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## **ETAG 014**

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GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL  
OF

**PLASTIC ANCHORS  
FOR FIXING OF EXTERNAL THERMAL INSULATION  
COMPOSITE SYSTEMS WITH RENDERING**

**EOTA©**

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# FOREWORD

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## Background of the subject

The Guideline for European Technical Approval of "PLASTIC ANCHORS FOR FIXING OF EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS WITH RENDERING" sets out the basis for assessing plastic anchors to be used for fixing of external thermal insulation composite systems with rendering in the substrates concrete and masonry.

The general assessment approach adopted in this Guideline is based on combining relevant existing knowledge and experience of plastic anchor behaviour with testing. Using this approach, testing is needed.

Plastic anchors and their behaviour in use are of interest to a number of bodies, including manufacturers, planning and design engineers, building contractors and specialist installers.

## Reference documents

- [1] Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products (89/106/EEC) amended by the Council Directive 93/68/EEC of 22 July 1993.  
"Construction Products Directive" (CPD)
- [2] Council Directive 89/106/EEC, Construction Products.  
Interpretative Documents (IDs), Brussels, 16-7-1993
- [3] ETAG 004:  
Guideline for European Technical Approval of EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS WITH RENDERING, edition 11 August 2000
- [4] ETAG 017:  
Guideline for European Technical Approval of VETURE KITS - PREFABRICATED UNITS FOR EXTERNAL WALL INSULATION, edition 16 December 2005
- [5] EN 771-1:2003/A1:2005  
Specification for masonry units – Part 1:  
Clay masonry units  
EN 771-2:2003/A1:2005  
Specification for masonry units – Part 2:  
Calcium silicate masonry units  
EN 771-3: 2003/A1:2005  
Specification for masonry units – Part 3:  
Aggregate concrete masonry units (Dense and light-weight aggregates)  
EN 771-4: 2003/A1:2005  
Specification for masonry units – Part 4:  
Autoclaved aerated concrete masonry units  
EN 771-5: 2003/A1:2005  
Specification for masonry units – Part 5:  
Manufactured stone masonry units
- [6] EN 1996-1-1:2005: Design of masonry structures - part 1-1: General rules for reinforced and unreinforced masonry structures
- [7] EN 206-1:2000-12/A1:2004/A2:2005  
Concrete – Part 1: Specification, performance, production and conformity
- [8] EN 1520:2002 + AC:2003  
Prefabricated components of lightweight aggregate concrete with open structure
- [9] EN 12602:2008  
Prefabricated reinforced components of autoclaved aerated concrete
- [10] ISO 1110:1995-02  
Plastics – Polyamides – Accelerated conditioning of test specimens

- [11] ISO 3167:2002-02  
Plastics; multipurpose test specimens
- [12] ISO 3506-1:2009  
Mechanical properties of corrosion-resistant stainless-steel fasteners –  
Part 1: Bolts, screws and studs
- [13] ISO 527-1:1993-06/Technical Corrigendum 1:1994-05/AMD 1:2005-09  
Plastics; determination of tensile properties; part 1: general principles
- [14] ISO 3146:2000-06  
Plastics-Determination of melting behaviour (melting temperature or melting range)  
of semi-crystalline polymers by capillary tube and polarizing-microscope methods
- [15] ISO 6783:1982-06  
Coarse aggregates for concrete;  
Determination of particle density and water absorption; Hydrostatic balance method
- [16] EN 197-1:2000-06 + A1:2004  
Cement – Part 1: Composition, specifications and conformity criteria for common cements
- [17] ISO 5468:2006  
Rotary and rotary impact masonry drill bits with hardmetal tips. Dimensions
- [18] Technical Report TR 026:  
Evaluation of plate stiffness from plastic anchors for fixing of external thermal insulation composite  
systems with rendering (ETICS), edition June 2007
- [19] EN 13163:2008-11  
Thermal insulation products for buildings - Factory made products of expanded polystyrene (EPS) –  
Specification

### **Updating conditions**

The edition of a reference document given in this list is that which has been adopted by EOTA for its specific use.

When a new edition becomes available, this supersedes the edition mentioned in the list only when EOTA has verified or re-established (possibly with appropriate linkage) its compatibility with the Guideline.

*EOTA comprehension documents* permanently take on board all useful information on the updating of reference documents and on the general understanding of this ETAG as developed when delivering ETAs by consensus among the EOTA members.

*EOTA Technical reports* go into detail in some aspects and as such are not part of the ETAG but express the common understanding of existing knowledge and experience of the EOTA-bodies at that moment. When knowledge and experience is developing, especially through approval work, these reports can be amended and supplemented. When this happens, the effect of the changes upon the ETAG will be determined by EOTA and laid down in the relevant comprehension documents.

Readers and users of this ETAG are advised to check the current status of the content of this document with an EOTA member.

# Section one:

## INTRODUCTION

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### 1. PRELIMINARIES

#### 1.1. Legal basis

This ETAG has been established in compliance with the provisions of the Council Directive 89/106/EEC (CPD) [1] and has been established taking into account the following steps:

- the final mandate issued by the EC November 1996
- the final mandate issued by the EFTA not relevant
- adoption of the Guideline by the Executive Commission of EOTA 21 November 2001 (Edition January 2002)  
XXX 20XX (Edition XXXXX 20XX)
- opinion of the Standing Committee for Construction 18/19 December 2001 (Edition January 2002)  
XXX 20XX (Edition XXXXX 20XX)
- endorsement by the EC 16 January 2002 (Edition January 2002)
  
- Amendment endorsed by EC 15 March 2011

This document is published by the Member States in their official language or languages according to art. 11.3 of the CPD.

This edition replaces the edition of December 2008.

#### 1.2. Status of ETAG

- a) **An ETA is one of the two types of technical specifications** in the sense of the EC 89/106 Construction Products Directive. This means that Member States shall presume that the approved products are fit for their intended use, i.e. they enable works in which they are employed to satisfy the Essential Requirements during an economically reasonable working life, provided that:
- the works are properly designed and built;
  - the conformity of the products with the ETA has been properly attested.
- b) **This ETAG is a basis for ETAs**, i.e. a basis for technical assessment of the fitness for use of a product for an intended use. An ETAG is not itself a technical specification in the sense of the CPD.

This ETAG expresses the common understanding of the Approval Bodies, acting together within EOTA, as to the provisions of the Construction Products Directive 89/106/EEC [1] and of the Interpretative Documents [2], in relation to the products and uses concerned, and is written within the framework of a mandate given by the Commission and the EFTA secretariat, after consulting the Standing Committee for Construction.

- c) When accepted by the European Commission after consultation with the Standing Committee for Construction this **ETAG is binding** for the issuing of ETAs for the products for the defined intended uses.

The application and satisfaction of the provisions of an ETAG (examinations, tests and evaluation methods) leads to an ETA and a presumption of fitness of a product for the defined use only through an evaluation and approval process and decision, followed by the corresponding attestation of conformity. This distinguishes an ETAG from a harmonised European Standard which is the direct basis for attestation of conformity.

Where appropriate, products which are outside of the precise scope of this ETAG may be considered through the approval procedure without guidelines according to art. 9.2 of the CPD.

The requirements in this ETAG are set out in terms of objectives and of relevant actions to be taken into account. It specifies values and characteristics, the conformity with which gives the presumption that the requirements set out are satisfied, wherever the state of art permits and after having been confirmed as appropriate for the particular product by the ETA.

This Guideline indicates alternative possibilities for the demonstration of the satisfaction of the requirements.

## 2. SCOPE

### 2.1. Scope

#### 2.1.1. General

The Guideline for European Technical Approval of "PLASTIC ANCHORS FOR FIXING OF EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS WITH RENDERING" (*short form: Plastic anchors for ETICS*) sets out the basis for assessing plastic anchors to be used for fixing of external thermal insulation composite systems with rendering [3] in the base material (substrates) made out of concrete and masonry. The plastic anchors may also be used for the fixing of VETURE Kits – Prefabricated Units for External Wall Insulation [4].

This Guideline covers only the assessment of plastic anchors in the different base materials when their use shall fulfil the Essential Requirement 4 of the CPD ([1] see 4.4) and when failure of anchorages made with these products represents a low risk to human life. The assessment of the plastic anchor as a component of the ETICS shall be done according to ETAG 004 [3]. This applies also for the plastic anchor as a component of a VETURE Kits according to ETAG 017 [4].

The plastic anchors judged using this document shall only be used as multiple fixings, which means that, in the case of excessive slip or failure of a fixing point, the load of the component can be transmitted to neighbouring fixing points. The load transfer in case of excessive slip or failure of one fixing point to neighbouring fixing points does not need to be taken into account in the design of the fastenings for the ETICS or VETURE Kits.

#### 2.1.2. Plastic anchors

##### 2.1.2.1. Types and operating principles

Plastic anchors for ETICS consist of an expansion element and a plastic expansion sleeve with a plate for fixing the ETICS (Figure 2.1a and 2.1b) or a plastic expansion sleeve with a collar for fixing profiles for the ETICS (Figure 2.2) or VETURE Kits. The plastic sleeve and expansion element are a unit.

The plastic sleeve is expanded by hammering or screwing in the expansion element which presses the sleeve against the wall of the drilled hole.

- Plastic anchors with a screw as an expansion element (setting: screwed in).
- Plastic anchors with a nail as an expansion element (setting: nailed in).

##### 2.1.2.2. Materials

- Expansion element: metal (steel) or polymeric material
- Plastic sleeve: Polymeric material
  - Polyamide PA 6 and PA 6.6
  - polyethylene PE or polypropylene PP
  - other polymeric materials

In general only virgin material (material which has not been moulded before) is to be used. In the moulding process only reworked material (e.g. sprue) shall be added received as waste material from the same moulding process. This regenerated material is of the same feedstock and identical with the rest of the material.

If materials other than virgin material are to be used then additional sustained load tests according to Table 5.1, line 9 are necessary.

##### 2.1.2.3. Dimensions

This Guideline applies to plastic anchors with an external diameter of plastic sleeve of at least 5 mm. The effective anchorage depth  $h_{ef}$  shall be at least 25 mm.

Depending on the specific design of the anchor, the overall plastic anchor embedment depth in the base material  $h_{nom}$  is equal to or larger than  $h_{ef}$ .

Figure 2.1a: Plastic anchor (nailed-in) for ETICS

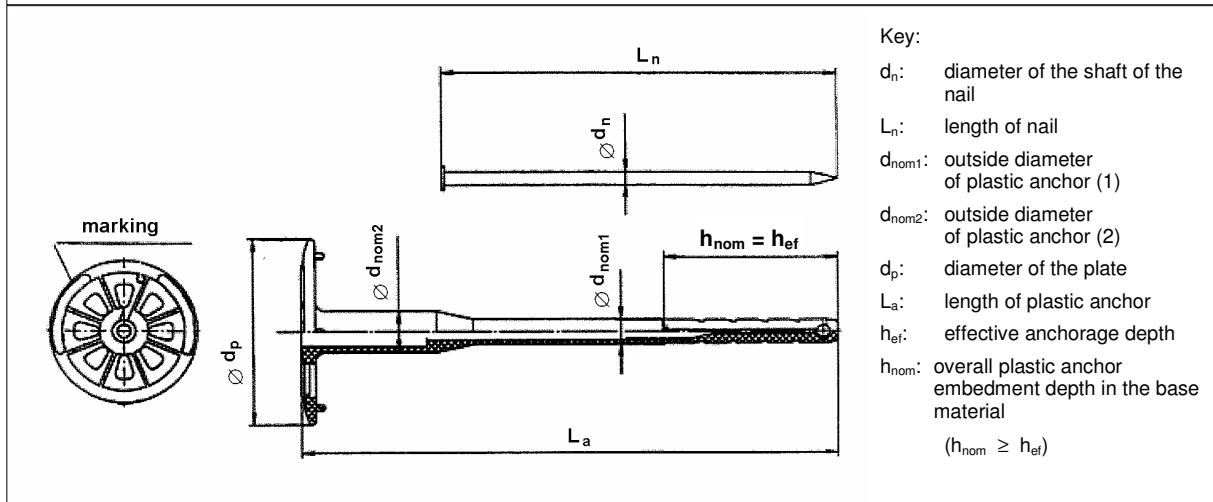
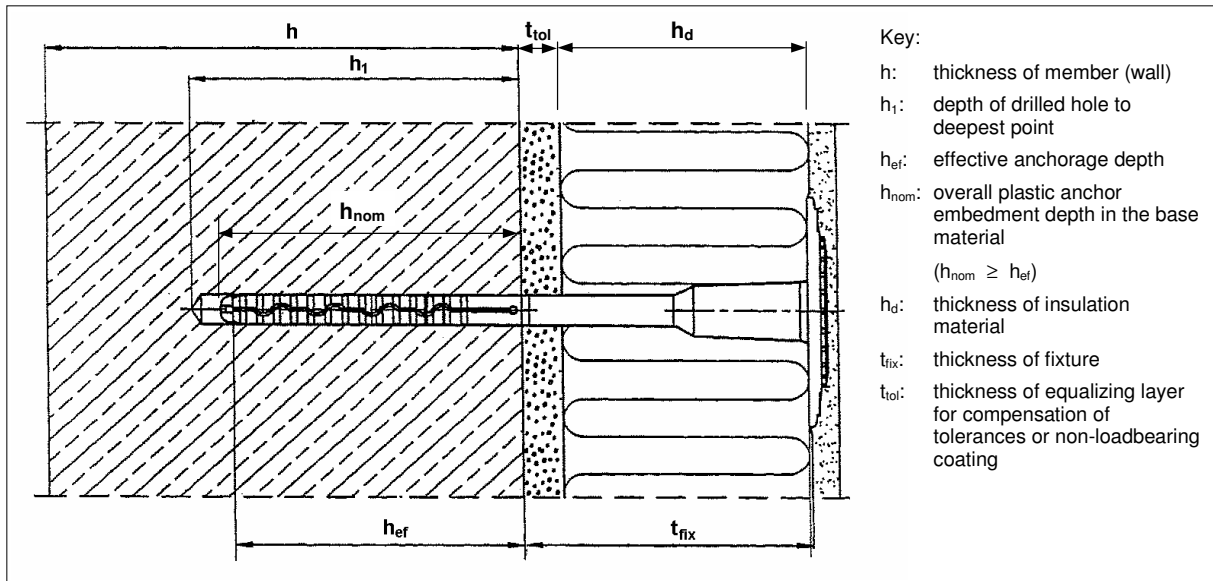


Figure 2.1b: Components of plastic anchor

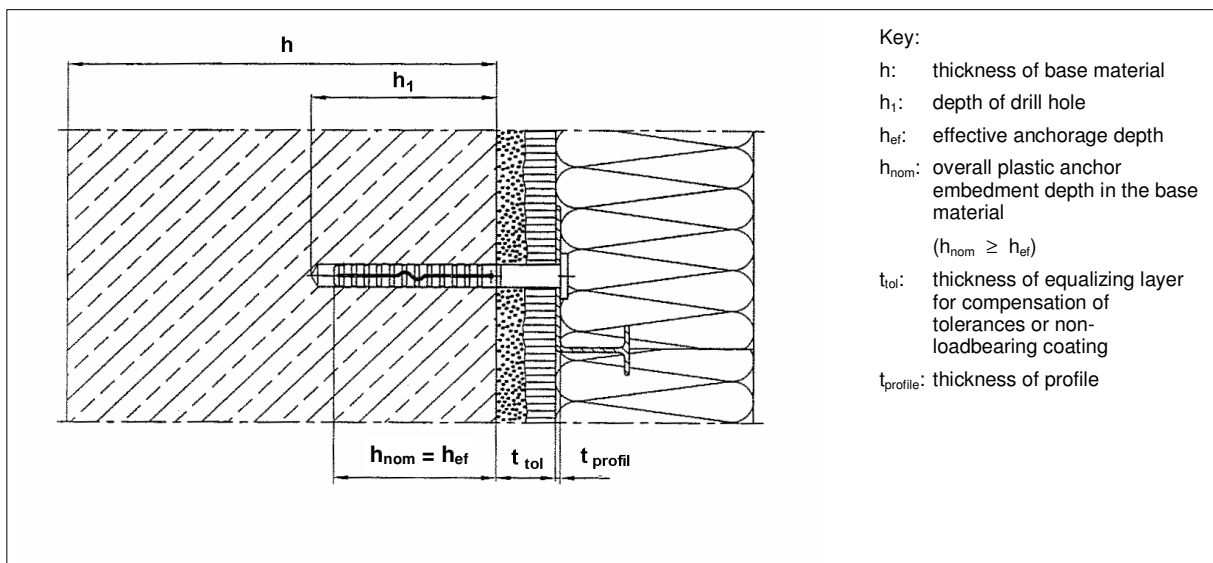


Figure 2.2: Plastic anchors for profiles for ETICS or VETURE Kits



### **2.1.3. Base materials**

#### **2.1.3.1. General**

This Guideline applies to the use of plastic anchors in concrete (normal weight; lightweight aggregate or autoclaved aerated) and/or masonry units of clay, calcium silicate, aggregate concrete, autoclaved aerated concrete or other similar materials. As far as the specification of the different masonry units is concerned EN 771-1 to 5 [5] shall be taken as reference. The design and construction of masonry structures in which the plastic anchors are to be anchored shall be in accordance with Eurocode 6, EN 1996-1-1 [6] and the relevant national regulations.

