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EAD **090010-00-0404**

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European Assessment Document for

# Bonded glazing kits and bonding sealants

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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# 1 SCOPE OF THE EAD

## 1.1 Description of the construction product

This EAD relates to bonded glazing kits and bonding sealants for use in facades and roofs, or parts thereof, with glazing at any angle between vertical and 7° above horizontal (see Figure 1.1.1.1, Figure 1.1.1.2, Figure 1.1.1.3 and Figure 1.3.1) and bonding sealants intended to be used in bonded glazing kits. The EAD covers the methods for assessing kits and bonding sealant. It covers supported (types I and II) and unsupported (types III and IV) systems (see Figure 1.1.1.1), where the bonding sealant adhesion surfaces are glass, either uncoated or with an inorganic coating, and anodised aluminium or stainless steel.

This EAD offers the possibility issuing ETAs for bonded glazing kits and for bonding sealants. The bonding sealant may be assessed in the framework of the ETA for a bonded glazing kit or may have its own ETA and CE marking.

In the case where the bonding sealant has its own ETA/CE marking, it shall only be assessed for its suitability for use in a bonded glazing kit.

Bonded glazing kits and bonding sealants are not covered by any harmonised European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product, as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

### 1.1.1 Bonded glazing kit

Bonded glazing kit use the technique of bonding the glazing in order to redistribute loads to the facade frame via a bonding sealant bead.

The ETA will indicate details on the components it covers, to be used in accordance with the ETA holder's design rules and installation guide. The ETA mentions the generic and specific (when relevant) types of bonding sealant adhesion substrates it covers.

This EAD covers the performance aspects of the Bonded Glazing Kit to be used in a façade or in a roof system as shown in Figure 1.3.1, and describes the options possible within the kit. The kit components may include the members required for the facade or roof structure, but these are not covered by this EAD (members indicated by dashes in Figure 1.3.1). These, however, will need to be taken into account when dealing with the pre-conditions specified in clause 1.2.

The system description includes the components necessary to determine the performance as specified below:

- A bonding sealant support frame,
- A set of accessory profiles and accessories (mechanical self-weight support, anchorage of the bonding sealant support frame to the frame, tightness technique …)
- The generic type of infill element (glass)
- An air and water tightness technique, including:
  - The gaskets (material and geometry) and their corner assembling technique (bonding or welding)

  - A rebate ventilation and drainage technique (section and distance between the drainage and ventilation holes)
  - Any complementary provisions for tightness such as sealant ropes, etc.
- Ironworks identified by a trademark and a serial reference
- An infill element setting technique, including:
  - The blocking of the infill elements in the framework and their setting blocks etc.
  - The tightness of the infill panel by sealant or gasket (material and geometry)
- Any other components or accessories as relevant

Bonded glazing kit can be constructed in four different ways. These are described below in Table 1.1.1.1 and depicted in Figure 1.1.1.1.

**Table 1.1.1.1 – Bonded glazing kit types**

| Types | Description |
|---|---|
| I: | Mechanical transfer of the self-weight of the infill to the bonding sealant support frame and from there to the structure. The bonding sealant transfers all other actions. Devices are used to reduce danger in the event of a bond failure |
| II: | Mechanical transfer of the self-weight of the infill to the bonding sealant support frame and from there to the structure. The bonding sealant transfers all other actions, and no devices are used to reduce danger in the event of bond failure. |
| III: | The bonding sealant transfers all actions including the self-weight of the infill to the bonding sealant support frame, and from there to the structure. Devices are used to reduce danger in the event of a bond failure. |
| IV: | The bonding sealant transfers all actions, including the self-weight of the infill, to the bonding sealant support frame and from there to the structure. No devices are used to reduce danger in the event of bond failure. |

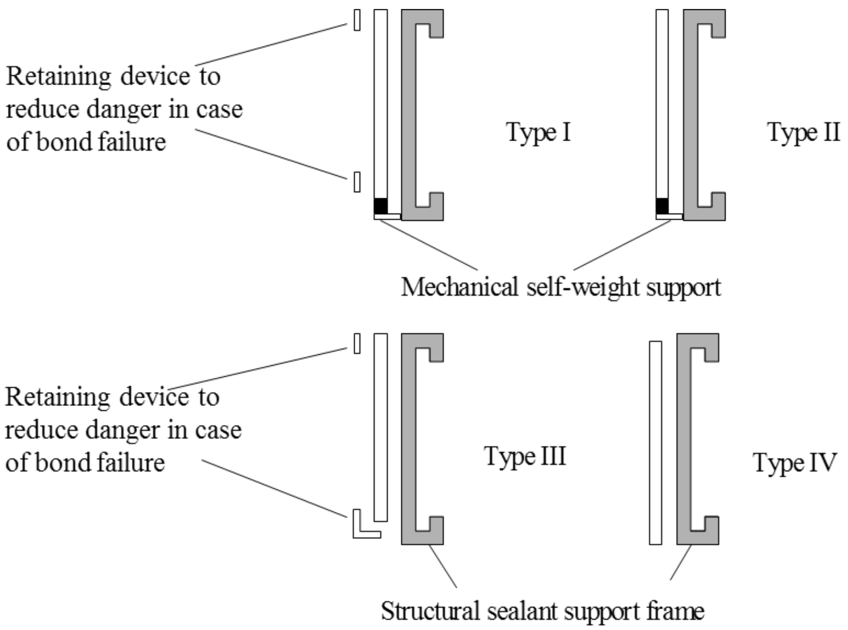


**Figure 1.1.1.1 – Schematic examples of the different types of bonded glazing kits, presenting the different types of mechanical accessories (the bonding sealant is not shown in this figure)**

According to the current state of the art this EAD only covers bonded glazing kits which fulfil the following conditions:

- The bonding sealant is silicone in the form of a linear bead.
- The design may include discontinuities in the bond, but no edge may be entirely free; some edges may be mechanically beaded.
- The bonding sealant is factory applied.
- Glass is selected to safely transmit the loads to the bonding sealant support frame via the bonding sealant in accordance with provisions in relation to the intended use or uses where the manufacturer intends the product to be made available on the market.
- The bonding sealant assessment fulfils all of the following conditions:
    - Residual tensile resistance and shear resistance after exposure to low and high temperatures is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.14.3.2 and 2.2.14.3.3.
    - Residual tensile resistance when exposed to immersion in water and exposure to UV for bonding sealant susceptible to UV irradiation is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.14.4.1.1.
    - Residual tensile resistance when exposed to immersion in water for bonding sealant not susceptible to UV irradiation is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.14.4.1.1.
    - Residual tensile resistance when exposed to humid salt atmosphere is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.14.4.2.1.
    - Residual tensile resistance when exposed to $SO_2$ atmosphere is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.14.4.3.1.
    - The bonding sealant does not present gas bubbles when assessed as per 2.2.15.1.1.
    - The bonding sealant does not present elastic relaxation more than 10% when assessed as per 2.2.15.1.2.
    - Shrinkage is limited to less than 10% when assessed as per 2.2.15.1.3.
    - Residual breaking stress and elongation after exposure to UV is at least 75% when assessed as per 2.2.15.1.4.
    - Residual tensile resistance when exposed to façade cleaning agents is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.15.1.6.
    - Residual tensile resistance when in contact with other materials for bonding sealant susceptible to come into contact with such materials while not exposed to UV is at least 85%, the type of rupture being at least 90% cohesive and without occurring discoloration when assessed as per 2.2.15.1.7.1.
    - Resistance to peeling when in contact with other materials for bonding sealant susceptible to come into contact with such materials while exposed to UV is without loss and without discoloration occurring when assessed as per 2.2.15.1.7.1.
    - Resistance to tearing is at least 75% (use category A) or 50% (use category B) when assessed as per 2.2.15.1.8.2.
    - Residual tensile resistance when exposed to cyclical mechanical loads is at least 75% and the type of rupture being at least 90% cohesive when assessed as per 2.2.15.1.9.1.
    - Creep and resistance when exposed to permanent shear load is at most 0,1 mm and the movement shall be stabilised after 91 days when assessed as per 2.2.15.1.10.1.
- Adhesion bead adhering on three surfaces is not covered by this EAD (see Figure 1.1.1.2). Adhesion to a spacer in an insulating glass unit is not considered a bond.

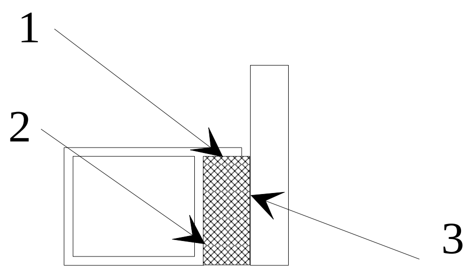


**Figure 1.1.1.2 – Bonding sealant on three surfaces - not covered by this EAD**

- The angle θ shows the range of permissible inclinations above 7° (see Figure 1.1.1.3)

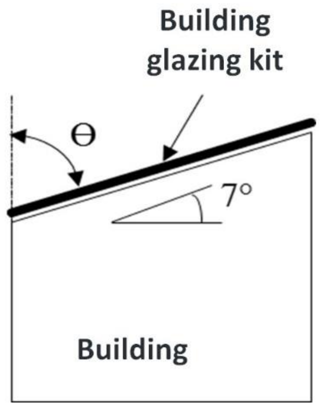


**Figure 1.1.1.3 – Permissible inclination θ**

- This EAD does not apply to a composite system in which the interior pane of the insulating glass unit (IGU) is mechanically fastened and the exterior pane is retained by bonding sealant.
- Types III and IV bonded glazing kit are only applicable to single glass units. This EAD covers only insulating glass units or laminated glass for which each pane of glass is supported (type I or II).

### 1.1.2 Bonding sealant

The bonding sealants are made of silicone and used in sealant bonded glazing kits to bond glazing products to metallic structures (anodised aluminium or stainless-steel), on bonding sealant support frames and/or as the second barrier of the hermetic seal in insulating glass units. (See Figure 1.3.1).

The ETA mentions the generic and specific (when relevant) types of bonding sealant adhesion substrates it covers.

If specified by the manufacturer, bonding sealants may be tested at a very low temperature (see this EAD, clause 2.2.14.3.2 and 2.2.14.3.3) to assess their suitability for use in cold regions, e.g., in Nordic countries.

## 1.2 Information on the intended use(s) of the construction product

### 1.2.1 Intended use(s)

This EAD relates to bonded glazing kit for use in facades and roofs, with glazing at any angle between vertical and 7° above horizontal.

This EAD also covers the bonding sealants for bonded glazing kits as product to be marketed separately.

### 1.2.2 Working life/durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer’s request to take into account a working life of the bonded glazing kit or of the bonding sealant for the intended use of 25 years when installed in the works (provided that the bonded glazing kit is subject to appropriate installation (see clause 1.1)) These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

## 1.3 Specific terms used in this EAD

The terminology is shown in the Figure 1.3.1 - a vertical section of a supported kit. Drainage is not shown.

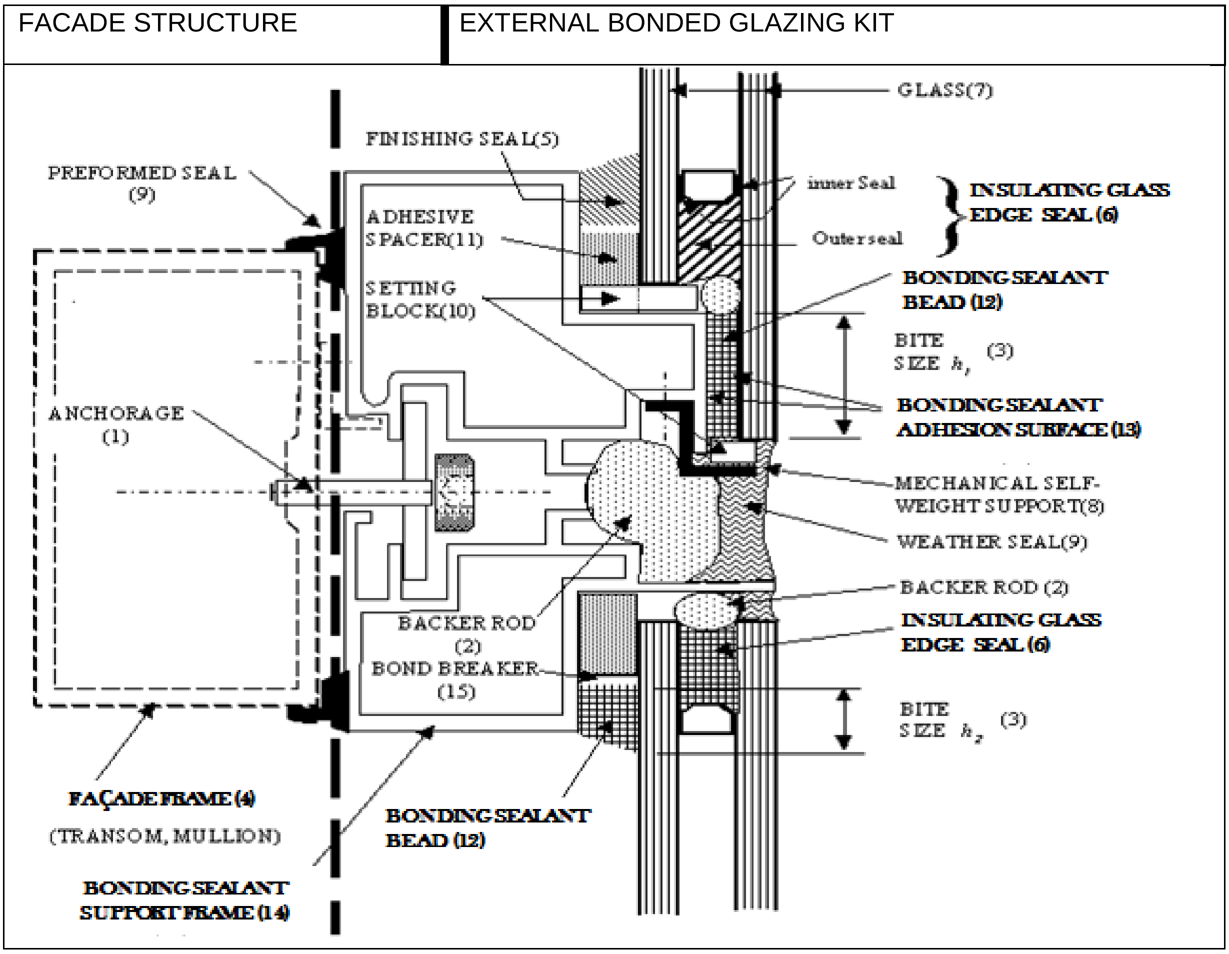


**Figure 1.3.1 – Vertical section (illustration for terminology purposes only)**

1 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

Numbers between brackets (x) in the following clauses correspond to the numbers of the terms shown in Figure 1.3.1.

### 1.3.1 Anchorage (1)

Anchorage of the bonding sealant support frame to the facade structure (not subject to an assessment based on this EAD).

### 1.3.2 Backer rod (2)

Continuous preformed strip limiting the depth of a seal.

### 1.3.3 Bite (3)

The dimension of the bonding sealant bead as measured in the plane of a panel. This term also refers to the same dimension of the hermetic seal of an insulating glass unit.

### 1.3.4 Facade frame (4)

Members to which the bonding sealant support frames are connected and that transmit forces to the building.

### 1.3.5 Finishing seal (5)

An extruded fillet of elastic sealant material of suitable cross-section, which when cured provides an adequate barrier to air and water, or a pre-formed gasket of cross-section.

