Section Two: GUIDANCE FOR THE ASSESSMENT OF THE FITNESS FOR USE

GENERAL NOTES

a) Applicability of the ETAG

This ETAG provides guidance on the assessment of a family of Systems of mechanically fastened flexible roof waterproofing membranes (MEFAWAME) and their intended uses. It is the manufacturer or producer who defines the kit for which he is seeking an 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 MEFAWAME, 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 kits or materials, or where there is a range of uses, the whole package of tests and assessment may be applicable.

b) General lay out of this section

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

- Chapter 4 clarifies the **specific requirements for the works** relevant to the MEFAWAME and uses
  concerned, beginning with the Essential Requirements for works (CPD art. 11.2) and then listing the corresponding relevant characteristics of the MEFAWAME
- 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
- Chapter 6 provides guidance on the **assessing and judging methods** to confirm fitness for the
  intended use of the MEFAWAME
- Chapter 7, **assumptions and recommendations** are only relevant in as so far they concern the
  basis upon which the assessment of the MEFAWAME is made concerning the fitness for the intended use

c) Levels or classes related to the Essential Requirements and to the product performance (see ID clause 1.2 and EC Guidance Paper E)

According to the CPD, “Classes” in this ETA refer only to mandatory levels or classes laid down in the EC-mandate.

This ETAG indicates however the compulsory way of expressing relevant performance characteristics for the MEFAWAME. If, for some uses at least one Member State has no regulations, a manufacturer always has the right to opt out 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 MEFAWAME does not any longer fall under the scope of this Guideline.

d) Working life (durability) and serviceability

The provisions, test and assessment methods in this ETAG or referred to have been written based on the assumption that the estimated working life of the product for the intended use is at least 10 years, provided that the product is subjected to normal use and maintenance. 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 indication given as to the working life of a product cannot be interpreted as a guarantee given by the producer or the approval body. They should 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. par. 5.2.2).

Many systems may have a working life well in excess of 10 years but higher working lives are not part of the assessments in this ETAG. Claims for longer working lives shall be verified independently by a special procedure according to the Construction Products Directive art. 9.2.

e) Fitness for the intended use

According to the CPD 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 MEFAWAME must 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 must, 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

4.0 General

This chapter sets out the aspects of performance to be examined in order to satisfy the relevant Essential Requirements for Systems for mechanically fastened flexible roof waterproofing membranes, by:

- expressing in more detail, within the scope of the Guideline, the relevant Essential Requirements of the CPD, in the Interpretative Documents 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 Guideline (product and where appropriate its constituents, components and intended uses), 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 important 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 may 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.

This chapter also takes into account further requirements, if any (e.g. resulting from other EC Directives) and identifies aspects of serviceability including specifying characteristics needed to identify the products (re. ETA-format par. II.2.).

Each Essential Requirement is considered in turn.

The relevant Essential Requirements, the relevant paragraphs of the corresponding IDs and the related requirements to product performances are indicated in Table 1:

Table 1. Link between the mandate, the IDs and the related requirements to product performance

ER	Corresponding ID paragraph for works	Corresponding ID paragraph for product performance	Mandate product characteristic	ETAG paragraph on product performance
1	-	-	-	-
2	§ 4.2.4.2a Limitation of spread of fire to neighbouring construction works: roof coverings	§ 4.3.1.2.2 Roofs exposed to an external fire	External fire performance Reaction to fire of components	External fire performance Reaction to fire of relevant components
3	§ 3.3.1.2 Indoor environment: Dampness	§ 3.3.1.2.3.2e.3 Dampness control: roofs, roofing materials	Watertightness Water vapour permeability Strength	Watertightness Water vapour permeability Strength

4	§ 3.3.1.2 Falling after slipping § 3.3.2.2 Impact of falling objects	§ 3.3.1.3 Falling after slipping § 3.3.2.3 Mechanical resistance and stability	Slipperiness Resistance to wind load	Slipperiness Resistance to wind load

5	-	-	-	-
6	§ 4.2 Energy consumption limitation	§ 4.3.2.2 Fabric components Table 4.2 Component characteristics	Thermal resistance	Thermal resistance
*)				Dimensional stability Resistance to deterioration caused by - physical agents - chemical agents

*) Aspects of durability, serviceability and identification

4.1 MECHANICAL RESISTANCE AND STABILITY:

Not relevant.

4.2 SAFETY IN CASE OF FIRE:

The Essential Requirement laid down in the COUNCIL DIRECTIVE 89/106/EEC is as follows:

The construction works must be designed and built in such a way that in the event of an outbreak of fire:

- *the load bearing capacity of the construction can be assumed for a specific period of time.*
- *the generation and spread of fire and smoke within the works are limited.*
- *the spread of fire to neighbouring construction works is limited.*
- *occupants can leave the works or be rescued by other means.*
- *the safety of rescue teams is taken into consideration.*

The following aspects of performance are relevant to this Essential Requirement for Systems of mechanically fastened flexible roof waterproofing membranes:

External fire performance

The requirements for the external fire performance of the mechanically fastened flexible roof waterproofing kits shall be in accordance with laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works and will be specified via the CEN classification documents.

Reaction to fire

Requirements for the reaction to fire of the components of the kits will be specified via the relevant CEN document and shall be in accordance with law, regulations and administrative provisions, applicable to the end use.

4.3 HYGIENE, HEALTH AND THE ENVIRONMENT

The Essential Requirement laid down in the COUNCIL DIRECTIVE 89/106/EEC is as follows:
The construction work must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours, in particular as a result of any of the following:

- *the giving-off of toxic gases*

- *the presence of dangerous particles or gases in the air*

- *the emission of dangerous radiation*

- *pollution or poisoning of the water or soil*

- *faulty elimination of waste water, smoke, solid or liquid wastes*

- *the presence of damp in parts of the works or on surfaces within the works.*

The following aspects of performance are relevant to this Essential Requirement for Systems of mechanically fastened flexible roof waterproofing membranes:

Indoor environment: Dampness

All materials and associated ancillary components of the roof covering shall be such that there will be no threat to the health of the occupants when the product is in service as a result of:

- vapour permeability

- water tightness

Systems of mechanically fastened flexible roof waterproofing membranes shall have sufficient strength so they will not be a threat to the hygiene or health of the occupants.

This means that they shall have sufficient strength to withstand accidentally large static and dynamic loads from the action of persons or objects and to withstand the static or dynamic loads from the fastening system without rupture of the membrane causing damp to penetrate the structure.

The loads may be in the form of:

- wind loads, snow loads, traffic loads etc.

- persons stepping directly on or beside one or more fasteners

- loads on joints and fasteners from snow, traffic, standing water etc.

Outdoor environment:

Installation and construction works shall not release pollutants to the immediate environment (air, soil, water).

The rate of release of pollutants to outdoor air, soil and water for building materials for roofs shall therefore be in accordance with laws, regulations and administrative provisions, applicable for the location where the product is incorporated in the works.

4.4 SAFETY IN USE:

The Essential Requirement laid down in the COUNCIL DIRECTIVE 89/106/EEC is as follows:

The construction works must be designed and built in such a way that it does not present unacceptable risks of accidents in service or in operation such as slipping, falling, collision, burns, electrocution, injury from explosion.

The following aspects of performance are relevant to this Essential Requirement for Systems of mechanically fastened flexible roof waterproofing membranes:

Slipperiness

The surface of the mechanically fastened flexible roof waterproofing membrane shall not be slippery due to either the inherent surface conditions or the presence of water or grease on the surface so that it will influence the probability of falling after slipping and thereby causing a risk for the occupants.

Mechanical resistance and stability

The systems of mechanically fastened flexible roof waterproofing membranes shall have sufficient strength to withstand the dynamic loads caused by wind loads without failure of the system in the form of:

a) Point or linear fasteners:

- failure of the fastener
  - in traction
  - in shear
  - in bending
  - in compression
- detachment of washer from fastener shaft
- failure of fastener sleeve or shank

b) Junction between point or linear fastener and load-bearing structure

- pull-out of fastener shaft
- loosening of junction between fastener shaft and load-bearing structure (lifting movement)
- unwinding of the fastener (pulsating movement)

c) Joints

- opening of the joint

d) Membrane

- mechanical failure of the membrane around the washer

4.5 PROTECTION AGAINST NOISE:

Not relevant.

4.6 ENERGY ECONOMY AND HEAT RETENTION

The Essential Requirement laid down in the COUNCIL DIRECTIVE 89/106/EEC is as follows:

The construction works and its heating and ventilation installations must be designed and built in such a way that the amount of energy required in use shall be low, having regard to the climatic conditions of the location and the occupants.

The following aspects of performance are relevant to this Essential Requirement for systems of mechanically fastened flexible roof waterproofing membranes:

The entire roof shall be built with adequate properties in order to

- control energy consumption

- control water vapour condensing within the roof as a result of cold bridges from the metallic fasteners

Water vapour permeability is also related to ID3 and has therefore already been dealt with.

4.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

The requirements considered in the following are those which are related to the Essential Requirements, but not to any one in particular. As a consequence, failure to meet these requirements means that one or more of the Essential Requirements can no longer be met.

Dimensional stability

The mechanically fastened flexible roof waterproofing membrane including the system of fastening shall have sufficient dimensional stability in order to prevent reduction of mechanical or other properties.

Resistance to deterioration

Roof coverings shall have an adequate resistance to deterioration caused by physical or chemical agents in order to prevent reduction of mechanical or other properties. The agents include:

Physical agents

The loads may be in the form of:

- cyclic movement
- effect of high/low temperature
- effect of UV radiation
- ageing

dependent of the material used.

Chemical agents

Water, carbon dioxide, oxygen (possible corrosion), sodium chloride solution (NaCl), saturated limewater ($Ca(OH)_2$), sulphuric acid solution (H_2SO_4) and other normal chemical hazards, e.g. as mentioned for bituminous membranes in prEN WI 000254041, Annex C, likely to come into contact.

5. METHODS OF VERIFICATION

5.0 General

Chapter 5 refers to the verification methods used to determine the various aspects of performance of the products in relation to the requirements for the works (calculations, tests, engineering knowledge, site experience, etc.).

The relevant Essential Requirements, the related requirements to product performance (as given in chapter 4), the corresponding product characteristics to be assessed and the corresponding verification methods are indicated in the Table 2.

The possibility exists to use existing data in accordance with the EOTA Guidance Document on The Provision of Data for Assessments Leading to ETA.

The parts of Table 2 which are accentuated by "bold" framing indicate the minimum testing necessary to obtain an ETA for a kit (or a component as part of a kit), provided the characteristics of the membrane and insulation are given by CE marking based on other European technical specifications (see art 5.2).

Table 2. Product characteristics and corresponding verification methods

ER	ETAG paragraph on product performance	ETAG paragraph on verification method of product characteristic	
		SYSTEM	COMPONENT
2	§ 4.2 External fire performance Reaction to fire	§ 5.1.2 SYSTEM § 5.1.2.1 Testing of external fire performance	§ 5.2.2 MEMBRANE § 5.2.2.1 Testing of the reaction to fire § 5.4.2 INSULATION § 5.4.2.1 Testing of the reaction to fire
3	§ 4.3 Water tightness Water vapour permeability Strength Release of dangerous substances	§ 5.1.3 SYSTEM § 5.1.3.1 Release of dangerous substances	§ 5.2.3 MEMBRANE § 5.2.3.1 Testing of peel resistance (joint) § 5.2.3.2 Testing of shear resistance (joint) § 5.2.3.3 Testing of resistance to tear § 5.2.3.4 Testing of resistance to cold bending/folding § 5.2.3.5 Testing of resistance to water pressure § 5.2.3.6 Determination of water vapour permeability § 5.2.3.7 Determination of tensile properties § 5.2.3.8 Testing of resistance to static loading and impact loading § 5.4.3 INSULATION § 5.4.3.1 Compressibility test
4	§ 4.4 Slipperiness Resistance to wind load	§ 5.1.4 SYSTEM § 5.1.4.1 Wind uplift test	§ 5.2.4 MEMBRANE § 5.2.4.1 Slipperiness

			§ 5.3.4 MECHANICAL FASTENERS § 5.3.4.1 Axial loading test § 5.3.4.2 Testing of unwinding of fastener § 5.3.4.3 Testing of mechanical resistance of sleeve

6	§ 4.6 Thermal resistance		§ 5.4.6 INSULATION § 5.4.6.1 Calculation or testing of thermal transmission
*)	§ 4.7 Dimensional stability Resistance to deterioration caused by - physical agents - chemical agents		§ 5.2.7 MEMBRANE § 5.2.7.1 Testing of peel resistance after long term exposure to heat and water*) § 5.2.7.2 Testing of shear resistance after long term exposure to heat and water*) § 5.2.7.3 Resistance to tear after long term exposure to heat *) § 5.2.7.4 Resistance to cold bending/folding after long term exposure to heat, UV, water and ozone § 5.2.7.5 Determination of dimensional stability § 5.3.7 MECHANICAL FASTENERS § 5.3.7.1 Testing of resistance to corrosion of metallic fasteners § 5.3.7.2 Testing of mechanical resistance after heat ageing of plastic fasteners

*)Aspects of durability, serviceability and identification

5.1 SYSTEM

5.1.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

5.1.2 SAFETY IN CASE OF FIRE (ER2)

5.1.2.1 External fire performance

Testing of the system including the expression of results (possible classification included) with respect to external fire performance is performed as described in:

prEN 1187-2000 Test methods for external fire exposure to roofs

The test regime will depend on the desired market.

Where assembled kits are protected by a durable protection layer, the external fire performance can be controlled by the nature of this protection layer. Therefore verification of the external fire performance may be omitted, provided the effect of the protection layer is assessed and/or stipulated by Commission Decision.

5.1.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

5.1.3.1 Release of dangerous substances

The product specifications (preferably in the form of a chemically unambiguous formula) shall be examined and where it is possible that a substance on the list referred to in art. 6.1.3.1 may be present, the appropriate tests and evaluations shall be carried out.