Attention is drawn to the fact that the standards for masonry structures are not very restrictive with regard to details of units (e.g. type, dimensions and location of perforations, number and thickness of webs). As load resistance and load displacement behaviour, however, decisively depend on these influences, an assessment of the plastic anchor is, in principle, only possible for each particular well-defined masonry unit concerned. For the assessment of the behaviour of the plastic anchor in other less well-defined masonry or hollow / perforated bricks, hollow blocks or other different base materials, tests on the construction site are to be carried out according to national requirements or Annex D. The characteristic resistance of the plastic anchor in less well-defined base materials may only be determined by so-called "job site tests" for use category A, B, C, D and E, if the plastic anchor has already an ETA with characteristic values for the equivalent base material (according to use category A, B, C, D and E) as it is present on the construction works.

This Guideline applies to applications where the minimum thickness of the base materials in which plastic anchors are installed is at least  $h = 100$  mm. In special cases [e.g. thin skins (weather resistant skin) of external wall panels] the minimum thickness of the base material may be reduced to 40 mm, if the influence of the setting position of the plastic anchor is considered according to 5.4.2, Figure 5.1.

#### **2.1.3.2. Normal weight concrete**

This Guideline applies to the use of plastic anchors in normal weight concrete between strength classes C12/15 and C50/60, inclusively, according to EN 206-1 [7].

This Guideline does not cover anchorages made in screeds or toppings, which can be uncharacteristic of the concrete and/or excessively weak.

#### **2.1.3.3. Solid masonry units**

This ETAG applies to masonry units consisting of solid units which do not have any holes or cavities other than those inherent in the material.

#### **2.1.3.4. Hollow or perforated units**

This ETAG applies to masonry units consisting of hollow or perforated units which have a certain volume percentage of voids which pass through the masonry unit. Because of the great variety of units with regard to location of hollows, thickness of webs, etc. the statement given in the second paragraph of 2.1.3.1. applies.

#### **2.1.3.5. Lightweight aggregate concrete**

This Guideline applies to the use of plastic anchors in lightweight aggregate concrete between strength classes LAC 2 and LAC 25, inclusively, according to EN 1520 [8] reinforced components of lightweight aggregate concrete with open structure and in lightweight aggregate concrete blocks.

#### **2.1.3.6. Autoclaved aerated concrete**

This Guideline applies to the use of plastic anchors in autoclaved aerated concrete according to EN 771-4 [5] autoclaved aerated concrete masonry units or EN 12602 [9] reinforced components of autoclaved aerated concrete. The strength class of the autoclaved aerated concrete defined in [9] has to lie in between AAC 2 and AAC 7, inclusively.

## 2.2. Use Categories

Use categories are defined as a function of base materials as follows:

- Use category **A**: Plastic anchors for use in **normal weight concrete**
- Use category **B**: Plastic anchors for use in **solid masonry**
- Use category **C**: Plastic anchors for use in **hollow or perforated masonry**
- Use category **D**: Plastic anchors for use in **lightweight aggregate concrete**
- Use category **E**: Plastic anchors for use in **autoclaved aerated concrete**

Combinations of different use categories are possible.

## 2.3. Assumptions

The state of the art does not enable the development, within a reasonable time, of full and detailed verification methods and corresponding technical criteria/guidance for acceptance for some particular aspects or products. This ETAG contains assumptions taking account of the state of art and makes provisions for appropriate, additional case-by-case approaches when examining ETA-applications, within the general framework of the ETAG and under the CPD consensus procedure between EOTA members.

The guidance remains valid for other cases which do not deviate significantly. The general approach of the ETAG remains valid but the provisions then need to be used case by case in an appropriate way. This use of the ETAG is the responsibility of the ETA-body which receives the special application, and subject to consensus within EOTA. Experience in this respect is collected, after endorsement in EOTA-TB, in the ETAG-Format-Comprehension document.

## 2.4. Design and installation quality

In setting out the assessment procedures in this Guideline, it has been assumed that the design of the anchorages and the specification of the plastic anchor are under the control of a person experienced in anchorages for ETICS or VETURE Kits. It is also assumed that the plastic anchor installation is undertaken by trained installer, to ensure that the specifications are effectively implemented.

## 3. TERMINOLOGY

### 3.1. Common terminology and abbreviations

Common terminology is listed and defined in Annex A.

### 3.2. Terminology and abbreviations specific to this ETAG

Terminology and abbreviations specific to this ETAG are listed and defined in Annex B.

## Section two:

# GUIDANCE FOR THE ASSESSMENT OF THE FITNESS FOR USE

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### GENERAL NOTES

#### (a) Applicability of the ETAG

This ETAG provides guidance on the assessment of a family of products and their intended uses. It is the manufacturer or producer who defines the product for which he is seeking ETA and how it is to be used in the works, and consequently the scale of the assessment.

It is therefore possible that for some products, which are fairly conventional, only some of the tests and corresponding criteria are sufficient to establish fitness for use. In other cases, e.g. special or innovative products or materials, or where there is a range of uses, the whole package of tests and assessment may be applicable.

Common clauses:

#### (b) General layout of this section

The assessment of the fitness of products with regard to their fitness for intended use in construction works is a process with the following steps:

- Chapter 4 clarifies *the specific requirements for the works* relevant to the products and uses concerned, beginning with the Essential Requirements for works (CPD [1] art. 11.2) and then listing the corresponding relevant characteristics of products.
- Chapter 5 extends the list in Chapter 4 into more precise definitions and *the methods available to verify* product characteristics and to indicate how the requirements and the relevant product characteristics are described. This is done by test procedures, methods of calculation and of proof, etc. (selection of the appropriate methods)
- Chapter 6 provides guidance on *the assessing and judging methods* to confirm fitness for the intended use of the products.
- Chapter 7 *assumptions and recommendations* is only relevant in so far as they concern the basis upon which the assessment of the product is made concerning its fitness for the intended use.

#### (c) Levels or classes or minimum requirements, related to the Essential Requirements and to the product performance (see ID [2] clause 1.2)

According to the CPD [1], "Classes" in this ETAG refer only to mandatory levels or classes laid down in the EC-mandate.

This ETAG indicates the compulsory way of expressing relevant performance characteristics for the product. If, for some uses, at least one Member State has no regulations, a manufacturer always has the right to opt out of one or more of them, in which case the ETA will state "no performance determined" against that aspect, except for those properties for which, when no determination has been made, the product does not any longer fall under the scope of the ETAG.

#### (d) Working life (durability) and serviceability

The provisions, test and assessment methods in this guideline or referred to, have been written, based upon the assumed intended working life of the product (ETICS or VETURE Kits) and the component (plastic anchors) for the intended use of at least 25 years (see ETAG for ETICS [3] or VETURE Kits [4]), provided that the product is subject to appropriate use and maintenance (cf. Ch. 7). These provisions are based upon the current state of art and the available knowledge and experience.

An "assumed intended working life" means that it is expected that, when an assessment following the ETAG-provisions is made, and when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

The indications given for characteristics linked to the working life of a product cannot be interpreted as a guarantee given by the producer or the Approval Body. They should only be regarded as a means for the specifiers to choose the appropriate criteria for products in relation to the expected, economically reasonable working life of the works (based upon ID [2] par. 5.2.2).

**(e) Fitness for the intended use**

According to the CPD [1] it has to be understood that within the terms of this ETAG, products shall “have such characteristics that the works in which they are to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the Essential Requirements” (CPD, art. 2.1).

Hence, the products shall be suitable for use in construction works which (as a whole and in their separate parts) are fit for their intended use, account being taken of economy, and in order to satisfy the essential requirements. Such requirements, shall, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern actions which are foreseeable. (CPD Annex I, preamble).

**4. REQUIREMENTS FOR WORKS, AND THEIR RELATIONSHIP TO THE PRODUCT CHARACTERISTICS**

This chapter sets out the aspects of performance to be examined in order to satisfy the relevant Essential Requirements, by:

- expressing in more detail, within the scope of the ETAG, the relevant Essential Requirements of the CPD [1] in the Interpretative Documents [2] and in the mandate, for works or parts of the works, taking into account the actions to be considered, as well as the expected durability and serviceability of the works.
- applying them to the scope of the ETAG for products, and providing a list of relevant product characteristics and other applicable properties.

When a product characteristic or other applicable property is specific to one of the Essential Requirements, it is dealt with in the appropriate place. If, however, the characteristic or property is relevant to more than one Essential Requirement, it is addressed under the most relevant one with cross reference to the other(s). This is especially important where a manufacturer claims “No performance determined” for a characteristic or property under one Essential Requirement and it is critical for the assessing and judging under another Essential Requirement. Similarly, characteristics or properties which have a bearing on durability assessments shall be dealt with under ER 1 to ER 6, with reference under 4.7. Where there is a characteristic which only relates to durability, this is dealt with in 4.7.

4.0.

4.1. Essential Requirements to product performance

**Table 4.1 The relevant Essential Requirements, the relevant paragraphs of corresponding IDs [2] and related product performance to be assessed.**

Essential Requirement	Corresponding ID paragraph	Corresponding ID for product performance	Plastic anchor performances and characteristics	Test method for verification of characteristic
ER 4 Safety in use	ID 4 3.3.2.1. impacts of falling objects, forming part of the work, upon users	3.3.2.3. mechanical resistance and stability	<ul style="list-style-type: none"> <li>– charact. resistance to tension loading</li> <li>– displacement for serviceability limit state</li> </ul>	<ul style="list-style-type: none"> <li>– tension loading not influenced by edge and spacing effects</li> <li>– verification of installation suitability with a layer of EPS for nailed-in plastic anchors</li> <li>– functioning depending on the diameter of the drill bit</li> <li>– functioning under conditioning</li> <li>– functioning under the effect of temperature</li> <li>– functioning under repeated loads</li> <li>– functioning under relaxation</li> <li>– maximum torque moment (screwed-in plastic anchors)</li> </ul>
Aspects of Durability			resistance against environmental conditions	Tests under different environmental conditions

The tests described in the following may not all be necessary if the product is not a newly developed one and has been used for several years so that existing data are available, see EOTA Guidance Document on The Provision of Data for Assessments leading to ETA (TB 98/31/12.6).

#### **4.2. Mechanical resistance and stability (ER 1)**

Requirements with respect to the mechanical resistance and stability of non load bearing parts of the works are not included in this Essential requirement but are under the Essential Requirement safety in use (see 4.4.).

#### **4.3. Safety in case of fire (ER 2)**

Requirements with respect to safety in case of fire are given in ETAG 004 [3] and ETAG 017 [4].

#### **4.4. Hygiene, health and the environment (ER 3)**

##### **4.4.1. Release of dangerous substances**

The product shall be such that, when installed according to the appropriate provisions of the Member States, it allows for the satisfaction of the ER 3 of the CPD [1] as expressed by the national provisions of the Member States and in particular does not cause harmful emission of toxic gases, dangerous particles or radiation to the indoor environment nor contamination of the outdoor environment (air, soil or water).

#### **4.5. Safety in use (ER 4)**

##### **4.5.1. General**

Even though a plastic anchor for ETICS or VETURE Kits is a product without a structural intended use, mechanical resistance and stability is still required.

Installed plastic anchors for ETICS or VETURE Kits shall sustain the design loads to which they are subjected for the assumed working life while providing:

- (1) an adequate resistance to failure (ultimate limit state),
- (2) adequate resistance to displacements (serviceability limit state).

For plastic anchors the following aspects of performance are relevant to this Essential Requirement:

##### **4.5.2. Admissible service conditions (characteristic resistance)**

The service conditions considered in an assessment are, to some extent, a subject to be chosen by the assessment applicant.

##### **4.5.3. Types of installation**

Plastic anchors shall function correctly for the types of installation for which they are intended by the manufacturer.

##### **4.5.4. Correct installation**

Correct installation of plastic anchors shall be easily achieved under normal site conditions with the equipment specified by the manufacturer, without damage resulting that can adversely affect their behaviour in service. Installation shall be practicable at normal ambient temperatures within the range 0 °C to +40 °C if other limit values are not explicitly prescribed (compare 4.4.6.: minimum installation temperature specified by the manufacturer: normally 0 °C to +5 °C, max short term temperature: +40 °C. It shall be possible to control and verify the correct installation of the plastic anchor.

Except in cases where special tools are provided by the manufacturer, installation shall be reasonably easily achieved using the tools normally available on site.

##### **4.5.5. Moisture Content**

The functioning of a plastic anchor, including its ability to sustain its design load with an appropriate safety factor and to limit displacements, shall not be adversely affected by the moisture content of the plastic sleeve.

#### **4.5.6. Temperature**

The functioning of a plastic anchor, including its ability to sustain its design load with an appropriate safety factor and to limit displacements, shall not be adversely affected by temperatures near to the surface of the base material within a base material temperature range:

0 °C to +40 °C (minimum installation temperature specified by the manufacturer: normally 0 °C to +5 °C, max short term temperature: +40 °C and max long term temperature: +24 °C)

The performance shall not be adversely affected by short term temperatures within the service temperature range or by long term temperatures up to the maximum long term temperature. Performance at the maximum long term temperature is checked by tests described in 5.4.6. a).

Functioning shall also be validated for the range of installation temperatures to be specified by the manufacturer in terms of lowest and highest installation ambient temperatures, normally in the range 0 °C to +40 °C. Performance at lowest installation temperature is checked by tests as described in 5.4.6. b). The minimum installation temperature is specified by the manufacturer; normally 0 °C to +5 °C

#### **4.5.7. Repeated loading**

Plastic anchors, in the long term, shall continue to function effectively when their service load is subject to variation.