### 1.3.6 Insulating glass edge seal (6)

A means of providing an airtight seal at the perimeter of an insulating unit. It also resists water or vapour ingress, light and ozone, while remaining compliant to glass displacement due to wind or other loading. In some kit configurations, this seal may perform as a bond in the sense of the definition (12).

### 1.3.7 Glass (7)

Glass element consisting of one of the following:

- A single pane (monolithic or laminated)
- An insulating glass unit (IGU) designed for use in bonded glazing kits

There can be two IGU types: the non-stepped IGU, where panes have the same nominal dimensions, and the stepped IGU, where panes of glass have different dimensions (see Figure 1.3.1).

See also references for CEN standards on glass.

### 1.3.8 Mechanical self-weight support (8)

Element positioned under the bottom edge of the glazing that transfers the weight of the glazing to the bonding sealant support frame.

### 1.3.9 Weather seal (9)

Fillet of elastic material or a pre-formed gasket of suitable cross-section, providing an adequate barrier to air and water.

### 1.3.10 Setting blocks (10)

Load-bearing elements between the mechanical self-weight support and the lower edge of the glass intended to position the glazing unit in the bonding sealant support frame.

### 1.3.11 Adhesive spacer (11)

A continuous preformed strip defining the cross-section of the bonding seal and serving to position and align the glass with respect to the bonding sealant support frame.

### 1.3.12 Bonding sealant bead (12)

Fillet of a factory-extruded elastic bonding sealant that, when cured, is of sufficient cross-section to adequately transfer the forces between the glass and the bonding sealant support frame, and between the panes in an insulating glass unit.

### 1.3.13 Bonding sealant adhesion surface (13)

A continuous surface on the glass or on the bonding sealant support frame on which the bonding sealant adheres.

### 1.3.14 Bonding sealant support frame (14)

Metal element to which the glass is bonded.

### 1.3.15 Bonding sealant breaker (15)

A non-adhesive interfacial surface that prevents sealant adhesion.

**Complementary terminology (items not shown in Figure 1.3.1)**

### 1.3.16 Location block

Resilient material between the bonding sealant support frame and a glass edge, other than the bottom edge, to position the glazing unit in the bonding sealant support frame.

### 1.3.17 Mullion

A vertical frame member supporting the vertical edges of the glass element. It may limit the flexibility of the glass element.

### 1.3.18 Retaining device

A means of retaining the glass to reduce danger in the event of bonding sealant failure.

### 1.3.19 Transom

A horizontal frame member.

### 1.3.20 Cleaning agent

Cleaning agents are substances used to remove dirt, including dust, stains, from façade components

## 1.4 Symbols

| | |
|---|---|
| $R_{u,5}$ | the characteristic breaking stress giving 75% confidence that 95% of the test results will be higher than this value |
| $X_{mean}$ | the average breaking stress, either under tension or under shear |
| $X_{mean,n}$ | the average breaking stress, either under tension or shear in the initial state |
| $X_{mean,c}$ | the average breaking stress, either under tension or shear after conditioning or ageing |
| $\tau_{\alpha ß}$ | the eccentricity of 5% with 75% confidence (see Table 2.2.14.2.1) |
| $s$ | the standard deviation of the series under consideration |
| $V_{mean}$ | average value |
| $K_x$ | stiffness of the sample at x% elongation in the initial state |
| $K_{x,c}$ | stiffness of the sample at x% elongation after conditioning |
| $R_{des}$ | design resistance |
| $F_{u,5}$ | the characteristic force giving 75% confidence that 95% of the test results will be higher than this value |
| $F_{mean}$ | the average breaking force |

# 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSEMENT METHODS AND CRITERIA

## 2.1 Essential characteristics of the product

Table 2.1.1 and Table 2.1.2 show how the performance of bonded glazing kits and bonding sealants is established in relation to the essential characteristics.

Many of the tests are used to assess more than one aspect, or subdivision, of a BWR. Hence, it is not possible to list the methods of assessment in the same order as the subdivisions of the BWRs.

**Table 2.1.1 – Essential characteristics of the product and methods and criteria for assessing the performance of the bonded glazing kit in relation to those essential characteristics**

| N° | Essential characteristic | Assessment method | Type of expression of product performance |
|---|---|---|---|
| Basic Works Requirement 2: Safety in case of fire | | | |
| 1 | Reaction to fire | 2.2.2 | Class |
| 2 | Resistance to fire | 2.2.3 | Class |
| 3 | Façade fire performance | 2.2.4 | Description/level/class (as relevant) |
| 4 | External fire performance of roofs | 2.2.5 | Class |
| 5 | Partial collapse in case of fire | 2.2.6 | Class |
| Basic Works Requirement 3: Hygiene, health and the environment | | | |
| 6 | Content, emission and/or release of dangerous substances | 2.2.7 | Levels |
| 7 | Air permeability | 2.2.8 | Classes |
| 8 | Watertightness under static pressure | 2.2.9 | Classes |
| Basic Works Requirement 4: Safety and accessibility in use | | | |
| 9 | Wind resistance | 2.2.10 | Classes |
| 10 | Tests of opening lights | 2.2.11 | Classes |
| 11 | Impact tests | 2.2.12 | Classes |
| 12 | Sill heights | 2.2.13 | Description |
| 13 | Mechanical devices | 2.2.16 | Description |
| Basic Works Requirement 5: Protection against noise | | | |
| 14 | Acoustic insulation | 2.2.18 | Level |
| Basic Works Requirement 6: Energy economy and heat retention | | | |
| 15 | Thermal insulation | 2.2.19 | Level |

**Table 2.1.2 – Essential characteristics of the product and methods and criteria for assessing the performance of the bonding sealant in relation to those essential characteristics**

| N° | Essential characteristic | Assessment method | Type of expression of product performance |
|---|---|---|---|
| Basic Works Requirement 2: Safety in case of fire | | | |
| 1 | Reaction to fire | 2.2.2 | Class |
| Basic Works Requirement 3: Hygiene, health and the environment | | | |
| 2 | Content, emission and/or release of dangerous substances | 2.2.7 | Description |
| Basic Works Requirement 4: Safety and accessibility in use | | | |
| 3 | Mechanical performance of the bonding sealant bead<br>• Initial mechanical strength of the bond<br>• Residual mechanical strength of the bond after artificial ageing | <br>2.2.14.3<br>2.2.14.4 | <br>Level<br>Level |
| 4 | Physical properties of bonding sealant bead | 2.2.15 | Description |

## 2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

### 2.2.1 Introduction

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as "shall be stated in the ETA" or "it has to be given in the ETA" shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

Testing will be limited only to the essential characteristics which the manufacturer intends to declare. If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

### 2.2.2 Reaction to fire

The bonded glazing kit components or the bonding sealant shall be tested, using the test method(s) relevant for the corresponding reaction to fire class according to EN 13501-1. The products shall be classified according to the Commission Delegated Regulation (EU) No 2016/364[2] in connection with EN 13501-1.

The obtained reaction fire class shall be stated in the ETA together with those conditions for which the classification is valid.

### 2.2.3 Resistance to fire

An assembly comprising the bonded glazing kit shall be tested according to the test method(s) relevant for the corresponding fire resistance class according to EN 13501-2. The product shall be classified according to Commission Decision 2000/367/EC[3], as amended by Commission Decision 2003/629/EC.

### 2.2.4 Façade fire performance

If the manufacturer intends to declare the façade fire performance of the product, in absence of a European assessment approach, the ETA shall state the results of the product assessment(s) according to the assessment method(s) required by the regulatory provisions of those countries, in which the manufacturer intends to make the product available on the market, according to the table given in Annex E.

### 2.2.5 External fire performance of roofs

The roof assembly in which the bonded glazing kit is intended to be incorporated in shall be tested according to the test method(s) relevant for the corresponding external fire performance class according to EN 13501-5. The product shall be classified according to Commission Decision 2001/671/EC[4].

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[2] See Official Journal L68, 15.3.2016, p.4

[3] See Official Journal L 133, 6.6.2000, p. 26

[4] See Official Journal L235, 4.9.2001, p.20

### 2.2.6 Partial collapse in case of fire – slow heating curve

The partial collapse in case of fire shall be assessed according to EN 13501-2, using the slow heating curve and notably when relevant in case the bonded glazing kit is equipped with fire resistant glass.

### 2.2.7 Content, emission and/or release of dangerous substances

The performance of the bonded glazing kit components or the bonding sealant related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[5], after identifying the release scenarios, taking into account the intended use of the product and the Member States where the manufacturer intends his product to be made available on the market.

If the manufacturer wants other dangerous substances to be assessed which are not specified below, this EAD may need to be amended or another EAD may need to be developed.

The identified intended release scenario for this product and intended use with respect to dangerous substances is ‘product with indirect contact to soil, ground- and surface water’ (S/W2).

**Leachable substances**

The performance of the bonded glazing kit components or the bonding sealant concerning leachable substances shall be assessed by performing a leaching test with subsequent eluate analysis, in duplicate. Leaching tests of the bonded glazing kit components or of the bonding sealant are conducted according to CEN/TS 16637-2. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area shall be (20 to 25) l/m².

As the sealant is the decisive component with regard to leachable substances, in both cases (assessment of the sealant as independent product as well as assessment of the kit including the sealant) the sealant is subject to the tests. A sandblasted glass plates coated with the bonding sealant (maximal thickness according to the technical data sheet) shall be prepared.

In eluates of "6 hours" and "64 days", the following biological tests shall be conducted:

- Acute toxicity test with Daphnia magna Straus according to EN ISO 6341
- Toxicity test with algae according to ISO 15799
- Luminescent bacteria test according to EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3 ([6])

For each biological test, EC20-values shall be determined for dilution ratios 1:2, 1:4, 1:6, 1:8 and 1:16.

If the parameter TOC is higher than 10 mg/l, the following biological tests shall be conducted with the eluates of "6 hours" and "64 days" eluates: Biological degradation according to OECD Test Guideline 301 part A, B or E.

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5 The manufacturer may be asked to provide to the TAB the REACH related information, which accompanies the declaration of performance in accordance with Regulation (EU) No 305/2011 Article 6(5).
The manufacturer is **not** obliged:
- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- to provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS, taking into account the installation conditions of the construction product and the release scenarios resulting from there.

Any information provided by the manufacturer regarding the chemical composition of the products may not be distributed to EOTA or to TABs.

6 The test methods EN ISO 11348-1, EN ISO 11348-2 and EN ISO 11348-3 are equivalent and produce similar results.

Determined toxicity in biological tests shall be expressed as EC20-values for each dilution ratio. Maximum determined biological degradability shall be expressed as "…% within …hours/days". The respective test methods for analysis shall be specified in the ETA.

### 2.2.8 Air permeability

The assessment of air permeability, watertightness under static pressure and wind resistance follow the test sequence described in Annex A. The description of the test assembly is given in Annex C.

The air permeability of a bonded glazing kit window shall be tested according to EN 1026 and assessed according to EN 12207. The air permeability of a bonded glazing kit curtain wall shall be tested according to EN 12153 and assessed according to EN 12152.

The ETA shall specify the method(s) used.

### 2.2.9 Watertightness under static pressure

The assessment of air permeability, watertightness under static pressure and wind resistance follow the test sequence described in Annex A. The description of the test assembly is given in Annex C.

The watertightness under static pressure of a bonded glazing kit window shall be tested according to EN 10267 and assessed according to EN 12208. The watertightness under static pressure of a bonded glazing kit curtain wall shall be tested according to EN 12155 and assessed according to EN 12154.

The ETA shall specify the method(s) used.

### 2.2.10 Wind resistance

The assessment of air permeability, watertightness under static pressure and wind resistance follow the test sequence described in Annex A. The description of the test assembly is given in Annex C.

The wind resistance of a bonded glazing kit window shall be tested according to EN 12211 with a test sample as described in this EAD, Annex C, Figure C1, and assessed according to EN 12210. The wind resistance of a bonded glazing kit curtain wall shall be tested according to EN 12179 and assessed according to EN 13116.

The ETA shall specify the method(s) used.

### 2.2.11 Tests of opening lights

The following tests are to be conducted in order to assess the effect of operation on the bond:

- Mechanical tests applicable to opening windows: EN 14609 and EN 14608
- Durability tests: 10.000 cycles of opening and closing the windows in accordance with EN 1191

Classification shall be performed according to EN 13115. After the test, no damage to the bond shall be evident. The windows shall be examined before, during and after the tests, noting the appearance of any defects, for example glazing breakage, detachment, etc.

### 2.2.12 Impact tests

The impact resistance of a bonded glazing kit window shall be tested and assessed according to EN 13049. The impact resistance of a bonded glazing kit curtain wall shall be tested and assessed according to EN 14019.

The ETA shall specify the method(s) used.

### 2.2.13 Sill heights

The range of sill heights shall be specified in the ETA. The sill is measured with a wooden or plastic foldable double-meter or metal ruler with a precision of 1 mm and expressed in SI length unit (L).

### 2.2.14 Mechanical performance of the bonding sealant bead

2.2.14.1 Testing - General considerations

To study the combination of the bonding sealant with the bonding sealant adhesion surface, a number of mechanical properties and the effects of potentially degrading agents need to be known. The following tests are used to determine these properties.

Reminder: Unless otherwise specified elsewhere in this EAD, the tests given in the following clauses are only intended for silicone bonding sealants and bonding adhesion surfaces of glass (uncoated or with an inorganic coating) and anodised aluminium or stainless steel.

Test pieces for mechanical performance

The test pieces are to be assembled by the manufacturer or in accordance with the manufacturer's instructions with the same material specifications used in the kit, i.e., the bonding sealant, the glass and the metal substrate as well as the surface preparation products (cleaning product, primer, etc.) and treatment of surface (anodising, glass coating, etc.).

The relevant reference paragraph of this document, the groups of test pieces for tensile testing, those for shear testing and the type of test pieces that need to be used, are given in Table 2.2..1.1.

**Table 2.2.14.1.1 – Type and number of test pieces**

| Clause | Tensile test | Shear test | Test pieces illustrated |
|---|---|---|---|
| Initial mechanical stress | | | |
| 2.2.14.3 | Group 1, 20 test pieces | Group 2, 20 test pieces | Figure 2.2.14.1.1 |
| Artificial ageing or conditioning | | | |
| 2.2.14.4.1 | Group 1, 10 test pieces | - | Figure 2.2.14.1.1 |
| 2.2.14.4.2 | Group 1, 10 test pieces | - | Figure 2.2.14.1.1 |
| 2.2.14.4.3 | Group 1, 10 test pieces | - | Figure 2.2.14.1.1 |
| 2.2.15.1.6 | Group 1, 10 test pieces | - | Figure 2.2.14.1.1 |
| 2.2.15.1.7 a | 5 + 2 test pieces or 10 + 2 test pieces | | Figure 2.2.15.1.7.1.1 |
| 2.2.15.1.7 b | 5 test pieces | | Figure 2.2.15.1.7.1.2 |
| * Dimensions of substrates and adhesive bead for Figure 2.2.15.1.7.1.1 are specified in Figure 2.2.14.1.1. | | | |

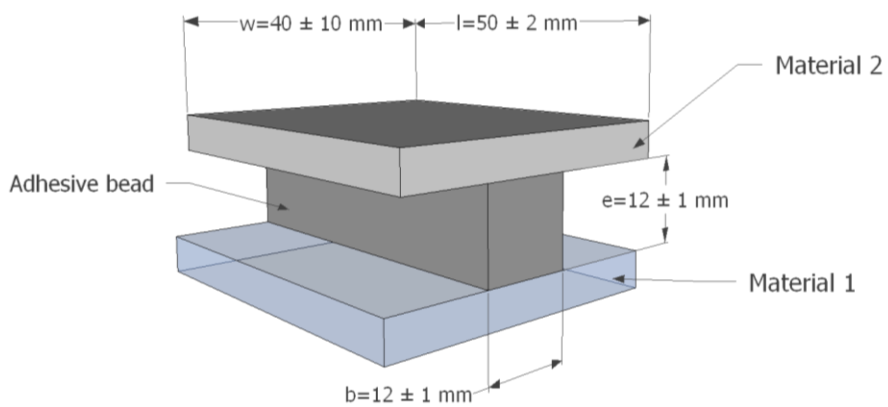


**Figure 2.2.14.1.1 – Dimensions of test pieces**

The substrate shall be sufficiently stiff to avoid bending.