5.1.4 SAFETY IN USE (ER4)

5.1.4.1 Wind uplift test

Concept of full scale and small scale testing:

Full scale testing
At least one combination of components is tested in the full scale wind uplift test. Determination of a representative combination to be tested is done in co-operation with the applicant. The combination that is tested will have the highest characteristic resistance of the combinations mentioned in the approval. The characteristic resistance's of other combinations are found by interpolation based on either calculation, if possible, or on small scale testing. Extrapolation to a higher value from the full scale test results is **not** an option because of the uncertainty of the failure mode. Depending on the experience of the approval body and test laboratory a full scale wind uplift test can be performed on the weakest assembled system as well, to determine the lower boundary of the interpolation.

Whilst there will always be at least **one** full scale wind uplift test, the applicant can always request additional full scale wind uplift tests on other combinations.

Small scale testing
Purpose of small scale testing:
- to form the basis for interpolation
- to reduce the amount of full scale testing

Principles/limitations on the use of small scale testing:
In order to use the test results to calculate a k-value smaller than 1 the failure mode in the small scale test shall be the same as in the full scale wind uplift test.

Only one type of component can be changed.

Additional limitations on the use of the small scale test concept shall be determined by the test laboratory and the approval body in co-operation, based on their experience.

Procedure for the use of small scale testing:
Based on the characteristic resistance of the kit determined in the full scale wind uplift test, the characteristic resistance of other combinations can be calculated using the following formula:

$W_{adm,nc} = k \times W_{adm,oc}$

where

$W_{adm,nc}$ is the admissible (design) load per fastener of the new combination
$W_{adm,oc}$ is the admissible (design) load per fastener of the original combination (as determined in the full scale wind uplift test)
k is a correlation factor between the strength of the new combination and the original combination, both determined by small scale testing.

The factor k can never be smaller than 0,5 or larger than 1,0. If the k-value is smaller than 0,5, the small scale concept can not be used and a new full scale test is necessary

Determination of k value:
The determination method is based on the characteristics of each **component** either derived by small scale testing or obtained from the documents accompanying a CE-marked product.

The k-value depends on the relationship between the characteristics of the original component and the new component and is determined according to the equations mentioned in annex C.

There are three possibilities for changes which can be covered by small scale testing: Variations to the fastener, variations to the membrane and variations to the jointing technique. Table 3 gives an overview of possible changes and where the small scale tests can be used and which tests should be performed.

Annex C illustrates how the three possibilities are linked with the failure mode and the types of small scale tests.

Table 3. Overview of small scale testing

Change of components See Annex C	**Full scale test**	**Small scale test concept applicable**	**No test necessary**
Fastening element			
• Drill point, piercing point geometry or point of powder actuated fastener	∗ 1)	Axial loading test and, possibly, unwinding test ∗1)	-
• Thread geometry	∗		-
• Shank dimension	-	-	-
• Head style	-	Axial loading test and, possibly, unwinding test	-
• Change of coating	-	Axial loading test and, possibly, unwinding test	-
• Material specs.		Axial loading test and, possibly, unwinding test	
• Heat treatment specs. for steel components	-		-
• Austenitic stainless steel components	-	Axial loading test	-
• Plastic components within the same material group	-	Axial loading test	-
• Plastic components not within the same material group	∗	Axial loading test	-
• Load distribution washer geometry	∗	-	-
• Plastic sleeve and/or washer geometry excl. sleeve length	∗	-	-
• Length of fastener	-	- -	2)
Membrane			
• Material specs.	∗ 3)	Tensile test/tear test ∗ 3)	-
• Reinforcement	∗ 4)	Tensile test/tear test ∗ 4)	-
• Position of reinforcement	∗ 5)	Tensile test/tear test ∗ 5)	-
• Thickness	∗ 6)	-	6)
• Changes affecting the peel strength	∗ 7)	Tensile test/tear test ∗ 7)	-
Jointing technique			
• New jointing technique (see 3.2.7)	-	Peel resistance test	-

∗ = test is necessary

1) If the performed axial loading test, and possibly unwinding test, result in a decreased pull-out performance, a new full scale test is required.
2) If the length of the fastener is changed, no test is required.
3) Changes in the material group (e.g. APP, PVC, etc.) requires a new full scale test.
4) Changes in the family of reinforcement (e.g. glass fibre reinforcement, polyester reinforcement or a reinforcement made of a combination of the two) requires a new full scale test.
5) Changes in the position of the reinforcement from inside the membrane to the surface of the membrane requires a new full scale test
6) If the "modified" membrane is thinner than the original membrane, a full scale test is required. Otherwise, no test is required.
7) If the peel strength performance of the "modified" membrane is smaller than that of the original membrane, a new full scale test is required.

If a new timber or steel substrate is thicker and/or stronger or if a new concrete substrate has a higher compressive strength and density than the one used in the full scale test a new test is not necessary. The value determined in the full scale test will be valid for the new substrates.

Description of the small scale tests:
Axial loading test: According to § 5.3.4.1 of this Guideline

Peel resistance: According to § 5.2.3.1 of this Guideline

Tear resistance: According to § 5.2.3.3 of this Guideline

Tensile properties: According to § 5.2.3.7 of this Guideline

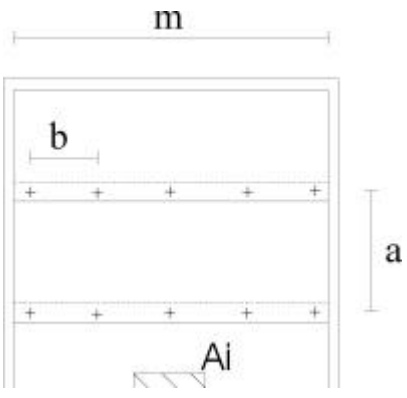
Unwinding test: According to § 5.3.4.2 of this Guideline.

Full scale wind uplift test
General
The test is performed on the whole assembled system, i.e. the load-bearing structure, the insulation (if part of the system) and the mechanically fastened membrane. Even if a vapour control layer is a part of the system the test is carried out without the vapour control layer, since this may influence the failure loads in a positive way and the test should be carried out in a worst case scenario. The test results will also then be applicable when the vapour control layer is included in the assembled system.

For systems with a mineral wool insulation thickness of 0 mm < t ≤ 350 mm, the thickness of the insulation material used in the test shall be 100 mm, when not forming part of the kit. The insulation material used in the test shall be specified by the applicant and stated in the ETA. The compressibility (10 %) according to EN 826 shall be equal to or greater than 0,06 N/mm^2 (the requirement applies to homogenous materials and the top layer of multi-layer or composite products). The point load behaviour according to EN 12430 shall be equal to or greater than 500 N, deformation 5 mm.

Apparatus
Pressure chamber of sufficient length and width to accommodate the dimensions of the test specimen and with such height, that the applied pressure is equally distributed and not affected by deformations, if any, of the test specimen.

Tests may be performed on systems of different dimensions:



A test system of standard dimensions is preferred:

$$(\alpha \times a + 200\ mm) \times (\beta \times b + 200\ mm)$$

consisting of (α + 1) rows and (β + 1) fasteners

where α = number of spaces between rows of fasteners

β = number of spaces between fasteners
a = maximum spacing between rows of fasteners
b = spacing between individual fasteners in a row

and consisting of at least 3 rows of 5 fasteners

$$(2 \times a + 200\ mm) \times (4 \times b + 200\ mm)$$

or consisting of at least 4 rows of 4 fasteners

$$(3 \times a + 200\ mm) \times (3 \times b + 200\ mm)$$

Figure 2: Definition of

The pressure chamber is provided with one or more windows, in such a way, that the test specimen can be observed during the testing.

The pressure chamber shall be capable of resisting a suction of 10 kPa. It shall be possible to create an airtight seal between the test specimen and the pressure chamber.

Fan, controlling equipment and recording equipment is connected to the pressure chamber, to achieve dynamic pressure cycles, each with a proportional sequence of loads according to figure 3 and a load accuracy of ±10 % for loads above 2000 Pa.

The substrate of the test rig will depend on the type of fastener and the wishes of the applicant. If the applicant does not specify a particular substrate the following should be used depending on whether the fastener is for concrete, timber or steel:

- Concrete should generally be normal weight concrete strength class C25 according to ENV 206:1990-03 with a thickness of at least 100 mm. If there is a range of concrete strengths, the most critical should be tested and the value found should be used for other types of concrete.

- Plywood should be grade 2 or 3 according to EN 636 with a nominal thickness of 19 mm, unless otherwise required by the applicant.

- Steel decks should be galvanised, min. 0,70 mm, specifications min. S280 according to EN 10147 and the value found may be valid for all thicker and/or stronger steel decks.

If the applicant wishes the test to be performed on another specific substrate (for example oriented strand board (OSB) or aerated or lightweight concrete) this should be used in the test and the value found can be valid for other stronger substrates of the same type.

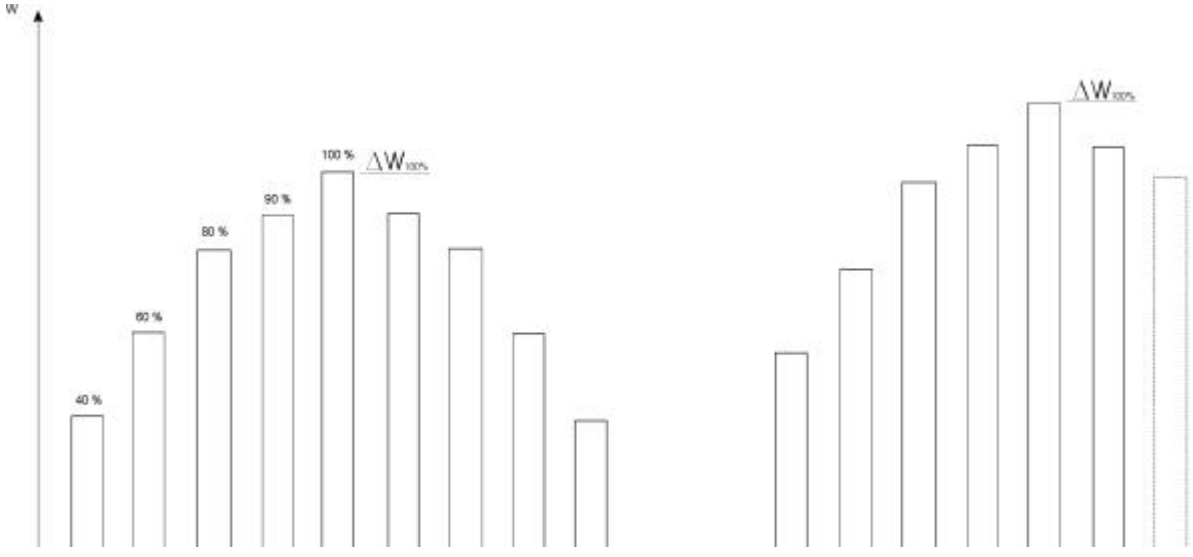


Figure 3: Proportional sequence of suction loads.

Test specimen
The test specimen is a model of a roof construction, incorporating a mechanically fastened flexible roof waterproofing membrane kit. If the insulation material is an integral part of the system the kit it shall be described in as much detail as possible by giving information on the compressive strength, density and other characteristics.

The sheets shall be symmetrically positioned and, independently of the width of the sheets, there shall be three rows of fasteners and the middle row shall run through the centre of the box. The kit shall be installed according to the manufacturers installation guide.
The number of test specimens is one.
The test specimen shall be conditioned at 23°C ± 5°C for at least 16 h.

Test procedure
The test shall be carried out at 23°C ± 5°C

The test specimen shall be fixed symmetrically in the pressure chamber. The membrane shall be clamped airtight between the edges of the pressure chamber and the support structure to assure an airtight seal over the complete length of the edges. For kits with linear fasteners the edge can be made with an expansion loop on the membrane.

The fan, the controlling and recording equipment shall be used to apply and control the proportional load pattern (figure 3) as dynamic pressure cycles on the test specimen.

The peak loads of each cycle in figure 3 are listed in Table 4:

Table 4. Peak loads of each cycle ($DW_{100\%}$)

Number of cycles	Load per fastener in N ($DW_{100\%}$)
1	300
1	300
1	300
1	300
1	400
1	500
1	600
1	700
.	.
.	.
.	.
1	2000
1	2100

The applied load shall correspond with the time/pressure diagram shown in figure 4.
The tolerance on the time is ± 0,1 sec and 90 % of the peak load shall be reached in between 0,7 - 1,0 sec. after the loading has started.

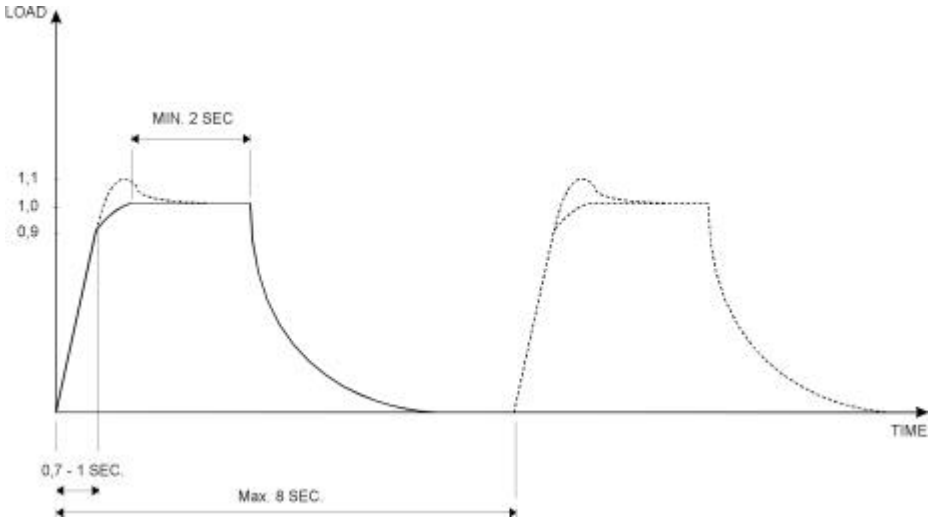


Figure 4: Time/pressure diagram

The behaviour of the test specimen shall be observed during each cycle; the stage, the number of cycles and the mode of failure, at which the system fails, shall be recorded.

