BRITISH STANDARD

BS EN 15381:2008

Geotextiles and geotextile-related products — Characteristics required for use in pavements and asphalt overlays

ICS 59.080.70; 93.080.20

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 15381:2008.

The UK participation in its preparation was entrusted to Technical Committee B/553, Geotextiles and geomembranes.

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

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

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2009

ISBN 978 0 580 53975 6

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15381

August 2008

ICS 59.080.70; 93.080.20

English Version

Geotextiles and geotextile-related products - Characteristics required for use in pavements and asphalt overlays

Géotextiles et produits apparentés - Caractéristiques requises pour l'utilisation dans les chaussées et couches de roulement en enrobés

Geotextilien und geotextilverwandte Produkte - Eigenschaften, die für die Anwendung beim Bau von Fahrbahndecken und Asphaltdeckschichten erforderlich sind

This European Standard was approved by CEN on 18 July 2008.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 15381:2008: E

Contents

Page

Foreword

This document (EN 15381:2008) has been prepared by Technical Committee CEN/TC 189 “Geosynthetics”, the secretariat of which is held by IBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2009, and conflicting national standards shall be withdrawn at the latest by May 2010.

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

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

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

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

Introduction

This standard allows manufacturers to describe geotextiles and geotextile-related products on the basis of declared values for characteristics relevant to the intended use and if tested to the specified method. It also includes procedures for evaluation of conformity and factory production control.

This standard may also be used by designers, end-users and other interested parties and enables them to define which functions and conditions of use are relevant.

Performance and index tests for several characteristics are still under study and will be included when the standard is revised.

The term “product” which is used in this standard refers to geotextiles and geotextile-related products.

This European Standard is part of a series of standards, addressing the requirements for geotextiles and geotextile-related products when used in a specific application.

1 Scope

This European Standard specifies the relevant characteristics of metallic and non-metallic geotextiles and geotextile-related products used in the construction of pavements and asphalt overlays and the appropriate test methods to determine these characteristics.

The intended use of these geotextiles and geotextile-related products is to fulfil one or more of the following functions: reinforcement, stress relief and barrier. The use of geotextiles and geotextile-related products is to be considered as a part of an interlayer and asphalt overlay system.

This standard is not applicable to geosynthetic barriers, as defined in EN ISO 10318.

This standard provides for evaluation of conformity of the product to this European Standard and for factory production control procedures.

This standard defines requirements to be met by manufacturers and distributors with regard to the presentation of product properties.

NOTE 1 Particular application cases or national specifications may contain additional requirements regarding product application or installation and specifying preferably standardized test methods, if they are technically relevant and not conflicting with European Standards.

2 Normative references

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

EN 1426*, Bitumen and bituminous binders – Determination of needle penetration*

EN 10002-1, *Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature*

EN 10080, *Steel for the reinforcement of concrete – Weldable reinforcing steel – General*

EN 10223-3, *Steel wire and wire products for fences – Part 3: Hexagonal steel wire netting for engineering purposes*

EN 10244-2, *Steel wire and wire products – Non ferrous metallic coatings on steel wire – Part 2: Zinc or zinc alloy coatings*

prEN 10348, *Steel for the reinforcement of concrete – Galvanized reinforcing steel*

EN 12224, *Geotextiles and geotextile-related products – Determination of the resistance to weathering*

EN 14030, *Geotextiles and geotextile-related products – Screening test method for determining the resistance to acid and alkaline liquids (ISO/TR 12960:1998, modified)*

EN ISO 1043-1:2001, *Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics (ISO 1043-1:2001)*

EN ISO 3146, *Plastics –– Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods (ISO 3146:2000)*

EN ISO 9862, *Geosynthetics – Sampling and preparation of test specimens (ISO 9862:2005)*

EN ISO 10318:2005, *Geosynthetics – Terms and definitions (ISO 10318:2005)*

EN ISO 10319, *Geotextiles – Wide-width tensile test (ISO 10319:1993)*

EN ISO 10320, *Geotextiles and geotextile-related products – Identification on site (ISO 10320:1999)*

EN ISO 12236, *Geosynthetics – Static puncture test (CBR test) (ISO 12236:2006)*

EN ISO 13433, *Geosynthetics – Dynamic perforation test (cone drop test) (ISO 13433:2006)*

EN ISO 13934-1, *Textiles – Tensile properties of fabrics – Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1:1999)*

EN ISO 15630-2, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 2: Welded fabric (ISO 15630-2:2002)*

ASTM A975-97 (2003), *Standard specification for double-twisted hexagonal mesh gabions and revet mattresses (metallic-coated steel wire or metallic-coated steel wire with poly(vinyl chloride) (PVC) coating)*

ASTM D6637-01, *Standard test method for determining tensile properties of geogrids by the single or multi-rib tensile method*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 10318:2005 and the following apply:

3.1.1
asphalt overlay
upper layer of a pavement which is in contact with traffic

3.1.2
course
structural element of a pavement, laid in one or more layers

3.1.3
pavement
structure, composed of one or more courses, to support the passage of traffic

3.1.4
specification
any document in which the work, functions and specific conditions of use of the product are described

3.1.5
interlayer system
geotextiles or geotextile-related products bonded in between two courses

3.1.6
tack coat
bituminous emulsion or hot bitumen, used to fix and/or impregnate a geotextile or geotextile-related product between the under- and overlay

3.1.7
stress relief
STR
function provided by a bitumen-saturated paving fabric (non-woven or purpose-built composite) which – when properly installed between a road surface and a new asphalt overlay – allows for slight differential movements

between the two layers and thus provides stress relief, which delays or arrests crack propagation in the asphalt overlay

3.1.8
interlayer barrier
function provided by paving fabrics, which act – in conjunction with a bitumen layer – as a barrier to the ingress of water and thus prevent or delay the deterioration of the pavement

3.1.9
product
geotextile or geotextile-related product

3.2 Abbreviations

For the purposes of this document the following abbreviations from EN ISO 1043-1:2001 apply:

PA: polyamide

PE: polyethylene

PET: polyethylene terephthalate (“polyester”)

PP: polypropylene

PVA: polyvinyl alcohol

Furthermore the following abbreviations apply:

MD: machine direction

CMD: cross machine direction

4 Required characteristics and corresponding test methods

4.1 General

The main function of geotextiles and geotextile-related products used in the construction and rehabilitation of roads and pavements subjected to thermal, fatigue and reflective cracking is to reduce the amount of cracking in a new pavement or asphalt overlay.