**Table 2.2.14.1.2 – Dimensions of test pieces**

| Symbol | Dimensions and tolerances (mm) |
|---|---|
| b:<br>e:<br>l:<br>w: | 12 ± 1<br>12 ± 1<br>50 ± 2<br>40 ± 10 |

Special care shall be taken to produce symmetrical test pieces.

If the test is conducted on the actual profile of the kit, tension shall be applied without bending the profile.

The clamps of the apparatus for tensile testing shall move in pure axial translation.

All the test samples are conditioned initially for 28 days after manufacture at a temperature of (23 ± 2) °C and at (50 ± 5) % relative humidity. Unless otherwise stated in the tests descriptions that follow, these shall also be the ambient conditions during testing.

The breaking stress of each sample shall be calculated using each breaking force and the measured dimensions of this sample. These values are then used to determine the mean value of $X_{mean}$ and $R_{u,5}$.

2.2.14.2 Statistical interpretation of the results for the validation criteria

In the most of following tests validation criteria, the statistical interpretation of the test result applies

$$R_{u,5} = X_{mean} - \tau_{\alpha,\beta} \times s$$

$$\Delta X_{mean} = \frac{X_{mean,c}}{X_{mean,n}}$$

The variable $\tau_{\alpha\beta}$ as a function of the sample numbers, is given in the table hereafter.

**Table 2.2.14.2.1 – Variable $\tau_{\alpha\beta}$ as a function of the number of test pieces ISO 16269-6, Table D2**

| Number of test specimens | 3 | 4 | 5 | 6 | 8 | 10 | 20 | 30 | ∞ |
|---|---|---|---|---|---|---|---|---|---|
| Variable $\tau_{\alpha\beta}$ | 3,152 | 2,681 | 2,464 | 2,336 | 2,189 | 2,104 | 1,932 | 1,869 | 1,645 |

Type of rupture

A number of tests prescribe "Rupture ≥ 90% cohesive", i.e., at least 90% of the sample ruptures shall be located within the sealant and a maximum of 10% at the interface between the bonding sealant bond and the glass or metallic substrate.

EN ISO 10365 gives pattern examples of adhesive and cohesive ruptures patterns.

2.2.14.3 Initial mechanical strength of the bond

2.2.14.3.1 General

After initial conditioning, the test pieces shall be subjected to tensile tests as shown in this EAD, Figure 2.2.14.3.2.1, and shear tests as shown in in this EAD, Figure 2.2.14.3.3.1.

2.2.14.3.2 Tension, rupture

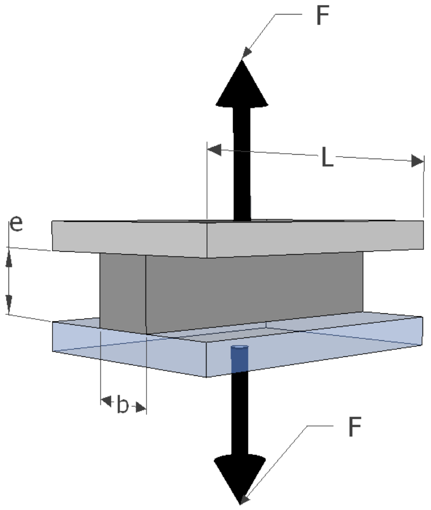
The aim of this test is to evaluate the resistance of the bonding sealant to the tensile forces acting on the joints.

After initial conditioning, the test specimens shall be further conditioned for (24 ± 4) hours as follows:

- 5 test specimens conditioned at (-20 ± 2)°C[7]
- 10 test specimens conditioned at (+23 ± 2)°C
- 5 test specimens conditioned at (+80 ± 2)°C.

The samples are removed of the temperature chamber subjected to tension until failure in accordance with this EAD, Figure 2.2.14.3.2.1. The tensile test is performed at the conditioning temperature.

The test is conducted at a speed of (5 ± 0,5) mm/min.




$$\sigma = \frac{F}{L\ x\ b}$$

**Figure 2.2.14.3.2.1 – Sample for tensile test - tension speed: (5 ± 0,5) mm/min**

Where

- F: tensile force
- σ: Tensile stress
- b and L are respectively the width and the length of the sealant section

From the stress-at-elongation graph recorded, the following shall be noted:

- The type of failure - whether cohesive or adhesive;
- Stress at elongations of 5, 10, 15, 20 and 25%;
- The stress and elongation at rupture, only for test specimens conditioned at + 23°C.

<u>For the test at -20°C, 23°C, + 80°C:</u> (see this EAD, clause 2.2.14.2)

$$R_{u,5} = X_{mean} - \tau_{\alpha,\beta} \times s$$

The variable $\tau_{\alpha\beta}$ as a function of the sample numbers, is given in this EAD, Table 2.2.14.2.1.

<u>The ETA shall state the design stress in tension at room temperature (MPa).</u>

<u>Validation criteria for the test at -20°C, + 80°C:</u>

$$\Delta X_{mean} = \frac{X_{mean,-20°C}}{X_{mean,23°C}} \text{ and } \Delta X_{mean} = \frac{X_{mean,+80°C}}{X_{mean,23°C}} \text{ with } \Delta X_{mean} \geq 0{,}75$$

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

7 This temperature can be -40°C for European Nordic countries if required by the Applicant (see clause 2.2).

<u>Validation criteria: type of rupture for the test at -20°C, 23°C, + 80°C:</u> rupture ≥ 90% cohesive; the type of rupture shall be recorded.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

The value expressing the secant stiffness at 12,5%, $K_{12,5}$ (see this EAD, Annex B) shall be recorded.

2.2.14.3.3 Shear, rupture

The aim of this test is to evaluate the inherent resistance of bonding sealants to the shear forces acting on the joints.

After initial conditioning, the test specimens shall be further conditioned for (24 ± 4) hours as follows:

- 5 test specimens conditioned at (-20 ± 2)°C[8]
- 10 test specimens conditioned at (+23 ± 2)°C
- 5 test specimens conditioned at (+80 ± 2)°C.

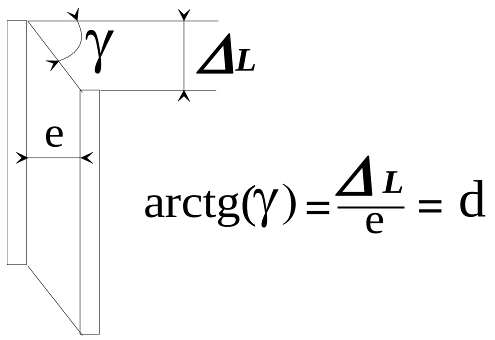
The samples are removed of the temperature chamber subjected to shear load until failure according to this EAD, Figure 2.2.14.3.3.2.

The shear test is performed at the conditioning temperature.

The test is conducted at a speed of (5,5 ± 0,5) mm/min.

From the stress-at-elongation graph recorded, the following shall be noted:

- The type of rupture - whether cohesive or adhesive
- Stress at relative displacement to thickness of the substrate (d) of 5, 10, 15, 20 and 25% and at rupture for test specimens conditioned at +23°C.




$$\mathrm{arctg}(\gamma) = \frac{\Delta L}{e} = d$$

**Figure 2.2.14.3.3.1 – Measurement of shear displacement**

8 This temperature can be -40°C for European Nordic countries if required by the Applicant (see clause 1.1.2)

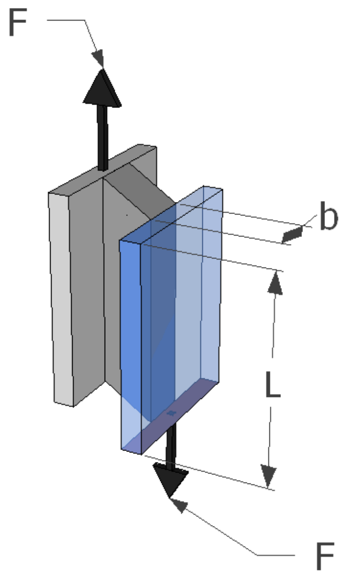



**Figure 2.2.14.3.3.2 – Sample for shear test - Shear speed 5,5 ± 0,5 mm/min**

$$\tau = \frac{F}{L \times b}$$

For the test at -20°C, 23°C, + 80°C: (see this EAD, clause 2.2.14.2)

$$R_{u,5} = X_{mean} - \tau_{\alpha,\beta} \times s$$

The variable $\tau_{\alpha\beta}$ as a function of the sample numbers, is given in the Table 2.2.14.2.1.

The ETA shall state the design stress in shear at room temperature (MPa).

Validation criteria: for the test at -20°C, + 80°C:

$$\Delta X_{mean} = \frac{X_{mean,-20°C}}{X_{meam,23°C}} \text{ and } \Delta X_{mean} = \frac{X_{mean,+80°C}}{X_{mean,23°C}} \text{ with } \Delta X_{mean} \geq 0{,}75$$

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

Validation criteria: Type of rupture for the test at -20°C, 23°C, + 80°C: Cohesive rupture ≥ 90%; the type of rupture shall be recorded.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.14.4 Residual mechanical strength of the bond after artificial ageing

2.2.14.4.1 Immersion in water at high temperature with or without solar radiation (see also this EAD, clause 2.2.15.1.4)

2.2.14.4.1.1 Assessment method

The aim of this test is to examine the effect of artificial ageing on the residual mechanical strength of the bonding sealant.

Materials and equipment:

- Supports of glass and metal, for the preparation of test specimens and reference specimens with dimensions as described in Figure 2.2.14.1.1 and Table 2.2.14.
- Spacers for the preparation of the specimens are with anti-adherent surface.

  If spacers are made of material to which the sealant adheres, their surfaces shall be made anti-adherent, e.g., by applying a thin wax coating.
- Anti-adherent substrate, for the preparation of test specimens, e.g., polytetrafluorethylene (PTFE) film or vellum paper, preferably according to the advice of the sealant manufacturer.
- Water container with heating device for immersing the test specimens, capable of maintaining a water temperature of (45 ± 1) °C, and a constant level of water
- Artificial light source with a spectral distribution characterised as follows:
- Type of lamp: Xenon (EN ISO 4892-2) or equivalent
- Power: (60 ± 5) W/m² measured at the level of the sample, and between 300 and 400 nm
- Total energy of the lamp: 500 to 600 watts
- Black panel thermometer with a blackened absorbing metal plate that approximates the absorption characteristics of a “black body”. The plate shall be at least 1 mm thick and of a size to fit the test specimen holders. The temperature of the metal plate is measured by a suitable thermometer or thermocouple with good thermal contact. For measuring the test temperature, it shall be mounted in a test specimen holder with the blackened side of the metal plate facing the artificial light source.
  - Readings shall only be taken after sufficient time has elapsed for the temperature to become steady. The temperature shall be controlled by adjusting the air exchange rate. Note – Temperature control may be achieved by means of a thermostat, the sensor of which is placed in the climate chamber.
- Test machine with recording device, capable of extending the test specimens at a rate of 5 to 6 mm/min.

The test specimen shall be stored for 21 days in demineralised water (resistivity 1 to 10 MΩ) of (45 ± 1) °C

*For glass substrates*, the assessment method combines immersion in water at high temperature with light exposure.

(See Figure 2.2.14.4.1.1.1 with material 1 a glass product and material 2 a metallic product)

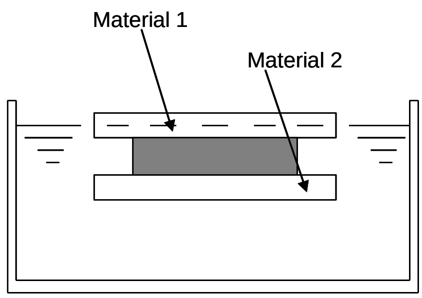



**Figure 2.2.14.4.1.1.1 – Position of samples with glass substrate**

*For metallic substrates,* the assessment method involves full immersion in water at high temperature without light exposure.

(See Figure 2.2.14.4.1.1.2, with material 1 a metallic product and material 2 a metallic product)

The test pieces are fully immersed (at least 20 mm under water level) in demineralised (resistivity 1 to 10 MΩ) hot water, temperature (45 ± 1) °C.

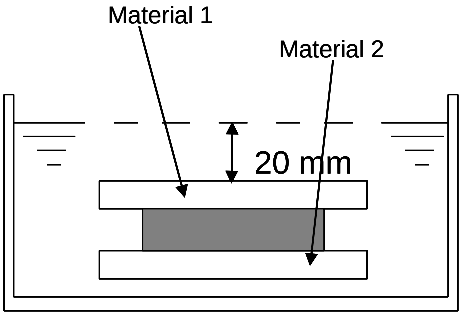



**Figure 2.2.14.4.1.1.2 – Position of samples with metallic substrate**

For both substrate combinations, the procedure is as follows:

- After 21 days ((504 ± 4) hours) of conditioning, five test pieces are to be removed from the chamber and conditioned for 24 ± 4 hours at a temperature of (23 ± 3)°C and (50 ± 5)% relative humidity.
- The test pieces are then to be subjected to a tensile test in accordance with clause 2.2.14.3.2.
- After a further 21 days ((504 ± 4) hours), the five remaining test samples are to be removed from the chamber and subjected to the same tensile test after the same conditioning.

The test results shall include:

- The date and time the test started
- The temperature, relative humidity and period of initial conditioning

and during immersion in water:

- A record of the water temperature
- A record of the temperature at the interface of the control samples
- Water conductance values, noting the date and time of measurement.

After removal from the water:

- The dates and times the samples were removed
- A record of the temperature, relative humidity and conditioning period after immersion in water
- The date, time, temperature and relative humidity during the tensile test
- The stress/strain curve

2.2.14.4.1.2 Validation criteria (see this EAD, clause 2.2.14.2)

The minimum requirement is 1000 hours immersion

- $\Delta X_{mean} = \frac{X_{mean,c}}{X_{mean,23°C}}$ with $\Delta X_{mean} \geq 0{,}75$ and

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

- Rupture ≥ 90% cohesive; the type of rupture shall be recorded.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

- For the elongations 0 ≤ x % ≤ 12,5 of the deformation/stress curve (see this EAD, Annex B), the stiffness, to be recorded, shall be as follows:

$$0{,}5 \leq K_{x,c}/K_x \leq 1{,}10$$

2.2.14.4.2 Humidity and NaCl atmosphere

2.2.14.4.2.1 Assessment method

The conditioning shall be carried out in accordance with EN ISO 9227, Atmosphere NSS, maintained for 480 hours.

The test pieces are placed on PVC trays. The test pieces are to be rotated every 24 hours to expose each longitudinal cut edge in turn.

After conditioning, the test pieces shall be conditioned for a further (24 ± 4) hours at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity. They shall then be subjected to tensile tests in accordance with this EAD, clause 2.2.14.3.