The test is carried out with increasing loads (in steps of 100 N as indicated in Table 4) until failure of the system or to the limit of the test equipment. The loads quoted per fastener are calculated loads derived

by multiplication of the area of influence A_i (see Figure 2) by the difference between the laboratory pressure P_{lab} and the reduced pressure in the pressure chamber $P_{chamb.}$:

$$W_{test} = P_w \times A_i = (P_{lab} - P_{chamb.}) \times A_i$$

It shall be ensured that, for each application, the pressure effectively stresses the membrane. The pressure under the membrane and the pressure in the laboratory are monitored and if the deviation is more than 10% the substrate shall be perforated additionally to fully stress the membrane.

The test load W_{test} in N is converted in kPa according to the following formula:

$$\text{(Load in N/1000)} \times \text{amount of fasteners pr. } m^2$$

To obtain the corrected load $W_{corr.}$ of a fastener the test load W_{test} is reduced by the factors C_a and C_d as indicated below. The values of C_a and C_d are selected as a function of the chosen test system.

$$W_{corr.} = W_{test} \times C_a \times C_d$$

where W_{test} = maximum load in the cycle preceding the failure cycle

W_{corr} = corrected load taking into account the correction factors C_a and C_d

C_a = a geometric factor allowing for the difference between the deformation of the waterproof covering in the test and the real deformation for the membrane on a complete roof. The factor C_a depends on the parameters a/b and m/b, where m

is the length of the shorter side of the test system. The factor C_a can be determined from figure 5 and for the three test systems given below, is ≤ 1

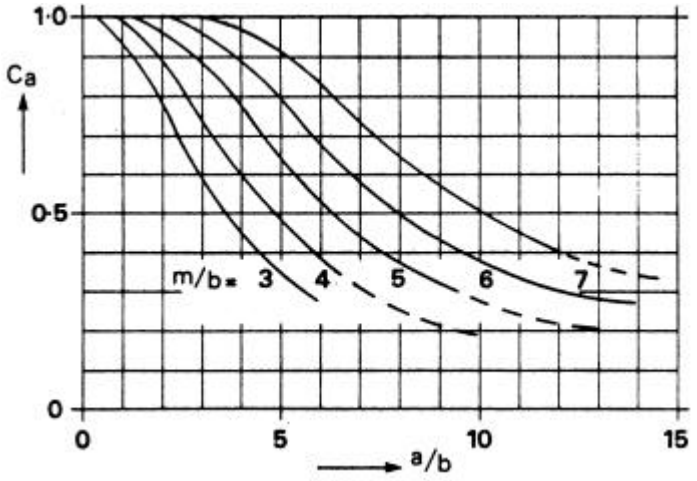


Figure 5: Determination of the factor C_a

On substrates where the fasteners are fixed through the substrate, the correction factor C_a can also be obtained by using a load-cell during the test. In order to perform a representative test it is important that the fixing pattern is regular. The washer and the upper part of the fastener should be representative of the fastening system being evaluated. The lower part of the fastener is connected to the load-cell through a hole in the substrate. At installation of the model the washer should be pressed on to the system with a force of 220 N ± 10 %.

At the maximum pressure just before the sample collapses the actual force is registered. As soon as the initial force of 220 N has dropped to 20 N the system is also deemed to have collapsed.

The correction factor is specified as:

C_a = measured force/theoretical force at the same point

C_d= a statistical factor allowing for the reduction in the probability of failure of one fastener, due to the reduced number of fasteners in the test system. The values of C_d as a function of the dimension of the chosen test system are given below

for	(2 × a + 200 mm) × (4 × b + 200 mm)	C_d = 0,85
for	(3 × a + 200 mm) × (3 × b + 200 mm) and (2 × a + 200 mm) × (5 × b + 200 mm) and (2 × a + 200 mm) × (6 × b + 200 mm) etc.	C_d = 0,90
for	(3 × a + 200 mm) × (4 × b + 200 mm)	C_d = 0,95
for larger dimensions		C_d = 1,0

The dimensions (2 × a + 200 mm) × (3 × b + 200 mm) are not allowed.

The admissible (design) load per fastener, W_{adm} is calculated according to the following formula:

$$W_{adm} = W_{corr}/\gamma_m$$

Where γ_m = factor relating to the effects of materials and defective quality of installation and set to 1,5.

5.1.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

5.1.6 ENERGY ECONOMY AND HEAT RETENTION (ER6)

Only considered in relation to kits with a thermal insulation product as a component, see 5.4.6.1.

5.1.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

Not relevant.

5.2 COMPONENT / MEMBRANE

Where the membrane is already CE marked and tested in accordance with the test methods mentioned hereafter, it is not necessary to repeat the tests. However, assessment still has to be carried out according to chapter 6 of this Guideline to ensure that the membrane is fit for the intended use. Where the membrane is not CE-marked the tests in this chapter shall be performed and an assessment according to the provisions in chapter 6 shall be carried out.

The test methods marked with *) in the following are repeated for durability purposes after appropriate ageing as described in art. 5.2.7.

5.2.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

5.2.2 SAFETY IN CASE OF FIRE (ER2)

5.2.2.1 Testing of reaction to fire

Testing of the membrane according to the test methods developed by CEN for the EUROCLASSES A_1 – F which are further specified in prEN 13501-1 – Classification using test data from reaction to fire tests.

5.2.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

5.2.3.1 Testing of peel resistance of joints (for single-layer waterproof coverings only)*)

Testing of the membrane with respect to peel resistance is performed as described in:

prEN 12316-1 and prEN 12316-2

5.2.3.2 Testing of shear resistance of joints (for single-layer waterproof coverings only)*)

Testing the system with respect to joint strength is performed as described in

prEN 12317-1 and prEN 12317-2

5.2.3.3 Resistance to tear *)

Testing of the membrane with respect to tear resistance is performed as described in:

prEN 12310-1 and prEN 12112-2

5.2.3.4 Resistance to cold bending/folding *)

Testing of the membrane with respect to resistance to cold bending is performed as described in:

prEN 1109 for bituminous sheets and prEN 495-5 for polymeric sheets

5.2.3.5 Testing of resistance to water pressure

Testing of the membrane with respect to resistance to water pressure is performed as described in:

prEN 1928

5.2.3.6 Determination of water vapour permeability

Declaration of a generic value or testing of the membrane with respect to water vapour permeability is performed as described in:

prEN 1931

5.2.3.7 Determination of tensile properties

Testing of the membrane with respect to tensile properties is performed as described in:

prEN 12311-1 and prEN 12311-2

5.2.3.8 Testing of resistance to static loading and impact loading

Testing of the kit with respect to resistance to static loading and impact loading is performed as described in:

prEN 12730:1997-01 for static perforation and prEN 12691:1998-01 for impact resistance.

5.2.4 SAFETY IN USE (ER4)

5.2.4.1 SLIPPERINESS

The coefficient of friction is determined in accordance with the Swedish standard

SS 92 35 15, (2) – Method for determination of the coefficients of friction of various materials with respect to slipping.

Roof surfaces of bituminous products are considered deemed to satisfy the requirements and the test is not performed on this material.

5.2.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

5.2.6 ENERGY ECONOMY AND HEAT RETENTION (ER6)

Not relevant

5.2.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

5.2.7.0 General

Ageing tests specific for the membrane as component of a MEFAWAME kit.

The characteristics to be tested and assessed and the relevant ageing media are shown in Table 5.

Table 5. Characteristics to be tested and assessed and ageing media
(N/A means Not Applicable)

Ageing media Characteristics	HEAT	UV	WATER	OZONE
PEEL RESISTANCE	ETAG art. 5.2.7.1 ETAG art. 6.2.7.1	N/A N/A	ETAG art. 5.2.7.1 **) ETAG art. 6.2.7.1 **)	N/A N/A
SHEAR RESISTANCE	ETAG art. 5.2.7.2 ETAG art. 6.2.7.2	N/A N/A	N/A N/A	N/A N/A
TEAR RESISTANCE	ETAG art. 5.2.7.3 *) ETAG art. 6.2.7.3 *)	N/A N/A	N/A N/A	N/A N/A
RESISTANCE TO COLDBENDING/FOLDING	ETAG art. 5.2.7.4 ETAG art. 6.2.7.4	ETAG art. 5.2.7.4 ETAG art. 6.2.7.4	N/A N/A	ETAG art. 5.2.7.4 ETAG art. 6.2.7.4

*) for non-reinforced materials only
**) for adhered joints only

5.2.7.1 Testing of peel resistance after long term exposure to heat and water

The membrane is conditioned as described in:

- for heat: prEN 1296 (for bituminous and polymeric membranes) for 168 days at 70 ± 2°C
- for water: prEN 1847 for 30 days at 60 ± 2°C

After each conditioning the membrane is tested with respect to peel resistance after ageing and performed as described in 5.2.3.1 of this Guideline.

5.2.7.2 Testing of shear resistance after long term exposure to heat

The membrane is conditioned as described in:

- for heat: prEN 1296 (for bituminous and polymeric membranes) for 168 days at 70 ± 2°C

After each conditioning the membrane is tested with respect to shear resistance after ageing and performed as described in 5.2.3.2 of this Guideline.

5.2.7.3 Resistance to tear after long term exposure to heat

The membrane is conditioned as described in:

- for heat: prEN 1296 (for bituminous and polymeric membranes) for 168 days at 70 ± 2°C

After the conditioning the membrane is tested with respect to resistance to tear after ageing and performed as described in 5.2.3.3 of this Guideline.

5.2.7.4 Resistance to cold bending/folding after long term exposure to heat, UV and ozone

The membrane is conditioned as described in:

- for heat: prEN 1296 (for bituminous and polymeric membranes) for 168 days at 70 ± 2°C

- for UV: according to EOTA Technical Report no. 10 using Climate Class S and a radiant exposure
  equivalent to 2 years *)
- for ozone: according to prEN 1844 for 168 hours at 40 ± 2ºC and concentration 65 ± 5 % **)

After each conditioning the membrane is tested with respect to resistance to cold bending/folding after ageing and performed as described in 5.2.3.4 of this Guideline.

*) The UV test is not performed on mineral finished materials with a good granule retention (according to prEN 12039).

**) The ozone test only applies to elastomeric membranes.

5.2.7.5 Determination of dimensional stability

Testing of the membrane with respect to dimensional stability is performed as described in:

prEN 1107

The test is performed only on the materials mentioned in the above mentioned standard.

5.3 COMPONENT / MECHANICAL FASTENINGS

5.3.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

5.3.2 SAFETY IN CASE OF FIRE (ER2)

Not relevant

5.3.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

Not relevant

5.3.4 SAFETY IN USE (ER4)

5.3.4.1 Axial loading test

This test method determines the axial failure of a fastener under static loading, irrespective of the failure mode.

Test apparatus
Test machine which can be operated with static tensile forces.
Load cell to measure the force.
Deformation gauge.
Holding device for the substrate.
Device for applying the force to the fastener. The steel jaws holding the fastener should be 10 mm thick and have a Ø 25 mm hole. See principle in Figure 6.

Test specimen
The plastic sleeves are stored for two weeks in the testing laboratory at 23 ± 2ºC and 50 ± 5 % RH.

The fasteners shall be installed in the specified substrate according to the manufacturer's installation guide.

The substrates used in the test are defined in art. 5.1.4.1 of this Guideline.

The test is performed at 23 ± 2ºC, 50 ± 5 % RH.

Procedure

The fastener and substrate are secured in the test machine in such a manner that any effects of bending are as far as possible avoided. The machine shall be operated at a speed of 5 - 10 mm/min.

10 specimen of fastener and substrate are tested.

Expression of results

The failure load of the fastener is found for each specimen. The mean value is calculated and the failure mode is noted.

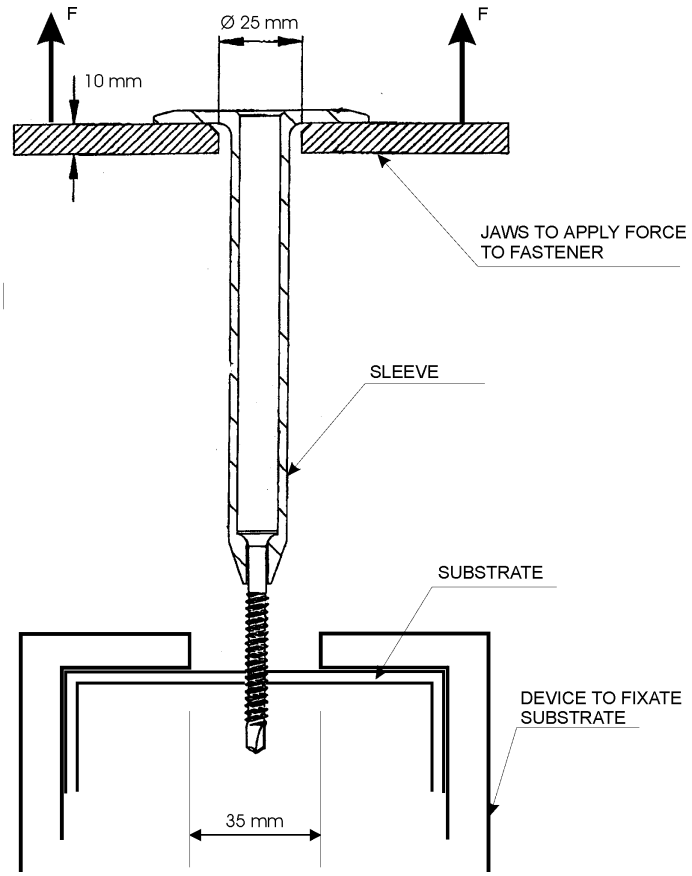


Figure 6. Principle of axial loading test

5.3.4.2 Testing of resistance to unwinding

This test method defines the conditions for testing the unwinding resistance of the mechanical fasteners. The test relates to coupling mechanisms (fastener plus washers) intended to secure the roof waterproofing membrane, laid over an insulation, onto galvanised steel sheet.

For kits where the unwinding susceptibility of the fastener is known based on existing test and/or field experience the test is not necessary.

The test is performed with the membrane which will be used with the fastener. Where there is more than one type of membrane to be used, the selection of membrane should be decided between the approval body and the applicant.

The test can also be used to assess the effect any changes in the fastener design may have e.g. change in drill point diameter, thread geometry and surface treatment.

