — burglar resistance;

  — pendulum body impact resistance;

  — resistance against sudden temperature changes and temperature differentials;

  — resistance against wind load, snow load, permanent load and/or imposed loads;

— direct airborne sound reduction;

— energy conservation and heat retention:

  — air tightness;

  — radiation properties;

  — thermal conductance;

For characteristics, requirements, tests and expression of results of windows, doors and curtain walling, refer to:

— EN 13830;

— EN 14351-1.

In relation to the product characteristics and testing requirements for the glass products, which may be assembled into and onto windows, door and curtain walling framework or directly installed in to the building construction with structural sealant, they should be produced, evaluated, marked and labelled in accordance with the product standards as listed in Table B.1.

In addition to the glass product standards, the requirements and conditions of EN 13022-1 should also be taken into consideration, during both the design and assembly of the glass products into or onto window, door and curtain walling framework.

Table B.1 — Glass product standards, which may be taken into account for assembling in structural works

EN 572-9:2004
EN 1096-4:2004
EN 1279-5:2005+A2:2010
EN 1748-1-2
EN 1748-2-2
EN 1863-2:2004
EN 12150-2:2004
EN 12337-2:2004
EN 14449:2005
EN 13024-2:2004
EN 14179-2:2005
EN 14178-2:2004
EN 14321-2:2005

For ensuring the relevant characteristics of the structural seal and bonding, structural sealant should comply with EN 15434 or with ETAG 002.

B.2 Characteristic details

B.2.1 General

As a useful guide, a number of intended use characteristics have been detailed below.

B.2.2 Safety in the case of fire – reaction to fire

Reaction to fire after assembling is ensured by selection of materials and components with appropriate classes of reaction to fire.

When an assembly is not tested, it could be classified with the same class as the component with the lowest performance classification.

B.2.3 Health – release of dangerous substances

Prevention of release of dangerous substances after assembling is ensured by selection of the appropriate materials and components.

NOTE An informative database of European and national provisions on dangerous substances is available at the Construction website on EUROPA, accessed through: http://ec.europa.eu/enterprise/sectors/construction/cpds/index_en.htm.

B.2.4 Safety in use

Resistance against actions from wind, snow and self-weight should be ensured by selection of an appropriate structural sealant. The selected structural sealant should be provided with:

— predetermined mechanical resistance, cohesive and adhesive, after curing. Refer to B.2.5.

— ability to maintain its mechanical resistance (durability) under:

  — solar radiation;

  — temperature and humidity variations or cycling;

  — environmental influences for example salt spray and SO_2;

    Refer to EN 15434:2006+A1:2010.

— ability to prevent mutual degradation of it and of the materials in contact, or in close environment of it (compatibility).

    Refer to EN 15434:2006+A1:2010.

B.2.5 Structural seal dimensions

B.2.5.1 Actions

For the determination of the action F refer to:

— EN 1991-1-1;

— EN 1991-1-3;

— EN 1991-1-4;

— EN 1991-1-5

and the related national application documents (NAD) or others national specifications.

If it is found that on the construction site a Eurocode part is not applicable, then the current (existing) method of determination of the action, valid for the construction site, should be used.

B.2.5.2 Mechanical resistance: characteristic ultimate limit state value, Calculation model