#### **4.5.8. Relaxation**

The functioning of a plastic anchor, including its ability to sustain its design load with an appropriate safety factor and to limit displacements, shall not be adversely affected by relaxation of the plastic components of the anchor.

#### **4.5.9. Maximum torque moment**

The maximum torque moment of a plastic anchor shall not adversely affect the performance of the plastic anchor.

#### **4.6. Protection against noise (ER 5)**

Not relevant

#### **4.7. Energy economy and heat retention (ER 6)**

Not relevant

#### **4.8. Aspects of durability, serviceability and identification**

The plastic anchor characteristics shall not change significantly during the working life, therefore the mechanical properties on which the suitability and bearing behaviour of the plastic anchor depends shall not be adversely affected by ambient physico-chemical effects such as corrosion and degradation caused by environmental conditions (e.g. alkalinity, moisture).

### **5. METHODS OF VERIFICATION**

This chapter refers to the verification methods used to determine the various aspects of performance of the products in relation to the requirements for the works as set out in chapter 4.

#### **5.1. Mechanical resistance and stability**

Not relevant

#### **5.2. Safety in case of fire**

ETAG 004 [3] and ETAG 017 [4] are relevant.

### **5.3. Hygiene, health and environment**

#### **5.3.1. Release of dangerous substances**

##### **5.3.1.1. Presence of dangerous substances in the product**

The applicant shall submit a written declaration stating whether or not the product contains dangerous substances according to European and national regulations, when and where relevant in the Member States of destination, and shall list these substances. The declaration and the list are assessed by the Approval Body.

##### **5.3.1.2. Compliance with the applicable regulations**

If the product contains dangerous substances as declared above, the ETA will provide the method(s) which has been used for demonstrating compliance with the applicable regulations in the Member States of destination, according to the EU data-base (method(s) of content or release, as appropriate).

##### **5.3.1.3. Application of the precautionary principle**

An EOTA member has the possibility to provide to the other members, through the Secretary General, warning about substances which, according to Health Authorities of its country, are considered to be dangerous under sound scientific evidence, but are not yet regulated. Complete references about this evidence will be provided.

This information once agreed upon, will be kept in an EOTA data base, and will be transferred to the Commission services.

The information contained in this EOTA data base will also be communicated to any ETA applicant.

On the basis of this information, a protocol of assessment of the product, regarding this substance, could be established on request by a manufacturer with the participation of the Approval Body which raised the issue.

### **5.4. Safety in use**

#### **5.4.1. General**

The tests involved in the assessment of plastic anchors fall into 3 categories:

- (1) Tests for determination of admissible service conditions of the plastic anchor (Table 5.1, line 1)
- (2) Tests for confirming suitability of the plastic anchor (Table 5.1, line 2 to 9)
- (3) Tests for checking durability of the plastic anchor (see section 5.7.).

This Guideline gives the general test conditions for testing of evaluation of plastic anchors for ETICS or VETURE Kits in the base material made out of concrete and/or masonry. The behaviour of the whole ETICS or VETURE Kits outside the base material and where the load transfer is into the anchor plate or collar shall be assessed according ETAG 004 [3] or ETAG 017 [4].

Plastic anchors usually have only one anchorage depth. If the anchor has more than one possible anchorage depth, then tests will need to be done at each specified depth, unless the manufacturer chooses to test the most onerous depth, in which case the results will also apply to less onerous depths.

The details of tests are given in Annex C.

The purpose of the tests is to establish whether a plastic anchor is capable of safe, effective behaviour in service including consideration of adverse conditions both during site installation and in service.

The tests according to Table 5.1, line 1 and line 3 to 9 are carried out without the external thermal insulation composite system. Instead of an ETICS a layer of EPS (see Annex C, Figure C.7.1) is applied for testing according to Table 5.1, line 2.



The tests for the assessment of the plastic anchors shall be performed in the base material for which the anchor is intended to be used according to the following Table 5.0.

**Table 5.0 Required tests for the intended use of plastic anchors for ETICS**

Use category for the intended use			Required Tests for the intended use
normal weight concrete C12/15 to C50/60	solid masonry clay or/and calcium silicate units	hollow or perforated units	
<b>A</b>			tests according to Table 5.1, line 1 to 9 in normal weight concrete
	<b>B</b>		tests according to Table 5.1, line 1 to 9 in clay or calcium silicate solid units with compressive strength about 12 N/mm <sup>2</sup> and density between 1,6 and 2,0 kg/dm <sup>3</sup>
<b>A</b>	<b>B</b>		tests according to table 5.1, line 1 to 9 in normal weight concrete and in addition tests according to line 1 of Table 5.1 in solid masonry (clay or calcium silicate units).
<b>A</b>	<b>B</b>	<b>C</b>	tests according to table 5.1, line 1 to 9 in normal weight concrete, tests according to line 1 of Table 5.1 in solid masonry (clay or calcium silicate units) and in hollow or perforated units for which it is intended to be used <sup>1)</sup> , and in addition tests according to line 2 of Table 5.1 in the hollow or perforated unit which is most critical regarding this test.
	<b>B</b>	<b>C</b>	tests according to Table 5.1, line 1 to 9 in clay or/and calcium silicate solid units with compressive strength about 12 N/mm <sup>2</sup> and density between 1,6 and 2,0 kg/dm <sup>3</sup> , and in addition tests according to line 1 of Table 5.1 in the hollow or perforated units for which it is intended to be used <sup>1)</sup> , and in addition tests according to line 2 of Table 5.1 in the hollow or perforated unit which is most critical regarding this test.
<b>D</b> lightweight aggregate concrete LAC 2 to LAC 25 or lightweight aggregate concrete blocks			tests according to table 5.1, line 1 to 9 in lightweight aggregate concrete LAC 2 or in lightweight aggregate concrete blocks.
<b>E</b> autoclaved aerated concrete AAC 2 to AAC 7			tests according to Table 5.1, line 1 to 9 in autoclaved aerated concrete AAC 2 or in autoclaved aerated concrete blocks.

<sup>1)</sup> If the base material on construction works in respect of the type of the material and of minimum strength and geometry of holes of the masonry units is not the same as the base material on which the laboratory or assessment tests have been performed, then "job site tests" according to national requirements or Annex D are necessary for the determination of the resistance in the existing base material.

The characteristic resistance of the plastic anchor in less well-defined base materials may only be determined by "job site tests" for use category A, B, C, D and E, if the plastic anchor has already an ETA with characteristic values for the equivalent base material (according to use category A, B, C, D and E) as it is present on the construction works.

**Table 5.1 Tests for plastic anchors for ETICS**

	1	2	3	4	5	6	7	8
	Purpose of test	Base material	Drill bit	Ambient temperature	Condition of plastic sleeve	Minimum number of tests per plastic anchor size	Criteria ultimate load req.α	Remarks to the test procedure described in chapter
				(3)	(4)			
1	Tests for determination of the characteristic resistance	(1)	d <sub>cut,m</sub>	normal	standard	10	-	5.4.2.
2	Test for the verification of installation suitability	(2)	d <sub>cut,m</sub>	normal	standard	5	≥ 0,9	5.4.3. (5)
3	Functioning, depending on the diameter of drill bit	(2)	d <sub>cut,min</sub> d <sub>cut,max</sub>	normal normal	standard standard	5 5	≥ 1,0 ≥ 0,8	5.4.4.
4	Functioning under conditioning	(2)	d <sub>cut,m</sub> d <sub>cut,m</sub>	normal normal	dry wet	5 5	≥ 0,8 ≥ 0,8	5.4.5. (7)
5	Functioning, Effect of temperature	(2)	d <sub>cut,m</sub> d <sub>cut,m</sub>	min t (6) +40 °C	standard standard	5 5	≥ 1,0 ≥ 0,8	5.4.6.
6	Functioning under repeated loads	(2)	d <sub>cut,m</sub>	normal	standard	3	≥ 1,0	5.4.7.
7	Functioning relaxation 500 h	(2)	d <sub>cut,m</sub>	normal	standard	5	≥ 1,0	5.4.8.
8	Maximum torque moment	(2)	d <sub>cut,m</sub>	normal	standard	10	-	5.4.9. (8)
9	Sustained tests	(2)	d <sub>cut,m</sub>	normal	standard	10	≥ 1,0	5.4.10. (9)

Notes to Table 5.1:

- (1) The tests shall be performed in the base material for which the anchor is intended to be used according to Table 5.0. For normal weight concrete 5 tests in C20/25 and 5 tests in C50/60 are necessary; the lower value shall be used to determine the characteristic resistance for all strength classes ≥ C16/20.
- (2) The tests shall be performed in the base material for which the anchor is intended to be used according to Table 5.0. For normal weight concrete the tests have to be performed in C20/25.
- (3) Normal ambient temperature: +21 ± 3 °C (plastic anchor and concrete)
- (4) Conditioning of plastic anchor sleeve according to 5.4.5
- (5) For nailed-in plastic anchors only:  
The tests have to be performed with a layer of EPS (see Annex C, Figure C.7.1) with the maximum t<sub>fix</sub> the nailed-in plastic anchor is applied for.
- (6) Minimum installation temperature as specified by the manufacturer; normally 0 °C to +5 °C
- (7) Tests are only necessary for plastics if their behaviour is influenced by humidity e.g. polyamide.  
For polyethylene PE or polypropylene PP these tests are not necessary.
- (8) For screwed-in plastic anchors only
- (9) These tests are only necessary if other materials than virgin material for the plastic sleeve are to be used, see 2.1.2.2.

#### 5.4.2. Tests for determination of the characteristic resistance

For determination of characteristic resistance of the plastic anchor to action (tension) in normal weight concrete the tests according to table 5.1, line 1 are to be used. From the required 10 tests, 5 tests shall be performed in C20/25 and 5 tests in C50/60; the lower obtained value shall be used. The tension tests in C20/25 are needed also as reference tests for the evaluation of the results of the suitability tests. The edge distance shall be  $c_{\min} \geq 100$  mm and the spacing  $s_{\min} \geq 100$  mm.

For determination of characteristic resistance of the plastic anchor in solid masonry or other base materials 10 tension tests in the base material for which it is intended to be used according to Table 5.0 under normal ambient temperature and standard condition are necessary.

Some plastic anchors can be set in a range of admissible setting depth (min  $t_{\text{fix}}$  ... max  $t_{\text{fix}}$ ). If these anchors are set in a thin skin  $100 \text{ mm} > h \geq 40$  mm (e.g. weather resistant skin of external wall panels according to 2.1.3.1.), the anchor may extend beyond the thin member (see Figure 5.1.b) and, hence, may negatively affect the load carrying capacity. In these cases the most adverse setting position shall be considered in additional tests according to Table 5.1, line 1 (under laboratory conditions) and, if required, by job site tests according to Annex D. Examples are given in Figure 5.1.

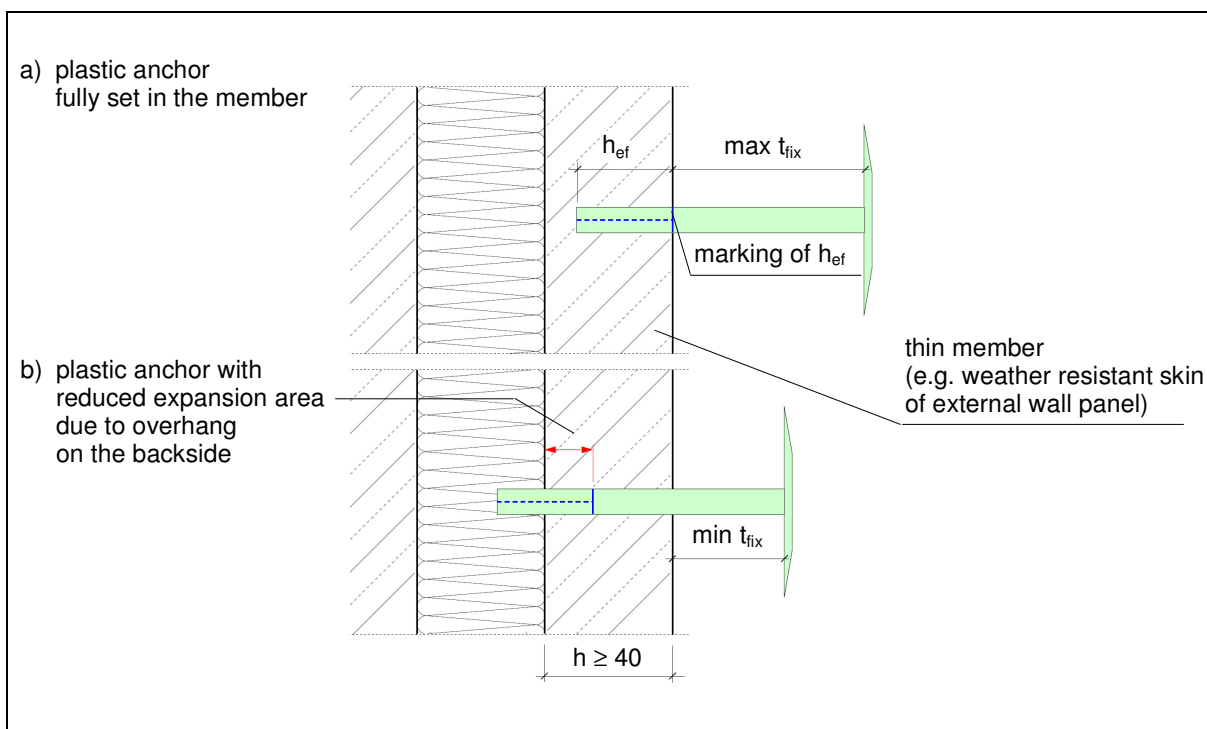


Figure 5.1: Example for different setting positions of plastic anchors in thin members

#### 5.4.3. Test for the verification of installation suitability

These tests are for nailed-in plastic anchors only.

The tests shall be carried out with a layer of EPS using the test setup (shown in Annex C, Figure C.7.1) for the setting of the anchor.

The tension tests shall be carried out according to Annex C, C.7.

#### 5.4.4. Correct installation

For the drill hole the maximum  $d_{\text{cut,max}}$  and the minimum  $d_{\text{cut,min}}$  diameter of drill bit according to Annex C.3. is to be used. The tension tests shall be carried out according to Annex C.

#### 5.4.5. Moisture Content

The moisture content of the plastic material may influence the plastic anchor behaviour. For the tests 3 different humidity levels are defined.

standard: equilibrium water content at  $T = +23 \text{ }^{\circ}\text{C}$  and 50 % relative humidity.

dry: equilibrium water content at  $T = +23 \text{ }^{\circ}\text{C}$  and  $\leq 10 \text{ } \%$  relative humidity.

wet: equilibrium water content after storing under water (wet condition means water saturated)

For standard humidity the conditioning may be done according to ISO 1110 [10]. *The dry conditioning is reached by drying the plastic sleeve in an oven at  $+70 \text{ }^{\circ}\text{C}$  until the mass loss is smaller than 0,1 % in 3 consecutive measurement every 24 h. For an example the wet conditioning can be reached by placing the plastic sleeve under water until the mass increase is smaller than 0,1 % in 3 consecutive measurements every 24 h.*

*E.g. For plastic anchor made out of polyamide PA 6 the following moisture contents be taken:*

*Standard:  $2,5 \pm 0,2 \text{ M}\%$  moisture content*

*dry:  $\leq 0,2 \text{ M}\%$  moisture content*

*wet:  $\geq 6,0 \text{ M}\%$  moisture content*

The tension tests shall be carried out according to Annex C.