In addition, a barrier to top-down water ingress to the subbase and/or subgrade may be provided for.

This is achieved by reinforcement, stress relief, (interlayer) barrier or a combination of these functions.

The producer of the geotextiles and geotextile-related products shall provide the data based on the results of tests specified in this standard.

The characteristics, their relevance to the conditions of use, and the test methods to be used, are given in Tables 1 and 2. The list of characteristics in these tables includes those needed for regulatory purposes (H) (see also [1]), those relevant to all conditions of use (A), and those relevant to specific conditions of use (S). ”--” indicates that the characteristic is not relevant for that function.

Where, for the same property, data for more than one function shall be provided, the following ranking order shall be observed: H overrules A, A overrules S, and S overrules "--".

The functions and conditions of use, corresponding with the characteristics, marked with “S” in Table 1, are specified in 4.2.

The producer of the geotextile or geotextile-related product shall provide the data based on the results of tests specified in this standard, as described in 5.1.

For the assessment of durability aspects (weathering, alkaline resistance or corrosion resistance) the rules described in Annex B shall be observed.

Table 1 - Non-metallic geotextiles and geotextile-related products used in pavements and asphalt overlays – Functions, function-related characteristics and test methods to be used

Characteristic	Test method	Function		
		Reinforce-ment	Stress relief	Interlayer barrier
(1) Tensile strength	EN ISO 10319 [a]	H	H	H
(2) Elongation at maximum load	EN ISO 10319 [a]	H	H	H
(3) Dynamic perforation [b]	EN ISO 13433	H	- -	H
(4) Static puncture strength [b]	EN ISO 12236	H	H	H
(5) Durability	Annex B	H	H	H
(6) Resistance to weathering [c]	EN 12224 B.1 of this standard	S	S	S
(7) Bitumen retention	Annex C	- -	H	A
(8) Melting point	EN ISO 3146	S	S	S
(9) Alkaline resistance (see remark 3)	EN 14030 B.2 of this standard	S	S	S

Relevance

H: required for regulatory purposes

A: relevant to all conditions of use, but not mandatory for design or specifications

S: relevant to specific conditions of use

"- - " indicates that the characteristic is not relevant for that function.

[a] EN ISO 10319 may not be suitable for specific products (e.g. glass fibre grids). In these cases the more appropriate methods EN ISO 13934-1 or ASTM D6637-01 shall be used. In any case, tensile tests shall be performed on finished products.

[b] The principle of this test may not be applicable for all materials and the validity of the test for some types of products, e.g. grids, should be considered. If tensile strength and static puncture are coded "H" in this table, the producer shall be able to provide data for both. In a specification the use of only one property – either tensile strength or static puncture – is sufficient.

[c] Required for regulatory purposes (H) if relevant to conditions of use (see 4.2).

Table 2 - Metallic geotextile-related products used in pavements and asphalt overlays – Functions, function-related characteristics and test methods to be used

Characteristic	Test method	Function
		Reinforcement
(1) Tensile strength		H
- steel wire mesh [a]		
- parallel to mesh orientation	Annex D	
- transverse to mesh orientation	EN 10002-1	
- steel welded fabric [b]	EN ISO 15630-2	
(2) Elongation at maximum load		H
- steel wire mesh		
- parallel to mesh orientation	Annex D	
- transverse to mesh orientation	EN 10002-1	
- steel welded fabric	EN ISO 15630-2	
(3) Dynamic perforation [c]	EN ISO 13433	--
(4) Static puncture strength [c]	EN ISO 12236	--
(5) Durability	Annex B3	H

Relevance

H: required for regulatory purposes [1]

"- - " indicates that the characteristic is not relevant for that function.

[a] As defined in EN 10223-3.

[b] As defined in EN 10080.

[c] The principle of this test characteristic is not applicable.

4.2 Characteristics relevant to specific conditions of use

4.2.1 General

The specification shall define which functions and conditions of use are relevant (see Tables 1 and 2). The producer of the product shall provide the necessary data based on the requirements and test methods described in this standard.

The list of characteristics in Tables 1 and 2 includes those required for regulatory purposes (H), those relevant to all conditions of use (A), and those relevant to specific conditions of use (S).These specific conditions of use are listed from 4.2.2 to 4.2.4.

NOTE "Damage during installation" is being influenced by the paving procedure and by the compaction of the asphalt. Relevant test methods are under preparation.

4.2.2 Alkaline resistance

Data on the alkaline resistance is needed for all functions if the product is to be used in direct contact with an unprotected concrete or cement stabilised surface.

4.2.3 Melting point

Data on the melting point of the reinforcing polymer is needed if the temperature of the installed asphalt is higher than the melting point itself.

4.2.4 Resistance to weathering

Data on resistance to weathering is needed when the product is not covered on the same day of the installation with asphalt mixture. The required residual tensile strength shall be defined in function of the application conditions (see B.1).

5 Evaluation of conformity

5.1 General

Compliance with the requirements of this standard and with the stated values shall be demonstrated by:

— initial type testing (5.3);

— factory production control (5.4) by the manufacturer, including product assessment.

The characteristics specified in Tables 1 or 2 – except for durability – shall be expressed as mean values and tolerance value(s) corresponding to the 95 % confidence level. They shall be given by the manufacturer, based on the statistical interpretation of his internal quality control measurements. Information on durability (weathering, alkaline resistance or corrosion resistance) shall be expressed in accordance with the guidelines of Annex B.

5.2 Verification of values

The marking and labelling of the rolls and of the products shall be checked (see also Clause 6).

NOTE The method, described in this clause, is not compulsory for an on-site control procedure.