2.2.14.4.2.2 Validation criteria (see this EAD, clause 2.2.14.2)

- $\Delta X_{mean} = \frac{X_{mean,c}}{X_{mean,23°C}}$ with $\Delta X_{mean} \geq 0{,}75$ and

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

- Rupture ≥ 90% cohesive; the type of rupture shall be recorded.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.14.4.3 Humidity and $SO_2$ atmosphere

2.2.14.4.3.1 Assessment method

The 10 test pieces shall be conditioned in accordance with ISO 3231.

Corrosion test in artificial atmosphere - Salt spray test - 20 cycles Atmosphere 0,20 litres of $SO_2$. After conditioning, the test pieces shall be removed from the chamber and further conditioned for (24 ± 4) hours at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity.

Then they shall be subjected to tensile tests in accordance with this EAD, clause 2.2.14.3.2.

2.2.14.4.3.2 Validation criteria (see this EAD, clause 2.2.14.2)

- $\Delta X_{mean} = \frac{X_{mean,c}}{X_{mean,23°C}}$ with $\Delta X_{mean} \geq 0{,}75$ and

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

- Rupture ≥ 90% cohesive; the type of rupture shall be recorded.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

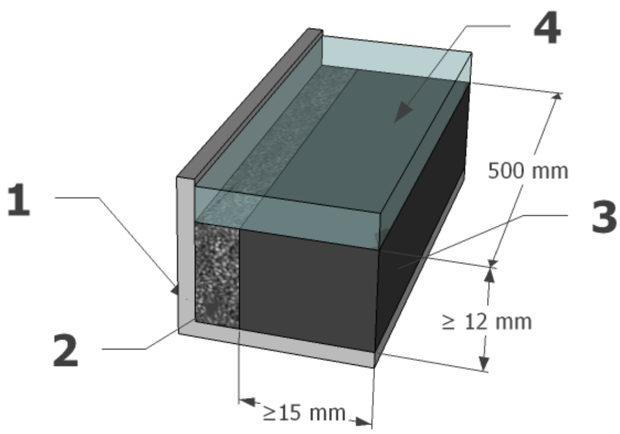
### 2.2.15 Physical properties of bonding sealant bead

2.2.15.1.1 Gas inclusions

With certain bonding sealants, gas bubbles can form at the glass/aluminium bonding sealant interfaces; these can affect the performance of the bond.

One test piece (see Figure 2.2.15.1.1.1) with a float glass upper face is prepared in accordance with the bonding sealant manufacturer's specifications. The bonding sealant shall completely fill the space created between the glass and the aluminium, without any air pockets.

The test specimen shall be stored at a temperature of (23 ± 2) °C and at a relative humidity of (50 ± 5) % for 21 days. The test specimen shall be checked visually every 7 days. Generation of gas bubbles and their rate of growth shall be recorded.




**Key:**
1- Aluminium profile
2- Backer rod
3- Bonding sealant
4- Glass

**Figure 2.2.15.1.1.1 – Sample for gas inclusion test**

Validation criterium: The application of the bonding sealant shall not present gas bubbles visible with normal corrected vision.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

#### 2.2.15.1.2 Elastic recovery

This test is to be used to evaluate the elastic relaxation behaviour and consequently the relaxation behaviour after long-term loading. The test shall be conducted on three samples in accordance with EN ISO 7389, Method A, with 25% extension.

The following shall be recorded.

- The initial stress and elongation
- The final stress and elongation
- The elongation after unloading the test pieces.

Validation criterium: One hour after unloading, the elongation shall be ≤ 10% of the initial elongation.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

#### 2.2.15.1.3 Shrinkage

The aim of this test is to evaluate the degree of shrinkage of the bonding sealants to limit the initial stresses in the bonding sealant bead. The test shall be conducted on three samples in accordance with EN ISO 10563, using a mechanically ventilated oven with closed flat.

Validation criterium: Shrinkage shall be less than 10%.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

#### 2.2.15.1.4 UV resistance of the sealant

If necessary, for example to determine the cause of problems occurring during the test detailed in this EAD, clause 2.2.14.4.1, with UV, the resistance to UV of the bonding sealant itself can be assessed using the following method. It should be noted that the number of UV hours applied in this test is intended to distinguish between products that behave well under such radiation and those that do not.

Ten test pieces are manufactured as type-5 test pieces according to EN ISO 527-3 with all the test pieces having a thickness of (2,2 ± 0,2) mm (these samples may also be used for the tests prescribed in this EAD, clause 2.2.15.1.5).

Five test pieces are then to be subjected to the tensile test according to EN ISO 527-3, at a speed of (5,5 ± 0,5) mm/min.

- Five test pieces are subjected to UV irradiation as follows:

- Type of lamp: Xenon, or equivalent
- Power: (60 ± 5) W/m² measured at the level of the sample, between 300 and 400 nm.
- Duration: (504 ± 4) hours

After irradiation, these five test pieces are to be subjected to the tensile test according to EN ISO 527-3, at a speed of 5-6 mm/min.

Validation criteria: $\Delta X_{mean} \geq 0{,}75$ for elongation and breaking stress

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.15.1.5 Elastic modulus of the bonding sealant

Five test pieces shall be manufactured as type-5 test pieces according to EN ISO 527-3, with all the test pieces having a thickness of (2,2 ± 0,2) mm. The assessment method is described in EN ISO 527-3, with a speed of (5 ± 0,5) mm/min.

The manufacturer provides the modulus type to be introduced in the calculation, either tangent or secant to the origin. In the latter case, the boundaries of the curve (deformation, stress ($\varepsilon_1$, $\sigma_1$), ($\varepsilon_2$, $\sigma_2$)) between which the calculation modulus is to be performed should also be given.

The maximum relative elongation allowed in the calculation shall be that corresponding to the upper boundary used to determine the calculation modulus.

The records shall contain the graphs (deformation, stress) for each sample.

<u>*E* value resulting from the assessment</u>

As a function of the type of curve obtained (a, b, c, d according to Figure 1 of EN ISO 527-1), the following pairs of values will be given ($\varepsilon_1$, $\sigma_1$), ($\varepsilon_2$, $\sigma_2$), ($\varepsilon_m$, $\sigma_m$), ($\varepsilon_y$, $\sigma_y$), ($\varepsilon_B$, $\sigma_B$). The calculation modulus: $E = \frac{\sigma_2 - \sigma_1}{\varepsilon_2 - \varepsilon_1}$

The ETA shall state the elastic modulus, tangent to the origin (MPa) and corresponding maximum relative elongation, or the elastic modulus, secant to the origin (MPa) and upper and lower deformation (%) and stress (MPa).

2.2.15.1.6 Facade cleaning agents

The aim of this test is to assess the effect of cleaning agents on the bond.

The test pieces are immersed for 21 days in the cleaning agent(s) (as used in practice) and stored at a temperature of (45 ± 2) °C.

After conditioning, the test pieces are removed from the cleaning agents and further conditioned for (24 ± 4) hours at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity. They are then subjected to tensile tests in accordance with this EAD, clause 2.2.14.3.2.

Validation criteria:

- $\Delta X_{mean} = \frac{X_{mean,c}}{X_{mean,23°C}}$ with $\Delta X_{mean} \geq 0{,}75$ and

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

- Rupture ≥ 90% cohesive; the type of rupture shall be recorded.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.15.1.7 Effects of materials in contact

2.2.15.1.7.1 Assessment method

The stability of a bonded glazing kit may be affected by incompatibility between the bonding sealant and other materials, which may be indicated by discoloration of one of the materials. The following test is designed to investigate this interaction.

It is vital for the test pieces to be prepared with all the material specifications used in the kit, such as bonding sealant, weather sealant, spacer materials, aluminium and glazing, as well as manufacturing materials, such as preparatory and cleaning products.

Two test methods are proposed to assess compatibility. Taking into consideration the risk of UV exposure in service, the most appropriate method is to be selected in regard to the intended use in agreement between the TAB and the manufacturer.

*Method without UV*

Seven test pieces are produced as shown in Figure 2.2.15.1.7.1.1 and conditioned at a temperature of (60 ± 2) °C and (95 ± 5) % relative humidity, five for 28 days and the remaining two for 56 days.

Special care is taken to produce symmetrical test pieces. The sequence of operations when producing the samples reproduces that used in practice.

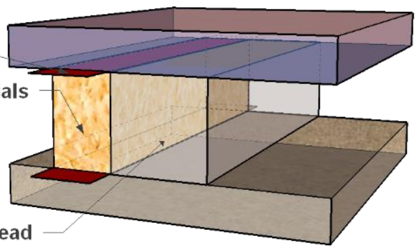



**Figure 2.2.15.1.7.1.1 – Typical sample for compatibility test**

The samples are tested as follows:

Mechanical strength: Five test pieces shall be subjected to the tensile test in accordance with this EAD, clause 2.2.14.3.2, after 28 days conditioning. The material to be tested for compatibility should be removed before the tensile test so that the results relate only to the bond between the bonding sealant and glass and to the bonding sealant itself.

If the two materials in the samples cannot be separated without damage, it will be necessary to take five additional samples and test these, as controls, with the secondary material in place and without conditioning.

Effect on colour: Two test pieces shall be examined for discoloration every 14 days throughout the 56-day conditioning period. The ETA shall state whether the colour has changed.

*a)* *Method with UV*

Assessment method

Five test pieces shall be made as shown in this EAD, Figure 2.2.15.1.7.1.2.

Products 2 and 3 are sealants with which compatibility with product nº1 is being checked. It may be necessary in some cases to conduct this test with a pale colour sealant specially supplied for this purpose, in order to ensure that any migration is visible. The pale colour sealant shall have the same curing kit as the product normally used.

After 1 to 3 days of curing of the various products, the test pieces are submitted to irradiation using a UV lamp.

- Type of lamp: Xenon (EN ISO 4892-2) or equivalent

- Power: (60 ± 5) W/m² measured at the level of the sample, and between 300 and 400 nm
- Temperature: (60 ± 2) °C
- Duration: (504 ± 4) hours

If adhesion has occurred between products n 1 and 2, or 1 and 3, a clean incision shall be made to separate them.

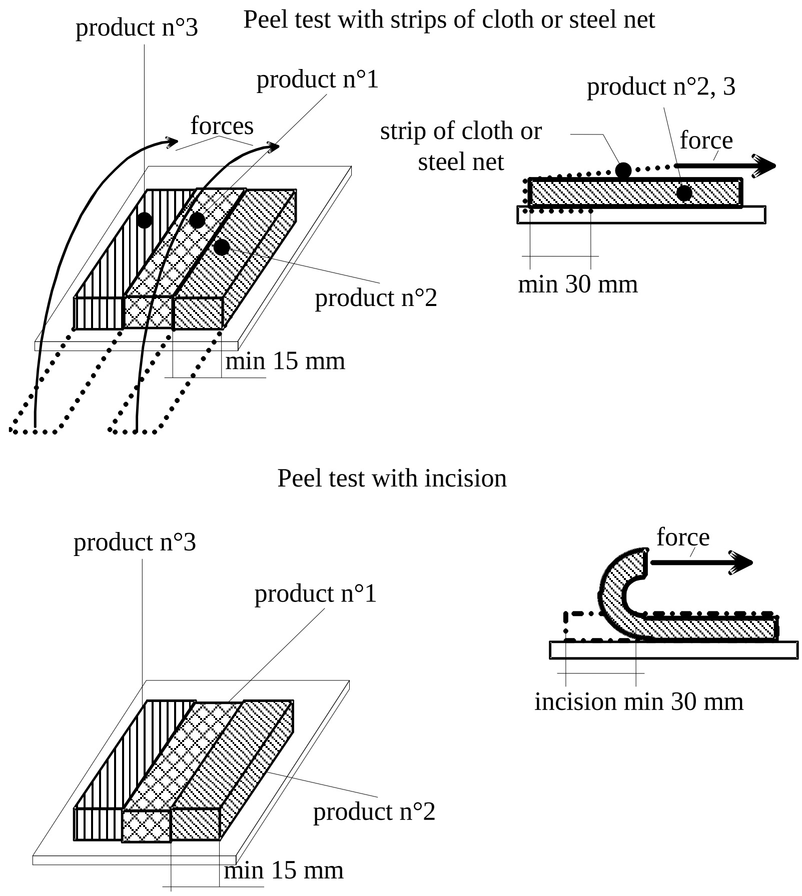



**Figure 2.2.15.1.7.1.2 – Peel test - alternatives**

*Peel test with strips of cloth/steel net:*

The samples are placed in a tensile test machine and the embedded cloth or steel net is peeled back at 180° to the substrate.

*Peel test with incisions:*

Clean incisions are made at the interface of the substrate and products 2 and 3.

The sealant beads are manually peeled back at 180° to the substrate.

Any signs of staining in the pale coloured sealant are noted.

2.2.15.1.7.2 Validation criteria (see this EAD, clause 2.2.14.2)

*Method a without UV:*

The ETA shall state that the materials are compatible if

- No discoloration occurs,
- $R_{u,5}$ after conditioning > 0,85 $R_{u,5}$ initial, and
- Rupture: 90% cohesive

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

*Method b with UV:*

The ETA shall state that the materials are compatible if

- After exposure, compatibility is determined by observation for discoloration with normal corrected vision, and
- Peel test requirement: no adhesion ruptures permitted during the peel test

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.15.1.8 Resistance to tearing

2.2.15.1.8.1 General

The aim of this test is to establish the mode of propagation of a cut in the bond.

2.2.15.1.8.2 Assessment method

Five test samples shall be produced and cut at the ends of the bond as shown in this EAD, Figure 2.2.15.1.8.2.1. The (5 ± 0,5) mm incisions are located in the middle of the height (b) and shall be clean, without removal of material. The samples shall then be subjected to a tensile test in accordance with this EAD, clause 2.2.14.3.2.

The average breaking stress for the reduced measured surface (e.g., 40 x 12 = 480 mm$^2$) is calculated.

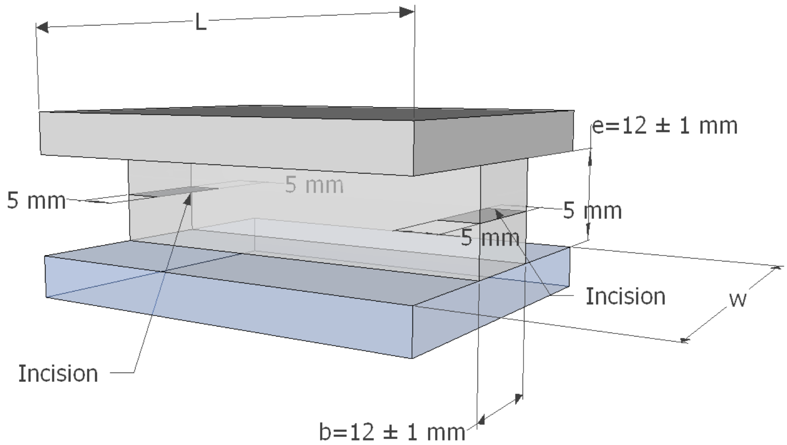



**Figure 2.2.15.1.8.2.1 – Sample for incision test**

2.2.15.1.8.3 Validation criteria (see this EAD, clause 2.2.14.2)

The ETA shall state that the bond resists tearing, for the given use category, if

- Use category A: $\Delta X_{mean} \geq 0{,}75$ kit with insert in the bonding sealant (e.g., mechanical self-weight support, safety devices, and other elements as relevant…)
- Use category B : $\Delta X_{mean} \geq 0{,}50$ kit without insert in the bonding sealant (section of the sealant bead is continuous and may not be interrupted by safety devices)

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.15.1.9 Mechanical fatigue

2.2.15.1.9.1 Assessment method

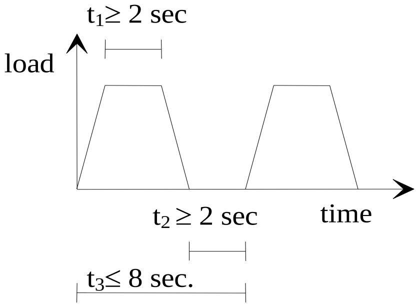
The aim of this test is to examine the effect of fatigue stresses on the residual mechanical strength of the sealant bond.