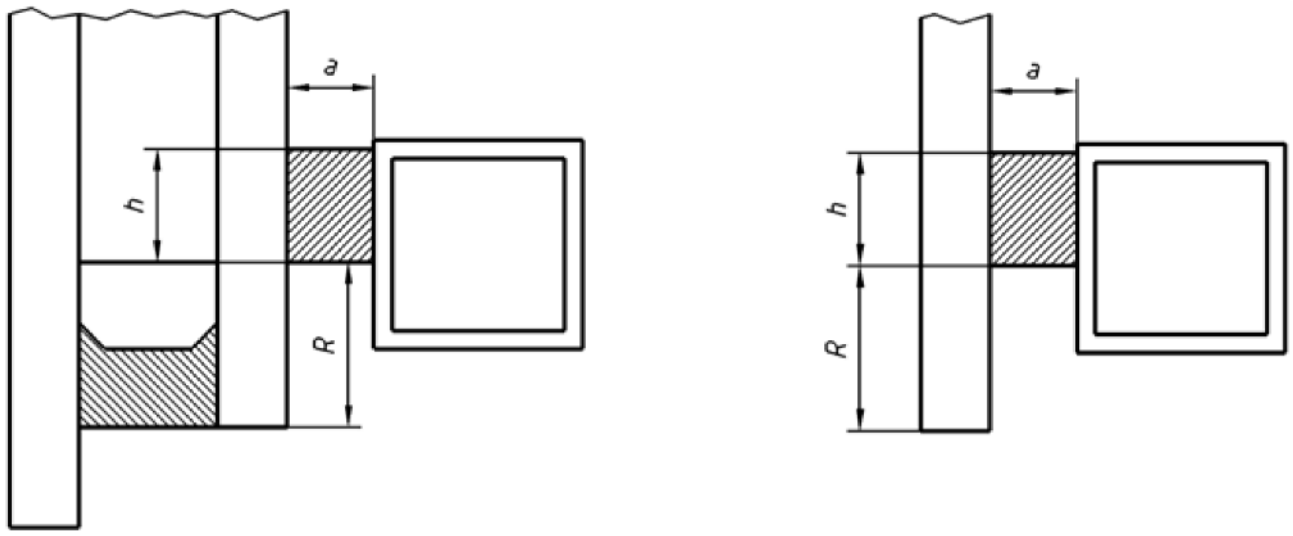
B.2.5.2.1 Numerical border conditions

Whatever the outcome of calculations, the following dimensional conditions of the structural seal should be respected (see Figure B.1 and Figure B.2):

— thickness e: minimal $e =$ 6 mm, maximal $e = h$;

— height h : $h \geq e$ with a minimum of 6 mm; and $h \leq 3e$ with a maximum of 20 mm for the mono component sealant;

— distance edge-bonding surface $R \leq 40$ mm.