The compliance of characteristics with the values defined in 5.1 shall be based on measurements made on two representative samples (A and B), taken from two different rolls. Sampling shall be made in accordance with EN ISO 9862.

The characteristics given in Table 1 or 2 shall be measured in accordance with the corresponding standards on specimens prepared from sample A.

If the test results for a particular characteristic are within the tolerance value(s) given by the manufacturer, the product is accepted as complying with respect to this characteristic.

If the test results for a particular characteristic are outside 1,5 times the tolerance value(s), the product does not comply with respect to that characteristic.

If the test results for a particular characteristic are within 1 and 1,5 times the tolerance value(s), specimens prepared from sample B shall be tested.

NOTE The 95 % confidence level corresponds to the mean value minus (and/or plus) 1,0 tolerance value(s).

If the test results of the sample B specimens for the same characteristic are within the given tolerance value(s), the product is accepted as complying with respect to that characteristic. If the test results are outside the tolerance value(s), the product is not accepted.

5.3 Initial type tests

Initial type tests shall also be carried out on existing products when a change in the basic materials or manufacturing procedures affects the declared properties or the use of a product. In these cases the initial type tests are those for the properties which are affected or shall be confirming and new properties introduced by a change of use.

The tests to be conducted shall be reference tests as specified in this standard and shall be selected from the characteristics specified in Table 3, consistent with the product's intended use.

Table 3 - Characteristics required for evaluation of conformity

Characteristic	Functions
Tensile strength	reinforcement, barrier, stress relief
Elongation	reinforcement, barrier, stress relief
Static puncture	reinforcement, barrier, stress relief
Dynamic Perforation	reinforcement, barrier
Bitumen retention	stress relief
Durability	reinforcement, barrier, stress relief (consistent with the application conditions)

The results of initial type tests shall be recorded and be available for inspection.

The sample for the type tests shall be drawn according to EN ISO 9862 from a normal production run using the materials and forming processes to be used for the full production process. The size of the sample shall be big enough to allow the determination of the characteristics specified in Table 1 or 2. Handmade samples, short trial batches and other development prototypes may be tested by the same methods, but shall not be used for establishing characteristic values in type tests.

5.4 Factory production control

A factory production control scheme shall be established and documented in a manual prior to a product type being placed on the market. Subsequently, any fundamental changes in raw materials and additives, manufacturing procedures or the control scheme that affect the properties or use of a product shall be recorded in the manual.

The manual shall include the factory production control procedures relevant to the declared properties, as confirmed by the initial type tests.

The factory production control procedures shall consist of a permanent internal production control system to ensure that such products comply with this standard and that the measured values conform with the declared values.

Annex A (normative) lists all the items that shall be considered to determine which is appropriate for the control exercised for a product. The manufacturer shall establish the applicable items and record them in his factory production control manual.

When relevant, the procedure given in 5.2 shall be used to check the conformity of the product for one or more characteristics.

5.5 Inspection

When required, inspection of the factory and of the factory production control shall be made on the provisions contained in 5.4 and Annex A.

6 Marking

The manufacturer shall clearly and indelibly mark the geotextiles and geotextile related products with the information specified in EN ISO 10320.

NOTE For CE-marking see ZA.3.

Annex A
(normative)

Factory production control

A.1 Items to be addressed in a factory production control system

A.1.1 General

This normative annex specifies the items to be addressed in the manufacturer's factory production control manual relating to the control scheme determined in 5.4. The manufacturer shall determine which items apply to his particular situation, depending on the stages of design, production and product storage he assumes responsibility for.

This annex also provides a check-list for the operation of such a control scheme (see A.2).

NOTE Manufacturers operating a quality system conforming to EN ISO 9001 [4] are presumed to be able to meet the requirements of this Annex A.

A.1.2 Product design

The manufacturer shall describe how design requirements and criteria are identified, checked, controlled and updated to be unambiguous and relevant to the use of the product and its specification.

The manufacturer shall describe the communication of the design to the internal production departments or to external subcontractors.

A.1.3 Production

Raw or incoming materials: the manufacturer shall define the acceptance criteria of raw or incoming materials and the procedures that he operates to ensure that these are met.

Production process: the relevant features of the plant and production process shall be defined giving the frequency of the inspections, checks and tests, together with the values or criteria required, both on equipment and on work in the process. The actions to be taken when control values or criteria are not obtained, shall be recorded. These records shall be kept available.

A.1.4 Finished products

A.1.4.1 Tests on the finished product

The size of the samples and the frequency of sampling, together with the results obtained, shall be recorded and shall be kept available.

A.1.4.2 Alternative tests

Where alternative tests to the reference tests are used, details of the alternative tests and procedures together with their correlation with the reference tests shall be recorded and shall be kept available.

A.1.4.3 Equipment

Test equipment having an influence on test results shall be calibrated to traceable national or international standards.

The manufacturer shall have or have available the installations, equipment and personnel which enable him to carry out the necessary verifications and tests. He may meet this requirement by concluding a subcontracting agreement with one or more organisations or persons having the necessary skills and equipment.

The manufacturer shall calibrate or verify, measuring or test equipment and maintain it in good operating condition, whether or not it belongs to him, with a view to demonstrating conformity of the product with its technical specification. The appropriate calibrations shall be carried out with defined measuring and test instruments according to standards or the manufacturer's test procedures.

The equipment shall be used in conformity with the specification or the test reference system to which the specification refers.

A.1.5 Applicable to A.1.2, A1.3 and A.1.4 (to be used where appropriate)

A.1.5.1 Records

The dates, together with details and results of inspections, checks and tests carried out during the factory production control shall be properly recorded. These records shall be maintained for 10 years.

The product description, the date of manufacture, test method adopted, test results and acceptance or rejection criteria shall be entered under the signature of the person responsible for control who carried out the verification.

A.1.5.2 Assessment of results

Where possible and applicable, the results of inspections, checks and tests shall be interpreted statistically by attributes or by variables to determine whether the corresponding production conforms with the requirements and the declared values for the products.