Ten test pieces in accordance with this EAD, Figure 2.2.14.1.1, are to be conditioned for 28 days at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity.

The test pieces are then to be subjected in room conditions ((23 ± 2) °C and (50 ± 5) %) to repetitive tensile loads with a cycle time of 6 seconds (see this EAD, Figure 2.2.15.1.9.1.1):

- 100 times from 0.1 $\sigma_{des}$ to the design stress $\sigma_{des}$
- 250 times from 0.1 $\sigma_{des}$ to 0.8 x the design stress $\sigma_{des}$
- 5000 times from 0.1 $\sigma_{des}$ to 0.6 x the design stress $\sigma_{des}$

where $\sigma_{des} = R_{u,5} \backslash \gamma_M$ (see clause 2.2.14.3, with $R_{u,5}$ at 23°C)




With:
"$t_1$": duration of the peak load,
"$t_2$": rest time,
"$t_3$": total time of the cycle

**Figure 2.2.15.1.9.1.1 – Stress cycle for fatigue test**

After cycling, the bonds shall be visually inspected.

The ten test pieces shall then be conditioned for a further (24 ± 4) hours at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity, and then subjected to the tensile test in accordance with this EAD, clause 2.2.14.3.

Validation criteria: $\Delta X_{mean} \geq 0{,}75$ and rupture ≥ 90% cohesive

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

2.2.15.1.10 Creep under long-term shear and cyclic tensile loading

The aim of this test is to evaluate the creep under long term shear and tensile loading.

2.2.15.1.10.1 Assessment method

*a)* *Test specimen*

Three test pieces (as illustrated in Figure 2.2.15.1.10.1.1) shall be assembled by the manufacturer or in accordance with his instructions. The glass support thickness shall be ≥ 6 mm. The sample dimension "*e*" (see in Figure 2.2.15.1.10.1.1) is to be provided by the sealant manufacturer.

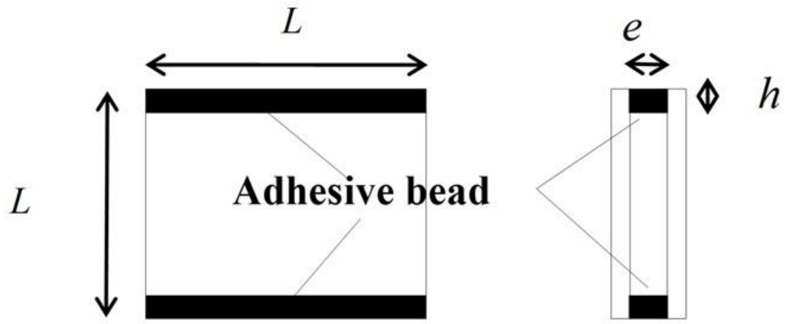



**Figure 2.2.15.1.10.1.1 – Sample geometry**

*b)* *Assessment method*

All the test samples shall be conditioned for 28 days after manufacture at a temperature of (23 ± 2) °C.

The creep test is performed at room climatic conditions ((21 ± 1) °C and R.H. (50 ± 5) %).

Loading (see this EAD, Figure 2.2.15.1.10.1.2)

- Tensile loading

The three test pieces are subjected to tensile loading $M_1$ with loading steps of:

$$M_1 = 2 \cdot h \cdot L \cdot P_t; \text{ with } L = 200 \text{ mm}, h = 9 \text{ mm}$$

$$M_1 = 3600. P_t$$

$$P_t = 0{,}3 \times \sigma_{des.} \text{ for 91 days}$$

and $\sigma_{des} = R_{u,5}/\gamma_M$ with $R_{u,5}$ set at 23°C, see clause 2.2.14.3.2.

- Permanent shear loading

Simultaneous with the tensile loading above, the samples shall be loaded with a weight $M_2$ calculated on the basis of the permanent shear stress provided by the manufacturer $\Gamma_\infty$, t

$$M_2 = 2 \cdot h \cdot L \cdot \Gamma_\infty; \text{ with } h = 9 \text{ mm}, L = 200 \text{ mm}$$

$$M_2 = 3600 \cdot \Gamma_\infty$$

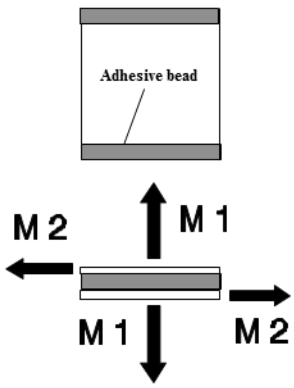



**Figure 2.2.15.1.10.1.2 – Loading principle**

Test duration

The overall duration of the test shall be 91 days, and the interval time for creep measurements 1 day, 3 days, 7 days, then every 7 days after the loading steps. Measurements shall be made on the loaded sample.

The following shall be recorded:

- The date and time the test started
- The temperature and relative humidity during the period of initial conditioning
- The creep evolution at 1 day, 3 days, 7 days, then every 7 days after the loading steps
- The deformation after 91 days before unloading
- The residual deformation 24 hours after unloading

2.2.15.1.10.2 Validation criteria

This test allows to characterise the shear $\Gamma_\infty$ under long time loading:

- For all samples, the maximum relative horizontal displacement 24 hours after unloading is 0,1 mm.
- Movement shall be stabilised after 91 days
- The maximum movement measured before unloading shall be compatible with that which the kit can accommodate.
- "*e*" (see Figure 2.2.15.1.10.1.1) is the maximum bead width.

Note: The criteria above reflect the limitation of the scope of the EAD (see 1.1).

### 2.2.16 Mechanical devices

2.2.16.1 Test of the strength of infill supports

2.2.16.1.1.1 Assessment method

Normally, the structural adequacy of such supports is assessed using conventional calculations based upon the strength of the materials, and testing will not be required. If the design incorporates novel features, the following the EN 17146 can be used. Remark: the supporting devices shall not cause any damage to the glass.

2.2.16.2 Test of the anchorage of the bonding sealant support frame to the facade structure

2.2.16.2.1 Assessment method

Normally, these fixings may be assessed by conventional calculation (usually FEM calculation). If the design precludes this, one of the following tests may be used. Conventional calculation (usually FEM calculation) and the testing methods are equivalent assessments.

Definitions applicable to both methods:

- $F_c$ =force applied during the cycling test
- $\gamma$ = load scenario factor
- $F_{u,5}$ =the characteristic force giving 75% confidence that 95% of the test results will be higher than this value
- $F_{mean}$ =the mean breaking force
- $\tau_{\alpha ß}$ = eccentricity of 5% with 75% confidence
- $s$ = the standard deviation of the series under consideration
- $P_{br,n}$ =breaking pressure, initial state
- $P_{br,c}$ =breaking pressure, after ageing test
- $\gamma_G$ =dead load partial factor

a) Method I

The test apparatus shall accurately reproduce the manner in which the fixing is loaded.

- For metallic anchorages, or when $\gamma = 3$ is required by the applicant, only a static test shall be conducted.

Static test:

- Five anchorages shall be submitted to tension until breaking, using a tension speed of 1 mm ± 0,5 minute
- The characteristic static breaking force $F_{u,5}$ value shall be calculated using the formula:
- $F_{u,5} = F_{mean} - \tau_{\alpha ß} . s$ where $\tau_{\alpha ß}$ = 2,46 (see Table 2.2.14.2.1)
- $F_c = F_{u,5} / \gamma$

- For other anchorages, or when $2 \leq \gamma \leq 3$ is required by the applicant, a static and dynamic test shall be conducted.

Static test:

See above static test for metallic anchorage with $\gamma = 3$

Dynamic test:

Five anchorages shall be subjected to repetitive tensile loads with the cycle described in Figure 2.2.16.2.1.1, as follows:

- 100 times from 0,1 x $F_c$ to $F_c$
- 250 times from 0,1 x $F_c$ to 0,8 x $F_c$
- 5000 times from 0,1 x $F_c$ to 0,6 x $F_c$

(for the description of the cycle, see this EAD, Figure 2.2.15.1.9.1.1).

b) Method II

When it is impossible to separately test the anchorage of the bonding sealant support frame to the facade structure, the anchorage can be tested on a glazed test assembly as shown in this EAD, Figure 2.2.16.2.1.1.

When the anchorage is designed to also handle the dead load as well as the wind, the test sample will be submitted to the maximum dead load allowed at each anchorage. If a dead load partial factor is used in the determination of the maximum dead load allowed at each anchorage, this shall be stated in the ETA, including its' value.

*Static pressure to rupture:*

One assembly equipped with four anchorages on a pressure test wall shall be exposed to pressure to the point of rupture. The pressure shall always simulate external suction. $P_{br,n}$ is the rupture pressure. The sample is preferably a square.

*Dynamic test:*

A second sample shall be subjected to fatigue cycles, as follows:

- 20 times from 0,1 x $P_{br,n}$ to 0,75 $P_{br,n}$; gust of max. 8 seconds, gust cycle, see Figure 2.2.15.1.9.1.1
- 200 times from 0,1 x $P_{br,n}$ to 0,50 x $P_{br,n}$; gust of max. 8 seconds, gust cycle, see Figure 2.2.16.2.1.1
- 200,000 times from 0,1 x $P_{br,n}$ to 0,25 x $P_{br,n}$; gust of 1 second, no particular cycle required
- 1 time from 0,1 x $P_{br,n}$ to 0,9 x $P_{br,n}$; 0.9 x $P_{br,n}$ is the cycle peak value, no particular cycle required

After the dynamic test, the static test to rupture is conducted on the second sample in order to determine $P_{br,c}$

If the criterion $P_{br,c} / P_{br,n} \geq 0,75$ is met, $F_{des}$ is defined as follows:

$F_{des} = P_{br,n}$ x a²/ 4 x $\gamma$ where $\gamma \geq 2$ and 'a' = side of the rig, see this EAD, Figure 2.2.16.2.1.1.

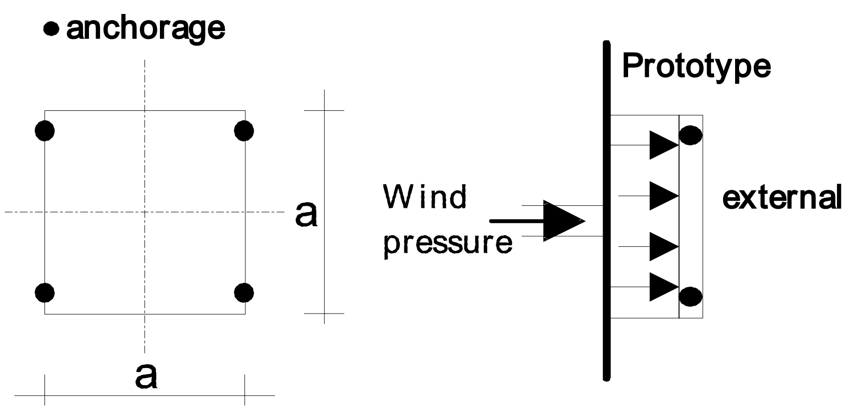



**Figure 2.2.16.2.1.1 – Test assembly for Method II**

2.2.16.2.2 Validation criteria

The ETA shall state the design resistance of the anchorage of the bonding sealant support frame to the façade structure $F_c$.

### 2.2.17 Support frame consisting in a metal profile with thermal barrier

The metal profile with thermal barrier shall be tested in accordance with EN 14024.

### 2.2.18 Acoustic insulation

The acoustic insulation of a facade will be governed by the design (size of the glazed elements, presence of opening lights, type and width of glazing, etc.) and the installation (air tightness, etc.).

No standardised calculation method or model has been established at present with which to determine the acoustic insulation of a facade. However, a number of methods of calculation are available based on the fundamental mathematical laws concerned with acoustic insulation, i.e., the laws of mass and frequencies, etc.

These methods generally are complicated, and the result obtained on site is greatly influenced by the care taken in assembly of the facade.

The assessment shall be performed in accordance with EN ISO 10140-3, the rating of sound insulation and presentation of the result in the ETA shall be done according to EN ISO 717-1.

### 2.2.19 Thermal insulation

2.2.19.1 General

Taking into consideration the typical detail shown in this EAD, Figure 1.3.1, it is necessary to allow for a number of materials and their interactions, resulting in a number of different U (thermal transmittance) values.

2.2.19.2 Assessment method

Thermal insulation and/or susceptibility to condensation may be determined by test or calculation, as follows:

a) Aggregate test method

This method involves determining the laboratory steady-state thermal transmission properties of building components for industrial use according to EN ISO 12567-1 or EN ISO 12567-2 and/or EN 12412-2 or EN 12412-4.

b) Calculation method

Thermal modelling of a bonded glazing kit may be done using thermal conductivity ($\lambda$) values determined by the relevant European methods in conjunction with various computer applications. For the results of these programmes to be useable, the programmes shall be at least two-dimensional and cover all the required parameters. The thermal insulation of a bonded glazing kit window shall be calculated according to EN ISO 10077-2, using detailed thermal bridges calculated according to EN ISO 10211 and heat transfer coefficients calculated according to EN 13789. The thermal insulation of a bonded glazing kit curtain wall shall be calculated according to EN ISO 12631 using detailed thermal bridges calculated according to EN ISO 10211 and heat transfer coefficients calculated according to EN 13789.

c) Susceptibility to condensation

Susceptibility to condensation shall be assessed in accordance with EN ISO 13788, Annex D.

2.2.19.3 Validation criteria

Aggregate or calculation method / susceptibility to condensation: The results are expressed in accordance with the relevant clause(s) given in the standard(s) of the chosen method. When the number of component combinations is too large, the necessary information may be given in the ETA to allow determination of performance.

# 3 ASSESSMENT AND VERIFICATION OF CONSISTANCY OF PERFORMANCE

## 3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by the EAD, the applicable European legal act is Commission Decision 96/582/EC.

The systems to be applied are laid down as here after

- Bonded glazing kits - Types II and IV: system 1
- Bonded glazing kits - Types I and III: system 2+
- Bonding sealant: system 1

## 3.2 Tasks of the manufacturer

### 3.2.1 Factory production control bonding sealant

The cornerstones of the actions to be undertaken by the manufacturer of the bonding sealant in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

**Table 3.2.1 – Control plan for the bonding sealant manufacturer; cornerstones**

| N° | Subject/type of control | Test or control method | Criteria, if any | Minimum frequency of control |
|---|---|---|---|---|
| **Factory production control (FPC)** | | | | |
| 1 | Quality management (system) | See clause 3.4.1 | - | - |
| 2 | Incoming material | Declaration of conformity or tests according to quality manual | Manufacturer's prescriptions | Every delivery |
| 3 | Testing during production | According to quality manual | Manufacturer's prescription | According quality manual |
| **Factory production control (FPC): testing on the final products - H-pieces** | | | | |
| 4 | Test on the cured bonding sealant | See clause 3.4.1 | See clause 3.4.1 | See clause 3.4.1 |

### 3.2.2 Factory production control on bonded glazing kit

The corner stones of the actions to be undertaken by the manufacturer of bonded glazing kits in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.2.