This test can also be performed with supports other than those envisaged in the following.

Principle of test:
The test involves subjecting an assembled specimen to the effects of alternating loads simulating the effect of wind induced ripples across the sheet in order to assess the likelihood of it unwinding.

Equipment:
Test apparatus as shown in figure 7.
- Mechanical screwdriver with adapted bit
- Galvanised steel deck 0,7 mm, specifications min. S280 according to EN 10147
- Roof waterproofing membrane forming part of the kit as specified by the applicant
- Mineral wool insulation having a density of 150 kg/m^3 ± 10 %, and a nominal thickness of 50 mm.

Dimensions: 300 mm x 250 mm (300 mm perpendicular to the direction of manufacture)

Test apparatus:
1. Washer
2. Roofing membrane
3. Fastener
4. Galvanised steel sheet
5. Loading mechanism
6. Mobile arm
7. Insulating panel
8. Dual action jack
9. Test sample (plan view)

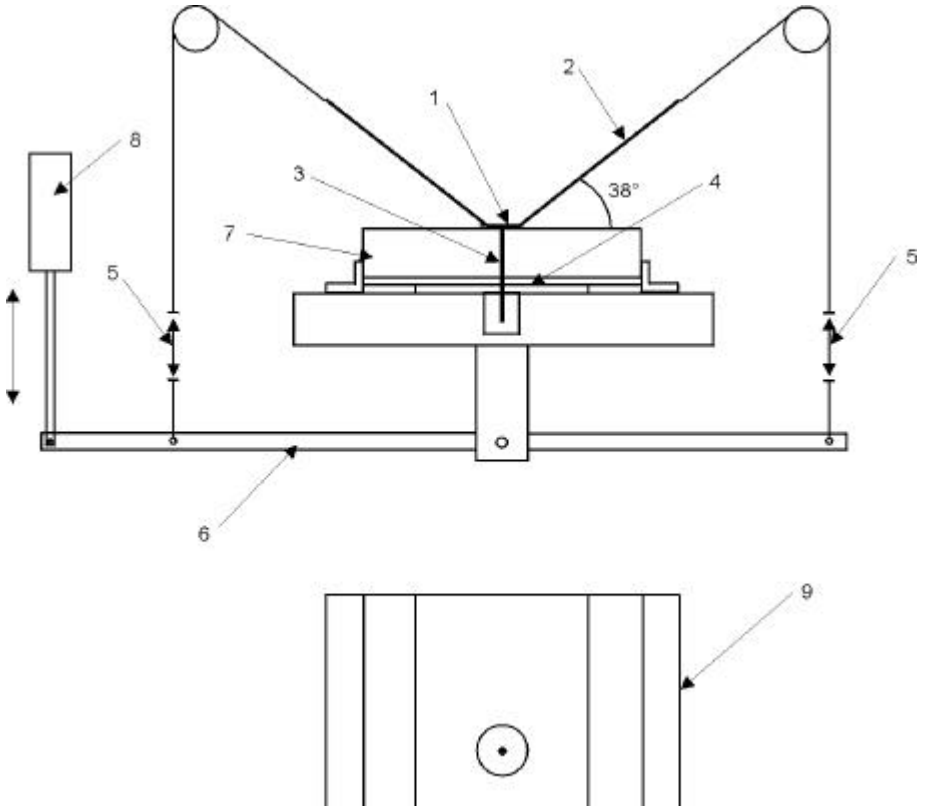


Figure 7. Test apparatus for unwinding test

Principles of test:
A dual action pneumatic jack equipped with adjustable limit switches activates an arm pivoted about a rigidly fixed axis.

This oscillating arm transmits alternating tensile loads to the roof waterproofing membrane (via the loading mechanism and cables) which then transmits these loads to the coupling.

A raked tensile angle of 38° is achieved via suitable positioned pulleys.

The loading mechanism limits the force to which the coupling will be subjected.

Cycle frequency: 200 ± 5 cycles per minute.

Number of cycles: 900. The test can be terminated when unwinding has taken place.

Preliminary adjustments:
- The mobile arm is positioned horizontally and the length of the cables are adjusted such that the
  load corresponds to a force of 0,1 kN.

- The jack limit switches are adjusted such that when the arm is at maximum inclination (in either direction) the extension of one loading mechanism corresponds to a force of 0,2 kN, the other loading mechanism is relaxed (i.e. zero load)

Procedure
Place the metal sheet into its housing, then position the specimen of insulation and the sample of roof waterproofing membrane centrally over the metal sheet.

Install the coupling at the centre of the sample using a mechanical screwdriver. Do not fully tighten the fastener. Use a manual screwdriver to finish tightening the fastener until the washer is flush with the surface of the waterproofing membrane (+0,-1 mm). If the fastener has an oblong washer the longitudinal axis shall be perpendicular to the direction of movement.

Using a fine felt-tipped pen, make a reference mark on the fastener head, washer and membrane in order to monitor the relative movement of the fastener head (possibly also of the washer) relative to the membrane.

Clamp the sample symmetrically onto the sheet and zero the test apparatus (0,1 kN on either side).

Commence the alternate mechanical cycles.

Note the number of cycles after rotation of the fastener head, i.e. ¼ and ½ turn.

Repeat the test in the same way on 9 other samples.

5.3.4.3 Mechanical resistance/brittleness of the plastic fastener

This method is intended to test the impact resistance and brittleness of the plastic fastener before and after ageing.

The top edge of the washer is struck by a cylindrical drop weight at an angle of 45º. The angle of impact is obtained by placing the fastener in a special shoe.

The mechanical resistance of the washer is carried out according to:

prEN 12691: September 1998 Impact resistance

with the following amendments:

- The fasteners are stored for two weeks in the testing laboratory at 23 ± 2ºC and 50 ± 5 % RH
- The vacuum or pressure device is not needed
- The mass of the drop weight including the tool shall be 2,0 ± 0,01 kg
- The puncturing sphere is replaced by a Ø 30 mm cylindrical piston made of steel hardened to 50
  HRC.

- The ballast ring and the expanded polystyrene panel is replaced by a wooden shoe to fix the fastener
  as shown in Figure 8. The fastener is fitted in the shoe and placed under the drop weight.
- The height is measured from the bottom edge of the puncturing tool to the top edge of the fastener
  in the shoe.
- The impact resistance is expressed as the drop height in mm which has not caused damage on the
  sleeve or washer of the fastener in any of the 5 specimens.

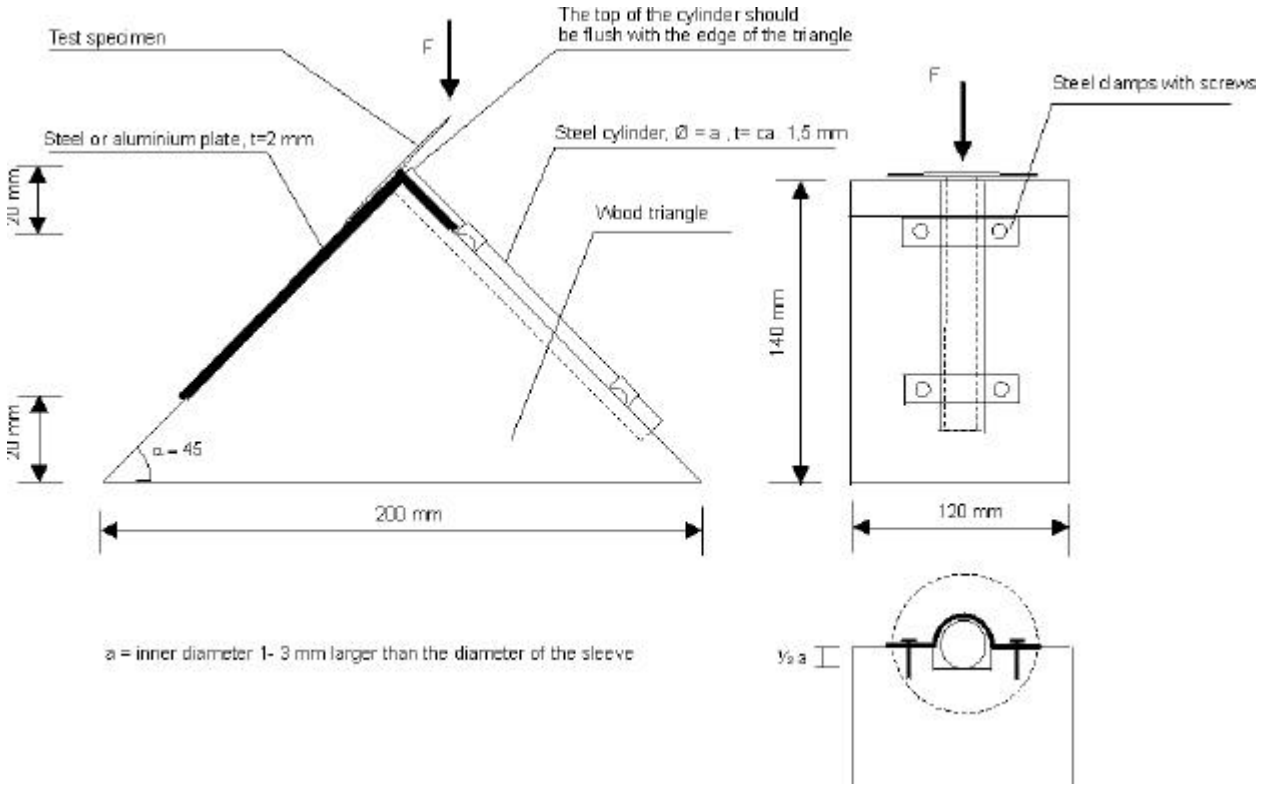


Figure 8: Principle of wooden shoe for holding the fastener

5.3.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

5.3.6 ENERGY ECONOMY AND HEAT RETENTION (ER6)

Not relevant

5.3.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

5.3.7.1 Testing of resistance to corrosion of metallic fasteners

The test described in this chapter shall be carried out on fasteners including metal parts unless they are made from materials which have been proven to be resistant to corrosion. Any fastener including metal components not composed of 1.4301 or 1.4401 according to EN 10088 austenitic stainless steel shall be subjected to this test.

Determination of the corrosion behaviour of fasteners is made by testing in accordance with ISO 6988:1995 - Testing in alternating atmosphere containing sulphur dioxide - on a total of 10 fasteners.

The fasteners are to be incorporated into the roof system, as in practice, according to the specifications of the fastener manufacturer. The fasteners are installed in a substrate corresponding to the use of the fastener with a thermal insulation of expanded perlite with a density of at least 150 kg/m^3 and a thickness corresponding to the maximum clamping range of the fastener, unless the insulation forms part of the kit in which case the actual insulation is used. If the clamping range has no influence on the corrosion performance of the fastener, the thickness of the thermal insulation shall be 100 mm. This is not a model of the roof construction but a build up for testing purposes only. The length of the fastener which passes through or is embedded in the substrate must be measured individually for each fastener and noted.

The fasteners are removed from the build up without causing further damage to the coating. This is facilitated by either cutting through the substrate and insulation, or - if unscrewing - ensuring that the fastener and washer are removed as a single item (i.e. that the screw thread does not spin in the washer)

The fasteners are subjected to 15 exposure cycles in an alternating humid atmosphere containing 2 litres of sulphur dioxide, concentration SFW 2.0 S in accordance with DIN 50018:1997.

The test specimens are to be arranged centrally in the test chamber by suspending them vertically by the use of an inert thread, such as nylon, with a minimum spacing of 20 mm between them. Only test specimens of the same type are to be used for each test, to rule out test specimens with different corrosion protection systems affecting each other. Washers (in the case of point fasteners); profiles (in the case of linear fasteners); and fastener shafts are to be arranged in the test chamber separately from each other. In order to compensate for the small surface area of the fasteners a galvanised steel blanking plate should be included to achieve the minimum surface test area of $0,5 \pm 0,1$ m^2.

The test specimens are exposed to the effect of condensation from water to which 2 litres of sulphur dioxide ($S0_2$) has been added. The 2 litres of sulphur dioxide ($S0_2$) are charged immediately after the test chamber is closed. The heating is switched on to reach a test temperature of 40 ± 3°C in 95 ± 5 minutes. One cycle comprises two test stages and last for a total of 24 hours. In the first test stage, totalling 8 hours (after the heating is switched on), the test specimens are exposed at 40 ± 3°C to the condensation and the sulphur dioxide. The second test stage begins when the heating is switched off and the test chamber is opened or ventilated. The test specimens are to be left in the chamber, where drying will take place over 16 hours. After the second test stage, the base tank of the test chamber is emptied, cleaned, if necessary, and filled with fresh distilled or de-ionised water. The test chamber is closed and charged with sulphur dioxide. A new cycle begins when the heating is switched on,

When the 15 cycles have been completed, the test specimens are removed from the test chamber and examined for surface corrosion (rusting). Any corrosion which may have formed beneath the corrosion protection coating is also to be recorded. If it is clear that the requirements of par. 6.3.7.1 cannot be achieved before the 15 cycles are completed, the result is considered unsatisfactory and the test may be terminated.

The head of the fastener and the part of the fastener which has passed through (metal) or is embedded in (concrete) the substrate, the rim around the external edges of the washer and profiles are not included in the determination of surface corrosion. Visual evaluation is made. In borderline cases, the evaluation shall be undertaken by 3 people, independently of each other.

5.3.7.2 Testing of mechanical resistance after heat ageing of plastic fasteners

Plastic fasteners are not used in a way which lead to exposure to UV and water.

Plastic fasteners are tested as follows:

- Heat ageing for 168 days at 70 ± 2°C in a joint with a fastener installed as on the roof.

- Heat ageing of the washers alone for 168 days at 70 ± 2°C.

Before and after ageing the washer is submitted to testing as described in 5.3.4.3.

5.4 COMPONENT / INSULATION

Where the insulation material is already CE marked and tested in accordance with the test methods mentioned hereafter, it is not necessary to repeat the tests. However, assessment still has to be carried out according to chapter 6 of this Guideline to ensure that the insulation material is fit for the intended use. Where the insulation material is not CE-marked the tests in this chapter shall be performed and an assessment according to the provisions in chapter 6 shall be carried out.