A.1.5.3 Traceability

Systems of traceability and control of designs, incoming materials, and the use of materials shall be given in the manual. The stock control system of manufactured products shall be given in the manual.

A.1.5.4 Corrective action for non-conforming materials and products

The immediate actions to be taken when incoming materials or finished products do not conform to specified requirements shall be described and recorded. These actions shall include the steps necessary to rectify the deficiency, modify the manual if required, identify and isolate the deficient raw or incoming materials and finished products and determine whether they shall be discarded or re-specified under a concessionary system.

A.1.5.5 Personnel

The manufacturer shall ensure that the personnel involved in the process are suitably trained. The job description and responsibility of the operatives shall be given in the manual.

A.1.5.6 Quality management

The activities to ensure that all of the above requirements operate shall be described in the manual.

A.2 Checklist for the assessment of a factory production control system

A.2.1 General

A factory production control certificate (FPC certificate) can only be issued for one production site. In case of several production lines at the same site, all of them shall be checked.

In order to have all production lines covered by the same FPC certificate number, the homogeneity of the products produced by different lines at the same production site shall be proven by the manufacturer.

The results of audits performed by a quality management system certification body (e.g. for EN ISO 9001 certification) shall be taken into account, although such certificate is not compulsory.

The FPC certificate shall cover specified product ranges produced on the same production site. Each product covered by the certificate shall be clearly identified in the certificate. To add a new product to the covered range, the producer shall inform the notified body and submit the results of the initial type testing of the new product for an extension of the FPC certificate. This shall be taken into account at the next follow-up inspection. In case of a new production process the manufacturer shall apply for a new inspection visit.

Follow-up inspections shall take place once a year.

All the questions in this checklist shall be checked at the first inspection visit and at each follow-up inspection.

A.2.2 Checklist

The items marked with "E" are considered to be of essential importance, i.e. immediate corrective actions are needed if the requirement is not fulfilled.

The assessment can lead to A-, B- or C-type remarks:

A: an immediate corrective action is needed to obtain or renew the certificate;

B: corrective action shall be taken within 3 months;

C: corrective action shall be taken before the next inspection visit

If a B-type remark is not corrected in due time, it becomes an "A" and if a C-type remark is not corrected in due time, it becomes a "B".

Question	Relevance	Comment
1 Design		
1.1 - Has the manufacturer a description how design requirements and criteria are identified, checked, controlled and updated to be unambiguous and relevant to the use of the product and its specification?		*To be assessed only if claimed by the manufacturer. The assessment body shall refer to the manufacturer's documentation.*
1.2 - Has the manufacturer a description of the communication of the design to the internal production departments or to external subcontractors?		*To be assessed only if claimed by the manufacturer. The assessment body shall refer to the manufacturer's documentation.*

2 Product identification and traceability		
2.1 - What are the means used for the unique identification of any individual finished product?	E	*Refer to the manufacturer's documentation.*
2.2 - Is it possible to identify and check date, place and general manufacturing conditions (including raw material used) through the identifications on the final product?	E	*Refer to the manufacturer's documentation.*
2.3 -Does the marking on the final product comply with EN ISO 10320, as requested in the relevant product standard?	E	
3 Production process control		
3.1 -Are there documents which define the production process parameters which could affect quality?	E	*Refer to the manufacturer's documentation.*
3.2 -Are the standards, quality plan and procedures implemented?	E	
3.3 -Are the specified requirements concerning process validation, including the associated personnel and equipment, documented?	E	*Refer to the manufacturer's documentation.*
4 Inspection and testing on receipt of raw materials		
4.1 - Are there specification sheets concerning incoming raw materials?	E	*Refer to the manufacturer's documentation.*
4.2 - Are there documents which define what shall be done in case of non-conformance of raw materials?	E	*Refer to the manufacturer's documentation.*
4.3 - Are the nature and frequency of the evaluation of incoming raw materials described and followed?	E	*Refer to the manufacturer's documentation.*
5 Inspection and testing during manufacturing		
5.1 - Are there inspections or tests during the manufacturing process with specific requirement for the results?	E	*Refer to the manufacturer's documentation.*
5.2 - Are there documents concerning inspection or testing during the manufacturing process with requirement for the results?	E	*Refer to the manufacturer's documentation.*
5.3 - Do they define what shall be done in case of non-conformance of the product with the requirements?	E	*Refer to the manufacturer's documentation.*
5.4 - Are non-conforming products discarded from conform products when they are detected during manufacturing?	E	*Refer to the manufacturer's documentation.*

5.5 - Is there a procedure for handling not conforming products?	E	*Refer to the manufacturer's documentation.*
6 Final inspection and testing		
6.1 - Are there installations, equipment and personnel for final inspection and tests?	E	*Refer to the manufacturer's documentation.* *This requirement may be fulfilled by concluding a subcontracting agreement with one or more organisations or persons having the necessary skills and equipment.*
6.2 - Are there standards and methods for final inspection and testing? Have they been implemented?	E	*Refer to the manufacturer's documentation.*
6.3 - What tests are implemented (standard used) and at what frequency? These tests should preferably be called up in the harmonised standards. If the tests are not performed to these European Standards, does there exist a proven correlation between the test(s) used for FPC and the corresponding EN? • EN ISO 13433, *Geosynthetics – Dynamic perforation test (cone drop test) (ISO 13433:2006)* • EN ISO 10319, *Geotextiles – Wide-width tensile test (ISO 10319:1993)* • EN ISO 12236, *Geosynthetics – Static puncture test (CBR test) (ISO 12236:2006)* • EN ISO 3146, *Plastics – Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods (ISO 3146:2000)* • Bitumen retention (see Annex C of this standard) • EN 12224, *Geotextiles and geotextile-related products – Determination of the resistance to weathering*	E	*Refer to the manufacturer's documentation.* *Procedure given in Annex C to this standard.*
6.4 - Are the characteristics tested in accordance with the announced "application/function" combination(s) (see the relevant harmonised standard(s))?	E	*Refer to the manufacturer's documentation.*
6.5 - Are there documented specifications concerning the results for final inspection and testing? What are they?	E	*Refer to the manufacturer's documentation.*