**Table 3.2.2 – Control plan for the bonded glazing kit; cornerstones**

| N° | Subject/type of control | Test or control method | Criteria, if any* | Minimum frequency of control |
|---|---|---|---|---|
| **Factory production control (FPC)** | | | | |
| **Incoming material** | | | | |
| 1 | Bonding sealant | See Table 3.2.1 | | |
| 2 | Anodised aluminium<br>• Admittance<br>• The thickness of the aluminium oxide layer<br>• The level of sealing, i.e. the level of surface porosity. | Same method as during the TT<br>clause 3.4.3 | Manufacturer's prescriptions | Once per batch (adhesion surface anodized of aluminium profiles group anodised in the same bath at the same time for one day maximum) |
| 3 | Stainless steel | Same alloy and state of surface than the one used for TT | The certificate provided by the stainless steel producer | Once per delivery |
| 4 | Clear float glass | EN 572-1<br>No additional verification required | | - |
| 5 | Coated glass | No specific test is required. The coated glass delivery shall be accompanied by a declaration related to the coated glass class | Classes A, B, S according to the EN 1096 series | Once per delivery |
| 6 | Insulated glass | No specific test is required.<br>Each delivery is documented according clause 3.4.2 | | Once per delivery |
| **Suitability tests** | | | | |
| 7 | Suitability tests | See clause 3.4.3 | See clause 3.4.3 | See clause 3.4.3 |
| **Testing during production** | | | | |
| 8 | Testing during production | See clause 3.4.4 | See clause 3.4.4 | See clause 3.4.4 |
| **Testing on the final production** | | | | |
| 9 | Testing on the final product | See clause 3.4.5 | See clause 3.4.5 | See clause 3.4.5 |
| * In case the FPC requirement corresponds with characteristics of components covered by other harmonised technical specifications and performance has already been declared by the component manufacturers in their DoP, as far as the intended use corresponds with the one specified in this EAD, the kit manufacturer is not required to re-assess the characteristic. | | | | |

## 3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for bonding sealant and BONDED GLAZING KIT are laid down in Table 3.3.1,

**Table 3.3.1 – Control plan for the notified body; cornerstones**

| N° | Subject/type of control | Test or control method | Criteria, if any | Minimum number of samples | Minimum frequency of control |
|---|---|---|---|---|---|
| **Initial inspection of the manufacturing plant and of factory production control** | | | | | |
| 1 | The notified body shall verify ability of the manufacturer for a continuous and orderly manufacturing of the product. In particular, the following items shall be appropriately considered<br>– personnel and equipment<br>– the suitability of the factory production control established by the manufacturer<br>– full implementation of the prescribed test plan | As defined in the control plan, based on clause 3.2 | As defined in the control plan, based on clause 3.2 | As defined in the control plan, based on clause 3.2 | *When starting the production, after starting a new production line or after modifications of production processes* |
| 2 | Assessment of technical data | As defined in the control plan, based on clause 2 | As defined in the control plan, based on clause 2 | As defined in the control plan, based on clause 2 | |
| **Continuous surveillance, assessment and evaluation of factory production control** | | | | | |
| 3 | Results of FPC | As defined in the control plan, based on clause 3.2 | As defined in the control plan, based on clause 3.2 | As defined in the control plan, based on clause 3.2 | Twice per year |

## 3.4 Special methods of control and testing used for the verification of constancy of performance

### 3.4.1 Test on the cured bonding sealant

3.4.1.1 Input data for testing the bonding sealant

See Annex D.1

3.4.1.2 Adhesion-cohesion under tension to rupture

On each batch of bonding sealant (production in one run, which may involve several barrels)

Adhesion-cohesion under tension to rupture, on float glass and on a reference metal (aluminium or stainless steel).

3.4.1.2.1 Test method

Six test pieces in the case of conditioning C1, or nine test pieces in case of conditioning C2, in accordance with Figure 2.2.14.1.1, are manufactured and stored according to the bonding sealant manufacturer's instructions.

Three test pieces are then subjected to a tensile test to rupture.

The remaining test pieces are subjected to one of 2 alternative conditionings:

- C1: 3 test pieces - immersion in water at (95 ± 2) °C for 24 hours.

or

- C2:
- 3 test pieces: immersion in water at (23 ± 2)°C for 7 days
- 3 test pieces: in an oven at (100 ± 2)°C for 7 days

They are then conditioned for (48 ± 4) hours at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity. The conditioned test pieces C1 or C2 are then subjected to the tensile tests to rupture.

3.4.1.2.2 Treatment of results and requirements

**Table 3.4.1.2.2.1 – Treatment of results**

| Tests | Treatment of results |
|---|---|
| For C1 (3 test pieces) or for C2 (6 test pieces) | Rupture 90% cohesive |
| Adhesion-cohesion under tension to rupture before and after immersion in water | Rupture value to be checked and noted. The minimum rupture value under the defined test conditions (T°, R.H., …) is to be provided by the bonding sealant manufacturer. |

### 3.4.2 Insulating glass units documentation

No specific test by the ETA holder is required.

However, the kit manufacturer shall ensure to have sufficient information about the IGU specifications. This relates to the IGU specifications of the supplier so that IGUs may be manufactured in accordance with the ETA, at least as listed here after:

*If the bonding sealant bead to the bonding sealant support frame is on the face 2 of the IGU:*

- The list of IGU sealant(s) compatible with the bonded glazing kit,
- The dimensional tolerances (in relation to the essential requirements) applicable to the IGU,
- Essential characteristics, in deviation from EN 1279-1,
- …

*If the bonding sealant bond to the metal frame is on another face then the face 2 of the IGU:*

- $R_{u,5}$, the characteristic breaking stress of the IGU bonding sealant(s),
- Dimensions and tolerances of the bite of the bonded edge seal or the detailed calculation method for the bite of the bonding edge seal, its permissible tolerance and the value of the variable to be used in the calculation method.
- The list of coatings to which the bonding sealant can be applied (on faces 2, 3 of the IGU)
- The list of the coatings to which the bonding sealant can be applied (on stepped IGU face 2, non-stepped IGU face 4),
- others, …

The technical file accompanying the IGU delivery shall include:

- A confirmation that the IGUs are manufactured in accordance with the EN 1279 series

- A confirmation that the IGUs are manufactured in accordance with ETA specifications provided by the ETA holder:

Additionally, if the bonding sealant bead to the bonding sealant support frame is on another face then the face 2 of the IGU:

- A summary of the test records collected during the factory production control of the IGU:
- The test programme shall either conform to Table 3.4.4.1 (Table 3.4.4.1, point 3, in this case not relevant), or it shall be as described in EN 1279-6:2018, Annex D, with the following modifications:
- Sample
  Geometry: described in EN 1279-6:2018, Annex D fig D.2, "glass, glass sample"
  The glass samples shall be coated for the present project.
- The Assessment method: EN 1279-6:2018, Annex D, clause D.2.3, shall be modified as follows:
  The tensile test shall be continued until rupture of the sample.
  Minimum requirement: rupture 90% cohesive.
  Rupture value to be checked and noted. The minimum rupture value under the defined test conditions (T°, R.H., …) shall be provided by the sealant manufacturer.
  Special delivery conditions may demand that the above requirement be set at a higher level.
  Frequency: Three samples in the morning, three in the afternoon and three samples at each packaging change (each time a component to be assembled comes from a different package, e.g. for the sealant, each time a new barrel is opened)

### 3.4.3 Checks on suitability for bonding of the bonding bead on substrates

#### 3.4.3.1 Characterisation of the components

For the bonding sealant: see Annex D.1

For the anodised aluminium: see Annex D.2

For the glass: see Annex D.3

For stainless steel see Annex D.4

#### 3.4.3.2 Adhesion-cohesion under tension to rupture on anodised aluminium substrates

These tests are to be performed prior to bonding runs on each batch of aluminium anodising. Normally, the result of these checks remains valid for 6 months from the anodising date if the aluminium is stored in dry conditions (relative humidity ≤ 60%). If not stored in suitable conditions, the test in clause 3.4.1.2.1 shall be conducted.

Adhesion-cohesion under tension to rupture of one reference batch of the bonding sealant referred to in the ETA and on each bath of aluminium (e.g., group of aluminium profiles anodised in the same bath at the same time for one-day maximum)

#### 3.4.3.3 Test method

See clause 3.4.1.2.1

#### 3.4.3.4 Treatment of results and requirements

See clause 3.4.1.2.2

### 3.4.4 Checks during the application of the bonding sealant.

**Table 3.4.4.1 – Checks over a two-day production cycle**

| **Production date:** | **Company:** | | **Project reference:** | | |
|---|---|---|---|---|---|
| | **$1^{st}$, $3^{rd}$ and $5^{th}$ day** | | **$2^{nd}$, $4^{th}$ and $6^{th}$ day** | | **Packaging change** |
| | **Morning** | **Afternoon** | **Morning** | **Afternoon** | |
| <u>1. General</u><br>extrusion machine cleaning (1) | reference to cleaning solvent | not applicable | not applicable | not applicable | reference to cleaning solvent |
| temperature (°C) | value | value | value | value | not applicable |
| relative humidity (%) | value | value | value | value | not applicable |
| <u>2. Bonding sealant</u><br>silicone lot number<br>for 2 comp, base + catalyst | reference | not applicable | reference | not applicable | reference |
| base / catalyst ratio (1), (3) | ratio value | ratio value | ratio value | ratio value | ratio value |
| glass plate (marble) test (1), (2) | pass/fail | pass/fail | pass/fail | pass/fail | pass/fail |
| <u>3. Metal</u><br>type<br>lot number<br>surface finishing | <br>alloy<br>reference<br>type | <br>not applicable<br>not applicable<br>not applicable | <br>not applicable<br>not applicable<br>not applicable | <br>not applicable<br>not applicable<br>not applicable | <br>alloy<br>reference<br>type |
| cleaning product name and lot number | reference | not applicable | not applicable | not applicable | reference |
| if any - primer name and lot number | reference | not applicable | not applicable | not applicable | reference |
| <u>4. Glass</u><br>surface finishing (5) | <br>coating reference | <br>not applicable | <br>not applicable | <br>not applicable | <br>coating reference |
| cleaning product name and lot number | reference | not applicable | not applicable | not applicable | reference |
| if any - primer name and lot number | reference | not applicable | not applicable | not applicable | reference |
| <u>5. Adhesion testing on H - pieces</u> (4)<br>sample 1<br>curing time: …<br>rupture ≥ 90% cohesive<br>rupture 100% cohesive<br>tensile strength (N) | <u>H - pieces</u> (4)<br>value<br>pass/fail<br>not applicable<br>value | <u>Peel test</u> (6)<br>on glass<br>value<br>not applicable<br>pass/fail<br>not applicable | <u>Peel test</u> (6)<br>on glass<br>value<br>not applicable<br>pass/fail<br>not applicable | <u>Peel test</u> (6)<br>on glass<br>value<br>not applicable<br>pass/fail<br>not applicable | <u>H - pieces</u><br>(4)<br><br>value<br>pass/fail<br>not applicable<br>value |
| sample 2<br>curing time: …<br>rupture ≥ 90% cohesive<br>rupture 100% cohesive<br>tensile strength (N) | <br>value<br>pass/fail<br>not applicable<br>value | on metal<br>value<br>not applicable<br>pass/fail<br>not applicable | on metal<br>value<br>not applicable<br>pass/fail<br>not applicable | on metal<br>value<br>not applicable<br>pass/fail<br>not applicable | <br>value<br>pass/fail<br>not applicable<br>value |
| sample 3<br>curing time: …<br>rupture ≥ 90% cohesive<br>rupture 100% cohesive<br>tensile strength (N) | <br>value<br>pass/fail<br>not applicable<br>value | not applicable | not applicable | not applicable | <br>value<br>pass/fail<br>not applicable<br>value |
| *(1) Only for two-component silicones bonding sealants* | | | | | |

| Production date: | Company: | | Project reference: | | |
|---|---|---|---|---|---|
| | 1st, 3rd and 5th day | | 2nd, 4th and 6th day | | Packaging change |
| | Morning | Afternoon | Morning | Afternoon | |

*(2) The glass plate (marble) test is used to check the homogeneity of the mixture.*
*A quantity of silicone product (mixed by the pump) is placed on one glass plate and squeezed by placing a second glass plate on top. If grey or white traces are visible, this indicates insufficient mixing, in which case bonding shall not commence until further mixing has been done and a successful glass plate test has been conducted.*

*(3) All two-component mixing equipment incorporates two tubes in which small quantities of base and catalyst can be placed to check that the actual mix ratio is compliant.*
*The H pieces are test pieces of silicone (12 x 12 x 50 mm) between two substrates. The samples shall be made with the products actually used in the project (metal and surface finishing, glass and coating, bonding sealant). The coated glass manufacturer shall furnish the bonding company with the samples necessary to allow the bonding company to perform the tests in accordance with Table 3.4.4.1.*
*Shaping of the test pieces can be assisted by e.g. treating wooden blocks with a soap solution to avoid adhesion of the silicone, or with spacer tape with release paper retained in place. With single component sealant, it shall be ensured that spacers are not air and vapour tight; otherwise, curing of the silicone may not take place.*

*(4) The H test pieces are subjected to tensile test to rupture. The minimum rupture value is to be provided by the sealant manufacturer. As soon as the first H test piece obtains a satisfactory result, the remaining test pieces are not tested and are stored for possible further testing.*

*(5) Where a special type of coated thermally-strengthened or heat-strengthened glass is prescribed in the project specifications, testing in accordance with Table 3.4.4.1 is performed with samples of coated float glass.*

*(6) Peel test description*
*The peel test samples shall be made with the products actually used in the project (metal and surface finishing, glass and coating, bonding sealant).*
*The peel test samples are made as follows (see Figure 3.4.4.1):*
*Two short pieces of bond breaker are placed on the substrate, 200 mm apart. A bead of bonding sealant about 25 x 6 x 250 mm in length is extruded between the bond breakers in accordance with Figure 3.4.4.1.*
*The peel test samples shall be stored under the same environmental conditions as the manufactured elements during production.*
*After the minimum curing time as provided by the manufacturer, the bonding sealant bead is peeled as follows:*
*The bead is detached from the substrate at one end and manually peeled back at 180° until rupture of the bead occurs. When rupture occurs, the next peel test is initiated via cuts with a knife at the interface bonding sealant/substrate or at the other end of the bead.*
*Cutting and peeling is repeated until the bead is totally peeled off the substrate.*

*The failure pattern is assessed. 100% cohesive failure is required (adhesive failure is unacceptable – see Figure 3.4.4.2).*

A peel test may always be replaced by tests of H pieces (see point (4) above).