5.4.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

5.4.2 SAFETY IN CASE OF FIRE (ER2)

5.4.2.1 Testing of reaction to fire

Testing of the insulation according to the test methods developed by CEN for the EUROCLASSES A_1 – F which are further specified in prEN 13501-1 - Classification using test data from reaction to fire tests.

5.4.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

5.4.3.1 Compressibility test for insulating materials

Determination of the compression behaviour and point load behaviour of the insulating materials is performed as described in:

EN 826 for the compression behaviour and EN 12430 for the point load behaviour.

5.4.4 SAFETY IN USE (ER4)

Not relevant

5.4.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

5.4.6 ENERGY ECONOMY AND HEAT RETENTION (ER6)

5.4.6.1 Calculation or testing of thermal transmission

Calculation of the thermal insulation characteristics is performed as described in:

EN/ISO 6946:, Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.

Testing of thermal resistance is performed as described in:

EN/ISO 8990, Thermal insulation – Determination of steady-state thermal transmission properties – calibrated and guarded hot box

prEN 12667, Building materials – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance

prEN 12939, Building materials – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance

EN/ISO 10211-1, Thermal bridges in building – Heat flows and surface temperatures – General calculation methods.

5.4.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

5.4.7.1 Durability of insulating materials

The durability of the thermal resistance of the insulation material is tested as described in:

PrEN 13164 – Thermal insulation products for buildings – Factory made products of extruded polystyrene foam (XPS) – Specifications
PrEN 13165– Thermal insulation products for buildings – Factory made rigid polyurethane foam (PUR) products – Specifications
PrEN 13166– Thermal insulation products for buildings – Factory made products of phenolic foam (PF) – Specifications

The durability of the thickness of the insulation material is tested as described in

EN 1604 – Thermal insulating products for building applications – Determination of dimensional stability under specified temperature and humidity conditions

The combination of the tests on the durability of the thermal resistance and of the thickness will provide information on the durability of the λ-value.

The tests are performed only on the insulation materials covered by prEN 13164, prEN 13165 and prEN 13165.

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

6.0 General

Chapter 6 details the performance requirements to be met by a System of mechanically fastened flexible roof waterproofing membranes (chapter 4) 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, using the verification methods (chapter 5).

The possible ways of expressing the results of the assessment of the mandatory performance requirements are shown in Table 6.

Table 6. Product performance and assessment criteria

ER	ETAG paragraph on product characteristic to be assessed	Category/Class/ Numeric value
2	§ 6.1.2 SYSTEM	
	§ 6.1.2.1 External fire performance	Assessment (prEN 1187)
	§ 6.2.2 COMPONENT/MEMBRANE	EUROCLASS
	§ 6.2.2.1 Reaction to fire	
	§ 6.4.2 COMPONENT/INSULATION	EUROCLASS
	§ 6.4.2.1 Reaction to fire	
3	§ 6.1.3 SYSTEM	
	§ 6.1.3.1 Dangerous substances	Declaration
	§ 6.2.3 COMPONENTS/MEMBRANE	
	§ 6.2.3.1 Peel resistance (joint) *)	Declared value
	§ 6.2.3.2 Shear resistance (joint) *)	Declared value
	§ 6.2.3.3 Tear resistance	Declared value
	§ 6.2.3.4 Resistance to cold bending/folding	Declared value
	§ 6.2.3.5 Resistance to water pressure	Declared value
	§ 6.2.3.6 Water vapour permeability	Declared value
	§ 6.2.3.7 Tensile properties	Declared values
	§ 6.2.3.8 Resistance to static loading and impact loading	Declared values
	§ 6.4.3 COMPONENTS/INSULATION	
	§ 6.4.3.1 Compressibility of insulation materials	Category
4	§ 6.1.4 SYSTEM	
	§ 6.1.4.1 Resistance to wind uplift	Admissible (design) load
	§ 6.2.4 COMPONENT / MEMBRANE	
	§ 6.2.4.1 Slipperiness	Declared value or no performance determined
	§ 6.3.4 COMPONENTS/MECHANICAL FASTENERS	
	§ 6.3.4.1 Axial loading of fastener	Mean value
	§ 6.3.4.2 Resistance to unwinding	Pass/fail or No performance determined
	§ 6.3.4.3 Mechanical resistance of sleeve	Declared value
6	§ 6.4.6 COMPONENTS/INSULATION	
	§ 6.4.6.1 Thermal resistance	Characteristic value or No performance determined

**)	§ 6.2.7	COMPONENTS/MEMBRANE	
	§ 6.2.7.1	Peel resistance after long term exposure to heat and water	Declared value and conclusion
	§ 6.2.7.2	Shear resistance after long term exposure to heat and water	Declared value and conclusion
	§ 6.2.7.3	Tear resistance after long term exposure to heat	Declared value and conclusion
	§ 6.2.7.4	Resistance to cold bending/folding after long term exposure to heat, UV and water	Declared value and conclusion
	§ 6.2.7.5	Dimensional stability	Declared value and conclusion
	§ 6.3.7	COMPONENTS/MECHANICAL FASTENERS	
	§ 6.3.7.1	Resistance to corrosion of metallic fasteners	Use category
	§ 6.3.7.2	Mechanical resistance after heat ageing of plastic fasteners	Use category

*) for single layer systems only
**) Aspects of durability, serviceability and identification

6.1 SYSTEM

6.1.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

6.1.2 SAFETY IN CASE OF FIRE (ER2)

6.1.2.1 External fire performance

Assessment of the result of the tests in 5.1.2.1.

6.1.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

6.1.3.1 Outdoor environment

Release of dangerous substances:
For the presence of materials listed in Council Directive of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (as amended) and in the document CONSTRUCT 99/348 Working Document of the Commission Services; Construction products and Regulations on Dangerous Substances and in accordance with CONSTRUCT 99/363 Guidance paper on a Harmonised Approach Relating to Dangerous Substances under Construction Products Directive, three possibilities exist:
- The materials are forbidden at EC level, i.e. no ETA can be issued
- The materials are forbidden in some countries, and the presence shall be declared
- The materials are allowed in all/some countries, but with restrictions, in which case the nature of the materials as well as their concentration/emission rate/etc shall be given

If no such materials are present, this information shall be given.

6.1.4 SAFETY IN USE (ER4)

6.1.4.1 Resistance to wind uplift

Admissible (design) load determined as the result of the wind uplift test and the possible small scale tests.

6.1.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

6.1.6 ENERGY CONSUMPTION AND HEAT RETENTION (ER6)

Only considered in relation to kits with a thermal insulation material as a component (see 6.4.6.1).

6.1.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

Not relevant.

6.2 COMPONENT / MEMBRANE

6.2.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

6.2.2 SAFETY IN CASE OF FIRE (ER2)

6.2.2.1 Reaction to fire

Classification of the membrane with respect to the reaction to fire is undertaken in accordance with prEN 13501-1 (Classification using test data from reaction to fire tests). The following range of EUROCLASSES is used: from A_1 – F, class F offering a no performance determined option.

6.2.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

Test results marked with *) are also for durability purposes as described in art. 6.2.7.

6.2.3.1 Peel resistance of joints*)

Indication of declared value

6.2.3.2 Shear resistance of joints*)

Indication of declared value

6.2.3.3 Tear resistance *)

Indication of declared value

6.2.3.4 Resistance to cold bending/folding*)

Indication of declared value

6.2.3.5 Resistance to water pressure

Indication of declared value

6.2.3.6 Water vapour permeability

Indication of declared value

6.2.3.7 Tensile properties

Indication of declared value

6.2.3.8 Resistance to static loading and impact loading

Indication of declared value

6.2.4 SAFETY IN USE (ER4)

6.2.4.1 Slipperiness

Indication of characteristic value or no performance determined.

6.2.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

6.2.6 ENERGY CONSUMPTION AND HEAT RETENTION (ER6)

Not relevant

6.2.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

6.2.7.1 Peel resistance after long term exposure to heat and water

If the decrease in the peel resistance is equal to or less than 20 % after ageing this may be considered to be applicable to an expected working life of at least 10 years since the overall quality of the kit is proven by the wind uplift test.

If the decrease in the peel resistance is more than 20 % after ageing further investigations (e.g. establishing further points on the degradation curve and/or level of declared value after ageing) shall be undertaken by the Approval Body. This assessment should be carried out in accordance with the provisions in EOTA Guidance Document for the Assessment of Working Life of Products, Final draft, March 1997, paragraph 4.3.4 Accelerated ageing conditions.

6.2.7.2 Shear resistance after long term exposure to heat and water

If the decrease in the shear resistance is equal to or less than 20 % after ageing this may be considered to be applicable to an expected working life of at least 10 years since the overall quality of the kit is proven by the wind uplift test.

If the decrease in the shear resistance is more than 20 % after ageing further investigations (e.g. establishing further points on the degradation curve and/or level of declared value after ageing) shall be undertaken by the Approval Body. This assessment should be carried out in accordance with the provisions in EOTA Guidance Document for the Assessment of Working Life of Products, Final draft, March 1997, paragraph 4.3.4 Accelerated ageing conditions.

6.2.7.3 Tear resistance after long term exposure to heat

If the decrease in the tear resistance is equal to or less than 20 % after ageing this may be considered to be applicable to an expected working life of at least 10 years since the overall quality of the kit is proven by the wind uplift test.

If the decrease in the tear resistance is more than 20 % after ageing further investigations (e.g. establishing further points on the degradation curve and/or level of declared value after ageing) shall be undertaken by the Approval Body. This assessment should be carried out in accordance with the provisions in EOTA Guidance Document for the Assessment of Working Life of Products, Final draft, March 1997, paragraph 4.3.4 Accelerated ageing conditions.

6.2.7.4 Resistance to cold bending/folding after long term exposure to heat, UV and water

If the decrease in the resistance to cold bending/folding is equal to or less than 15°C after ageing this may be considered to be applicable to an expected working life of at least 10 years since the overall quality of the kit is proven by the wind uplift test.

If the decrease in the resistance to cold bending/folding is more than 15ºC after ageing further investigations (e.g. establishing further points on the degradation curve and/or level of declared value after ageing) shall be undertaken by the Approval Body. This assessment should be carried out in accordance with the provisions in EOTA Guidance Document for the Assessment of Working Life of Products, Final draft, March 1997, paragraph 4.3.4 Accelerated ageing conditions.

6.2.7.5 Dimensional stability

The dimensional stability of non-reinforced membranes shall be ≤ 2 %

The dimensional stability of reinforced membranes shall be ≤ 0,6 %

6.3 COMPONENT / MECHANICAL FASTENERS

6.3.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

6.3.2 SAFETY IN CASE OF FIRE (ER2)

Not relevant

6.3.3 HYGIENE, HEALTH AND THE ENVIRONMENT

Not relevant

6.3.4 SAFETY IN USE (ER4)

6.3.4.1 Axial loading of fastener

Mean value and failure mode.

6.3.4.2 Resistance to unwinding

All fasteners shall meet the requirements specified below.

For each fastener:

Indicate the rotation made by the fastener head after 500 cycles. The rotation of the fastener head shall be less than or equal to ¼ turn.

Indicate the rotation made by the fastener head after 900 cycles (end of test). The rotation of the fastener head shall be less than or equal to ½ turn.

Indicate any vertical movement made by the fastener head after 900 cycles. Allowing for the pitch of the fastener thread, the calculated vertical displacement shall be less than or equal to 1 mm per fastener turn.

6.3.4.3 Mechanical resistance/brittleness of plastic fastener

Indication of drop height for new fasteners.

6.3.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

6.3.6 ENERGY CONSUMPTION AND HEAT RETENTION (ER6)

Not relevant

6.3.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

6.3.7.1 Resistance to corrosion of metallic fasteners

Fasteners for use without restrictions on the risk of corrosion and condensation shall be made of materials which are deemed to satisfy the requirements on corrosion, e.g. made from austenitic stainless steel 1.4301 or 1.4401 according to EN 10088 and are considered deemed to satisfy.

Other metallic fasteners shall have undergone an anti-corrosion treatment. In this respect, the moisture content of the material of the load-bearing structure and any condensation likely to occur shall be taken into account.

After the test in accordance with 5.3.7.1, the metallic parts shall not exhibit more than 15% surface corrosion (rust formation) or corrosion formation recognisable beneath the corrosion protection coating.

Fasteners which fulfil the above mentioned requirements after testing according to 5.3.7.1 may only be used on roofs presenting only a slight risk of corrosion and condensation (eg. above

rooms with low humidity, in non-aggressive atmosphere and/or in an environment not harmful to the fastener).

Fasteners for use in concrete with a metallic shaft totally protected by a plastic sleeve above the surface of the concrete to the head of the metallic element may also be used without restrictions if they fulfil the requirements mentioned above after testing according to 5.3.7.1.

6.3.7.2 Resistance to heat ageing of plastic fasteners

Indication of the drop height after ageing.

If the decrease in the drop height is equal to or less than 20 % after ageing this may be considered to be applicable to an expected working life of at least 10 years since the overall quality of the kit is proven by the wind uplift test.

If the decrease in the drop height is more than 20 % after ageing further investigations (e.g. establishing further points on the degradation curve and/or level of declared value after ageing) shall be undertaken by the Approval Body. This assessment should be carried out in accordance with the provisions in EOTA Guidance Document for the Assessment of Working Life of Products, Final draft, March 1997, paragraph 4.3.4 Accelerated ageing conditions.

6.4 COMPONENT / INSULATION

6.4.1 MECHANICAL RESISTANCE AND STABILITY (ER1)

Not relevant

6.4.2 SAFETY IN CASE OF FIRE (ER2)

6.4.2.1 Reaction to fire

Classification of the insulation product with respect to the reaction to fire is undertaken in accordance with prEN 13501-1 (Classification using test data from reaction to fire tests). The following range of EUROCLASSES is used: from A_1 – F, class F offering a no performance determined option.

6.4.3 HYGIENE, HEALTH AND THE ENVIRONMENT (ER3)

6.4.3.1 Compressibility test for insulation materials

Indication of category in accordance with EN 826 and EN 12430.

Compressibility (10 %) according to EN 826: $\geq$ 0,06 N/mm^2. (the requirement applies to homogenous materials and the top layer of multi-layer or composite products)
Point load behaviour according to EN 12430: $\geq$ 500 N, deformation 5 mm.