6.6 - Do the required test results comply with the characteristics declared in the accompanying documents?	E	*Refer to the manufacturer's documentation.*
6.7 - Are the requirements on the announced tolerances fulfilled for each product?	E	*Refer to the manufacturer's documentation.*
6.8 - Are there documented procedures which define what shall be done in case of non-conformance of the final product with the specified requirements?	E	*Refer to the manufacturer's documentation.*
6.9 - Are there appropriated records which complete evidence that a product has been tested and is in conformance with the specified requirements?	E	*Refer to the manufacturer's documentation.*
6.10 - Is it possible through these records to identify the accredited persons responsible for testing final products and for releasing the products for the market?	E	*Refer to the manufacturer's documentation.*
7 Control of inspection, measuring and test equipment		
7.1 - Are there defined procedures to control, calibrate and maintain the equipment used, to bring evidence of the conformance of the products with the specified requirements?	E	*Refer to the manufacturer's documentation.*
7.2 - Are inspection, measuring and test equipment calibrated and adjusted against equipment having a known and valid relationship to nationally or internationally recognized standards?	E	*Refer to the manufacturer's documentation.* (Check calibration records for inspection, measuring and test equipment and – if existing – round robin test results.)
8 Control of non-conforming products		
8.1 - Are there documented procedures to ensure that non-conforming products cannot be inadvertently used or delivered?	E	*Refer to the manufacturer's documentation.*
8.2 - In particular, are non-conforming products identified, documented and segregated from the rest of the production?	E	*Refer to the manufacturer's documentation.*

8.3 - Are there documented procedures (organisation charts) which define responsibilities for the examination of non-conforming products and who has the authority to take decision concerning them?	E	*Refer to the manufacturer's documentation.*
9 Corrective actions		
9.1 - Are there documented procedures to implement proper corrective and preventive actions concerning non-conformity?	E	*Refer to the manufacturer's documentation.*
9.2 - In this case are these procedures implemented and the corrective or preventive actions recorded (mainly these concerning customer complaints)?	E	*Refer to the manufacturer's documentation.*
9.3 - Have corrective actions been carried out from the previous audit? With which result?	E	*Refer to the manufacturer's documentation.*
10 Handling, storage and packaging		
10.1 - Are the methods which permit to protect the product during handling, storage and packaging described?		*Refer to the manufacturer's documentation.*
10.2 - Are handling, storage and packaging methods and means appropriate to prevent final products from being damaged or deteriorated?		
10.3 - Is the labelling of final products in conformance with the provisions of the harmonised standards?	E	
11 Control of quality records		
11.1 - Are quality records legible and retained for at least 10 years period so as to be easily available on request?	E	*Electronically stored records shall be protected against changes and deletion. Refer to the manufacturer's documentation.*
12 Personnel		
12.1 - Does the manufacturer ensure that the personnel involved in the process is suitably trained?	E	*Refer to the manufacturer's documentation.*
12.2 - Are the job descriptions and responsibilities of the operators specified in the manual?	E	*Refer to the manufacturer's documentation.*
13 Withdrawal of certificates		
13.1 -Have temporary or final withdrawals been pronounced? If so, what practical measures have been defined and implemented?	E	*Refer to the manufacturer's documentation.*

Annex B
(normative)

Durability aspects

B.1 Weathering

All geotextiles and geotextile-related products shall pass the accelerated weathering test according to EN 12224, unless they are to be covered on the day of installation.

The strength retained by the product at the end of this test, together with the specific application of product, will determine the length of the time that the material may be exposed on site. The maximum exposure times are given in Table B.1.

NOTE 1 If materials are exposed for a longer duration than indicated in Table B.1, they should be submitted to extended weathering testing according to EN 12224.

Table B.1 – Maximum exposure times

Application	**Retained strength**	**Maximum time of exposure after installation**
Reinforcement or other applications where long-term strength is a significant parameter	> 80 %	1 month [a]
	60 % to 80 %	2 weeks
	< 60 %	1 day
Other applications	> 60 %	1 month [a]
	20-60%	2 weeks
	< 20 %	1 day
[a] Exposure of up to 4 months may be acceptable depending on the season and on the location in Europe.		

A geotextile or geotextile-related product, which has not been tested for resistance to weathering shall be covered within 1 day. This shall be clearly indicated in the instructions for use.

For a range of products identical except for mass per unit area, initially only the product with the lowest mass per unit area should be subjected to the tests. The results of the test may be applied for the other products in the range, unless they have been tested separately.

The product information shall state: "To be covered within (*duration*) after installation".

NOTE 2 As the 50 mm strip tensile test EN 12226 is not applicable for all geotextiles and geotextile-related products, values of the tensile strength can for some products (e.g. glass fibre grids) be established by using the single rib method (see ASTM D6637-01) of the finished product.

B.2 Alkaline resistance

A geotextile or geotextile-related product exposed to fresh concrete or to a cement stabilised surface with pH > 9 shall be tested according to EN 14030, method B. The percentage retained strength shall be greater than 50%. The results shall be interpreted in the context of the local site conditions.

B.3 Corrosion resistance

A metal (steel) reinforcement product applied in asphalt layers shall include testing according to EN 10244-2 in case of wired mesh or testing according to prEN 10348 in case of welded fabrics.

Annex C
(normative)

Test method for the determination of the bitumen retention in paving fabrics used in pavements and asphalt overlays

C.0 Introduction

This testing procedure for bitumen retention addresses the requirements for geotextiles and geotextile-related products when used in pavements and asphalt overlays in the functions stress relief and barrier.

In order to provide a moisture barrier that prevents water from penetrating the road structure both before and after cracking, paving fabrics act as a carrier of bitumen. The waterproofing function of the overlay system arises from the combination of fabric and tack coat. The overlay of hot-mix asphalt draws the tack coat through the textile creating an impervious, bitumen-impregnated membrane interlayer.

C.1 Scope

This test method specifies the procedure for determining the bitumen retention in paving fabrics.