#### 5.4.6. Temperature

##### a) Effect of increased temperature

The tests shall be carried out according to Annex C at the following temperature given in 4.4.6.

Temperature range: maximum short term temperature up to  $+40 \text{ }^{\circ}\text{C}$ :

Test are performed with the maximum short term temperature at  $+40 \text{ }^{\circ}\text{C}$ . The maximum long term temperature at approximately  $+24 \text{ }^{\circ}\text{C}$  is checked by the tests at normal ambient temperature.

The tests are carried out in slabs or, where space of the heating chamber is restricted, in cubes. Splitting of the concrete shall be prevented by means of specimen size or reinforcement.

After installation of the plastic anchors at normal ambient temperature raise the test specimen temperature to the required test temperature at a rate of approximately 20 K per hour. Maintain the test specimen at this temperature for 24 hours.

While maintaining the temperature of the test member in the area of the plastic anchor at a distance of 1d from the concrete surface at  $\pm 2 \text{ K}$  of the required value, carry out tension tests according to Annex C.

##### b) Effect of minimum installation temperature

The plastic anchor shall be installed at the lowest installation temperature (plastic anchor and base material) specified by the manufacturer. The pullout tests shall be performed according to Annex C immediately after setting to avoid any major increase of the temperature of the test specimen.

#### 5.4.7. Repeated/variable loading

The plastic anchor is subjected to  $10^5$  load cycles with a maximum frequency of approximately 6 Hz. During each cycle the load shall follow a sine curve between max N and min N according to equation (5.1) and (5.2) respectively. The displacement shall be measured during the first loading up to max N and either continuously or at least after 1, 10, 100, 1000, 10000 and 100000 load cycles.

$$\text{max N} = \text{smaller value of } 0,6 \cdot N_{R,K} \quad \text{and} \quad 0,8 \cdot A_S \cdot f_{yk} \quad (5.1)$$

$$\text{min N} = \text{higher value of } 0,25 \cdot N_{R,K} \quad \text{and} \quad N_{Rk} - A_S \cdot \Delta\sigma_S \quad (5.2)$$

$N_{Rk}$  = characteristic tensile resistance in concrete C20/25 evaluated according to 6.4.3.

$A_S$  = stressed expansion element cross section

$\Delta\sigma_S$  =  $120 \text{ N/mm}^2$

After completion of the load cycles the plastic anchor shall be unloaded, the displacement measured and a tension test performed according to Annex C.

#### **5.4.8. Relaxation**

The plastic anchors are installed in the test member and left there unloaded for 500 h. After that tension tests shall be carried out according to Annex C.

#### **5.4.9. Maximum torque moment**

The screwed-in plastic anchor shall be installed with a screw driver. The torque moment shall be measured with a calibrated torque moment transducer. The torque moment shall be increased until the failure of the plastic anchor.

The torque moment is measured depending on the time. From the curve gradient two moments can be determined, the one if the screw is fully attached to the plastic anchor collar ( $T_{inst}$ ) and the other if the plastic anchor fails ( $T_u$ ).

#### **5.4.10. Sustained tests**

These tests are only necessary if materials other than virgin polymers for the plastic sleeve are to be used, see 2.1.2.2.

The plastic anchors are installed in the test member and left there unloaded for 5000 h at least. After that, tension tests shall be carried out according to Annex C. For comparison 10 tension tests with plastic anchors without waiting period of 5000 h are required in the same test member.

#### **5.5. Protection against noise**

Not relevant.

#### **5.6. Energy economy and heat retention**

Not relevant.

#### **5.7. Aspects of durability, serviceability and identification**

##### **5.7.1. Tests for checking durability of the metal parts (Corrosion)**

No special tests are required, if the conditions given in 6.7.1. are complied with. If the plastic anchor is to be used in particularly aggressive conditions special considerations including testing are necessary, taking into account the environmental conditions and the available experience.

The durability of the coating of the metal part that ensures the suitability and the bearing behaviour of the plastic anchor shall be shown. No special test conditions can be given in this Guideline for checking the durability of any coating because they depend on the type of coating. Any appropriate tests shall be decided on by the responsible Approval Body.

##### **5.7.2. Tests for checking durability of the plastic sleeve**

The durability of the plastic sleeve material shall be verified against high alkalinity (pH = 13,2).

*This can be done for an example for PA 6 material by the following tests:*

*Test specimen:*

- 1. Manufactured of tension bars according to ISO 3167 [11].*
- 2. Determination of the water content of the tension bars following ISO 3167. If the water content is higher than 0,1 percentage by weight, the slices have to be dried.*
- 3. Drilling holes (diameter 2,8 mm) with a drill into the centre of the tension bars perpendicularly to the flat side of the specimen followed by rubbing the hole with a reamer (diameter  $3,0 \pm 0,05$  mm).*

4. Pressing a round pin (diameter according to Table 5.2) quickly into tension bars.
5. Putting the tension bars into the different agents (see table 5.2 for number of necessary tension bars).
  - .- Water (reference tests)
  - High alkalinity (pH = 13,2)

*High Alkalinity:*

The tension bars with pins are stored under standard climate conditions in a container filled with an alkaline fluid (pH = 13,2). All slices shall be completely covered for 2000 hours ( $T = +21 \text{ °C} \pm 3 \text{ °C}$ ). The alkaline fluid is produced by mixing water with  $\text{Ca(OH)}_2$  (calcium hydroxide) powder or tablets until the pH-value of 13,2 is reached. The alkalinity shall be kept as close as possible to pH 13,2 during the storage and not fall below a value of 13,0. Therefore the pH-value has to be checked and monitored at regular intervals (at least daily).

6. Visual analysis to observe cracks after storage. Perform tension tests following ISO 3167 on tension bars with pins.

The tests have to be carried out for each colour of the plastic anchor.

**Table 5.2: Necessary number of tests on tension bars with pins**

	Diameter of pins [mm]	water	High alkalinity
reference-test	3,0	5	-
test	3,5	-	5

For PP, PE or other polymeric materials (compare 2.1.2.2.) equal or equivalent tests have to be performed.

### 5.7.3. Influence of UV-exposure

No tests are required. In general the plastic anchors used for the application defined in the scope of this Guideline are not exposed to UV-radiation for an extended period of time during the use as they are protected by the rendering after installation.

## 6. ASSESSING AND JUDGING THE FITNESS OF PRODUCTS FOR AN INTENDED USE

This chapter details the performance requirements to be met (chapter 4) in precise and measurable (as far as possible and proportional to the importance of the risk) or qualitative terms, related to the product and its intended use, using the outcome of the verification methods (chapter 5).

### 6.1. Mechanical resistance and stability

Not relevant.

### 6.2. Safety in case of fire

ETAG 004 [3] is relevant.

### 6.3. Hygiene, health and environment

#### 6.3.1. Release of dangerous substances

The product shall comply with all relevant European and national provisions applicable for the uses for which it is brought to the market. The attention of the applicant shall be drawn on the fact that for other uses or other Member States of destination there may be other requirements which would have to be respected. For dangerous substances contained in the product but not covered by the ETA, the NPD option (no performance determined) is applicable

## 6.4. Safety in use

### 6.4.1. General

#### 6.4.1.1. 5%-fractile of the ultimate loads (characteristic resistance)

The 5%-fractile of the ultimate loads measured in a test series is to be calculated according to statistical procedures for a confidence level of 90 %. If a precise verification does not take place, in general, a normal distribution and an unknown standard deviation of the population shall be assumed.

$$F_{5\%} = \bar{F} (1 - k_s \cdot v) \quad (6.0)$$

e.g.: n = 5 tests:  $k_s = 3,40$

n = 10 tests:  $k_s = 2,57$

#### 6.4.1.2. Conversion of ultimate loads to take account of concrete, masonry and steel strength

In general the influence of the concrete strength C16/20 to C50/60 is not taken into account in the evaluation of the tests. For concrete C12/15 the reduction factor 0,7 has to be taken for the ultimate loads.

The influence of the masonry compressive strength  $\geq 12 \text{ N/mm}^2$  is not taken into account in the evaluation of the tests. For masonry material with compressive strength  $< 12 \text{ N/mm}^2$  and for lightweight aggregate and autoclaved concrete a linear conversion to the nominal compressive strength is to be used.

In the case of steel failure the failure load shall be converted to the nominal steel strength by Equation (6.0a)

$$F_{Ru} (f_{uk}) = F_{Ru}^t \cdot \frac{f_{uk}}{f_{u,test}} \quad (6.0a)$$

where:

$F_{Ru} (f_{uk}) =$  failure load at nominal steel ultimate strength

#### 6.4.1.3. Criteria for all tests

In all tests the following criteria shall be considered:

**a)** If a coefficient of variation of the ultimate loads in one test series is larger than 20 % an additional factor  $\alpha_v$  shall be considered in the determination of the characteristic loads.

$$\alpha_v = \frac{1}{1 + (v(\%) - 20) \times 0,03} \quad (6.1)$$

with  $v(\%) =$  maximum value of coefficient of variation ( $\geq 20 \%$ ) of the ultimate loads of all test series.

**b)** In the tests according to Table 5.1 line 2 to 7 and line 9 the factor  $\alpha$  shall be larger than the value given in this Table:

$$\alpha = \text{lower value of } \frac{N_{Ru,m}^t}{N_{Ru,m}^r} \quad (6.2a)$$

$$\text{and } \frac{N_{Rk}^t}{N_{Rk}^r} \quad (6.2b)$$

where:

$N_{Ru,m}^t ; N_{Rk}^t =$  mean value or 5%-fractile, respectively, of the ultimate loads in a test series

$N_{Ru,m}^r ; N_{Rk}^r =$  mean value or 5%-fractile, respectively, of failure load in the test for admissible service conditions according to line 1, Table 5.1.

Equation (6.2b) is based on test series with a comparable number of test results in both series. If the number of tests in the two series is very different, then Equation (6.2b) may be omitted when the coefficient of variation of the test series is smaller than or equal to the coefficient of variation of the reference test series (line 1, Table 5.1) or if the coefficient of variation is  $v \leq 15 \%$  in the tests.

If the criteria for the required value of  $\alpha$  (see Table 5.1) are not met in a test series, then the factor  $\alpha_1$  shall be calculated.

$$\alpha_1 = \frac{\alpha}{\text{req.}\alpha} \quad (6.3)$$

where:

$\alpha$  lowest value according to Equation (6.2) in the test series  
 $\text{req.}\alpha$  required value of  $\alpha$  according to Table 5.1

## 6.4.2. Criteria for specific tests

### 6.4.2.1. Temperature

#### a) Effect of increased temperature

The required  $\alpha$  for the maximum long term temperature is:

$$\text{req.}\alpha \geq 0,8 \text{ for } +40 \text{ }^\circ\text{C}$$

#### b) Effect of minimum installation temperature

The mean failure loads and the 5%-fractile of failure loads measured in tests at the minimum installation temperature shall be equal to the corresponding values measured in tests at normal ambient temperature ( $\text{req.}\alpha \geq 1,0$  line 5, Table 5.1).

### 6.4.2.2. Repeated loading

The increase of displacements during cycling shall stabilise in a manner indicating that failure is unlikely to occur after some additional cycles.

The displacement after the cycling shall be less than the medium displacement for the ultimate load in the reference tests.

The ultimate failure load of the tension tests after the cycling shall be equal to the ultimate failure load in the reference tests,  $\text{req.}\alpha \geq 1,0$ .

### 6.4.2.3. Relaxation

The required  $\alpha$  in the tests after 500 h is  $\geq 1,0$ .

### 6.4.2.4. Maximum torque moment

The installation of the screwed-in plastic anchor shall be practicable without steel failure or turn-through in the hole.

The ratio of the failure moment  $T_u$  to the installation moment  $T_{\text{inst}}$  shall be checked. The ratio shall be at least 1,5 in 90 % of the tests and shall be  $\geq 1,3$  in 10 % of the tests.

### 6.4.2.5. Sustained tests

These tests are only necessary if materials other than virgin polymers for the plastic sleeve are to be used, see 2.1.2.2.

The ultimate failure load of the tension tests after the sustained load shall be equal to or higher than the ultimate failure load in the comparison tests (test with plastic anchors without a conditioning period of 5000 h);  $\text{req.}\alpha \geq 1,0$ .

### 6.4.2.6. Test for the verification of installation suitability (nailed-in anchor mounted with EPS layer)

The verification of the installation suitability is done if all of the following criteria are fulfilled:

- The installed anchor is either flush with the surface of the EPS-block (anchor types for mounting on the surface) or countersunk in the EPS-block (anchor types for deep mounting) in accordance with the installation instruction supplied by the manufacturer.
- After removing the EPS-block the anchor shaft does not show any cracks and/or breaks that influence the performance of the anchor. Cracks and/or breaks have to be assessed regarding their influence on the load carrying capacity of the anchor as well as the corrosion outside of the base material.

The required  $\alpha$  for installation suitability is  $\text{req.}\alpha \geq 0,9$ .



### 6.4.3. Characteristic resistance of single plastic anchor

The characteristic resistance  $N_{Rk}$  for single plastic anchors under tension load shall be calculated as follows:

- for nailed-in plastic anchors:

$$N_{Rk} = N_{Rk0} \cdot \alpha_{1, \text{line 2}} \cdot \min\alpha_{1, \text{line 4,5}} \cdot \min\alpha_{1, \text{line 3,6,7}} \cdot \alpha_{1, \text{line 9}} \cdot \alpha_v \quad (6.4a)$$

- for screwed-in plastic anchors:

$$N_{Rk} = N_{Rk0} \cdot \min\alpha_{1, \text{line 4,5}} \cdot \min\alpha_{1, \text{line 3,6,7}} \cdot \alpha_{1, \text{line 9}} \cdot \alpha_v \quad (6.4b)$$

$N_{Rk}$  = characteristic resistance in the ETA, These values shall be rounded to the following numbers:  
0,3 / 0,4 / 0,5 / 0,6 / 0,75 / 0,9 / 1,2 / 1,5 kN

$N_{Rk,0}$  = concrete: characteristic resistance (5%-fractile of the failure load) from the test for determination of the characteristic resistance according to table 5.1, line 1 in normal weight concrete

other materials: characteristic resistance (5%-fractile of the failure load) from the test for determination of the characteristic resistance according to table 5.1, line 1 in the different base materials according to Table 5.0.

$\alpha_{1, \text{line 2}}$  = value  $\alpha_1$  according to Equation (6.3) of the tests for the verification of installation suitability  $\leq 1,0$

- for use category A and B: value of A applies for both use categories unless voluntary tests are also performed specifically for use category B

- for use category C: value of the most critical material applies unless voluntary tests are carried out for different materials of this use category

$\min\alpha_{1, \text{line 4,5}}$  = minimum value  $\alpha_1$  according to Equation (6.3) of the tests under conditioning and temperature  $\leq 1,0$

$\min\alpha_{1, \text{line 3,6,7}}$  = minimum value  $\alpha_1$  according to Equation (6.3) of the tests for functioning depending on the diameter of the drill hole, functioning under repeated loads and functioning relaxation  $\leq 1,0$

$\alpha_{1, \text{line 9}}$  = value  $\alpha_1$  according to Equation (6.3) of the tests for sustained load  $\leq 1,0$

$\alpha_v$  = value  $\alpha_v$  to represent a coefficient of variation of the ultimate loads in the tests larger than 20 % (see Equation 6.1)  $\leq 1,0$

For the intended use in solid masonry or any other base materials, "job site tests" for determination of characteristic resistance of the plastic anchor are required, if the base material at the construction works in relation to the type of the material and/or minimum strength and/or geometry of holes in the masonry units is different to the base material used in the laboratory or assessment tests.