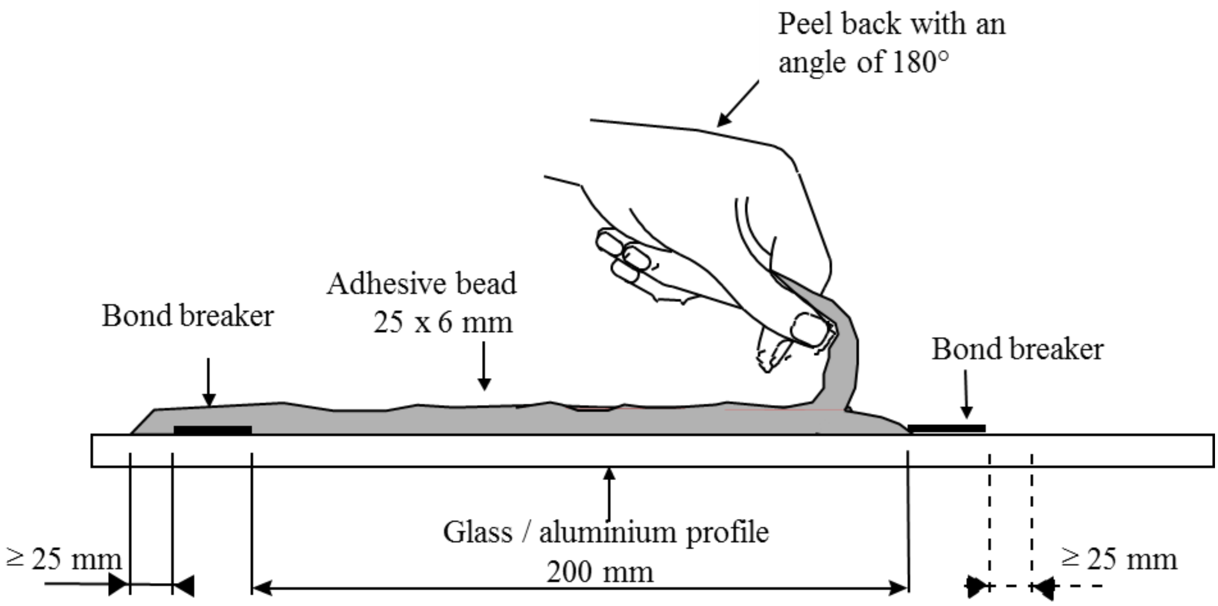



**Figure 3.4.4.1 – Peel test description**

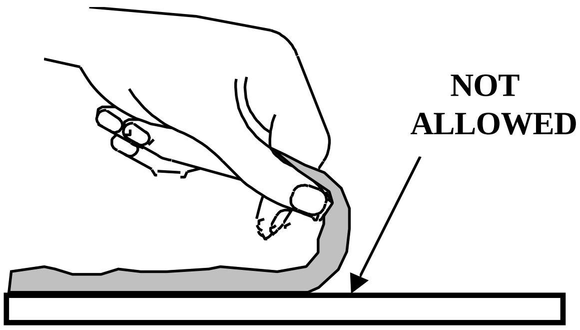



**Figure 3.4.4.2 – Unacceptable failure pattern**

### 3.4.5 Checks on assembled bonded glazing kits elements

The list of checks given below is not exhaustive and may be adapted in each individual case:

- Visual inspection of the finished element (verification that gas inclusions are not present)
- Checks on the joint dimensions
- Glass assembly as a function of the specification
- Relative position of the bonded element
- Correct provision of drainage/pressure equalisation as required by the specification
- Correct fixing of mechanical devices
- Correct provision and placing of spacers, if these are factory fitted

# 4 REFERENCE DOCUMENTS


EN 515:2017 Aluminium and aluminium alloys - Wrought product - Temper designation

EN 572-1:2012+A1:2016 Basic soda lime silicate glass products - Part 2: Float glass

EN 572-2:2012 Basic soda lime silicate glass products - Part 2: Float glass

EN 573-3:2019 Aluminium and aluminium alloys - Chemical composition and form of wrought product - Part 3: Chemical composition

EN 1026:2016 Windows and door - Air permeability - Test method

EN 1027:2016 Windows and door - Watertightness - Test method

EN 1096-1:2012 Glass in building - Coated glass - Part 1: Definitions and classification

EN 1096-2:2012 Glass in building - Coated glass - Part 2: Requirements and test methods for class A, B and S coatings

EN 1096-4:2018 Glass in building - Coated glass - Part 4: Product standard

EN 1191:2012 Windows and doors - Resistance to repeated opening and closing – Test method

EN 1279-1:2018 Glass in building. Insulating glass units. Generalities, system description, rules for substitution, tolerances and visual quality

EN 1279-6:2018 Glass in building - Insulating glass units - Part 6: Factory production control and periodic tests

EN 1863-1:2011 Glass in building - Heat strengthened soda lime silicate glass - Part 1: Definition and description

EN 1863-2:2004 Glass in building - Heat strengthened soda lime silicate glass - Part 2: Evaluation of conformity/Product standard

EN 10088-1:2014 Stainless steels - Part 1: List of stainless steels

EN 10088-2:2014 Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip for general purposes

EN 10088-3:2014 Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes

EN 12150-1:2015+A1:2019 Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description

EN 12150-2:2004 Glass in building - Thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/Product standard

EN 12152:2002 Curtain walling - Air permeability - Performance requirements and classification

EN 12153:2000 Curtain walling - Air permeability - Test method

EN 12154:1999 Curtain walling - Watertightness - Performance requirements and classification

EN 12155:2000 Curtain walling - Watertightness - Laboratory test under static pressure

EN 12179:2000 Curtain walling - Resistance to wind load - Test method

EN 12207:2016 Windows and door - Air permeability – Classification

EN 12208:1999 Windows and doors – Watertightness – Classification

EN 12210:2016 Windows and door – Resistance to wind load – Classification

EN 12211:2016 Windows and doors - Resistance to wind load - Test method

EN 12337-1:2000 Glass in building - Chemically strengthened soda lime silicate glass - Part 1: Definition and description

EN 12337-2:2004 Glass in building - Chemically strengthened soda lime silicate glass - Part 2: Evaluation of conformity / Product standard

EN 12412-2:2003 Thermal performance of windows, doors and shutters - Determination of thermal transmittance by hot box method - Part 2: Frames

EN 12412-4:2003 Thermal performance of windows, doors and shutters - Determination of thermal transmittance by hot box method - Part 4: Roller shutter boxes

EN 13049:2003 Window – Soft and heavy body impact – Test method – Safety requirement and classification

EN 13115:2020 Windows. Classification of mechanical properties. Racking, torsion and operating forces

EN 13116:2001 Curtain walling - Resistance to wind load – Performance requirement

EN 13501-1:2018 Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 13501-2:2016 Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation service

EN 13501-5:2016 Fire classification of construction products and building elements. Classification using data from external fire exposure to roofs tests

EN 13830:2003 Curtain walling - Product standard

EN 14019:2016 Curtain walling – Impact resistance – Performance requirement

EN 14024:2004 Metal profiles with thermal barrier - Mechanical performance - Requirements, proof and tests for assessment

EN 14608:2004 Windows – Determination of the resistance to racking

EN 14609:2004 Windows – Determination of the resistance to static torsion

EN 17146:2018 Determination of the strength of infill supports - Test method and requirements

EN ISO 527-3:2018 Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets

EN ISO 717-1:2013 Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

EN ISO 868:2003 Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)

EN ISO 1183-1:2019 Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method

EN ISO 1463:2004 Metallic and oxide coatings - Measurement of coating thickness - Microscopical method.

EN ISO 2106:2011 Anodizing of aluminium and its alloys - Determination of the mass per unit area (surface density) of anodic oxidation coating - Gravimetric method.

EN ISO 2128:2010 Anodizing of aluminium and its alloys - Determination of the thickness of anodic oxidation coating - Non-destructive measurement by split-beam microscope.

EN ISO 2143:2017 Anodizing of aluminium and its alloys. Estimation of the loss of absorptive power of anodic oxidation coating after sealing by a spot test with prior acid treatment.

EN ISO 2360:2017 Non-conductive coatings on non-magnetic electrically conductive basis materials - Measurement of coating thickness - Amplitude-sensitive eddy current method

EN ISO 2931:2018 Anodizing of aluminium and its alloys - Assessment of the quality of a sealed anodic oxidation coating by measurement of admittance.

EN ISO 3210:2017 Anodizing of aluminium and its alloys - Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in phosphoric acid/chromic acid solution.

EN ISO 4892-2:2013 Methods of exposure to laboratory light sources - Part 2 Xenon-arc source

EN ISO 6341:2012 Water quality - Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea) - Acute toxicity test

EN ISO 7389:2003 Building construction - Jointing products - Determination of elastic recovery of sealants

EN ISO 8339:2005 Building construction - Sealants - Determination of tensile properties (Extension to break)

EN ISO 9227:2017 Corrosion tests in artificial atmosphere - Salt spray tests

EN ISO 10077-2:2017 Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames

EN ISO 10140-3:2010+A1:2015 Acoustics - Laboratory measurement of sound insulation of building elements - Part 3: Measurement of impact sound insulation

EN ISO 10211:2017 Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations

EN ISO 10365:1995 Adhesives - Designation of main failure patterns

EN ISO 10563:2017 Buildings and civil engineering works - Sealants - Determination of change in mass and volume

EN ISO 11348-1:2008+A1:2018 Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 1: Method using freshly prepared bacteria (ISO 11348-1:2007)

EN ISO 11348-2:2008 Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 2: Method using liquid-dried bacteria (ISO 11348-2:2007)

EN ISO 11348-3:2008 Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 3: Method using freeze-dried bacteria (ISO 11348-3:2007)

EN ISO 11358-1:2014 Thermogravimetry of polymers – General Principles

EN ISO 12567-1:2010 Thermal performance of windows and doors - Determination of the thermal transmittance by hot box: method - Part 1: Complete windows and door

EN ISO 12567-2:2005 Thermal performance of windows and doors - Determination of thermal transmittance by hot box method - Part 2: Roof windows and other projecting windows

EN ISO 12631:2017 Thermal performance of curtain walling - Calculation of thermal transmittance

EN ISO 13788:2012 Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods

EN ISO 13789:2017 Thermal performance of buildings - Transmission and ventilation heat transfer coefficients - Calculation method

ISO 4660:2011 Rubber, raw natural - Colour index test

ISO/CIE 11664-4:2019 Colorimetry - CIE 1976 L*a*b* Colour space

ISO 15799:2019 Soil quality - Guidance on the ecotoxicological characterization of soils and soil materials

ISO 16269-6:2014 Statistical interpretation of data - Part 6: Determination of statistical tolerance intervals

CEN/TS 16637-2:2014 Construction products – Assessment of release of dangerous substances – Part 2: Horizontal dynamic surface leaching test

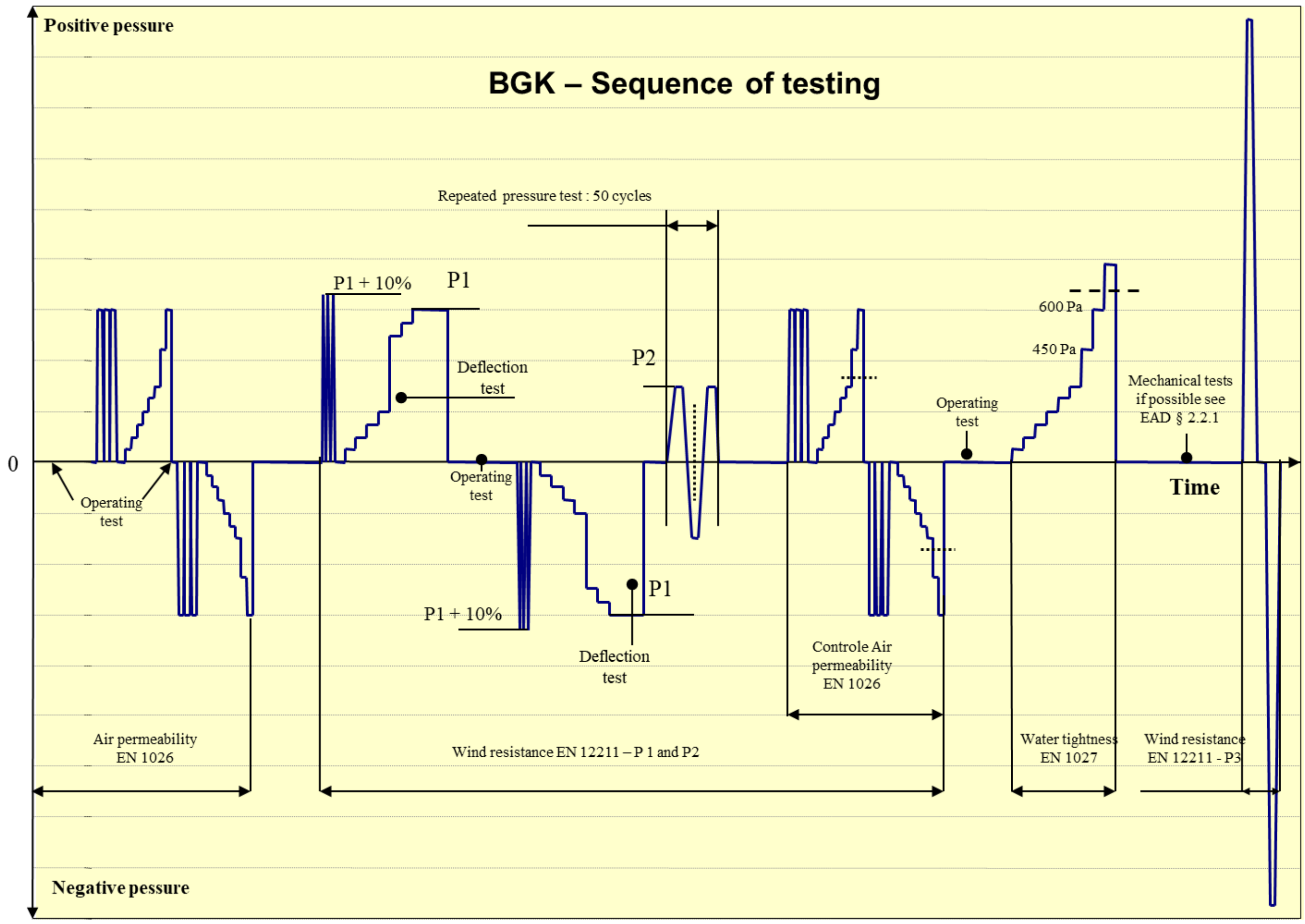
## ANNEX A- TESTING SEQUENCE

The assessment of air permeability and watertightness may require the application of wind load to the sample as a conditioning process (as an integral part of the test sequence described below). The structural effects of wind loading are relevant to BWR4 (Safety in use).

The purpose of these tests is to determine, by using the components of the defined bonded glazing kit, whether it is possible to build a facade fit for purpose with respect to air permeability, watertightness and wind resistance.

If the windows standards are being used, no testing sequence is established by the EN standards. The testing sequence given below, shall then be adopted.

If the curtain walling standards are used, the testing sequence for different performance with respect to air, wind and water is given in EN 13830, clause 5.1.



## ANNEX B – DETERMINATION OF THE SECANT STIFFNESS OF THE BEAD

This annex describes the linearization method for the tension curves. It can be used for the elastic area of the material and for materials with a Poisson's' ratio of approximately 0,5 (normal for sealants used in bonded glazing kits). This method has the following advantages:

- Greater accuracy for the modulus with a reduced number of test samples
- Verification of the relationship between the tensile, compressive and shear stiffness of the same material
- Greater reliability in applying the calculation models

A typical curve of deformation under tension is shown in figure B.1. This curve shows irregularities. Given the application of a certain amount of pre-stressing, determination of the zero point can give rise to difficulties and affect the precision of the stiffness at different elongations. An improvement can be gained by linearizing the curve in the elastic area of the bonding sealant.