The intended use of paving fabrics is to fulfil the function of water barrier purposes in order to protect the subbase layers against intrusion of water (defined in 3.1.8).

The waterproofing element of the overlay system will not be present unless the fabric absorbs the minimum quantity of tack coat determined for the actual fabric. As different types of paving fabrics desire different amount of tack coat, the goal of this standard is to determine the part of the necessary application rate in kg/m² necessary to saturate a given paving fabric.

The necessary application rate of tack coat prior to installing for a given paving fabric is to be estimated on forehand. The roughness of the road surface, the porosity of the road, and the presence or absence of a levelling course will affect the desired application rate.

NOTE The minimum bitumen retention to assure installation integrity have been formalized by industry experts in the AASHTO M288 specifications for geotextiles as 0,9 l/ m².

C.2 Test specimens

C.2.1 Handling

The sample shall not be folded and shall be handled as infrequently as possible to avoid disturbance to its structure. The sample shall be kept in a flat position without any load.

C.2.2 Selection

Take specimens from the sample according to EN ISO 9862.

C.2.3 Number and dimensions

Cut four machine direction (MD) and four cross machine direction (CMD) specimens measuring 100 mm by 200 mm each.

Create an individual specimen designation so that a specific specimen is tracked throughout the test. Mark each specimen as to 1, 2, 3 and 4 in the MD and 1, 2, 3 and 4 in the CMD. Do this by placing a staple along the edge of the specimen. Placement along the 20 cm side designates MD and placement along the 10 cm side designates CMD. Place the staples at varying distances from the corner to the centre of the edge. The staple closest to the corner designates specimen 1 and progresses to specimen number 4 closest to the centre.

C.2.4 Condition of specimens

The specimens shall be clean, free from surface deposits and without visible damage or folding marks.

C.3 Testing procedure

1) Weigh each specimen keeping track of the specific specimen designation.

2) Use a bitumen quality with a measured needle penetration value (pen) of (85 ± 5), expressed in dmm (deci-millimetres) according to EN 1426.

3) Preheat the tested bitumen to 135 °C.

NOTE In the ASTM D6140 testing procedure, AR 4000 (AC 20) is used as a standard bitumen for paving fabrics, where AR 4000 refers to the viscosity of the aged residue. This corresponds to a European needle penetration value of about 85.

4) Attach a binder clip to each specimen. Connect the binder clip to a support frame with a wire.

5) Submerge each specimen in the bitumen and place in an oven for 30 min at 135 °C.

6) Remove the specimen from the bitumen and hang to dry – long axis vertical – for 30 min, keeping the sample in the oven at 135 °C.

7) Place a binder clip on the bottom of the sample, invert the sample to reverse the direction of hanging, and allow drying for another 30 min at 135 °C. Remove the first binder slips.

8) Remove the specimens from the oven and allow cooling for 30 min. Trim any excess bitumen, such as edge drippings.

9) Weigh the trimmed bitumen-coated specimens.

10) Calculate the bitumen retention as follows:

$$R_a = \frac{M_{sat} - m_g}{A_g}$$

where

R_a = bitumen retention, in kg/m^2

M_{sat} = mass of fabric specimen after testing, in kg

m_g = mass of fabric specimen before test, in kg

A_g = area of fabric specimen before test, in m^2

11) If desired, the change in area of the specimen after the test can be determined. Flatten the specimen and measure the dimensions. Calculate the change in area in percent as the difference in the area of the specimen before and after the test divided by the area of the specimen before the test.

C.4 Test report

The test report shall include the following information:

- the number and year of publication of this standard;
- the test laboratory and, if required, the test operator;
- a description of the product tested (in accordance with EN ISO 10318);
- the specimen size and number if different from specified;
- penetration of the bitumen type;
- the calculated mean bitumen retention in both MD and CMD;

and, in addition, if required:

- details of apparatus used;
- the experimental data and calculations for each specimen.

Annex D
(normative)

Tensile test on steel wire mesh

The tensile test on steel wire mesh shall be carried out according to the test procedures specified in ASTM A975-97, *Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (metallic-coated steel wire or metallic-coated steel wire with poly(vinyl chloride) (PVC) coating)* (reapproved 2003) – 13.1.1.

The width of the test specimen may be reduced, but shall not be less than ten repetitions of a mesh pattern, nor shall the length be less than three repetitions.

Annex ZA
(informative)

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

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under mandate M/107 "Geotextiles" given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard, shown in this annex meet the requirements of the Mandate M/107, given under the EU Construction Products Directive (89/106/EEC).

Provision of data in accordance with this standard confers a presumption that the values quoted can be relied upon as being correct within the tolerances stated.

Compliance with these clauses confers a presumption of fitness of the geotextiles and geotextile-related products covered by this annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking

WARNING Other requirements and other EU Directives, not affecting the fitness for intended use, may be applicable to the construction products falling within the scope of this standard.

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

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (http://ec.europa.eu/enterprise/construction/internal/dangsub/dangmain_en.htm).

This annex has the same scope as Clause 1 of this standard with regard to the products covered. It establishes the conditions for the CE marking of geotextiles and geotextile-related products intended for the use indicated below and shows the relevant clauses applicable (see Tables ZA.1.1 to ZA.1.5).

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

NOTE 3 For some products testing in only one direction may be applicable, in which case it should be clearly specified in the information accompanying the CE marking.

NOTE 4 The 95 % confidence level corresponds to the mean value minus (and/or plus) 1,0 tolerance value(s).