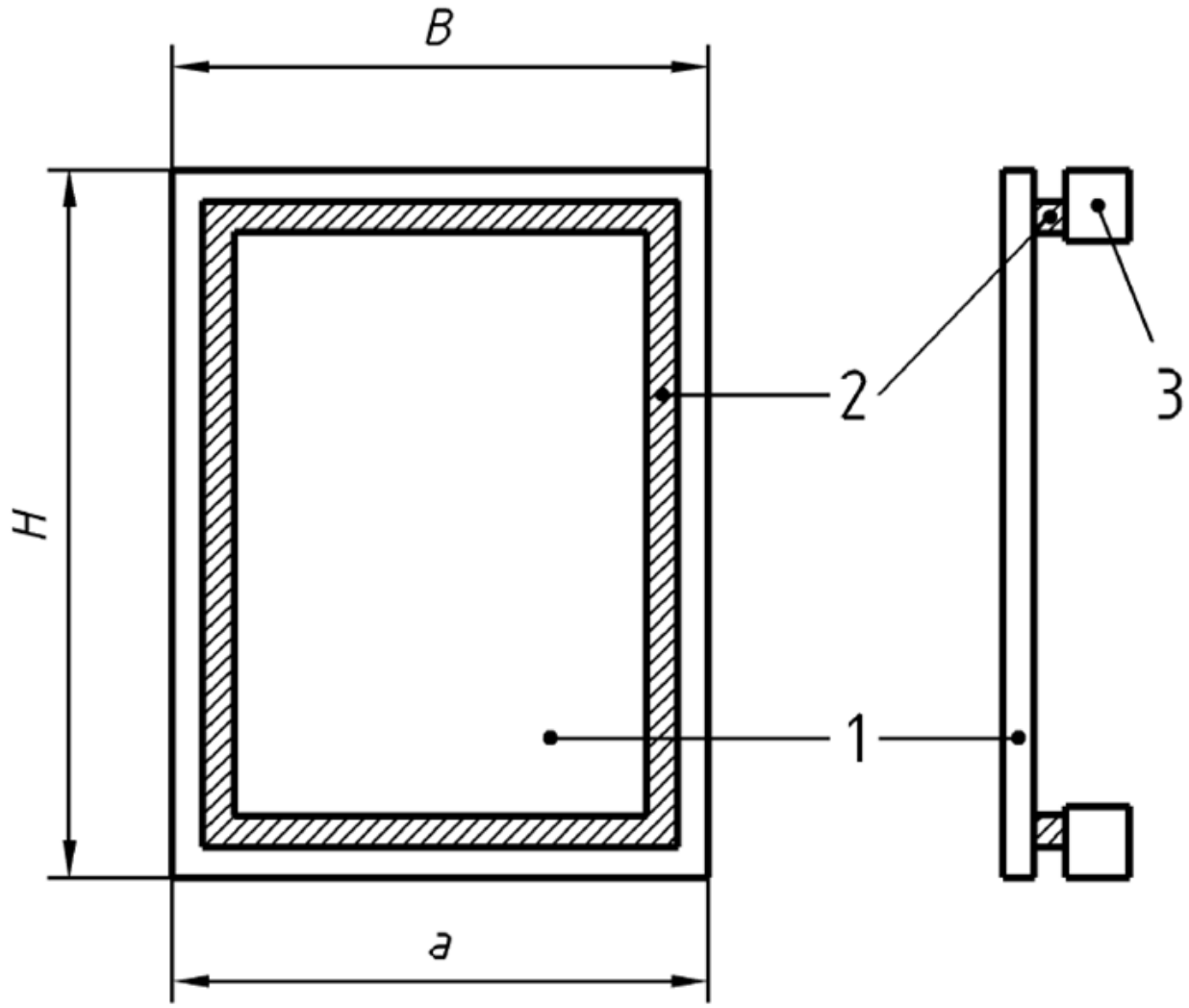
Key

e structural seal thickness

h structural seal height

R distance edge-bonding surface

Figure B.1 — Illustrative examples of the structural seal and its position to the glass edge



Key

1 glass element
2 structural seal
3 framework
B width or horizontal dimension of the glass element
H height or vertical dimension of the glass element
a smallest dimension (when $H < B$, $a = H$)

Figure B.2 — Structural element

B.2.5.2.2 Supported systems – Bite thickness e

The load in the plane of the glass surface, derived from temperature differences between glass element and framework, determines the bite thickness. The load generates shear stress in the structural seal. The maximum shear stress is considered to develop in the corners of the pane, and for a rectangular pane it can be calculated as:

$$f_{\text{shear;s}} = \frac{G\Delta_s}{e} \tag{B.1}$$

where

e is the bite thickness in mm;

G is the shear modulus;

Δ_s is the shear deformation in m and is calculated as:

$$\Delta_s = \left[\left(T_f - T_0 \right) \alpha_f - \left(T_g - T_0 \right) \alpha_g \right] \sqrt{\left(\frac{B}{2} \right)^2 + H^2} \quad \text{(B.2)}$$

where

B is the horizontal dimension of the glass element in m;

H is the vertical dimension of the glass element in m;

T_f is the temperature of the framework at moment t in K;

T_g is the temperature of the glass element at moment t in K;

T_0 is the temperature during extrusion of structural sealant in K;

α_f is the linear elongation coefficient of the framework in m/K;

α_g is the linear elongation coefficient of the glass element in m/K.

The selected thickness should ensure that:

$$f_{shear;s} \leq R_{shear,d} \quad \text{(B.3)}$$

where

$R_{shear,d}$ is the design stress value for structural sealant in shear; see B.2.5.2.6

B.2.5.2.3 Supported and unsupported systems – Bite height *h*

The loads perpendicular to the glass surface, derived from wind loads, snow loads, densities, self-weight and impacts, determine the bite height. These loads generate tensile/compression stresses in the structural seal. The maximum tensile stress is considered to develop at the centre of the longest side of the pane, and can be calculated as:

$$f_{tensile} = \frac{aF}{2h} \quad \text{(B.4)}$$

where

h is the bite height in m;

a is the smallest edge of a rectangular pane in m;

F is the load to be taken into consideration in N in accordance with B.2.5.1.