The characteristic resistance of the plastic anchor in less well-defined base materials may only be determined by "job site tests" for use category A, B, C, D and E, if the plastic anchor has already an ETA with characteristic values for the equivalent base material (according to use category A, B, C, D and E) as it is present on the construction works.

#### 6.4.4. Displacement

As a minimum, the displacement under short term tension loading shall be given in the ETA for a load  $N$  which corresponds approximately to the admissible tension load [ $N_{Sk} = N_{Rk} / (\gamma_M \cdot \gamma_F)$ ] of the plastic anchor.

These displacements are evaluated from the tension tests for admissible service conditions.

The displacement of nailed-in anchors under short term tension loading shall be given in the ETA as the displacement increase  $\Delta\delta_N$  between  $N_{preload} = 0,05 \cdot N_{Rk}$  and the admissible tension load [ $N_{Sk} = N_{Rk} / (\gamma_M \cdot \gamma_F)$ ] of the plastic anchor (see Figure 6). These displacements of nailed-in anchors are evaluated from the tension tests for the verification of installation suitability.

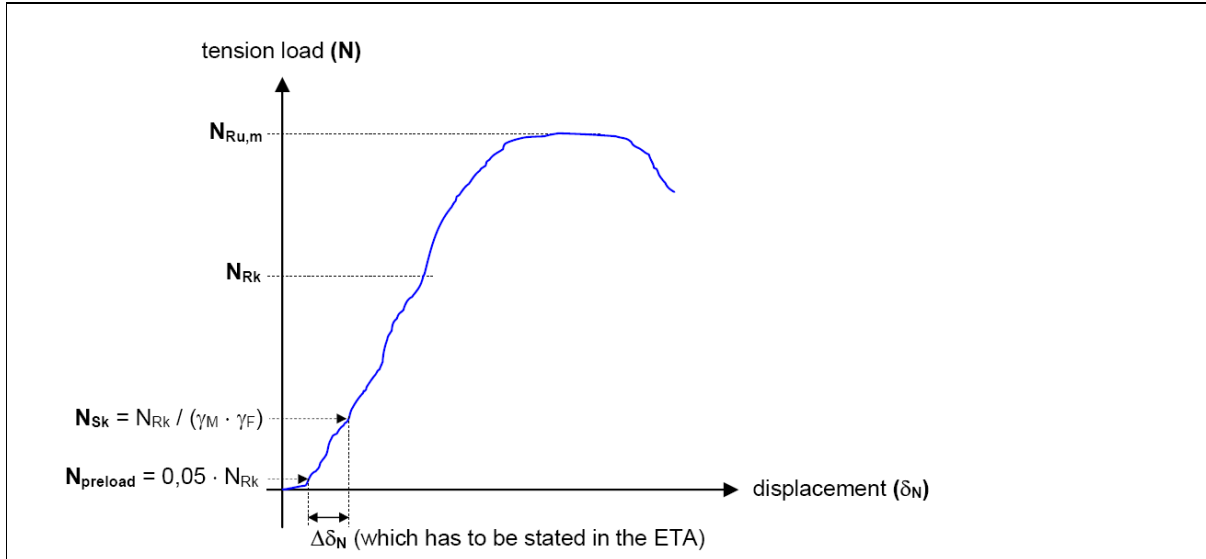


Figure 6: Example of load displacement diagram for a nailed-in plastic anchor.  
Evaluation of  $\Delta\delta_N$ , which has to be given in the ETA

#### 6.4.5. Evaluation of plate stiffness

The stiffness of the anchor plate may optionally be determined according to Technical Report 026 "Evaluation of plate stiffness from plastic anchors for fixing of external thermal insulation composite systems with rendering (ETICS)" [18]. If the plate stiffness will not be determined, the relevant ETA for plastic anchors will state "no performance determined" against that aspect.

#### 6.5. Protection against noise

Not relevant.

#### 6.6. Energy economy and heat retention

Not relevant.

#### 6.7. Aspects of durability, serviceability and identification

##### 6.7.1. Durability of the metal parts

The assessment/testing required with respect to corrosion resistance will be dependent upon the specification of the plastic anchor in relation to its use for ETICS or VETURE Kits. Supporting evidence that corrosion will not occur is not required if the plastic anchors are protected against corrosion of steel parts, as set out below:

If the metal parts of the plastic anchors consist of steel with zinc coating, this is considered to be sufficiently durable against any moisture (the head covers the sleeve which generally prevents moisture from entering the sleeve). The protection of the head of the metal part made of steel with zinc coating is not necessary, if the metal part of the plastic anchor is covered by at least 50 mm insulation material (e.g. fixing of profiles).

The protection of the head of the metal part is also not necessary if the metal part is made out of an appropriate grade of stainless steel, Grade A2 or A4 of ISO 3506 [12] or equivalent.

Where a form of protection (material or coating) other than those mentioned above is specified, it will be necessary to provide evidence in support of its effectiveness in the defined service conditions; with due regard to the aggressiveness of the conditions concerned.

Assessment of the durability of the coating is based on the type of coating and the intended conditions of use. The appropriate tests shall be decided on by the responsible Approval Body.

### 6.7.2. Durability of the plastic sleeve

The assessment/testing required with respect to high alkalinity (pH = 13,2) shall be presented and it will be dependent upon the specification of the plastic anchor in relation to its use.

*A critical susceptibility to environmental exposure is present e.g. for PA 6, if the following limits in comparison with the results of the tests of table 5.2, line 2 with line 1 are exceeded.*

**Table 6: Limits for susceptibility to environmental stress cracking**

<i>Test-method</i>	<i>criteria</i>	<i>limit for susceptibility to environmental exposure</i>
<i>Visual analysis</i>	<i>cracking</i>	<i>in all specimens no cracks visible with naked eye</i>
<i>tension test ISO 527<sup>1)</sup></i>	<i>tension strength</i>	<i>≤ 5 % reduction of tension strength</i>
<i>tension test ISO 527</i>	<i>strain <math>\epsilon_u</math> at maximum load</i>	<i>≤ 20 % reduction of strain <math>\epsilon_u</math></i>
<i>tension test ISO 527</i>	<i>strain <math>\epsilon_1</math> at 50 % of the maximum load</i>	<i>≤ 20 % reduction of strain <math>\epsilon_1</math></i>

<sup>1)</sup> ISO 527-1:1993-06 [13]

PP, PE or other polymeric materials (compare 2.1.2.2.) have to be assessed based on the selected equal or equivalent test procedure (compare 5.7.2).

### 6.7.3. Influence of UV-exposure

The manufacturer shall ensure that the packaging of the plastic anchors protects the plastic anchors against UV-radiation during the storage.

#### **6.7.4. Identification**

##### **6.7.4.1. General**

Characteristics as specified in the manufacturer's specification for production control and as required above are to be checked using ISO, European or recognised standard test methods as nominated by the manufacturer and accepted by the Approval Body.

Wherever possible, checks should be carried out on finished components. Where dimensions or other factors prevent testing to a recognised standard, e.g. tensile properties where the required ratio of length to diameter does not exist in the finished component, then the tests should still be carried out on the finished component if practicable, in order to produce results for comparison purposes. Where this is not possible, tests should be carried out on the raw material; however, it shall be noted that where the production process changes the characteristics of the material, then a change to the production process can render the results of these tests invalid.

Deviations of samples from the specification on the manufacturer's drawings shall be identified and appropriate action taken to ensure compliance before testing plastic anchors.

A minimum number of each component of the plastic anchors and special drill bits and setting tools, if appropriate, depending on factors such as the production process and the bag size is to be taken and dimensions measured and checked against the drawings provided by the manufacturer. The tolerances specified for all components shall be complied with and the dimensions shall conform to the appropriate ISO or European standards where relevant.

The results obtained shall be assessed to ensure that they are within the manufacturer's specification.

##### **6.7.4.2. Identification of the plastic parts**

The product shall be clearly identified. Where possible, reference to European standards shall be made. The chemical constitution and composition of the materials will be submitted by the applicant to the Approval Body which will observe strict rules of confidentiality. Under no circumstances will such information be disclosed to any other party.

This composition shall be checked by the Approval Body on the basis of the declaration made by the applicant, and it will be documented by fingerprint whenever possible.

The following characteristics for virgin material (see 2.1.2.2.) shall be specified, where relevant, in accordance with ISO, European or national standards, together with any others, as necessary:

DSC curve: differential scanning calorimetry ISO 3146 [14]

MFI value: melt flow index

For other material than virgin material, further specifications are necessary.

## 7. ASSUMPTIONS AND RECOMMENDATIONS UNDER WHICH THE FITNESS FOR USE OF THE PRODUCTS IS ASSESSED

This chapter sets out the assumptions and recommendations for design, installation and execution, packaging, transport and storage, use, maintenance and repair under which the assessment of the fitness for use according to the ETAG can be made (only when necessary and in so far as they have a bearing on the assessment or on the products).

### 7.1. Design methods for anchorages

The overall assumption shall be made that the design and dimensioning of anchorages is based on technical considerations and in particular the following:

- the characteristic resistance of single plastic anchors in the different base materials is evaluated according to 6.4.3. Taking a simple approach the characteristic resistance of single plastic anchors may be used for the different loading directions (shear load or combined tension and shear loads).

In the absence of national regulations the partial safety factors for the resistance of the plastic anchor shall be taken as  $\gamma_M = 2$ .

- the minimum edge distance ( $c_{min} = 100$  mm) and spacing ( $s_{min} = 100$  mm) shall not fall below these values, unless specific proof is provided.
- the preparation of verifiable calculation notes and drawings for determining the relevant concrete or masonry in the region of the anchorage, the loads to be transmitted and their transmission to the supports of the structure.
- investigations and evaluations according to ETAG 004 [3] are necessary for the verification of the loading imposed by the ETICS on to the plastic anchor.

### 7.2. Packaging, transport and storage

#### Storage conditions

The storage conditions shall be clearly stated, including any temperature limits.

#### Temperature requirements for installation

Any time limitations on exposure to high or low temperatures are to be clearly stated.

### 7.3. Installation of plastic anchors

Plastic anchors shall be used only as supplied by the manufacturer. It is not permissible to exchange the components on which the suitability and loading capacity of the plastic anchors depend.

Plastic anchors shall be installed in accordance with the technical approval, the manufacturer's specifications and the drawings prepared for that purpose, using the appropriate tools. Plastic anchor installation shall be carried out by trained personnel. Before inserting a plastic anchor, checks are to be made to ensure that the base material in which it is to be placed is the base material to which the characteristic loads apply.

Holes are to be drilled perpendicular to the surface unless specifically required otherwise by the manufacturer's specifications. Normally hard metal hammer-drill bits in accordance with ISO or current national standards shall be used. Many drill bits exhibit marks indicating that these requirements have been met. If the drill bits do not bear a conformity mark, proof of suitability shall be provided.

Plastic anchors are to be installed at not less than the specified embedment depth. The minimum edge distance and minimum spacing are to be kept to the specified values, no minus tolerances are to be allowed.

When drilling holes in concrete, care is to be taken not to damage reinforcement in close proximity to the hole position.

## Section three:

# ATTESTATION OF CONFORMITY (AC)

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### 8. ATTESTATION OF CONFORMITY

#### 8.1. EC decision

The system of attestation of conformity specified by the European Commission in mandate Construct 96/193 REV.1, Annex 3, is system 2<sup>+</sup> described in Council Directive (89/106/EEC) Annex III, 2(ii) [1], First possibilities and is detailed as follows:

- (a) tasks for the manufacturer
  - (1) initial type-testing of the product; (see 8.2.1)
  - (2) factory production control; (see 8.2.2)
  - (3) testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan. This testing is covered by normal FPC testing.
- (b) tasks for the approved body
  - (4) certification of factory production control on the basis of:
    - initial inspection of factory and of factory production control; (see 8.2.3)
    - continuous surveillance, assessment and approval of factory production control. (see 8.2.3)

#### 8.2. Responsibilities

##### 8.2.1. Initial type-testing

Initial type-testing will be available as part of the work required for the assessment of products for ETA.

The tests will have been conducted by the Approval Body or under its responsibility (which may include a proportion conducted by an approved laboratory or by the manufacturer) in accordance with chapter 5 of this ETAG. The Approval Body will have assessed the results of these tests in accordance with chapter 6 of this ETAG, as part of the ETA issuing procedure.

##### 8.2.2. Factory production control (FPC)

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This production control system shall ensure that the product is in conformity with the ETA.

### **8.2.3. Initial inspection and continuous surveillance, assessment of the factory production control system**

Assessment of the factory production control system is the responsibility of the approved body.

An assessment shall be carried out on each production unit to demonstrate that the FPC is in conformity with the ETA and any additional information. This assessment shall be based on an initial inspection of the factory.

Subsequently continuous surveillance of FPC is necessary to ensure continuing conformity with the ETA.

It is recommended that surveillance inspections be conducted at least twice per year. However, for factories which are the subject of a certified quality assurance system assessed by a body notified under the CPD for these products or working under sub-contract to the approved body, surveillance visits may be carried out at less frequent intervals.

### **8.3. Documentation**

In order to help the approved body make an evaluation of conformity the Approval Body issuing the ETA shall supply the information detailed below. This information together with the requirements given in EC Guidance Paper B Construct 95/135 Rev 1, will generally form the basis on which the FPC is assessed by the approved body.

- (1) the ETA
- (2) basic manufacturing processes
- (3) product and materials specifications
- (4) test plan
- (5) other relevant information

This information shall initially be prepared or collected by the Approval Body and where appropriate shall be agreed with the manufacturer. The following gives guidance on the type of information required:

- (1) The ETA

See chapter 9 of this ETAG.

Any additional (possibly confidential) information shall be declared in the ETA.

- (2) Basic manufacturing processes

The basic manufacturing process shall be described in sufficient detail to support the proposed FPC methods.

Plastic anchors are normally manufactured using conventional moulding techniques. Any critical process or treatment of the parts which affects performance shall be highlighted.

- (3) Product and materials specification

Product and materials specifications will be required for the various components and any bought-in components.

These specifications can take the form of:

detailed drawings (including manufacturing tolerances)

raw materials specifications

references primarily to European standards and grades (International standards may be used if an EN does not exist, and national standards may only be used if they are accepted in the country of use of the anchor)

manufacturer's data sheets e.g. for raw materials not covered by a recognised standard

- (4) Test plan

The manufacturer and the Approval Body issuing the ETA shall agree on a test plan (CPD [1] Annex III 1b).

This test plan is necessary to ensure that the product specification remains unchanged.

The validity of the type and frequency of checks/tests conducted during production and on the final product shall be considered as a function of the production process. This will include the checks conducted during manufacture on properties that cannot be inspected at a later stage and for checks on the final product. These will normally include:

- material properties e.g. tensile strength, hardness, surface finish
- determination of the dimensions of component parts
- coating thickness
- checking correct assembly.

Where bought-in components/materials are supplied without certificates of relevant properties they shall be subject to checks/tests by the manufacturer before acceptance.

#### **8.4. CE marking and information**

Every plastic anchor shall be clearly identifiable before installation and shall be marked by:

- the name or identifying mark of the producer
- the plastic anchors identity (commercial name)
- the minimum anchorage depth or the maximum admissible thickness of the fixture

In addition, the symbol „CE“ can be put on the plastic anchor.