Table ZA.1.1

Product: Geotextiles and geotextile-related products (metallic and non-metallic) **Intended use:** For reinforcement (R) in pavements and asphalt overlays			
Essential characteristics	**Requirement clauses in this European Standard**	**Mandated level(s) or class(es)**	**Notes (mean value, tolerance value(s))**
Tensile strength	4.1, Table 1 (1) and 5.1	None	(kN/m, -kN/m) in both directions
Elongation	4.1, Table 1 (2) and 5.1	None	(%, +/- %) in both directions
Resistance to static puncture	4.1, Table 1 (4) and 5.1	None	(kN, -kN)
Dynamic perforation resistance	4.1, Table 1 (3) and 5.1	None	(mm, + mm)
Durability (alkaline resistance, weathering)	Annex B, 4.1, 5.1 and Table 1 (5)	None	% residual strength

Table ZA.1.2

Product: Geotextiles and geotextile-related products (non-metallic) **Intended use:** For stress relief (STR) in pavements and asphalt overlays			
Essential characteristics	**Requirement clauses in this European Standard**	**Mandated level(s) or class(es)**	**Notes (mean value, tolerance value(s))**
Tensile strength	4.1, Table 1 (1) and 5.1	None	(kN/m, -kN/m) in both directions
Elongation			
Elongation	4.1, Table 1 (2) and 5.1	None	(%, +/- %) in both directions
Bitumen retention	4.1, Table 1 (7) and 5.1	None	(kg /m^2 , +/- kg/m^2)
Resistance to static puncture	4.1, Table 1 (4) and 5.1	None	(kN, -kN)
Durability (alkaline resistance, weathering)	Annex B, 4.1, 5.1 and Table 1 (5)	None	% residual strength

Table ZA.1.3

Product: Geotextiles and geotextile-related products (non-metallic) **Intended use:** As an interlayer barrier (B) in pavements and asphalt overlays			
Essential characteristics	**Requirement clauses in this European Standard**	**Mandated level(s) or class(es)**	**Notes (mean value, tolerance value(s))**
Tensile strength	4.1, Table 1 (1) and 5.1	None	(kN/m, -kN/m) in both directions
Elongation	4.1, Table 1 (2) and 5.1	None	(%, +/- %) in both directions
Resistance to static puncture	4.1, Table 1 (4) and 5.1	None	(kN, -kN)
Dynamic perforation resistance	4.1, Table 1 (3) and 5.1	None	(mm, + mm)
Durability (alkaline resistance, weathering)	Annex B, 4.1, 5.1 and Table 1 (5)	None	% residual strength

Table ZA.1.4

Product: Geotextiles and geotextile-related products (non-metallic) **Intended use:** For reinforcement, stress relief and interlayer barrier (R+STR+B) in pavements and asphalt overlays			
Essential characteristics	**Requirement clauses in this European Standard**	**Mandated level(s) or class(es)**	**Notes (mean value, tolerance value(s))**
Tensile strength	4.1, Table 1 (1) and 5.1	None	(kN/m, -kN/m) in both directions
Elongation			
Elongation	4.1, Table 1 (2) and 5.1	None	(%, +/- %) in both directions
Bitumen retention	4.1 Table 1 (7) and 5.1	None	(kg /m^2 , +/- kg/m^2)
Resistance to static puncture	4.1, Table 1 (4) and 5.1	None	(kN, -kN)
Dynamic perforation resistance	4.1, Table 1 (3) and 5.1	None	(mm, + mm)
Durability (alkaline resistance, weathering)	Annex B, 4.1, 5.1 and Table 1 (5)	None	% residual strength

Table ZA.1.5

Product: Geotextiles and geotextile-related products (non-metallic) **Intended use:** For stress relief and interlayer barrier (STR+B) in pavements and asphalt overlays			
Essential characteristics	**Requirement clauses in this European Standard**	**Mandated level(s) or class(es)**	**Notes (mean value, tolerance value(s))**
Tensile strength	4.1, Table 1 (1) and 5.1	None	(kN/m, -kN/m) in both directions
Elongation Elongation	4.1, Table 1 (2) and 5.1	None	(%, +/- %) in both directions
Bitumen retention	4.1, Table 1 (7) and 5.1	None	(kg /m^2 , +/- kg/m^2)
Resistance to static puncture	4.1, Table 1 (4) and 5.1	None	(kN, -kN)
Dynamic perforation resistance	4.1, Table 1 (3) and 5.1	None	(mm, + mm)
Durability (alkaline resistance, weathering)	Annex B, 4.1, 5.1 and Table 1 (5)	None	% residual strength

ZA.2 Procedure for the attestation of conformity of geotextiles and geotextile-related products used in pavements and asphalt overlays

ZA.2.1 Systems of attestation of conformity

The system of attestation of conformity for the geotextiles and geotextile-related products indicated in Tables ZA.1.1 to ZA.1.5, in accordance with the decision of the Commission (96/581/EC of 8th October 1996) as given in Annex III of the mandate M/107 "Geotextiles", is shown in Table ZA.2 for the indicated intended use(s):

Table ZA.2 – System of attestation of conformity

Product	**Intended use**	**Levels or classes**	**Attestation of conformity system**
Geosynthetics, geotextiles, geocomposites, geogrids	Used in pavements and asphalt overlays: - for reinforcement - for stress relief - as an interlayer barrier	None	2+
System 2+: See CPD Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of its continuous surveillance, assessment and approval.			

The attestation of conformity of the geotextiles and geotextile-related products in Table ZA.1.1 to ZA.1.5 shall be according to the evaluation of conformity procedures indicated in Table ZA.3 resulting from the application of the sub-clauses of this European Standard indicated therein.

Table ZA.3 – Assignation of evaluation of conformity tasks

Tasks			**Coverage of the task**	**Clauses to apply**
Tasks for the manufacturer	Factory production control (F.P.C.)		Parameters related to all characteristics of the relevant Table ZA.1	5.2, 5.4 and Annex A
	Initial type testing		All characteristics of the relevant Table ZA.1	5.1, 5.3
Tasks for the notified body	Certification of F.P.C. on the basis of:	– initial inspection of factory and of F.P.C.	Parameters related to all characteristics of the relevant Table ZA.1, in particular parameters related to: Tensile strength – dynamic perforation resistance *(for products for all uses of Table ZA.1.1 and Z.A.1.4)* Elongation *(for products for uses of Tables ZA.1)* Bitumen retention (*for products for uses of Tables Z.A.1.2, Z.A.1.4 and Z.A.1.5)*	5.5 and Annex A
		– continuous surveillance, assessment and approval of F.P.C.	Parameters related to all characteristics of the relevant table ZA.1, in particular, parameters related to: Tensile strength – dynamic perforation resistance *(for products for all uses of Table ZA.1.1 and Z.A.1.4)* Elongation *(for products for uses of Tables ZA.1.)*	5.4 and Annex A

ZA2.2 Certificate and declaration of conformity

When compliance with the system of attestation of conformity is achieved, the notified body shall draw up a certificate of the factory production control including the following information:

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

- description of the product (type, identification, use, function,...);
- provisions to which the product conforms (Annex ZA of this European Standard);
- particular conditions applicable to the use of the product;
- the certificate's number;
- conditions and period of validity of the certificate;
- name of, and position held by, the person empowered to sign the certificate.