The selected bite height should ensure that:

$$f_{\text{tensile}} \leq R_{\text{tensile,d}} \tag{B.5}$$

where

$R_{\text{tensile,d}}$ is the design stress value for structural sealant in tension; see B.2.5.2.6.

B.2.5.2.4 Unsupported systems – Permanent shear load – Height *h*

The permanent load in the plane of the glass surface, derived from the self-weight of the glass element determines the bite height. This type of load generates permanent shear stress in the structural seal. The maximum permanent shear stress is considered to develop r along the vertical structural seals, and for a rectangular pane it can be calculated as:

$$f_{\text{perm.shear;u}} = \frac{P}{2hH} \tag{B.6}$$

where

h is the bite height;

H is the vertical edge of a rectangular pane;

P is the self weight of the glass element.

The selected height should ensure that:

$$f_{\text{perm.shear;u}} \leq \Gamma_{\infty} \tag{B.7}$$

where

$\Gamma_{\infty} = R_{\text{shear,d}} / \gamma_{\text{C}}$ is the declared permanent shear design stress, with $\gamma_{\text{C}} \geq 10$.

B.2.5.2.5 Unsupported systems – Permanent shear load - Thickness *e*

The load in the plane of the glass surface, derived from temperature differences between glass element and framework, determines the bite thickness. The load generates shear stress in the structural seal. The maximum shear stress is considered to develop in the corners of the pane, and for a rectangular pane it can be calculated as:

$$f_{\text{shear;u}} = \frac{G\Delta_{\text{u}}}{e} \tag{B.8}$$

where

e is the bite thickness in mm;

G is the shear modulus;

Δ_{u} is the shear deformation and is calculated as:

$$\Delta_u = \left\{\left(T_f - T_0\right)\alpha_f - \left(T_g - T_0\right)\alpha_g\right\}\sqrt{\left(\frac{B}{2}\right)^2 + \left(\frac{H}{2}\right)^2} \quad \text{(B.9)}$$

where

B is the horizontal dimension of the glass element in m;

H is the vertical dimension of the glass element in m;

T_f is the temperature of the framework at moment t in K;

T_g is the temperature of the glass element at moment t in K;

T_0 is the temperature during extrusion of structural sealant in K;

α_f is the linear elongation coefficient of the framework;

α_g is the linear elongation coefficient of the glass element.

The selected thickness should ensure that:

$$f_{\text{shear;u}} \leq R_{\text{shear,d}} \quad \text{(B.10)}$$

where

$R_{\text{shear,d}}$ is the design value for structural sealant in tension; see B.2.5.2.6.

B.2.5.2.6 Design value

The requirement for ultimate limit state is:

$$E_{\text{ULS,d}} \leq R_d \quad \text{(B.11)}$$

where

$E_{\text{ULS,d}}$ is the design value of the effect of the action(s), expressed as calculated stress, caused by the action(s);

R_d is the design value of the corresponding resistance, expressed as maximum ultimate limit state allowable stress $R_{\text{shear,d}}$ or $R_{\text{tensile,d}}$, taking into account the material partial factor for the ultimate limit state γ_M.

The recommended value is γ_M = 2,5.

The values of the material partial factor for structural sealant to be used on the territory of [Member State] are:

Member State	γ_M

When not filled in, the recommended values of γ_M = 2,5 shall be used.

The proposal way is based on an exploitation of the tensile or shear test at 23 °C.

Perform the tension or shear test with 10 pieces (minimum recommended) and with glass and metal support conditioned (24 ± 4) h at 23 °C according to EN 15434.

The stress at elongation 5 %, 10 %, 15 %, 20 %, and 25 % shall be noted.

The stress and elongation at rupture shall be noted.

B.2.5.2.7 Determination of σ_{des}

B.2.5.2.7.1 First step

Determine the point of reference (σ_{el0} , ε_{el0}).