The packaging or the delivery tickets associated with the product shall contain the CE conformity marking which shall consist of the symbol CE and be accompanied by:

1. Identification number of the certification body
2. The name or identifying mark of the producer and manufacturing plant.  
If the plastic anchor is produced in a stepped procedure, in different plants, one plant has to be identified, which is responsible for the mark.
3. The last two digits of the year in which the marking was affixed.
4. Number of the European Technical Approval
5. Number of the relevant part of the ETAG Plastic Anchor for use in concrete and masonry
6. size of the plastic anchor
7. Use category A, B, C, D and/or E

All installation data and the allowable base material shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- base material for the intended use
- drill bit diameter ( $d_{cut}$ )
- maximum thickness of the ETICS ( $\max t_{fix}$ )
- minimum effective anchorage depth ( $h_{ef}$ )  
or  
overall plastic anchor embedment depth in the base material ( $h_{nom}$ )
- minimum hole depth ( $h_o$ )
- information on the installation procedure, including cleaning of the hole, preferably by means of an illustration
- reference to any special installation equipment needed
- identification of the manufacturing batch

All data shall be presented in a clear and explicit form.



## Section four:

# ETA CONTENT

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### 9. THE ETA CONTENT

#### 9.1. The ETA-content

##### 9.1.1. Model ETA

The format of the ETA shall be based on the Commission Decision of 1997-07-22, EC Official Journal L236 of 1997-08-27.

##### 9.1.2. Checklist for the issuing body

The technical part of the ETA shall contain information on the following items (9.1.3. to 9.1.4.), in the order and with reference to the relevant Essential Requirement. For each of the listed items, the ETA shall either give the mentioned indication/statement/description or state that the verification/assessment of this item has not been carried out and therefore that the NPD option is used. The items given here are with reference to the relevant clause of this guideline.

##### 9.1.3. Definition of the plastic anchor and its intended use

- Definition
- Intended use

##### 9.1.4. Characteristics of the plastic anchor with regard to safety in use and methods of verification

- characteristic values to be used for the calculation of the ultimate limit state
- characteristic values of displacement for serviceability limit state
- Definition of the base material which was used in the tests (type of material, strength, density, type of aggregate, hole dimension and location of the masonry unit). The base material on construction works for which the plastic anchor is intended to be used shall have at least the required material properties. This means that the base material on site shall be such that the performance of the anchor is not worse than that declared by the manufacturer (but could be better).
- minimum allowable edge distance and minimum allowable spacing

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

The ETA is issued for the product with the chemical composition and other characteristics as deposited with the issuing Approval Body. Changes of materials, of composition or characteristics, shall be immediately notified to the Approval Body, which will decide whether a new assessment will be necessary.

##### 9.1.5. Assumptions under which the fitness of the plastic anchor for the intended use was favourably assessed

- Transport and storage
- Installation of plastic anchors

# Annex A: COMMON TERMINOLOGY AND ABBREVIATIONS

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## A. Common terminology and abbreviations

This common terminology is based upon the Construction Products Directive 89/106/EEC [1] and the Interpretative documents [2] as published in the Official Journal of the EC on 28.2.1994. It is limited to items and aspects relevant for approval work. They are partly definitions and partly clarifications.

### A.1. Works and Products

#### A.1.1. Construction works (and parts of works) (often simply referred to as “works”) (ID 1.3.1)

Everything that is constructed or results from construction operations and is fixed to the ground.

(This covers both building and civil engineering works, and both structural and non structural elements).

#### A.1.2. Construction products (often simply referred to as “products”) (ID 1.3.2)

Products which are produced for incorporation in a permanent manner in the works and placed as such on the market.

(The term includes materials, elements, components and systems or installations)

#### A.1.3. Incorporation (of products in works) (ID 1.3.2)

Incorporation of a product in a permanent manner in the works means that:

- its removal reduces the performance capabilities of the works, and
- that the dismantling or the replacement of the product are operations which involve construction activities.

#### A.1.4. Intended use (ID 1.3.4)

Role(s) that the product is intended to play in the fulfilment of the Essential Requirements.

(N.B. This definition covers only the intended use as far as relevant for the CPD)

#### A.1.5. Execution (ETAG-format)

Used in this document to cover all types of incorporation techniques such as installation, assembling, incorporation, etc.

#### A.1.6. System (EOTA/TB guidance)

Part of the works realised by:

- particular combination of a set of defined products, and
- particular design methods for the system, and/or
- particular execution procedures.

### A.2. Performances

#### A.2.1. Fitness for intended use (of products) (CPD 2.1)

Means that the products have such characteristics that the works in which they are intended to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the Essential Requirements.

(N.B. This definition covers only the intended fitness for intended use as far as relevant for the CPD)

### **A.2.2. Serviceability (of works)**

Ability of the works to fulfil their intended use and in particular the essential requirements relevant for this use.

The products shall be suitable for construction works which (as a whole and in their separate parts) are fit for their intended use, account being taken of economy, and in this connection satisfy the (following) essential requirements where the works are subject to regulations containing such requirements. Such requirements must, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern actions which are foreseeable (CPD [1] Annex I, Preamble).

### **A.2.3. Essential requirements (for works)**

Requirements applicable to works, which may influence the technical characteristics of a product, and are set out in objectives in the CPD, Annex I (CPD, art. 3.1).

### **A.2.4. Performance (of works, parts of works or products) (ID 1.3.7)**

The quantitative expression (value, grade, class or level) of the behaviour of the works, parts of works or of the products, for an action to which it is subject or which it generates under the intended service conditions (works or parts of works) or intended use conditions (products).

As far as practicable the characteristics of products, or groups of products, shall be described in measurable performance terms in the technical specifications and guidelines for ETA. Methods of calculation, measurement, testing (where possible), evaluation of site experience and verification, together with compliance criteria shall be given either in the relevant technical specifications or in references called up in such specifications.

### **A.2.5. Actions (on works or parts of the works) (ID 1.3.6)**

Service conditions of the works which may affect the compliance of the works with the essential requirements of the Directive and which are brought about by agents (mechanical, chemical, biological, thermal or electro-mechanical) acting on the works or parts of the works.

Interactions between various products within a work are considered as "actions".

### **A.2.6. Classes or levels (for essential requirements and for related product performances) (ID 1.2.1)**

A classification of product performance(s) expressed as a range of requirement levels of the works, determined in the IDs or according to the procedure provided for in art. 20.2a of the CPD.

## **A.3. ETAG - Format**

### **A.3.1. Requirements (for works) (ETAG-format 4.)**

Expression and application, in more detail and in terms applicable to the scope of the guideline, of the relevant requirements of the CPD (given concrete form in the IDs and further specified in the mandate) for works or parts of the works, taking into account the durability and serviceability of the works.

### **A.3.2. Methods of verification (for products) (ETAG-format 5.)**

Verification methods used to determine the performance of the products in relation to the requirements for the works (calculations, tests, engineering knowledge, evaluation of site experience, etc.).

These verification methods are related only to the assessment of, and for judging, the fitness for use. Verification methods for particular designs of works are called here "project testing", for identification of products are called "identification testing", for surveillance of execution or executed works are called "surveillance testing", and for attestation of conformity are called "AC-testing".

### **A.3.3. Specifications (for products) (ETAG-format 6.)**

Transposition of the requirements into precise and measurable (as far as possible and proportional to the importance of the risk) or qualitative terms, related to the products and their intended use. The satisfaction of the specifications is deemed to satisfy the fitness for use of the products concerned.

Specifications may also be formulated with regard to the verification of particular designs, for identification of products, for surveillance of execution or executed works and for attestation of conformity, when relevant.

#### **A.4. Working life**

##### **A.4.1. Working life (of works or parts of the works) (ID 1.3.5(1))**

The period of time during which the performance will be maintained at a level compatible with the fulfilment of the Essential Requirements.

##### **A.4.2. Working life (of products)**

Period of time during which the performance of the product are maintained - under the corresponding service conditions - at a level compatible with the intended use conditions.

##### **A.4.3. Economically reasonable working life: (ID 1.3.5(2))**

Working life which takes into account all relevant aspects, such as costs of design, construction and use, costs arising from hindrance of use, risks and consequences of failure of the works during its working life and cost of insurance covering these risks, planned partial renewal, costs of inspections, maintenance, care and repair, costs of operation and administration, of disposal and environmental aspects.

##### **A.4.4. Maintenance (of works) (ID 1.3.3(1))**

A set of preventive and other measures which are applied to the works in order to enable the works to fulfil all its functions during its working life. These measures include cleaning, servicing, repainting, repairing, replacing parts of the works where needed, etc.

##### **A.4.5. Normal maintenance (of works) (ID 1.3.3(2))**

Maintenance, normally including inspections, which occurs at a time when the cost of the intervention which has to be made is not disproportionate to the value of the part of the work concerned, consequential costs (e.g. exploitation) being taken into account.

##### **A.4.6. Durability (of products)**

Ability of the product to contribute to the working life of the work by maintaining its performances, under the corresponding service conditions, at a level compatible with the fulfilment of the essential requirements by the works.

#### **A.5. Conformity**

##### **A.5.1. Attestation of conformity (of products)**

Provisions and procedures as laid down in the CPD [1] and fixed according to the directive, aiming to ensure that, with acceptable probability, the specified performance of the product is achieved by the ongoing production.

##### **A.5.2. Identification (of a product)**

Product characteristics and methods for their verification, allowing to compare a given product with the one that is described in the technical specification.

## ABBREVIATIONS

Concerning the Construction products directive:

AC:	Attestation of Conformity
CEN:	Comité Européen de Normalisation
CPD:	Construction Products Directive
EC	European Commission
EFTA:	European Free Trade Association
EN:	European Standards
EU	European Union
FPC:	Factory Production Control
ID:	Interpretative Documents of the CPD
ISO:	International Standardisation Organisation
SCC:	Standing Committee for Construction of the EC

Concerning approval:

EOTA:	European Organisation for Technical Approvals
ETA:	European Technical Approval
ETAG:	European Technical Approval Guideline
ETICS:	External Thermal Insulation Composite Systems with Rendering
TB:	EOTA-Technical Board
UEAtc:	Union Européenne pour l'Agrément technique dans la construction

General:

TC:	Technical Committee
WG:	Working Group

## Annex B: TERMINOLOGY AND ABBREVIATIONS SPECIFIC TO THIS ETAG

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### B.1. General

- Plastic anchor = a manufactured, assembled component for achieving anchorage between the base material and the fixture.
- Fixture = component to be fixed to the base material, in this case external thermal insulation composite system.
- Anchorage = an assembly comprising base material, plastic anchor and fixture.

### B.2. Plastic anchors

The notations and symbols frequently used in this Guideline are given below. Further particular notation and symbols are given in the text.

- $b$  = width of the member of the base material
- $c_{\min}$  = minimum allowable edge distance
- $d_o$  = drill hole diameter
- $d_{\text{cut}}$  = cutting diameter of drill bit
- $d_{\text{cut,max}}$  = cutting diameter at the upper tolerance limit  
(maximum diameter bit)
- $d_{\text{cut,min}}$  = cutting diameter at the lower tolerance limit  
(minimum diameter bit)
- $d_{\text{cut,m}}$  = medium cutting diameter of drill bit
- $d_f$  = diameter of clearance hole in the fixture
- $d_n$  = diameter of the shaft of the nail
- $d_{\text{nom}}$  = outside diameter of plastic anchor = outside diameter of plastic sleeve
- $d_p$  = diameter of the plate
- $h$  = thickness of member (wall)
- $h_{\min}$  = minimum thickness of member
- $h_o$  = depth of cylindrical drill hole at shoulder
- $h_1$  = depth of drilled hole to deepest point
- $h_{\text{ef}}$  = effective anchorage depth
- $h_{\text{nom}}$  = overall plastic anchor embedment depth in the base material
- $h_D$  = thickness of insulation material
- $L_a$  = length of plastic anchor
- $L_n$  = length of nail
- $l_s$  = length of special screw
- $s_{\min}$  = minimum allowable spacing
- $T$  = torque moment
- $T_{\text{inst}}$  = required or maximum recommended setting torque
- $t_{\text{fix}}$  = thickness of fixture
- $t_{\text{tol}}$  = thickness of equalizing layer for compensation of tolerances or non-load bearing coating

### B.3. Base materials

$f_c$	=	concrete compressive strength measured on cylinders
$f_{c,cube}$	=	concrete compressive strength measured on cubes
$f_{c,test}$	=	compressive strength of concrete at the time of testing
$f_{cm}$	=	mean concrete compressive strength
$f_{ck}$	=	nominal characteristic concrete compressive strength (based on cylinder)
$f_{ck,cube}$	=	nominal characteristic concrete compressive strength (based on cubes)
$\rho$	=	bulk density of unit
$f_b$	=	unit compressive strength
$f_{b,test}$	=	unit compressive strength at the time of testing
$f_{bk}$	=	nominal characteristic unit compressive strength
$f_{y,test}$	=	steel tensile yield strength in the test
$f_{yk}$	=	nominal characteristic steel yield strength
$f_{u,test}$	=	steel ultimate tensile strength in the test
$f_{uk}$	=	nominal characteristic steel ultimate strength

### B.4. Loads/forces

$F$	=	force in general
$N_{Sk}$	=	characteristic value of normal force (+N = tension force)
$N_{Rk}$	=	characteristic plastic anchor resistance (5%-fractile of results) under tension force
$N_{Ru,m}$	=	mean value of the ultimate loads under tension force
$\gamma_F$	=	partial safety factor for action
$\gamma_M$	=	material partial safety factor (according to 7.1.)

### B.5. Tests

$F_{Ru}^t$	=	ultimate load in a test
$F_{Ru,m}^t$	=	mean ultimate load in a test series
$F_{Rk}^t$	=	5%-fractile of the ultimate load in a test series
$n$	=	number of tests of a test series
$v$	=	coefficient of variation
$\delta(\delta_N, \delta_V)$	=	displacement (movement) of the plastic anchor at the surface of the base material relative to the surface of the base material in direction of the load (tension) outside the failure area The displacement includes the steel and base material deformations and a possible plastic anchor slip.

## Annex C: DETAILS OF TESTS

### C.1. Test samples

Samples shall be chosen to be representative of normal production as supplied by the manufacturer, including screws, nails and plastic sleeves.

Sometimes the tests are carried out with samples specially produced for the tests before issuing the ETA. If so, it shall be verified that the plastic anchors subsequently produced conform in all respects, particularly suitability and bearing behaviour, with the plastic anchors tested.

### C.2. Test members

#### C.2.1. Concrete test member

The test members shall be made in accordance with EN 206-1 [7] and comply with the following:

##### - Aggregates

Aggregates shall be of medium hardness and with a grading curve falling within the boundaries given in Figure 2.1. The maximum aggregate size shall be 16 mm or 20 mm. The aggregate density shall be between 2,0 and 3,0 t/m<sup>3</sup> (see EN 206-1 [7] and ISO 6783 [15]).