6.4.4 SAFETY IN USE (ER4)

Not relevant

6.4.5 PROTECTION AGAINST NOISE (ER5)

Not relevant

6.4.6 ENERGY ECONOMY AND HEAT RETENTION (ER6)

6.4.6.1 Thermal resistance

Where the insulation material does not form part of the kit an assessment is not carried out. Otherwise, the thermal resistance of the insulation material used in the kit is indicated according to the standards mentioned in 5.4.6.1.

6.4.7 ASPECTS OF DURABILITY, SERVICEABILITY AND IDENTIFICATION

6.4.7.1 Durability of the insulating materials

The decrease in the thermal resistance shall be considered to be applicable to an expected working life of at least 10 years. The overall quality of the kit is proven by the wind uplift test.

6.8 IDENTIFICATION OF THE PRODUCT

All components of the mechanically fastened flexible roof waterproofing membrane kit shall be clearly identified. Where possible, this shall be done by reference to European Standards.

Where components are not covered by European Standards, they shall be precisely defined by reference to physical characteristics as indicated in this Guideline.

The determination of the product characteristics shall be based on testing in accordance with the appropriate CEN or EOTA test methods as far as they exist.

7. ASSUMPTIONS AND RECOMMENDATIONS under which the fitness for use of the products is assessed

7.0 General

Chapter 7 sets out the preconditions for design, execution, maintenance and repair which are a presumption for the assessment of the fitness for use according to the Guideline (only when necessary and in so far as they have a bearing on the assessment or on the products).

The issued European Technical Approvals shall state these conditions, where relevant.

7.1 DESIGN AND EXECUTION OF SYSTEMS OF MECHANICALLY FASTENED FLEXIBLE ROOF WATERPROOFING MEMBRANES INTO THE WORKS

The substrate is assumed to fulfil the following basic requirements:

Design

The design of the roof intended to be covered by the mechanically fastened roof waterproofing system should take account of the following factors:

- Dead and imposed loads
- Design wind pressure
- Structural strength, stiffness and deflection limits
- Attachment of the roof deck to the structural framing
- The provision of insulation
- The assessment of condensation risk and the provision of vapour control layers
- Sound insulation
- Fire precautions
- Roof attachments, fixtures and penetrations
- Falls and drainage
- Means of access for inspection and maintenance

The desired properties of the roof should be determined and specified accordingly.

Substrates

The substrate onto which the waterproofing kit is to be laid should be sufficiently rigid, dense and dimensionally stable to support the system (membrane and insulation). Its nature will depend on the type of roof selected (warm deck, cold deck, or inverted) and in turn will have a direct influence on the method of attachment.

In order to support the loads imposed by traffic, insulation materials for use in warm decks should be capable of resisting permanent deformation or damage when subjected to concentrated loads. They should have a dust-free surface and sufficient laminar strength to resist with a margin of safety any stress imposed by wind uplift forces.

It shall be ensured that the insulation material on site has at least the characteristics as the insulation material used in the wind uplift test and stated in the ETA.

When insulation materials with a compressibility of $<0.1 Nmm^{-2}$ (at 10% compression) are used, the membrane may be vulnerable to puncture by the fastener penetrating through the underside. This may be prevented by using a fastener/washer, strip or lath with an “anti-pop-up” design. These designs are often marketed as “Treadfast” and may feature a mechanical interlock between the fastener and the washer strip or lath, which is engaged upon fastener installation. Examples of other designs include a deep recess in the washer, strip or lath, or a

plastic washer with integrated sleeve.

Roof materials

The following is a list of recommendations for roof deck materials to receive the mechanically fastened roof waterproofing system.

- *Reinforced concrete.* Where a roof slab of reinforced concrete is designed as the deck, which will directly support the waterproofing, it is preferable to lay the slab to provide adequate drainage falls and adequate provision should be made for drying out the slab. A concrete surface, which is not adequately smooth, or does not provide even drainage falls, should be screeded. The surface of the concrete should be finished with a wood float to provide a reasonably smooth surface free from ridges and hollows.

- *Profiled metal decking.* Metal decking does not provide a continuous supporting surface for the application of the waterproofing membrane and therefore it shall always be used in conjunction with a continuous support, e.g. insulation material. The metal decking should not be less than 0,70 mm.

- *Timber boarding, including OSB*. Roof decks of timber boarding should be designed using naturally durable timber or pre-treated against infestation by wood boring insects and fungal decay. Any method of pre-treatment should be compatible with the kit components. Boarding should not be less than 19 mm nominal thickness, planed, closely clamped together with tongued and grooved joints or closely butted and secured by nailing with nail heads not protruding.

- *Plywood*. Roof decks of plywood should be specified as “water boil proof” bonded veneer plywood and durable or treated with a compatible preservative and should not be less than 19 mm nominal thickness. Plywood for roof decks may be square edged or tongued and grooved. Longitudinal joints should occur on the centre of supporting joists. Cross joists should be staggered and in the case of square edged boarding additional support is required, such as the use of noggins.

If there is doubt about the suitability of the substrate, e.g. on a construction site, a pullout test on site should be performed to verify the performance of the kit (see Annex D). Furthermore, care should be taken during design that bimetallic corrosion between metal parts, especially between the substrate and the screw, does not occur. Likewise, the use of insulation materials containing substances which can affect the performance of the fasteners shall be avoided.

Further conditions for design and execution of the system into the works shall be taken from the manufacturer's installation guide. The quality and sufficiency of this installation guide shall be assessed, in particular concerning the aspects indicated in chapter 9.1 of this Guideline; Information on the design.

It shall be stated in the ETA that the installation guide forms part of the ETA. The ETA holder is responsible for delivering the installation guide to the roofing contractor. The ETA may take over the essential parts of the installation guide.

7.2 PACKAGING, TRANSPORT AND STORAGE

The components of the kit shall be handled and stored with care and be protected from accidental damage.

7.3 EXECUTION OF WORKS

The kit shall be installed in accordance with the ETA holder's installation instructions by competent roofing contractors. ETA holders may operate an approved contractors scheme.

Extra care should be taken when handling and installing the insulation material.

7.4 MAINTENANCE AND REPAIR

The assessment of the fitness for use is based on the assumption that a normal maintenance of the system is performed.

This maintenance should include:

- inspections of the roof at regular intervals, e.g. twice a year
- this inspection should include:
  - cleaning of downpipes and leaf filters
  - removal of stones, branches and leafs etc.
  - inspection of flashings along the edge of the roof, chimneys, drains and roof lights
  - removal of organic growths such as vines
- Elastic joints around cover strips should be inspected every 5 years and replaced if necessary
- Flashings to caps, drains etc. should be inspected every 5 years and joint sealants should be replaced if necessary
- Inspection, and if necessary, replacement of mineral finishes on bituminous membranes
- Abrasions and minor impact damage shall be repaired.

When replacing components they shall be approved by the manufacturer and covered by the ETA.

Section Three: ATTESTATION OF CONFORMITY (AC)

8. ATTESTATION AND EVALUATION OF CONFORMITY

8.1 EC DECISION

The system of attestation of conformity specified by the European Commission in mandate Construct 97/223 Annex 3 is system 2+ described in Council Directive (89/106/EEC) Annex III, 2(ii), First possibility and is detailed as follows:

(a) **Tasks of the manufacturer**

- initial type-testing of the product
- factory production control

(b) **Tasks of the approved body**

- initial inspection of factory and of factory production control
- continuous surveillance, assessment and approval of factory production control

8.2 RESPONSIBILITIES

8.2.1 Tasks of the manufacturer covering the factory production control

8.2.1.1 ***Factory production control***

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 European Technical Approval (ETA).

Manufacturers having an FPC system which complies with EN ISO 9000 **and** which addresses the requirements of an ETA are recognised as satisfying the FPC requirements of the Directive.

8.2.1.2 ***Declaration of Conformity***

When all the criteria of the Conformity Attestation are satisfied the manufacturer shall make a Declaration of Conformity.

8.2.2 Tasks of the manufacturer covering the product

8.2.2.1 ***Initial Type Testing***

Approval tests will have been conducted by the approval body or under its responsibility (which may include a proportion conducted by a laboratory or by the manufacturer, witnessed by the approval body) in accordance with section 5 of this ETAG. The approval body will have assessed the results of these tests in accordance with section 6 of this ETAG, as part of the ETA issuing procedure.
These tests should be used for the purposes of Initial Type Testing[1].
This work should be taken over by the manufacturer for Declaration of Conformity purposes.

[1]In this respect Approval Bodies shall be able to have open arrangements with relevant Approved Bodies to avoid duplication, respecting each others responsibilities.

8.2.3 **Tasks of the approved body**

8.2.3.1 ***Assessment of the factory production control system - initial inspection and continuous surveillance***

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

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

Subsequently continuous surveillance of factory production control is necessary to ensure continuing conformity with the ETA.

It is recommended that surveillance inspections be conducted at least twice per year. However, if the results of the first inspection are satisfactory, the inspection interval can be reduced to once per year.

8.2.3.2 ***Certification of Factory Production Control***

The approved body shall issue Certification of Factory Production Control.

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 will generally form the basis on which the factory production control (FPC) is assessed by the approved body.

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

(1) The ETA

See section 9 of this Guideline.

The nature of any additional (confidential) information shall be declared in the ETA.

(2) Basic manufacturing process

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

The different components of MEFAWAME are generally manufactured using conventional techniques. Any critical process or treatment of the components which affects the performance shall be highlighted.

(3) Product and materials specifications

These may include:

detailed drawings (including manufacturing tolerances)
incoming (raw) materials specifications and declarations
references to European and/or international standards or appropriate specifications
manufacturers data sheets.

(4) Quality plan

The manufacturer and the approval body issuing the ETA shall agree an FPC test plan.

An agreed FPC test plan is necessary as current standards relating to quality management systems (Guidance Paper B, EN 29002, etc), do not ensure that the product specification remains unchanged and they cannot address the technical validity of the type or frequency of checks/tests.

The validity of the type and frequency of checks/tests conducted during production and on the final product shall be considered. 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:

Membrane:

Checks on incoming materials:

Supplier's certificate of conformity possibly including tests and/or combined with a simple material related test, e.g. penetration test for bitumen. Frequency: Each batch.

Checks on process:

Process parameters, e.g. thickness, width and monitoring of speed and temperature, shall be included in the FPC. Frequency: At least at the beginning, the middle and the end of every shift.

Checks on finished products:

Test plan according to prEN (WI 00254041) where relevant. If the membrane is CE marked this test plan is assumed to be carried out.

Some of the above mentioned tests on finished products may not be necessary for certain applications.

Fasteners:

Checks on incoming materials:

Suppliers certificate of conformity for steel materials and for plastic materials according to EN 10204, including density according to ISO 1183 and Melt Flow Index (MFI) according to ISO 1183. Frequency: Each batch.

Checks on process:

Metal parts:
Not applicable

Plastic parts:
Check the most important process parameters for plastic part manufacturing

Checks on finished products:

Dimensions of:

- Thread diameter
- Point diameter
- Core diameter
- Length
- Dimension of washer
- Corrosion protection.

For steel parts:

- Torsional strength and hardness for screw type fasteners

For coated steel parts:

- Cleaning/pretreatment process data
- Coating process data
- Mass and/or thickness of coating

For plastic parts:

- Geometry

Insulation materials:
Checks on incoming materials:
Not applicable.

Checks on process:
Not applicable.

Checks on finished products:
Further to the test plan required by the CE marking of the insulation material:

Point load and compression behaviour
Thermal properties if these are not part of the CE marking.

Where materials/components are not manufactured and tested by the supplier in accordance with agreed methods, then where appropriate they shall be subject to suitable checks/tests by the manufacturer before acceptance.

8.4 CE MARKING AND INFORMATION

The ETA shall indicate the information to accompany the CE marking and the placement of CE marking and the accompanying information (the kit/components itself/themselves, an attached label, the packaging, or the accompanying commercial documents).

According to the EC Guidance Paper D on CE marking, the required information to accompany the symbol “CE” is:

- name or identifying mark of the producer
- last two digits of the year in which the marking was affixed
- number of the ETA (valid as indications to identify the characteristics of the mechanically fastened flexible roof waterproofing system and the characteristics where the “no performance determined” approach is used).

Section Four: ETA CONTENT

9. THE ETA CONTENT

9.1 THE ETA CONTENT

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

The ETA shall specify the kits/components covered by the ETA (type of membrane, type of fastener, possibly type of insulation, vapour control layers etc.) and basic requirements for the substrate (see art. 7.1). The ETA shall also state that on site pull out tests can be performed if there is doubt concerning the suitability of the substrate.

The technical part of the ETA shall contain the information listed hereafter. The ETA shall either give the appropriate indication, classification, statement or description or - where relevant – indicate the “no performance determined” option. The items are given with reference to the relevant clauses of this Guideline:

Information on the performance of the kit:

- Type of approval, kit or component (clause 2.2)
- Indication of the assumed working life (clause 4)
- Classification of the kit with respect to external fire performance (clause 6.1.2.1)
- Statement on the presence or otherwise of dangerous substances including concentration (clause 6.1.3.1)
- Indication of the performance characteristics with respect to wind uplift (clause 6.1.4.1)
- Indication of the calculated or tested thermal resistance of the kit (clause 6.4.6.1)

Information on the components:

- Indication of the performance characteristics of the membrane with respect to:
  - peel (clause 6.2.3.1)
  - shear (clause 6.2.3.2)
  - tear (clause 6.2.3.3)
  - cold bending/folding (clause 6.2.3.4)
  - water pressure (clause 6.2.3.5)
  - water vapour permeability (clause 6.2.3.6)
  - tensile properties (clause 6.2.3.7)
  - static and dynamic indentation (clause 6.2.3.8)
- Indication of the resistance to ageing of the membrane (clauses 6.2.7.1 - 6.2.7.5)
- Indication of the performance characteristics of the fastener with respect to:
  - pull-out (clause 6.3.4.1)
  - resistance of the sleeve (clause 6.3.4.2)
- Indication of the resistance to corrosion of the fastener (clause 6.3.7.1)
- Indication of the resistance to heat ageing of plastic fasteners (clause 6.3.7.2)
- Compressibility of insulating panels (clause 6.4.3.1)

Information on the design:

- Principle sketches:
  - type of mechanical fastening of membranes
  - type of arranging of fasteners at upstands and penetrations

- Membrane:
  - seam overlap according to detailing

- Fastening:
  - design of fastener spacing and areas according to national requirements
  - spacing of fasteners (according to kind of fastening)
    - minimum distance in row
    - maximum distance in row
    - distance of the washer to the seam edge
  - design of perimeter and edge fixation
    - fastener spacings at upstands and penetrations
    - fastening system and fastener spacings
      - linear fastening
        - with coated metal
        - with metal trim / -profile
      - spot fastening (linear fastening)
        - spot fastening in row and in seam overlap
        - spot fastening with cover strips
  - fastening with support construction, e.g. timber beam

- Insulation:
  - fixation of the insulation

- Design principles of upstands and flashings, e.g.
  - height of upstand
  - fastening
    - entire flashing area
    - intermediate fixations
    - support constructions
    - upper edge of flashings / upstands
  - air-tight roofing membrane / vapour barrier

- Design principles of penetrations fastening of installed parts / units

The ETA may include annotated drawings with the dimensions marked and drawn to an adequate scale. The drawings should be accompanied by a description of particular installation details.