The reference point is shown on the graph below:

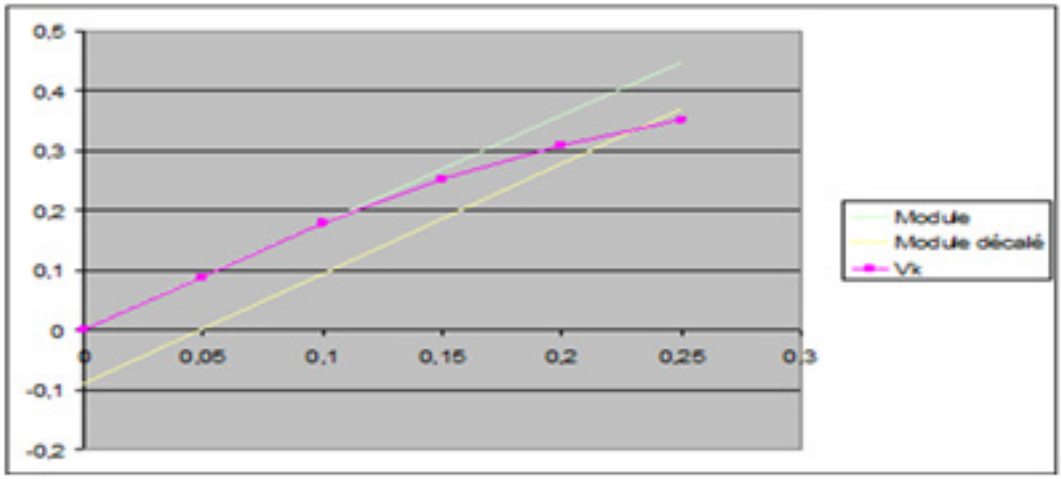


Figure B.3 — Reference point determination

Draw the characteristic curve with the result of tensile test at 23 °C.

Find the tangent linear with a regression coefficient R_2 > 0,99.

Drawn the parallel linear crossing the point (σ_{el} = 0, ε_{el} = 5 %).

Find the intersection between the parallel curve and the characteristic curve.

B.2.5.2.7.2 Second step: check the safety with the rupture and elongation

Verify

$$\frac{\sigma_{el0}}{\sigma_{rup}} < 1/2 \qquad \text{(B.12)}$$

and

$$\frac{\varepsilon_{el0}}{\varepsilon_{rup}} < 1/2 \quad \text{(B.13)}$$

or choose on the linear the right point.

B.2.5.2.7.3 Third step: choose γ_M

Because, coefficient after conditioning or ageing tests is:

4/3 or 2 after resistance to tearing:

$\gamma_M = 2,5$

B.2.5.2.7.4 Fourth step: choose σ_{des}

$$\sigma_{des} = \frac{\sigma_{el0}}{2,5} \quad \text{(B.14)}$$

if

$$\varepsilon_{des} = \frac{\varepsilon_{el0}}{2,5} \quad \text{(B.15)}$$

then

$$\varepsilon_{des} < \varepsilon_{25\%} \quad \text{(B.16)}$$

according to elastic recovery test.

If not

$$\varepsilon_{des} = \left(\frac{\sigma_{el0}}{\varepsilon_{el0}}\right) \cdot \varepsilon_{25\%} \quad \text{(B.17)}$$

B.3 Initial assessment of the design

Materials and components to be used should be evaluated for the intended uses foreseen by the design, and conform to the relevant European specifications.

Any bonding of structural sealant with a substrate should be tested at least once as described in the following table for the anodised and coated aluminium.

For procedures, refer to EN 15434:2006+A1:2010, Annex G.

Table B.2 — Bonding control depending of the adhesion surface

Type of surface	Anodised aluminium	Coated aluminium Alloy AW 6060 or AW 6063 Coating Polyester powder ≥ 60 µm	Other coated aluminium
Control of the surface	EN 12373 Parts 1 to 10 label for architectural purpose (with audit)	EN 12206-1 and Qualimarine (or Seaside AA) label (with audit)	EN 12206-1 (with audit)
Initial type testing (ITT)	Complete Annex G of EN 15434:2006+A1:2010, 5.4.2, 5.4.3, 5.4.4 on anodised aluminium EN 12373 Parts 1 to 10 for architectural purpose		Complete Annex G of EN 15434:2006+A1:2010, 5.4.2, 5.4.3, 5.4.4 on each particular coated aluminium EN 12206-1

Then for each project the bonding of structural sealant with the substrate at least with one batch should be tested according to Annex A.