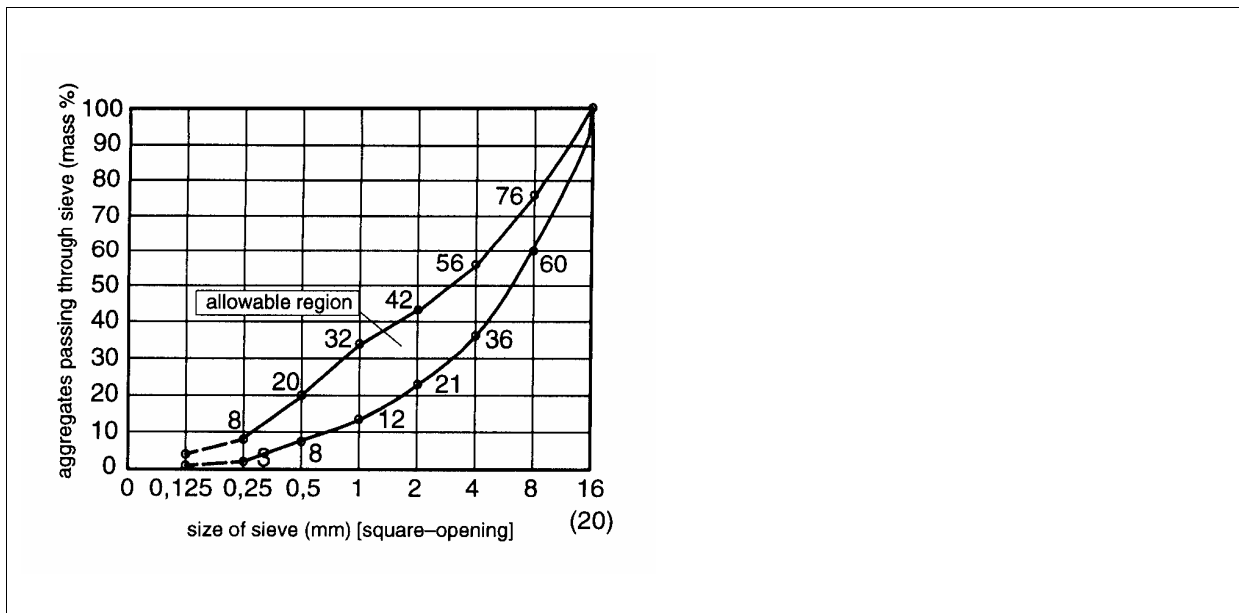


Figure C.2.1 Admissible region for the grading curve

##### - Cement

The concrete shall be produced using cement type CEM I or CEM II/A-LL, CEM II/B-LL (see EN 197-1 [16]).

##### - Water/cement ratio and cement content

The water/cement ratio shall not exceed 0,75 and the cement content shall be at least 240 kg/m<sup>3</sup>.

No additives likely to change the concrete properties (e.g. fly ash, or silica fume, limestone powder or other powders) shall be included in the mix.

##### - Concrete strength

Tests are carried out in concrete strength class C20/25 and in C50/60.



The following mean compressive strengths at the time of testing plastic anchors shall be obtained:

C20/25	$f_{cm}$	=	20-30 MPa (cylinder: diameter 150 mm, height 300 mm)
		=	25-35 MPa (cube: 150 x 150 x 150 mm)
C50/60	$f_{cm}$	=	50-60 MPa (cylinder: diameter 150 mm, height 300 mm)
		=	60-70 MPa (cube: 150 x 150 x 150 mm)

It is recommended to measure the concrete compressive strength either on cylinders diameter 150 mm, height 300 mm, or cubes 150 mm.

For every concreting operation, specimens (cylinder, cube) shall be prepared having the dimensions mentioned in this clause; the specimens being made and treated in the same way as the test members.

Generally, the concrete control specimens shall be tested on the same day as the plastic anchors in the corresponding concrete test member. If a test series takes a number of days, the specimens shall be tested at a time giving the best representation of the concrete strength at the time of the plastic anchor tests, e.g. in general at the beginning and at the end of the tests.

The concrete strength at a certain age shall be measured on at least 3 specimens, the mean value shall be used to check compliance with the requirement.

If, when evaluating the test results, there are doubts about whether the strength of the control specimens represents the concrete strength of the test members, then at least three cores of 100 mm or 150 mm diameter shall be taken from the test members outside the zones where the concrete has been damaged in the tests, and tested in compression. The cores shall be cut to a height equal to their diameter, and the surfaces to which the compression loads are applied shall be ground or capped. The compressive strength measured on these cores shall be converted into the strength of cubes by Equation (C.2.1):

$$f_{c,cube\ 200} = 0,95 \cdot f_{c,cube\ 150} = f_{c,core\ 100} = f_{c,core\ 150} \quad (C.2.1)$$

#### - Dimensions of test members

Generally, the tests are carried out on unreinforced test members.

In cases where the test member contains reinforcement to allow handling or for the distribution of loads transmitted by the test equipment, the reinforcement shall be positioned such as to ensure that the loading capacity of the tested plastic anchors is not affected. This requirement will be met if the reinforcement is located outside the zone of concrete cones having a vertex angle of 120°.

In general, the thickness of the members shall correspond to the minimum member thickness applied by the manufacturer which will be given in the ETA [at least 100 mm or 40 mm in case of e.g. weather resistant skin elements (see 2.1.3.1.)].

#### - Casting and curing of test members and specimens

In general, the test members shall be cast horizontally. They may also be cast vertically if the maximum height is 1,5 m and complete compaction is ensured.

Test members and concrete specimens (cylinders, cubes) shall be cured and stored indoors for seven days. Thereafter they may be stored outside provided they are protected such that frost, rain and direct sun do not cause a deterioration of the concrete compressive and tension strength. When testing the plastic anchors the concrete shall be at least 21 days old.

#### **C.2.2. Test member for other base material**

The tests shall be carried out in the base material for which the plastic anchor is intended to be used (see Table 5.0). Solid clay bricks and solid calcium silicate bricks shall have approximately the following dimensions: Length x width x height = 240 x 115 x 113 (or alternatively 71) mm and the following properties: compressive strength  $\geq 12 \text{ N/mm}^2$  and density between 1,6 and 2,0  $\text{kg/dm}^3$ .

The bricks of the test wall may be laid in a prestressing frame. The frame can be prestressed by hand. However it shall not restrict lateral expansion. The plastic anchor shall be installed in the centre of the brick.

### C.3. Plastic anchor installation

The plastic anchors shall be installed in accordance with the installation instruction supplied by the manufacturer.

The screw-in plastic anchors shall be installed using a suitable electrical screwdriver. The nailed-in plastic anchors shall be installed with a hammer having a reasonable hammer weight commonly used in the practical application.

In case of concrete the tested plastic anchors shall be installed in the cast surface of the concrete test member.

The holes for plastic anchors shall be perpendicular to the surface of the member unless specifically required otherwise by the manufacturer's specifications.

In the tests the drilling tools specified by the manufacturer shall be used.

If hard metal hammer-drill bits are required, these bits shall meet the requirements of the standards ISO 5468 [17] with regard to dimensional accuracy, symmetry, symmetry of insert tip, height of tip and tolerance on concentricity.

The diameter of the cutting edges as a function of the nominal drill bit diameter is given in Figure C.3.1.

The diameter of the drill bit shall be checked every 10 drilling operations to ensure continued compliance.

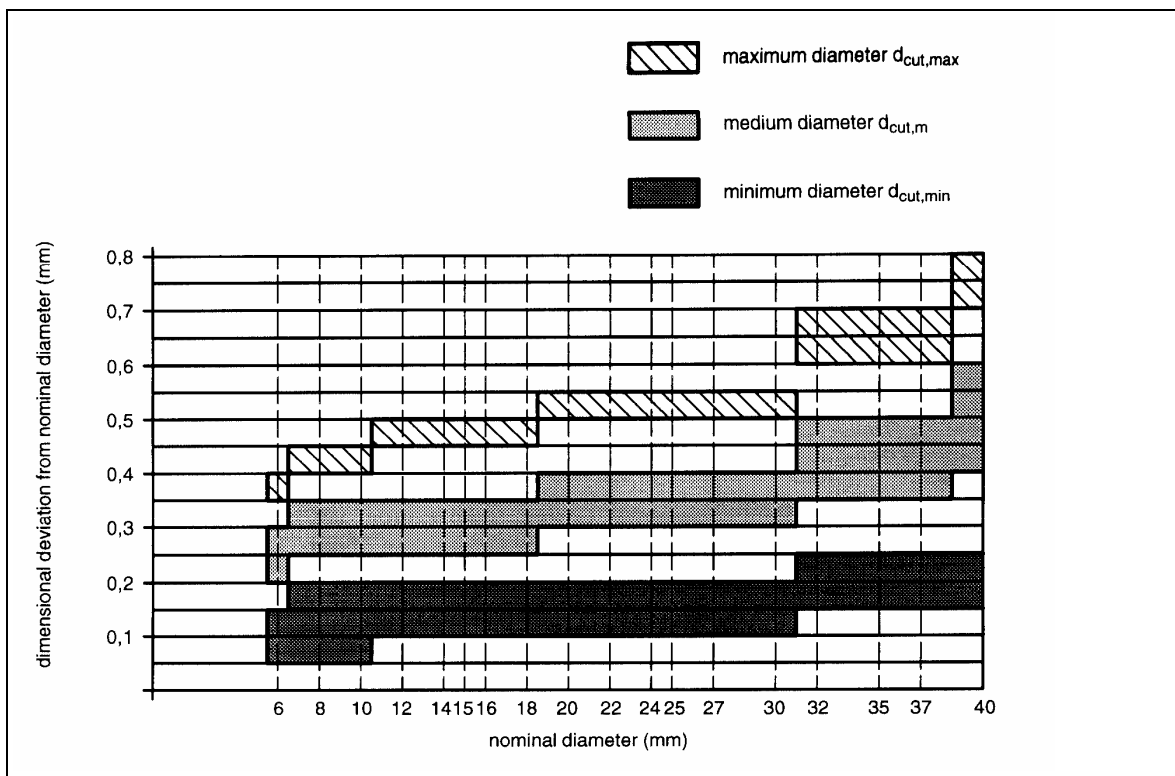


Figure C.3.1 Cutting diameter of hard metal hammer-drill bits

### C.4. Test equipment

Tests shall be carried out using measuring equipment having traceable calibration. The load application equipment shall be designed to avoid a sudden increase in load especially at the beginning of the test. The measuring error of the load shall not exceed 2 % throughout the whole measuring range.

Displacements shall be recorded continuously (e.g. by means of electrical/electronic displacement) with a measuring error of less than 0,02 mm.

In general, the test rigs shall allow the formation of an unrestricted rupture cone. For this reason the clear distance between the reaction support and a plastic anchor shall be at least  $2 \cdot h_{ef}$  (or  $2 \cdot h_{nom}$ ). If the failure mode is pull-out failure the clear distance between the reaction support and a plastic anchor could be smaller. For tests in masonry units the clear distance between the reaction support and a plastic anchor could be smaller.

During tension tests, the load shall be applied concentrically to the plastic anchor. To achieve this, hinges shall be incorporated between the loading device and the plastic anchor.

In torque tests the relation between the torque moment by installation and the torque moment at failure are measured. For this a calibrated torque moment transducer with a measuring error  $< 3\%$  throughout the whole measuring range shall be used. The plastic anchor shall be installed with an electric screwdriver.

### **C.5. Test procedure**

The plastic anchors shall be installed in accordance with the standard instructions supplied by the manufacturer.

The standard conditioning of the plastic shall be according to the specification of the plastic manufacturer except in the tests "Functioning under conditioning". The dry conditioning can be reached by drying the plastic sleeve in an oven at  $+70\text{ °C}$  until the mass loss is smaller than  $0,1\%$  in 3 consecutive measurements every 24 h. The wet condition means water saturated. It can be reached by placing the plastic sleeve under water until the mass increase is smaller than  $0,1\%$  in 3 consecutive measurements every 24 h.

After installation, the plastic anchor is connected to the test rig and loaded to failure. The displacements of the plastic anchor relative to the concrete surface at a distance of  $\geq 1,5 \cdot h_{ef}$  (or  $\geq 1,5 \cdot h_{nom}$ ) from the plastic anchor shall be measured by use of either one displacement transducer on the head of the plastic anchor or at least two displacement transducers on either side; the mean value shall be recorded in the latter case.

### **C.6. Test report**

As a minimum requirement, the report shall include at least the following information:

#### General

- Description and type of plastic anchor
- Plastic anchor identification (dimensions, materials, coating, production method)
- Name and address of manufacturer
- Name and address of test laboratory
- Date of tests
- Name of person responsible for test
- Type of test (e.g. tension, short-term or repeated load test)

#### Number of tests

Testing equipment: load cells, load cylinder, displacement transducer, software, hardware, data recording

- Test rigs, illustrated by sketches or photographs
- Particulars concerning support of test rig on the test member

#### Concrete test members:

- Composition of concrete. Properties of fresh concrete (consistency, density)
- Date of manufacture
- Dimensions of control specimens, and/or cores (if applicable) measured value of compressive strength at the time of testing (individual results and mean value)
- Dimensions of test member
- Nature and positioning of any reinforcement
- Direction of concrete test member pouring

#### Test members for other base materials:

- Type of material, compressive strength, density, geometry and type of holes
- Date of manufacture
- Measured value of compressive strength at the time of testing (individual results and mean value)
- Dimensions of test member

#### Plastic anchor installation

- Information on the positioning of the plastic anchor
- Distances of plastic anchors from edges of test member and between adjacent plastic anchors
- Tools employed for plastic anchor installation, e.g. impact drilling tool, drilling hammer, other equipment
- Type of drill bit, manufacturer's mark and measured drill bit dimensions, particularly the effective diameter,  $d_{cut}$ , of the hard metal insert
- Information on the direction of drilling
- Information on cleaning of the hole
- Depth of drill hole
- Depth of anchorage
- Tightening torque or other parameters for control of installation
- Quality and type of screws and nuts employed

#### Measured values

- Parameters of load application (e.g. rate of increase of load or size of load increase steps)
- Displacements measured as a function of the applied load
- Any special observations concerning application of the load
- Failure load
- Failure mode
- Radius (maximum radius, minimum radius) and height of a concrete cone produced in the test (where applicable)
- Particulars of repeated load tests
  - minimum and maximum load
  - frequency of cycles
  - number of cycles
  - displacements as function of the number of cycles
- Particulars of torque test
  - maximum torque moment at installation
  - maximum torque moment at failure

The above measurements shall be recorded for each test.

- Particulars of identification tests
  - dimensions of the parts of the plastic anchor and the drilling- and installation tools
  - properties (e.g. tensile strength, elastic limit, elongation at rupture, hardness and surface conditions of plastic anchor, if applicable)

### C.7. Test for the verification of installation suitability

#### a) Preparation of the test

The setting of the nailed-in plastic anchor has to be carried out using the test setup shown in Figure C.7.1 (flush or countersunk to a certain extent according to the manufacturer's installation instructions).

The drill hole in the base material has to be drilled according to C.3 with drill bit diameter  $d_{cut,m}$  and the drill method (rotary drill or hammer or impact drilling) given by the manufacturer's installation instructions.

The EPS block (see Figure C.7.2) is placed into the supporting body and the tested anchor is set into the drill hole according to the manufacturer's installation instructions.

#### b) Thickness of fixture

5 tests with max  $t_{fix}$  (maximum thickness of the ETICS which can be fixed) have to be performed.