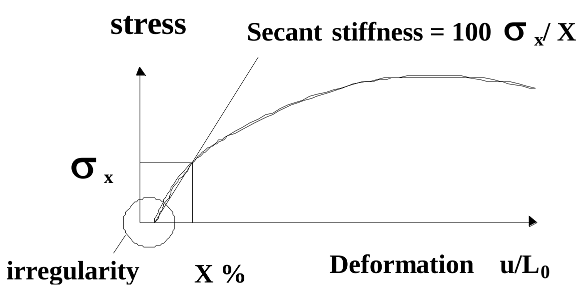



**Figure B.1 – Secant stiffness**

The linearization is produced by a conversion of the deformation. For an initial length ($L_0$) of the test piece and the length of the loaded test piece (L, where L = $L_0$ + deformation), the scale for the deformation is expressed as:

$$\frac{u_c}{L_0} = \frac{(a - 1/a^2)}{3} \quad \text{where } a = L/L_0 \ (^1)$$

When this technique is applied to several points on the curve, a converted line of regression stress/deformation is obtained, the slope of which represents the tangent stiffness ($K_0$) at the origin.

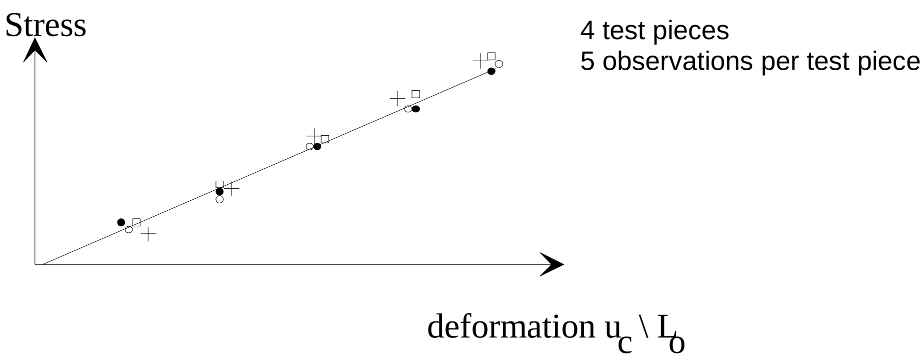



**Figure B.2 – Stress/deformation converted line of regression**

(1) Paul Flory, Principle of polymer chemistry. Cornell Univ. Press, Ithaca, N. Y., USA (1953)

$K_0$ can be calculated directly from the measured points as follows:

$$K_0 = \sum_{i=1}^{m} \sum_{j=1}^{m} \frac{K_{ij}}{m \times n} \text{ with } K_{ij} = \frac{3 \times \sigma_{ij}}{a_{ij} - 1/a_{ij}^2} \text{ ; } a_{ij} = \frac{e_i + u_{ij}}{e_i}$$

where:

- $m$ = number of observations per test piece
- $n$ = number of test pieces per test for the temperature concerned
- $u_{ij}$ = the displacement under tension or compression ($e_i + u_{ij}$ represents $L$)
- $e_i$ = the initial thickness per test piece representing $L_0$
- $\sigma_{ij}$ = the tensile stress at the tensile displacement $u_{ij}$.

The relationships between the tangent stiffness at the origin on one hand and the secant stiffness on the other are defined and given in Table B.1.

**Table B.1 – Conversion of the elongation related to tension or displacement related to compression ($u/L_0$) for values of converted deformation ($u_c/L_0$)**

| $u/L_0$ values | $u_c/L_0$ values = $(a - 1/a^2)/3$ ($a = L/L_0$) |
|---|---|
| 0 | 0 |
| 0,05 | 0,048 |
| 0,10 | 0,091 |
| 0,125 | 0,112 |
| 0,15 | 0,131 |
| 0,20 | 0,169 |
| 0,25 | 0,203 |
| 0,30 | 0,236 |
| 0,35 | 0,267 |
| 0,40 | 0,297 |
| 0,45 | 0,325 |
| 0,50 | 0,352 |
| 0,55 | 0,378 |
| 0,60 | 0,403 |
| 0,65 | 0,428 |
| 0,70 | 0,451 |
| 0,75 | 0,474 |
| 0,80 | 0,497 |
| 0,85 | 0,519 |
| 0,90 | 0,541 |
| 0,95 | 0,562 |
| 1,00 | 0,583 |

The relationship between the secant stiffness and tangent stiffness at the origin is:

$$K_{sec} = K_0 \times \frac{\left(\frac{u_c}{L_0}\right)}{\left(\frac{u}{L_0}\right)}$$

# ANNEX C – PERFORMANCE WITH RESPECT TO AIR PERMEABILITY, WATERTIGHTNESS, WIND RESISTANCE

## C.1 Introduction

The assessment of air permeability and watertightness may require the application of wind load to the sample as a conditioning process; therefore, the wind load test procedure is included here for convenience. The structural effects of wind loading are relevant to BWR4 (Safety in use) and reference to deflection under load is to be included in the ETA.

The purpose of these tests is to determine, by using the components used for the bonded glazing kit, whether it is possible to define a bonded glazing kit with respect to air permeability, watertightness and wind resistance. Exceptionally, kits may be offered for use only where air permeability and watertightness are not claimed (building entrances, covered gangways, etc.). In such cases, tests need not be conducted.

## C.2 The test assembly

The test assembly shall be fully representative of the kit. For example, it shall include an opening light where these are supported by the kit and be designed so that at least one of the elements has the largest surface area for which the drainage arrangements are designed. Tests of a number of separate assemblies or modifications to the original assembly may be necessary in order to include all the declared options, such as inside corners, outside corners and areas of non-vertical glazing. If the use of single – or double – glazing is permissible and the weather sealing details vary as a result, these options shall also be tested.

The sample shown in Figure C.1 is only an example of the possible configurations.

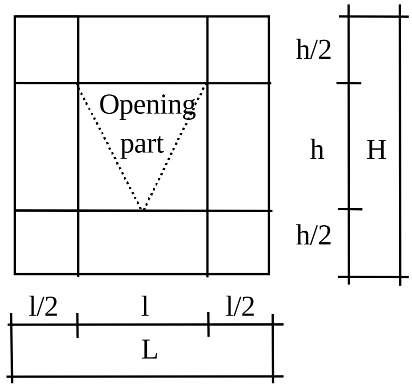



**Figure C.1 – Example of test assembly**

# ANNEX D- INPUT DATA FOR ASSESSMENT METHODS

## D.1 Bonding sealant

### D.1.1 Specific mass

Determination of the specific mass on three specimens in accordance with EN ISO 1183-1.

### D.1.2 Hardness

Measuring shore A hardness in accordance with EN ISO 868.

The measurement shall be carried out on three test pieces after full polymerisation on the air exposed side, i.e.

- After 28 days for single-component silicones
- After 7 days for two-component silicones

### D.1.3 Thermogravimetric analysis

This identification test seeks to determine the products of the thermal decomposition. Losses are quantified as a function of an even temperature increase.

The test shall be carried out on one specimen in accordance with EN ISO 11358-1.

The results are drawn from the graph in well-defined conditions

### D.1.4 Colour

The colour shall be determined in accordance with ISO/CIE 11664-4 or ISO 4660. The ETA shall indicate the method used. If the black and white colours are tested, the all grey shades are covered.

## D.2 Anodised aluminium adhesion surface

### D.2.1 Aluminium alloys

The specification for the aluminium alloy shall be examined in accordance with EN 573-3 and EN 515 for suitability in the bonded glazing kit.

### D.2.2 Anodising characteristics

The aluminium adhesion surface on which the tests in clauses 2.2.14.3 and 2.2.14.4 are to be performed, are identified as follows.

#### D.2.2.1Measuring thickness

Depending on the types of products involved, the possible methods are:

- Eddy current test method according to EN ISO 2360
- Split-beam optical method according to EN ISO 2128
- Microsection method according to EN ISO 1463
- Gravimetric method according to EN ISO 2106

The ETA shall specify the method(s) used; all mentioned methods produce an equivalent and comparable result.

#### D.2.2.2Sealing tests

Depending on the types of products involved, the possible methods are:

- Stain test according to EN ISO 2143
- Immersion test according to EN ISO 3210
- Measurement of admittance test at 1000 Hz according to EN ISO 2931

The ETA shall specify the method(s) used; all mentioned methods produce an equivalent and comparable result.

#### D.2.2.3Description of the anodising process

The applicant provides the TAB with the following information:

D.2.2.3.1 Scouring

- Composition of the bath
- Aluminium bath immersion time

D.2.2.3.2 Anodic oxidation

- Composition of the bath
- Aluminium bath immersion time
- Bath temperature

D.2.2.3.3 Sealing[9] of the anodised layer

- Bath composition or reference name
- Aluminium bath immersion time
- Bath temperature

Where cold sealing is proposed, additional proof shall be provided by the manufacturer.

**D.3 Glass adhesion surface**

D.3.1 Identification of glass

The applicable glass and glass products are identifiable by reference to the various European standards.

The type of glass used to create the samples for the adhesion-cohesion tests in this EAD, clauses 2.2.14.3 and 2.2.14.4, is usually normal float glass. For safety reasons, special types of glass can be required for particular projects. Type of breakage shall be tested according to EN for the type of glass in question.

Possible extrapolation for adhesion between sealant and glass substrates:

When tests in this EAD, clauses 2.2.14.3 and 2.2.14.4, are performed on non-coated float glass according to EN 572-2, the adherence of the glass-bonding sealant can be extrapolated to the type of glass: EN 12150-1 and EN 12150-2 and EN 1863-1 and EN 1863-2.

The present state of the art does not consider chemically toughened soda lime silicate glass (these products are covered by EN 12337-1 and EN 12337-2 to be extrapolatable.

D.3.1.1 Glass products

D.3.1.1.1 Insulated glass unit (IGU)

If double or multiple-glazing units are to be used, these shall be suitable for use in bonded glazing kits. The hermetic seal shall meet the requirements of the relevant standards; if it is required to act as a bond, it shall also prove its adequacy by meeting the requirements of this EAD.

D.3.1.1.2 Laminated safety glass

No supplementary test of the adhesion/cohesion between the bonding sealant and glass substrate used for laminated glass is required

The following exceptions apply:

- Fire resistant laminated glass
- Laminated glass with cast-in-place resin interlayer (e.g., acoustic glazing)

which can be assessed in the framework of a European Technical Assessment.

D.3.1.1.3 Enamelled glass (spandrels):

When applying the bonding sealant bead to enamelled glass, this enamelled glass substrate shall be considered as particular substrate to be tested as follows:

9 The word "sealing" can give rise to a misunderstanding: it is a post-treatment, after anodising. The equivalent in French is "*colmatage*" and in German "*Verdichtung*"

- Clause 2.2.14.3Initial Mechanical Strength
- Clause 2.2.14.3.2Tension, rupture
- Clause 2.2.14.4Residual mechanical strength after artificial ageing
- Clause 2.2.14.4.1Immersion in water at high temperature with or without solar radiation
- Clause2.2.14.4.2Humidity and NaCl atmosphere
- Clause2.2.14.4.3Humidity and $SO_2$ atmosphere
- Clause 2.2.15.1.6Facade cleaning products

Opacified glass with organic resin: These substrates may not be considered suitable substrates for bonded glazing kits. If the opacified organic layer is applied to an inorganic coating, the opacified layer shall be removed and the subjacent inorganic coating assessed according to clause D.3.1.1.4.

D.3.1.1.4 Coated glass

D.3.1.1.4.1 Suitable coatings

Suitable coatings are the inorganic coatings classified as A, S and B according to EN 1096-1 and EN 1096-2. Additional coatings may be added to an amended ETA, when they have been shown to be suitable for use in bonded glazing kits.

Other coatings meeting EN 1096-4 shall be removed along the sealant adhesion surface

D.3.1.1.4.2 Grouping the coatings in families - Representative coating of the family

If the applicant wishes to assess a large number of coatings, to limit the number of tests, the following conditions apply:

- The rules contained in EN 1096-2, Annex F, are also valid concerning the grouping of coatings into families based on the validity of durability tests for bonded glazing kit application.
- The representative coating(s) of the family then is/are the one (those) in which all the interfaces between the stacking layers of the family can be found. The interfaces “glass first layer of the stacking” and “last layer of the coating layer - particular sealant” are considered interfaces to be tested. The representative coating(s) - sealant shall be assessed according to clause D.3.1.1.4.3 and the tests results are valid for all coated glass of the family.

D.3.1.1.4.3 Evaluation of the suitability of the bonding of coatings and their layers

For the product submitted for assessment, the manufacturer provides a description conforming to EN 1096-1, clause 8.2 “identity card”, and EN 1096-4, clause 4.1, regarding the coating layer compositions.

For each coating or family of coated glass representatives of a bonding sealant adhesion surface, it shall be demonstrated that the bonding is sufficiently strong between glass and coating, between sealant and coating, and between the different layers of the coating. Such a demonstration consists of adhesion tests and assessment according to the following clauses in this EAD:

- Clause 2.2.14.3Initial Mechanical Strength
- Clause 2.2.14.3.2Tension, rupture
- Clause 2.2.14.4Residual mechanical strength after artificial ageing
- Clause 2.2.14.4.1Immersion in water at high temperature with or without solar radiation
- Clause 2.2.14.4.2Humidity and NaCl atmosphere
- Clause 2.2.14.4.3Humidity and $SO_2$ atmosphere
- Clause 2.2.15.1.6Facade cleaning products

Evaluation from existing test reports

When a coating is submitted for an evaluation for suitability, the manufacturer may present existing test reports containing the outcome of testing on coatings, consisting of:

- The bonding between the particular bonding sealant and the particular top layer of the coating
- And/or the bonding between the glass and the particular base layer of the coating
- And/or the interlayer bonding between any two layers of the coating

D.3.1.1.4.4 Glass substrates for coated glass

When the tests of clause D.3.1.1.4.2 are performed on one of the coated glass substrates listed below, the coated glass-bonding sealant adherence can be extrapolated to other types of glass on this list: EN 572-2**,** EN 12150-1 and EN 1863-1.

## D.4 Stainless steel adhesion surface

D.4.1 Stainless steel alloys

Rolled or pressed stainless steel adhesion surfaces shall be identified by their alloy and surface finish, in accordance with EN 10088-1, EN 10088-2 or EN 10088-3.

Stainless steel adhesion surfaces shall be assessed by the following:

~~B~~

- Clause 2.2.14.3 Initial Mechanical Strength
- Clause 2.2.14.3.2Tension, rupture
- Clause 2.2.14.4 Residual mechanical strength after artificial ageing
- Clause 2.2.14.4.1Immersion in water at high temperature with or without solar radiation
- Clause 2.2.14.4.2Humidity and NaCl atmosphere
- Clause 2.2.14.4.3Humidity and $SO_2$ atmosphere
- Clause 2.2.15.1.6Facade cleaning products

# ANNEX E: ASSESSMENT METHODS APPLIED IN EU/EFTA MEMBER STATES FOR ASSESSING THE FIRE PERFORMANCE OF FACADES

| Country | Assessment method |
|---|---|
| Austria | ÖNORM B 3800-5 |
| Czech Republic | ČSN ISO 13785-1 |
| Denmark, Sweden, Norway | SP Fire 105 |
| Finland | • SP Fire 105<br>• BS 8414 |
| France | LEPIR 2 |
| Germany | • DIN 4102-20 Complementary reaction-to-fire test for claddings of exterior walls,<br>• Technical regulation A 2.2.1.5 |
| Hungary | MSZ 14800-6:2009 Fire resistance tests. Part 6: Fire propagation test for building façades |
| Ireland | BS 8414 (BR 135) |
| Poland | PN-B-02867:2013 |
| Switzerland, Liechtenstein | • DIN 4102-20<br>• ÖNorm B 3800-5<br>• Prüfbestimmung für Aussenwandbekleidungssysteme |