Compatibility of materials should also be tested at least once. For procedures, refer to EN 15434.

B.4 Assembling details

In order to ensure the requirements in Clause 4 are met, the designer should prepare information for the assembler containing drawings and a list of assembly details, especially when such detailing is not foreseen in this European Standard.

Particular attention should be given to information on:

— temperature and the humidity range that sealant may be applied;

— use of cleaning materials;

— use of primer;

— use of temporary retainer clips during curing time;

— application of retainer devices as part of the design;

— setting block materials and locations;

— storage conditions for the incoming materials;

— frequency of adhesion testing and the minimum strength of the adhesion and cohesion;

— compatibility of the various materials and components.

Annex C
(normative)

Adhesion tests in assembling/bonding control

C.1 General

This annex provides a method to evaluate the strength of bonding to substrates. The description of the methods of measurement and of testing given below is intended to help assembling/bonding control. Every effort has been made to keep these methods as simple as possible without detracting from the achievement of consistency of quality in the manufactured products.

C.2 Purpose

The purpose of the test is to ensure that the structural sealant and the substrates are adequately prepared.

The three tests described below allow the adherence of the sealant to the substrates to be demonstrated for the assembly control scheme:

— peel test;

— static tensile test;

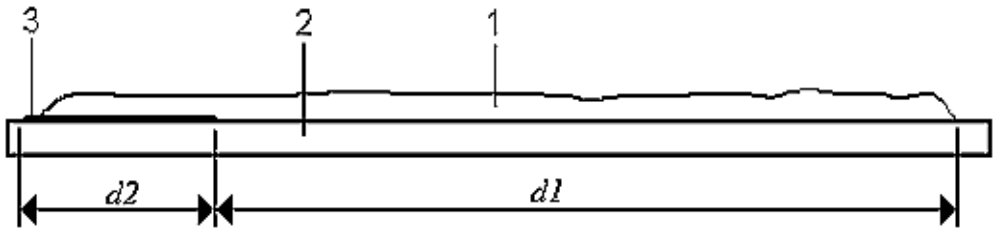
— dynamic tensile test.

C.3 Peel test – Method 1

C.3.1 Test specimens

The test specimen shall be prepared in accordance with Figure C.1 in the same conditions where the structural sealant will be applied and subsequently conditioned in the same environment where the complete elements are stored.

The curing time is in accordance with the sealant supplier recommendations.



Key

1 structural sealant, width approximately (12 +2, −0) mm, height minimum 6 mm
2 substrate with surface representative for delivery
3 bond breaker
d1 is minimum 250 mm
d2 is (50 ± 10) mm

Figure C.1— Illustration of a peel test specimen

The specimens for test shall consist of:

— structural sealant used in the application;

— specimen of the glass with a surface representative of the glass delivery on to which the structural sealant will be applied;

— specimen of the framework with a surface representative of the framework delivery on to the structural sealant will be applied.

The glass and framework suppliers should include in each delivery sufficient specimens for the test.

C.3.2 Curing time

After a minimum curing time in accordance with the sealant supplier's recommendations, the specimen is ready for peeling.

C.3.3 Test procedure

The bead shall be detached from the substrate at one end and manually peeled back at 180° until rupture of the bead occurs. When rupture occurs, the next peeling is initiated by cuts with a knife at the interface of the structural seal-substrate or at the other end of the bead.

Cutting and peeling shall be repeated until the bead is peeled for 2/3 of the length of the substrate. The remaining 1/3 can be used for purpose controls or for archive.

C.3.4 Observation

Breakage should be 100 % cohesive.