For anchors that take into account a tolerance layer  $t_{tol}$  (e.g. plaster, stucco, ...), an intermediate layer  $t_{tol} \geq 10$  mm (with  $t_{tol}$  according to manufacturer's installation instructions) may be placed between the EPS block and the base material according to Figure C.7.3. An intermediate layer could be e.g. a drywall board. Adhesives are not acceptable as they adhere to the base material and, hence, may influence the test.

$$l_a = h_{nom} + t_{fix}$$

$$\text{with: } t_{fix} = (t_{tol} + h_D)$$

$$l_a = \text{length of plastic anchor}$$

$$h_{nom} = \text{overall plastic anchor embedment depth in the base material}$$

$$t_{fix} = \text{thickness of fixture}$$

$$t_{tol} = \text{thickness of equalizing layer or non-load bearing coating}$$

$$h_D = \text{thickness of insulation material}$$

#### c) Setting of the nailed-in plastic anchor

The expansion element is driven in with a defined impact energy resultant from the mass of the drop weight and the height of fall.

The mass of the drop weight shall be chosen in such a way that the anchor is installed with 3 blows at minimum and 8 blows at maximum by a free height of fall of 500 mm.

The setting is finished if the highest point of the anchor plate becomes flush with the surface of the EPS-block or 2 mm below the surface at maximum (anchor types for mounting on the surface, see Figure C.7.3) or the installed anchor is countersunk in the EPS-block with the permitted measure given by the manufacturer's installation instructions (anchor types for deep mounting).

The number of any setting failures has to be stated in the test report.

#### d) Execution of the tension test

After setting, the supporting body and the EPS-block (and the intermediate layer) are removed carefully. Any adverse influence on the anchor (e.g. bending) shall be avoided during this step.

Allowing for the same load transfer into the anchor shaft the tension test has to be carried out in the same way as the test for the determination of the characteristic resistance according to Table 5.1, line 1. A preload  $N_{preload}$  has to be applied first.

$$N_{preload} \leq 0,05 \cdot N_{Rk} \quad (N_{Rk} = \text{characteristic resistance in the ETA})$$

The tension load has to be increased continuously and constantly with a loading rate of  $(1 \pm 0,2)$  kN/min up to failure according to C.5.

The displacement has to be measured in the direction of the anchor axis and has to be recorded continuously throughout the test.

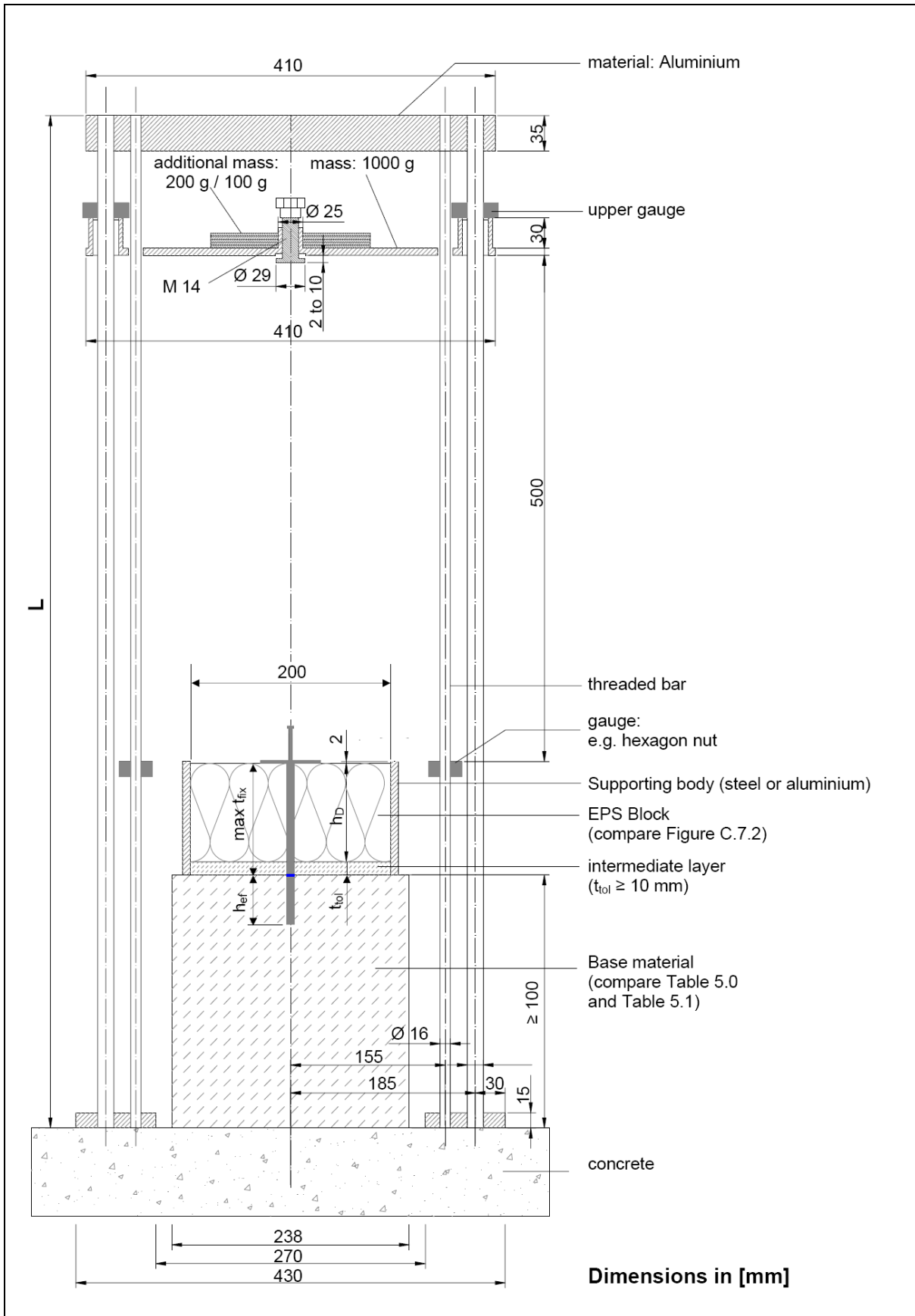


Figure C.7.1: Layout for the test setup (for nailed-in anchors)

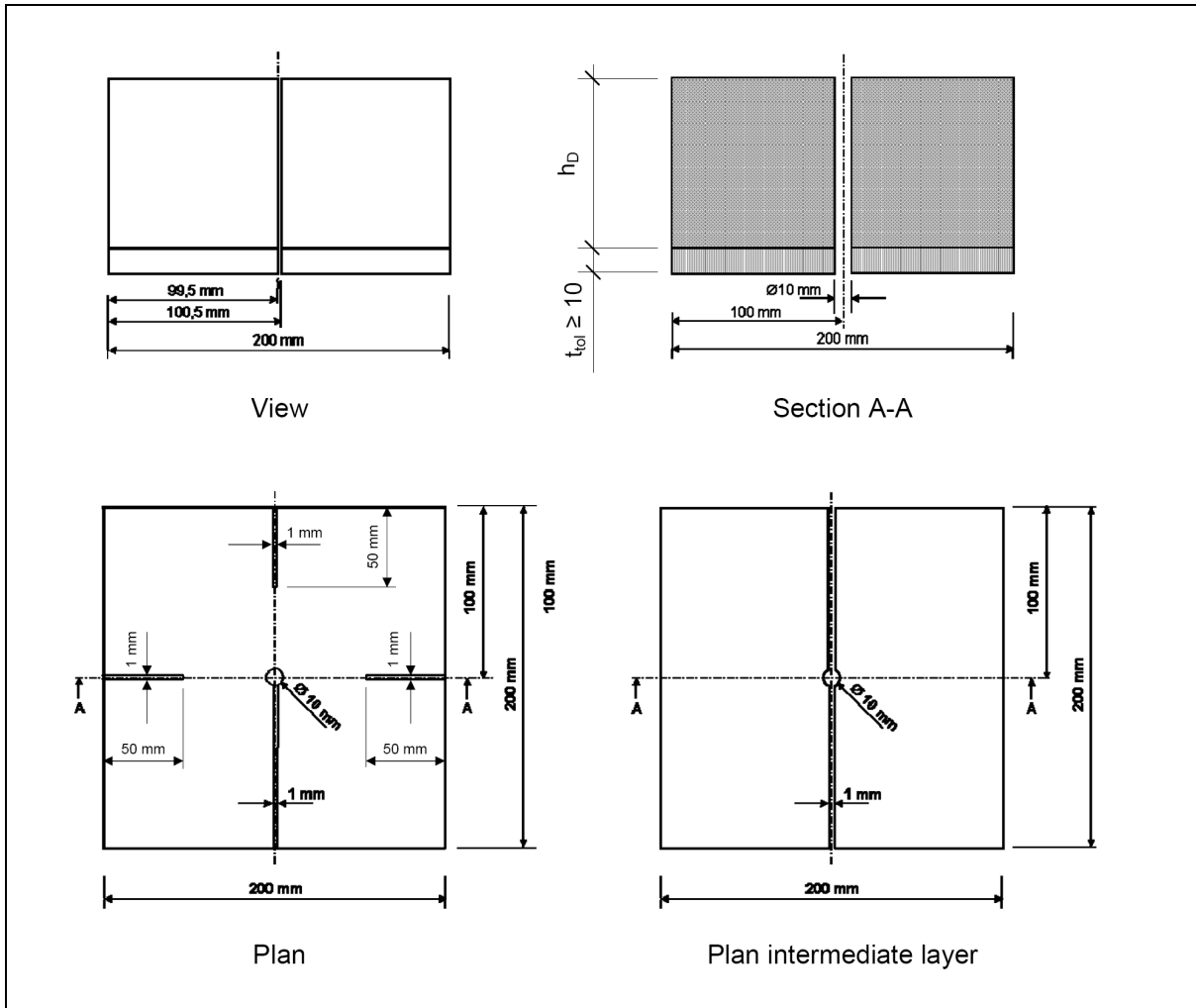


Figure C.7.2: EPS-block {Materials: EPS-EN 13163-T2-L2-S2-P4-DS(70,-)2-BS100-DS(N)2-TR150 (or TR100 according to [19] ); intermediate layer being e.g. a drywall board, an adhesive is not acceptable

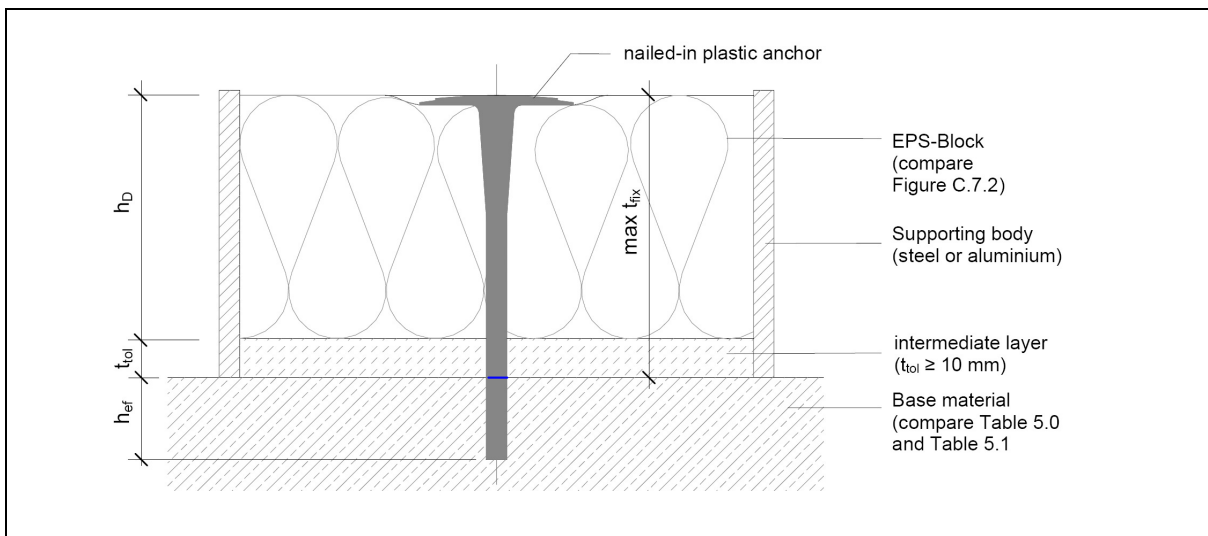


Figure C.7.3: Installed anchor (example for installation flush with surface)

# Annex D: GUIDANCE ON TESTS TO BE CARRIED OUT ON CONSTRUCTION WORKS

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## D.1. General

In the absence of national requirements the characteristic resistance to actions for admissible service conditions has to be determined by means of job site pull-out tests carried out on the material actually used, if this base material was not used for the tests according to 5.4 (for example masonry made of other solid masonry units, hollow or perforated bricks, hollow blocks, aggregated concrete masonry units and aerated concrete).

The characteristic resistance to be applied to a plastic anchor shall be determined by means of at least 15 pull-out tests carried out on the construction works with a centric tension load acting on the plastic anchor. These tests are also possible in a laboratory under the same conditions.

Execution and evaluation of the tests as well as issue of the test report and determination of the characteristic resistance should be under the responsibility of approved testing laboratories or supervised by the person responsible for the execution of works on site.

The number and position of the plastic anchors to be tested shall be adapted to the relevant special conditions of the construction works in question and, for example, in the case of blind and larger areas be increased such that reliable information about the characteristic resistance of the plastic anchor embedded in the base material in question can be derived. The tests shall take account of the most unfavourable conditions of practical execution.

## D.2. Assembly

The plastic anchor to be tested shall be installed (e.g. preparation of drill hole, drilling tool to be used, drill bit) and as far as spacing and edge distances are concerned be distributed in the same way as foreseen for the fixing of the external thermal insulation composite system.

Nailed-in plastic anchors shall be installed through the insulation material on site (having the largest  $t_{fix}$  used at the job site) according to the manufacturer's installation instructions. The insulation material has to be removed carefully before the test rig is attached to the anchor. Any adverse influence on the anchor (e.g. bending) should be avoided during this step.

Depending on the drilling tool hard metal hammer-drill bits or hard metal percussion drill bits according to ISO 5468 [17] shall be used the cutting diameter of which is at the upper tolerance limit.

## D.3. Execution of test

The test rig used for the pull-out tests shall allow a continuous slow increase of load controlled by a calibrated load cell. The load shall act perpendicularly to the surface of the base material and be transmitted to the plastic anchor via a hinge. The reaction forces shall be transmitted to the base material at a distance of at least 15 cm from the plastic anchor. The load shall be continuously increased so that the ultimate load is achieved after about 1 minute. Recording of load is carried out at the ultimate load ( $N_1$ ) is achieved.

## D.4. Test report

The test report shall include all information necessary to assess the resistance of the tested plastic anchor. It shall be included in the construction dossier. The following minimum information is necessary:

- Construction work; building owner; date and place of tests, air temperature; type of structure (ETICS or VETURE Kits) to be fixed
- Masonry (type of brick, strength class, all dimensions of bricks, mortar group); Visual assessment of masonry (flush joints, joint clearance, regularity)
- Plastic anchors and screws or nails; cutting diameter of hard metal hammer-drill bits, value measured before and after drilling
- Test rig; Results of tests including indication of value  $N_1$
- Nailed-in plastic anchors: After removing the EPS-block the anchor shaft does not show any cracks and/or breaks that influence the performance of the anchor.
- Tests carried out or supervised by; Signature



#### **D.5. Evaluation of test results**

The characteristic resistance  $N_{Rk1}$  is obtained from the measured values of  $N_1$  as follows

$$N_{Rk1} = 0,6 \cdot N_1 \leq 1,5 \text{ kN}$$

$N_1 =$  the mean value of the five smallest measured values at the ultimate load

Nailed-in plastic anchors: Cracks and/or breaks have to be assessed regarding their influence on the load carrying capacity of the anchor as well as on the corrosion outside of the base material according to 6.4.2.6.