9.2 ADDITIONAL INFORMATION

It shall be stated in the ETA that the manufacturer's installation guide forms part of the ETA, see 7.1.

Similarly, it shall be stated in the ETA whether or not any additional information (possibly confidential) shall be supplied to the approved body for the evaluation of attestation of conformity, see 8.3 of this Guideline.

Annex A

A. List of reference documents

Council Directive 89/106/EEC (CPD) 21 December 1988 – O.J. L40 – 11 February 1989

prEN 1187-2000	Test methods for external fire exposure to roofs
prEN 206:1991	Concrete – performance, production, placing and compliance criteria
EN 636:1997	Plywood. Specifications
EN 10147:1993	Continuously hot-dip zinc coated structural steel sheet and strip – technical delivery conditions
prEN 12316-1:1996-02	Flexible sheets for roofing – Determination of peel resistance of joints – Part 1: Bitumen sheets
prEN 12316-2:1995-02	Flexible sheets for roofing – Determination of peel resistance of joints – Part 2
prEN 12317-1: 1996-02	Flexible sheets for roofing – Determination of shear resistance of joints – Part 1: Bitumen sheets
prEN 12317-2:1995-02	Flexible sheets for roofing – Determination of shear resistance of joints – Part 2
prEN 12310-1:1996-02	Flexible sheets for roofing – Determination of nail shank tear resistance – Part 1: Bitumen sheets
prEN 12112-2:1995-09	Flexible sheets for waterproofing – Determination of tear properties – Part 2: Thermoplastic and elastomeric sheets
prEN 1109:1996-07	Flexible sheets for roofing – Bitumen sheets – Determination of flexibility at low temperature
prEN 495-5:1991-05	Thermoplastic and elastomeric roofing and sealing sheets; low temperature folding test
prEN 1928:1995-05	Flexible sheets for waterproofing – Determination of water tightness
prEN 1931:1995-05	Flexible sheets for waterproofing – Determination of water vapour transmission properties
prEN 12311-1:1996-02	Flexible sheets for roofing – Determination of tensile properties – Part 1: Bitumen sheets
prEN 12311-2:1998-07	Flexible sheets for roofing – Determination of tensile properties – Part 2
prEN 1844:1995-02	Elastomeric and thermoplastic sheets for waterproofing – Determination of resistance to ozone cracking
prEN 1847:1995-02	Elastomeric and thermoplastic sheets for waterproofing – Method of exposure to liquid chemicals including water

prEN 12730:1997-01	Flexible sheets for roofing – Determination of resistance to static loading
prEN 12691:1998-01	Flexible sheets for waterproofing – Testing of roofing – Determination of resistance to impact loading
prEN 1296:1998-05	Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roofing – Artificial ageing by long term exposure to elevated temperature
prEN 1297:1994-01	Flexible sheets for roofing; determination of resistance to UV and water ageing; part 1: bitumen sheeting
prEN 12039:1995-07	Flexible sheets for roofing – bitumen sheeting – Determination of loss of granules
prEN 1107-1:1996-08	Flexible sheets for roofing – Determination of dimensional stability; Part 1
prEN 1107-2:1993-06	Flexible sheets for roofing – Determination of dimensional stability; Part 2
prEN 12691:1998-09	Flexible sheets for waterproofing – Testing of roofing – Determination of resistance to impact loading
ISO 3506:1997	Mechanical properties of corrosion-resistant stainless-steel fasteners
ISO 4892-2:1994	Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc sources
prEN 1297:1999-05	Flexible Sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Method of artificial ageing by long term exposure to the combination of UV radiation, elevated temperature and water
EN/ISO 6946:1997	Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.
EN/ISO 8990:1997	Thermal insulation – Determination of steady-state thermal transmission properties – calibrated and guarded hot box
prEN 12667:1996-12	Building materials – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance
prEN 12939:1997-06	Building materials – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance
EN/ISO 10211-1:1995	Thermal bridges in building construction – Heat flows and surface temperatures – Part 1: General calculation methods.
ISO 6988:1998-06	Testing in alternating atmosphere containing sulphur dioxide
EN 10088-1:1995-08	Stainless steel – Part 1: List of stainless steels

DIN 50018:1997-06	Prüfung im Kondenswasser – Wechselklima mit schwefel-dioxidhaltiger Atmosphäre
EN 826:1996	Thermal insulation products for building applications – Determination of compression behaviour
EN 12430:1998	Thermal insulation products for building applications – Determination of behaviour under point load
CONSTRUCT 95/148 – Rev. 1	Working Document on Dangerous Substances and in accordance with CONSTRUCT 97/219 – Rev. 1 Guidance paper on the Treatment of Dangerous Substances under Construction Products Directive

EOTA Guidance Document for the Assessment of Working Life of Products, Final draft, March 1997

EOTA Technical Report no. 10	Liquid Applied Roof Waterproofing Kits (LARWK) – Exposure procedure for artificial ageing
Construct 97/223 – Rev. 1	Mandate to EOTA for Systems of mechanically fastened flexible roof waterproofing membranes
prEN (WI 00254041):1999-02-15	Flexible sheets for waterproofing – reinforced bitumen sheets for roof waterproofing – Definitions and characteristics
EN 10204:1993	Metallic products – types of inspection documents
ISO 1183:1985	Methods for determining the density and relative density (specific gravity) of plastics excluding cellular plastics
EC Guidance Paper C	The Treatment of Kits and Systems under the Construction Products Directive
EC Guidance Paper D	CE Marking under the Construction Products Directive
EC Guidance Paper E	Levels and Classes in the Construction Products Directive
prEN 13501-1	Fire classification of construction products and building elements: Part 1 – Classification using test data from reaction to fire tests
SS 92 35 15 (2) materials	Methods for determination of the coefficients of friction of various with respect to slipping (Swedish standard)

Annex B

B COMMON TERMINOLOGY AND ABBREVIATIONS

B.1 Works and products

B.1.1 ***Construction works (and parts of works)*** (often simply referred to as “works”) (ID1.3.1)

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).

B.1.2 ***Construction products*** (often simply referred to as “products”) (ID 1.3.2)

Products manufactured for incorporation in a permanent manner in the works and placed as such on the market.
(The term includes materials, elements and components of prefabricated systems or installations.)

B.1.3 ***Incorporation*** (of products in works) (ID 1.3.1)

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 involving construction activities.

B.1.4 ***Intended use*** (ID 1.3.4)

Role(s) that the product is intended to play in the fulfilment of the essential requirements.

B.1.5 ***Execution*** (ETAG-format)

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

B.1.6 ***Kit*** (Guidance Paper C)

Construction product consisting of at least two separate components that need to be put together to be installed permanently in the works.

B.2 Performances

B.2.1 ***Fitness for intended use*** (of products) (CPD 2.1)

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.

B.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 must be suitable for construction works which (as a whole and in their separate parts) are fit for their intended use, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern foreseeable actions (CPD Annex I, Preamble).

B.2.3 ***Essential requirements (for works)***

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

B.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).

B.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-magnetic) acting on the works or parts of the works.

B.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 ID's or according to the procedure provided for in art. 20.2a of the CPD.

B.3 **ETAG-format**

B.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 ID's and further specified in the mandate, for works or parts of the works, taking into account the durability and serviceability of the works.

B.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.)

B.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.

B.4 **Working life**

B.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.

B.4.2 ***Working life*** (of products)

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

B.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.

B.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.

B.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.

B.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.

B.5 **Approval and Approved Bodies**

B.5.1 **Approval Body**

Body notified in accordance with Article 10 of the CPD, by an EU Member State or by an EFTA State (contracting party to the EEA Agreement), to issue European Technical Approvals in (a) specific construction product area(s). All such bodies are required to be members of the European Organisation for Technical Approvals (EOTA), set up in accordance with Annex II.2 of the CPD.

B.5.2 **Approved Body**

Body nominated in accordance with Article 18 of the CPD, by an EU Member State or by an EFTA State (contracting party to the EEA Agreement), to perform specific tasks in the framework of the Attestation of Conformity decision for specific construction products (certification, inspection or testing). All such bodies are automatically members of the Group of Notified Bodies.

B.6 **Abbreviations**

B.6.1 ***Abbreviations concerning the Construction products directive***

AC: Attestation of conformity
CEC: Commission of the European Communities
CEN: Comité européen de normalisation (European Committee for Standardization)
CPD: Construction products directive
EC: European communities
EFTA: European free trade association
EN: European Standards
FPC: Factory production control
ID: Interpretative documents of the CPD
ISO: International standardisation organisation
SCC: Standing committee for construction of the EC.

B.6.2 ***Abbreviations concerning approval***:

EOTA: European organisation for technical approvals
ETA: European technical approval
ETAG: European technical approval guideline
TB: EOTA Technical Board
UEAtc: Union Européenne pour l'Agrément technique dans la construction (European Union of Agrement).

B.6.3 ***General abbreviations:***

WG: Working group.

Annex C

C. Flow charts for the small scale/full scale concept

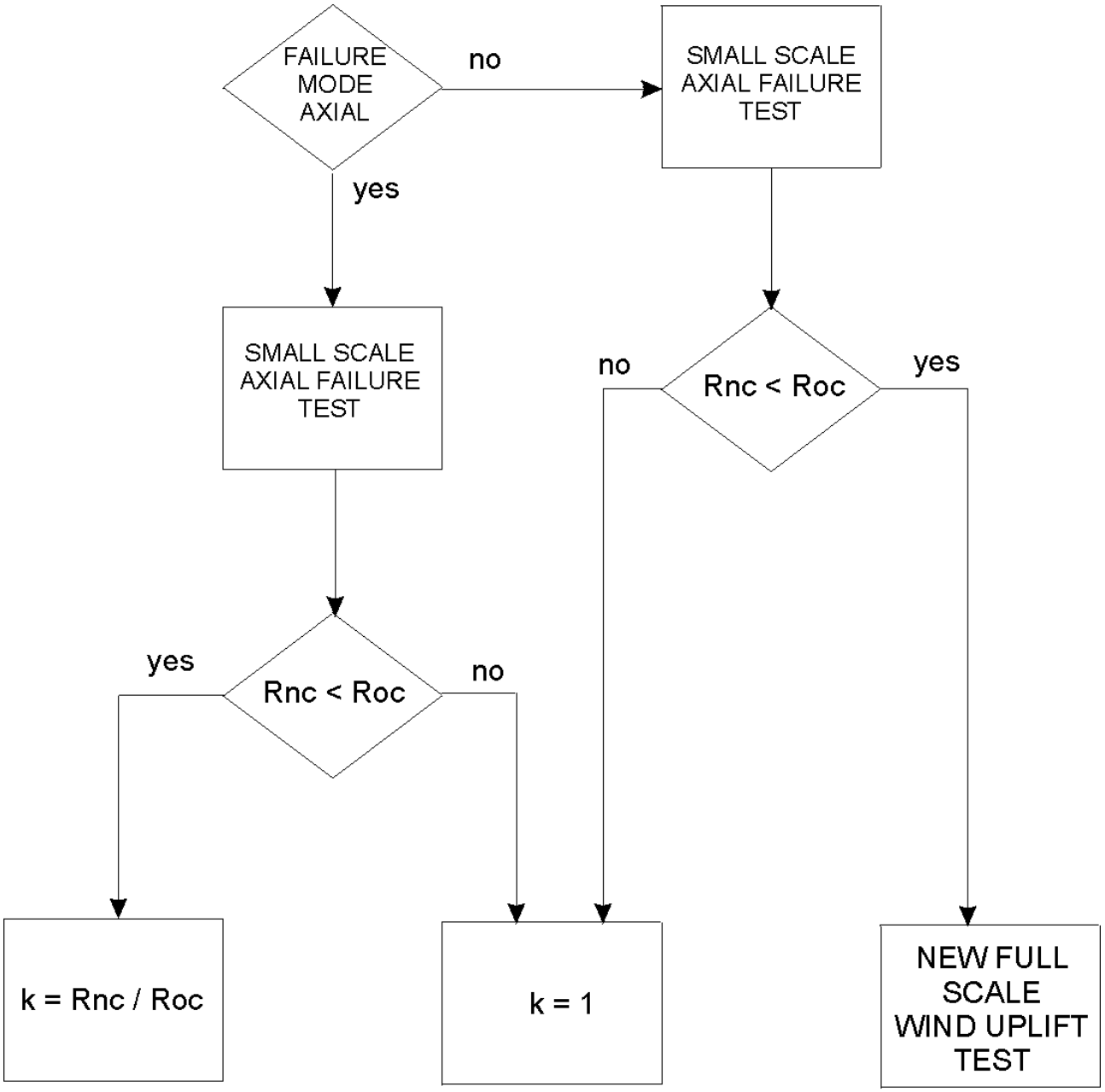
Philosophy of the flow charts:

1) (Left column of the charts): If the original failure mode of the full scale wind uplift test relates to the component that is changed, a small scale test is performed on the new component in order to find the relationship between the strength of the original component and the strength of the new component. (In some cases it is not necessary to perform a test, e.g. if the new component is CE-marked and the characteristic which needs to be determined appears from documents accompanying the CE-marking). If the resistance of the new component is smaller than the resistance of the original component then the k-factor can be determined by dividing the new resistance with the original resistance. If the resistance of the new component is higher than the original resistance the k-factor is set at 1,0, since extrapolation can not take place.