C.4 Static tensile test – Method 2

C.4.1 Test specimens

Four test standard H specimens shall be prepared in accordance with EN 15434, in the same conditions where the structural sealant will be applied, subsequently conditioned in the same environment where the complete elements are stored. The specimens for test shall consist of:

— structural sealant used in the application;

— dimensions used as in the application;

— specimen of the glass with a surface representative of the glass delivery on which the structural sealant will be applied;

— specimen of the framework with a surface representative of the framework delivery on which the structural sealant will be applied.

The glass and framework suppliers should include in each delivery sufficient specimens for the test.

C.4.2 Curing time

After a minimum curing time in accordance with the sealant supplier's recommendations, the specimen is ready for the static tensile loading.

C.4.3 Test procedure

The static tensile test shall be performed during the 10 min period that the sealant is under a stress equal to the declared resistance value at a temperature between 15 °C and 30 °C.

C.4.4 Observation

During the test or after unloading, no test specimen shall show any break or cracking of the sealant or any loss of adhesion.

C.5 Dynamic tensile test

C.5.1 Test specimens

Four test standard “H” specimens shall be prepared in accordance with EN 15434, in the same conditions where the structural sealant will be applied, subsequently conditioned in the same environment where the complete elements are stored. The specimens for test shall consist of:

— structural sealant used in the application;

— dimensions used in the application;

— specimen of the glass with a surface representative of the glass delivery on which the structural sealant will be applied;

— specimen of the framework with a surface representative of the framework delivery on which the structural sealant will be applied.

The glass and framework suppliers should include in each delivery sufficient specimens for the test.

C.5.2 Curing time

After a minimum curing time in accordance with the sealant supplier's recommendations, the specimen is ready for the dynamic tensile process.

C.5.3 Test procedure

For the dynamic tensile test, the test specimen will be clamped in the tensile equipment. The tensile speed shall be between 5 mm/min and 10 mm/min.

C.5.4 Observation

As long as the tensile stress is not above the declared resistance value, the test specimen shall not show breaks or cracks in the sealant or in the bond. Any breakage in the sealant at increased loads shall be cohesive.

C.6 Report

The report shall indicate the test methods and the observations. Furthermore, the report shall include:

— pass or fail of each test specimen;

— designation and lot number of the sealant;

— information to identify the glass and framework;

— date of test;

— any deviation from the test described above.

Annex D
(informative)

Two-component sealant: Check on the thoroughness of mixing and air inclusions

D.1 General

This annex gives a method to evaluate the quality of the mixing. The descriptions of the method of measurement and of testing given below are intended to validate the integrity of the assembly. Every effort has been made to keep this method as simple as possible without detracting from the achievement of consistency of quality in the manufactured products.

D.2 Purpose

The purpose of the test is to ensure that the two parts of the sealant, usually referred to as base and curing agent are mixed thoroughly.

D.3 Test specimen

Two pieces of 4 mm float glass of approximate size 250 mm × 150 mm shall be prepared to ensure a good clean surface. Approximately 10 g of mixed sealant, freshly taken from the production line are required. The test, which includes a visual inspection, should be carried out within five minutes of obtaining the sample.

D.4 Test procedure

Hold the two pieces of glass by the edges, and examine them visually to ensure they are clean and free from smears, grease marks, fingerprints or other contamination.

Place approximately 10 g of freshly mixed sealant in the centre of one piece of glass, which should be laid flat on a clean surface. Ideally the sealant should form a cone, with a minimum entrapment of air. Where meter/mix machines are used, either robotic or manual, the sealant should be applied directly from the nozzle.

Place the second piece of glass onto the sealant to form a glass/sealant/glass combination and, using slight finger pressure, press the two pieces of glass together until the sealant is approximately1 mm thick or less.

View both sides of the combination immediately, and examine for signs of striations (marbling or streaks), which would indicate poor mixing. The sealant should be evenly coloured over both surfaces and should be air inclusion free.

NOTE The shade of colour in this test can be ignored, as sealant manufacturers do not guarantee colour. Any overall difference in shade of colour from the specification cannot be construed as evidence of an incorrect ratio.

D.5 Report

The report should indicate the quality of mix as noted by the test indicated above and should include the following:

— identification of mixer;

— designation and lot number of the sealant;

— date of test;

— any deviation from the test described above.