2) (Right column of the charts): If the failure mode does **not** relate to the component that is changed, a small scale test is still performed, but in this case to ensure that the new component is not weaker than the original component. This will ensure that the failure mode will stay the same and the k-factor is therefore set at 1,0. If the new component turns out to be weaker than the original component, a full scale wind uplift test shall be performed with the new component.

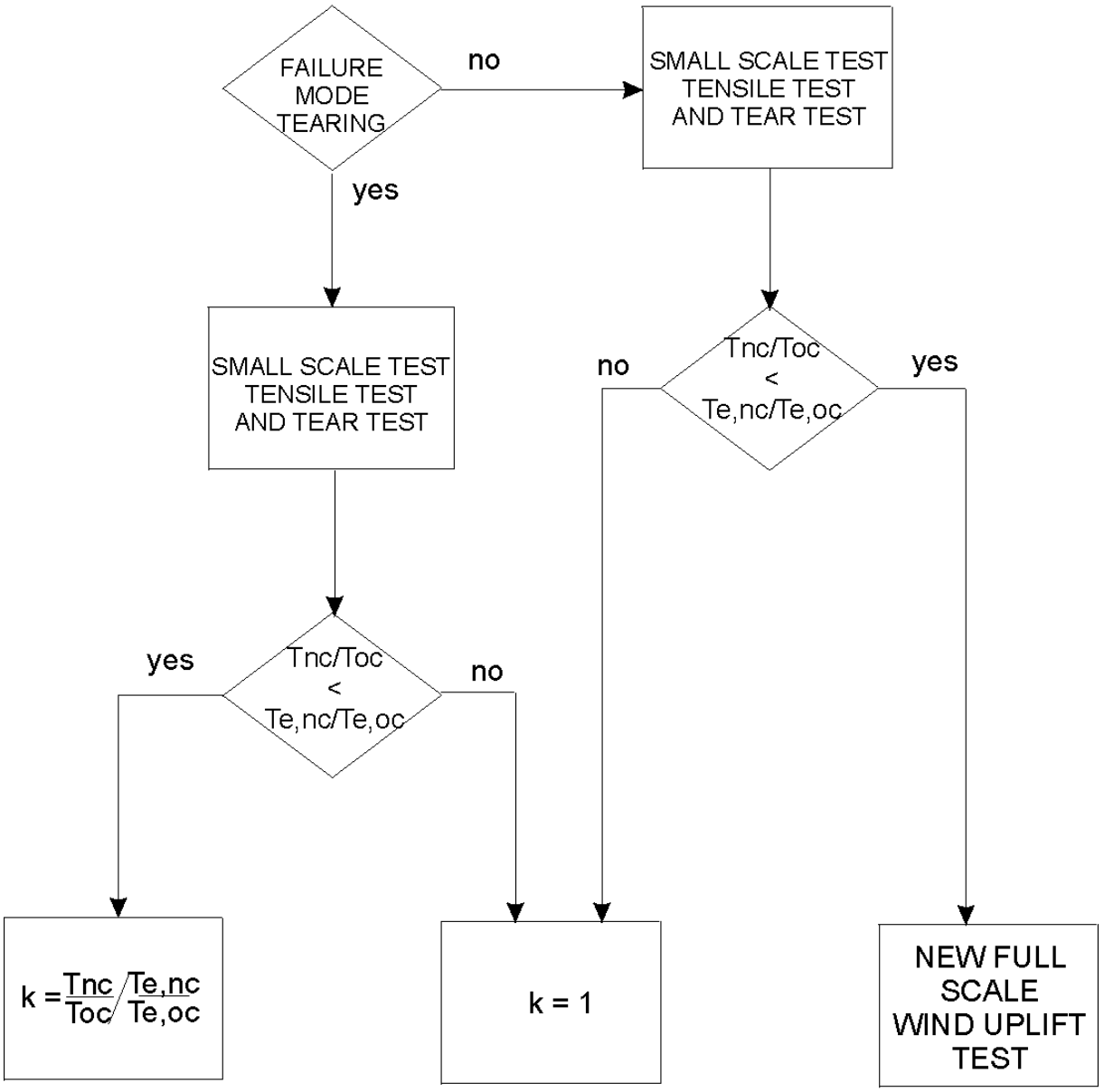
   The concept means that k values smaller than 1,0 can only be found if the new component is weaker than the original component.

SMALL SCALE CONCEPT 1: VARIATIONS TO FASTENER EXCL. WASHER



Rnc: Axial resistance of new fastener
Roc: Axial resistance of original fastener

SMALL SCALE CONCEPT 2: VARIATIONS TO MEMBRANE



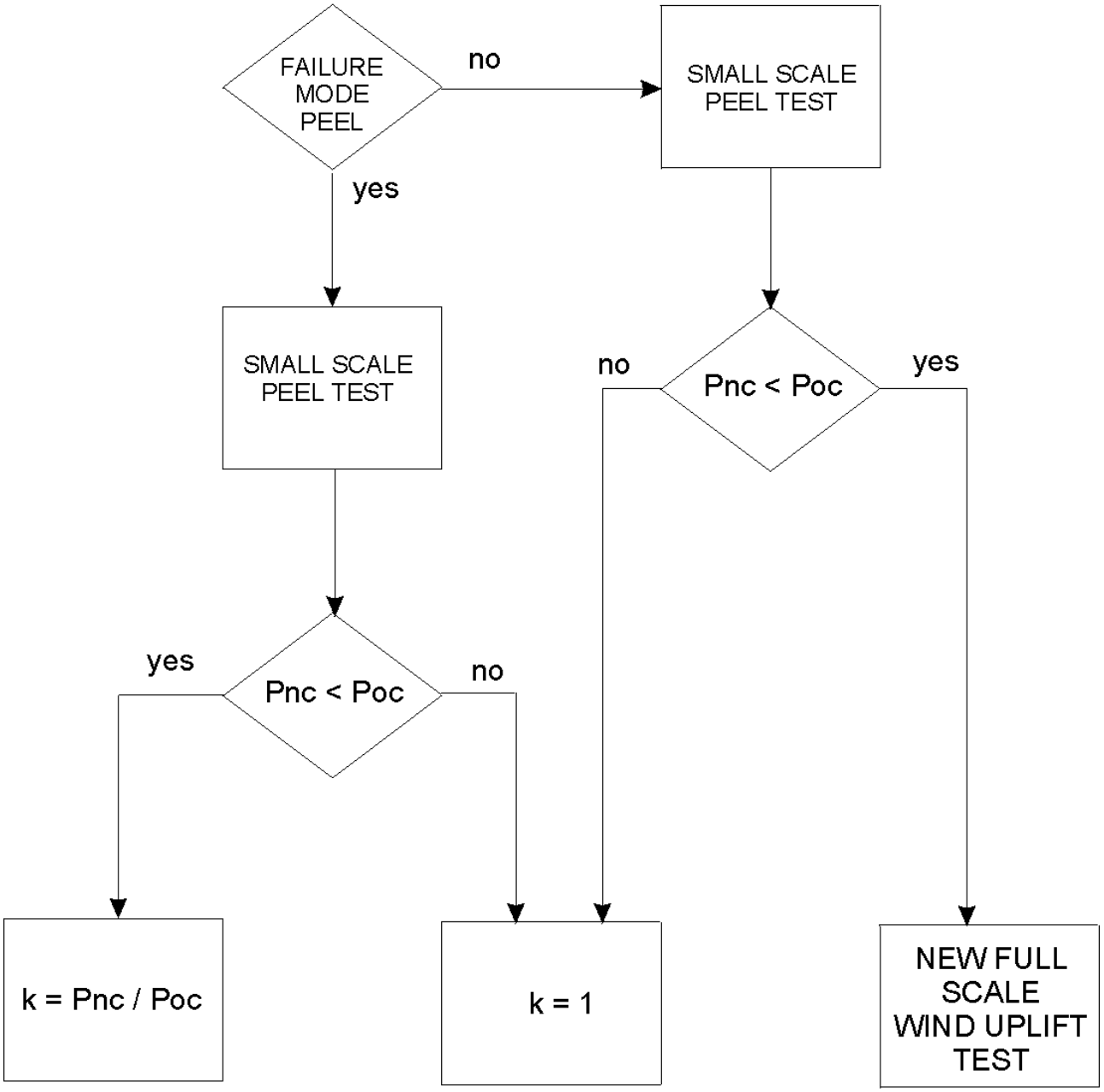
The above concept is valid only if the following conditions are fulfilled:

$0,8 < Te,nc/Te,oc < 1,2$

$0,8 < Tnc/Toc < 1,2$

Tnc: Tensile strength of new membrane
Toc: Tensile strength of original membrane
Te,nc: Tear strength of new membrane
Te,oc: Tear strength of original membrane

SMALL SCALE CONCEPT 3: VARIATIONS TO JOINTING TECHNIQUE



Pnc: Peel resistance of new jointing technique
Poc: Peel resistance of original jointing technique

Annex D

D. Site pullout test.

The following is a recommendation for the carrying out of an on site pullout test.

Purpose of test

The site pullout test is used to confirm the behaviour and ultimate pullout load at failure of the fastener. This is then divided by a safety factor to give the admissible (design) pullout load for that specific fastener type into that specific substrate on a given project.

Equipment

Although many variations are in use, a basic pullout test unit will comprise (see figure D1):

Base plate

Supports the unit on the roof surface.
Should have a reasonable surface area.

Pulling plate/jaw

Fits under the head of the fastener.
Due to the wide range of fastener types it often has interchangeable inserts for different shank diameters or threaded collars for testing studding etc.

Tensioning device

Usually a threaded high tensile steel screw and handle.

Measuring scale/gauge

Usually hydraulic and measures the force applied by the tensioning screw. The test unit shall be calibrated frequently.

Method

Pullout testing requires a fixing with sufficient space beneath the head to insert the pulling plate. On a new build project or a refurbishment project involving new mechanical fixings, a partially driven fixing would be used. Any roofing material (e.g. membrane, existing insulation) that may influence the pullout values shall be removed before the test is performed. The fastener shall be installed using the same method as will be used during actual construction (i.e. depth of installation, hole diameter, installation tools).

A minimum of six samples per 5000 m^2 roof shall be tested. The tests should be performed across the roof in various areas including corners and the perimeter, to provide a good cross section example of performance. The location of the tests should allow for 50 % more tests in the corner and perimeter. Any area that is likely to have deck damage due to leaks should be tested.

A sketch indicating the location of the pullout tests should be available.

Procedure

- The correct insert or collar for the fixing to be tested is selected and fitted it into the pulling plate.
- If different indicator gauges are available the most suitable is selected and the Maximum Load indicator is set to zero.
- The testing unit is located over the fixing and the pulling plate insert is slid beneath to engage the head of the fixing.
- The load is applied to the fastener by slowly turning the tensioning handle and the Current and Maximum Load needles are observed. The load is applied gradually, and the needle behaviour is noted until the Current Load needle starts to fall away.

- The travelling Maximum Load indicator will remain at the highest position to identify the maximum pullout figure
- The tension is gradually released and the pulling plate is returned to its flush starting position and withdrawn from
  the fixing.

Treatment of results

The admissible (design) pullout load is calculated from the following formula:

$F_{adm} = X/\nu$

Where F_{adm} = admissible (design) load per fastener
X = mean value of all pullout tests
ν = safety factor
2,0 for steel decks
2,5 for wood and aluminium decks
3,0 for all concrete decks (poured, thin slabs, lightweight etc.)

For design purposes the lowest of either W_{adm} derived from full scale or small scale testing according to this Guideline or F_{adm} from the on site pullout test is to be used.

F_{adm} derived at building sites reflects only the pullout performance of the fastener and does not take into account other failure modes such as washer deformation, membrane tearing etc. Therefore, a value higher than W_{adm} determined according to this Guideline may never be used.

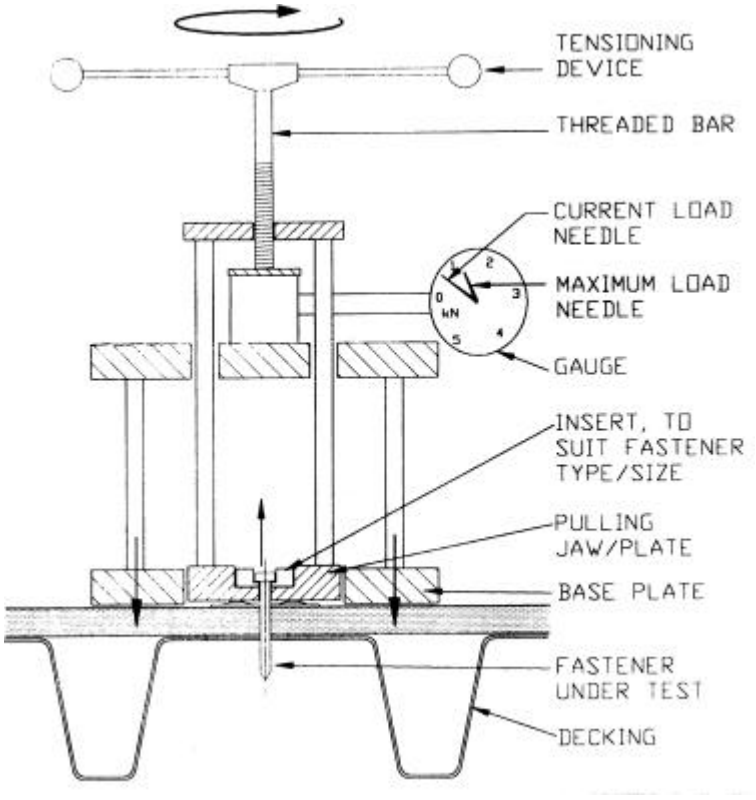


Figure D.1. Principle of on site pullout test