Annex E
(informative)

Sealants, hardness measurements

E.1 General

This annex gives a method to evaluate the hardness of the sealant after curing. The description of the method of measurement and of testing given below are intended to validate the integrity of the assembly. Every effort has been made to keep this method as simple as possible without detracting from the achievement of consistency of quality in the manufactured products.

E.2 Purpose

The purpose of this method of measurement is to be able to confirm the hardness of cured sealants in accordance with defined curing conditions.

E.3 Definitions

E.3.1 Curing time

— For two-part sealants: the time from completion of mixing of material until the final hardness in accordance with sealant manufacturer's information is achieved.

— For one-part sealants: the time from removal of the sealant from its supply container into the open atmosphere until the final hardness in accordance with sealant manufacturer's information, is achieved.

E.3.2 Free surface

When a mould has been filled with sealant, the top surface is planed with a scraper and cured towards the air side. This surface is called the free surface.

E.4 Instruments

— Shore A instrument is used for the measurement of hardness. There are two alternatives for the contact forces, of which alternative (a) is the most precise for insulating glass unit sealants:

  — Method a) a contact force of 50 N (total weight of instrument, guide, and weight: (5,0 ± 0,1) kg is obtained when the instrument is mounted in a stand;

  — Method b) a contact force in the form of firm finger pressure applied to the measuring instrument.

— A mould of polyethylene with an internal diameter of minimal 50 mm and a depth of minimal 6 mm is used for the preparation of sealant specimens.

— Rotating spiral mixer.

E.5 Calibration

The Shore A instrument is calibrated and adjusted regularly as described in ISO 7619. Using scales, the Shore A is calculated from:

$$F_s = 500 + 75HA \quad \text{(E.1)}$$

where

F_s is the force in millinewton (mN) measured by the scales;

HA is hardness measured by the Shore A instrument.

The difference allowed between the calculated and measured force is ± 80 mN.

E.6 Test specimens

Sealant for the test specimens can be taken from machines with sealant ready for use. Sufficient sealant for filling the mould is taken out.

The polyethylene mould is filled, avoiding air inclusions in sealant. The free surface is planed with a scraper.

Alternatively sealant could be placed on paper and the top surface planed at a thickness more than 6 mm and area greater than 50 mm of diameter.

For curing conditions, one of the three following alternatives are recommended:

— A: (60 ± 5) min, 60 °C heating condition (e.g. infrared lamp, oven, etc.);

— B: (24 ± 0,5) h, factory conditions;

— C: (168 ± 4) h, factory conditions.

Condition A, B or C is chosen in agreement with the sealant supplier.

At the end of the curing time, the specimen is taken out of the mould (if used) and its temperature cooled down to factory conditions over the following periods depending on the curing conditions:

— A: (60 ± 5) min;

— B and C: (10 ± 2) min.

E.7 Test procedure

The specimen is tested on a plane and firm base.

The hardness is measured on the free surface, or alternatively on the cut surface or on the surface which had been adjacent to the polyethylene mould. The final result is taken as the average measurement taken at five different points (greater than 12 mm from edge and greater than 15 mm between the measuring spots).

The time from contact of the instrument with the free surface to reading of the instrument shall be no more than one second. If the instrument has a maximum indicator, this shall be used.

The instrument shall be read to the nearest whole Shore A value.

E.8 Report

Statement of hardness according to this method should include the following:

— type of sealant and delivery number, mixing machine, date, etc.;

— hardness in whole numbers in unit of Shore A;

— contact force, in whole numbers in N;

— curing conditions: time, temperature;

— temperature during hardness measurement;

— surface, e.g. free surface;

— any deviation from conditions in this test method.

Annex F
(informative)

Provisions for voluntary involvement of third party(ies)

F.1 General

A manufacturer/assembler 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.

F.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 assembling rules covered by this European Standard then the assessment shall be in accordance with Clause 5 and Clause 6 of 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.

F.3 Marking and labelling

The format of the label and the 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 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 regulatory marking and/or labelling”.

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