In addition, for each product, the manufacturer shall draw up a declaration of conformity (EC declaration of conformity) including the following information:

- name and address of the manufacturer, or his authorised representative established in the EEA;
- number of the attached certificate of factory production control;
- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

This declaration of conformity entitles the manufacturer to affix the CE-marking, as described in ZA.3.

The above mentioned certificate and declaration shall be available in the official language(s) of the Member State in which the product is to be used.

ZA.3 CE-marking and labelling

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol shall be in accordance with Directive 93/68/EEC and shall be shown on the accompanying commercial documents. The following information and characteristics shall accompany the CE marking symbol:

- identification number of the certification body;
- name or identifying mark of the producer;
- registered address of the producer;
- the last two digits of the year of affixing the CE marking;
- number of the certificate of factory production control;
- reference to this European Standard;
- information on the mandated characteristics: values to be declared as indicated in 5.1 of this standard.

NOTE 1 The purpose of this information is to identify the legal entity responsible for the manufacture of the product.

The affixing will be done on the packaging of the geosynthetic barriers in the way indicated in Figure ZA.1, which gives the simplified label to affix to the product. This figure contains the minimum set of information and the link to the accompanying document, where the other required informations are given.

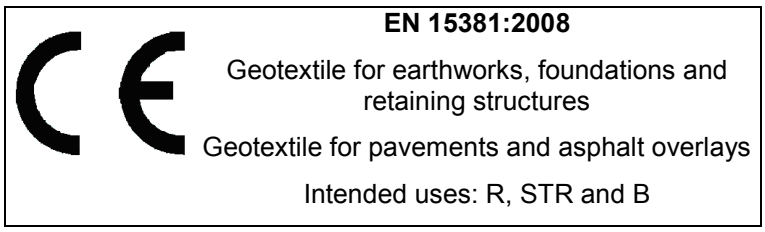
CE	CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.
0123-CPD	Identification number of the certification body
08	Year of affixing the CE mark
Geo A	Name and type of the product

Figure ZA.1 – Example of CE marking on the packaging of a geotextile or a geotextile-related product

CE	CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.
0123-CPD	Identification number of the certification body
Geo A	Name and type of the product
GeoCo Ltd, PO Box 21, B-1050	Name or identifying mark and registered address of the producer
08	Last two digits of the year of affixing the CE marking
0123-CPD-0456	Number of the FPC certificate
EN 15381:2008	Number(s) of applicable European Standard(s) (see NOTE 1)
Geotextile for pavements and asphalt overlay **Intended uses: R, STR, B**	Identification of product and intended use(s) (see NOTE 2)
Tensile strength (EN ISO 10319): MD 50kN/m(-2 kN/m) / CMD 50 kN/m (-2 kN/m) **Elongation** **Elongation** (EN ISO 10319): MD 5% (+/- 1%) / CMD 5% (+/- 1%) **Bitumen retention** (Annex C) 1,0 kg/m2 (+/- 0,2 kg/m2) **Resistance to static puncture** (EN ISO 12236): 1,2 kN (-0,1kN) **Dynamic perforation resistance** (EN ISO 13433): 8 mm (+1mm)	and information on regulated characteristics Example with values – mean value and tolerance value (see NOTE 3)
Durability: – To be covered on the day of installation – Alkaline resistance (in % residual strength)	

Figure ZA.2 – Example of accompanying documents

NOTE 2 In the case of several standards being applicable for the CE marking of the same product, the accompanying document should contain the detailed information specified in Figure ZA.2 and in addition refer to all applicable standards and intended uses as shown in the following example:



NOTE 3 Intended uses of geotextiles and geotextile-related products in pavements and asphalt overlays can be one of the following:

- Reinforcement R
- Stress relief STR
- Barrier B
- Reinforcement and stress relief and barrier R +STR + B
- Stress relief and barrier STR + B

NOTE 4 If required in Tables ZA.1.1 to ZA.1.5 the tolerance value(s) corresponding to the 95 % confidence level, should be given by the manufacturer as follows:

- Tensile strength - α kN/m example (- 2 kN/m)
- Elongation +/- α % example (- 4%, + 6%)
- Resistance to static puncture - α kN example (- 15kN)
- Dynamic perforation resistance + α mm example (+ 20 mm)
- Bitumen retention +/- α kg/m^2 example (+ 0,2 kg/m^2 , - 0,2 kg/m^2)

NOTE 5 The manufacturer should declare: "This product is to be covered within (*duration*) after installation."

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

NOTE 6 European legislation without national derogations need not be mentioned.

Bibliography

[1] M/107 – Mandate to CEN/CENELEC concerning the execution of standardization work for harmonized standards on geotextiles – European Commission – 1996

[2] EN 12226, *Geotextiles and geotextile-related products - General tests for evaluation following durability testing*

[3] EN 12591*, Bitumen and bituminous binders – Specifications for paving grade bitumens*

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

[5] EN ISO 9864, *Geosynthetics – Test method for the determination of mass per unit area of geotextiles and geotextile-related products (ISO 9864:2005)*

[6] EN ISO 13431, *Geotextiles and geotextile-related products – Determination of tensile creep and creep rupture behaviour (ISO 13431:1999)*

[7] CR ISO 13434, *Guidelines on durability of geotextiles and geotextile-related products*

[8] ASTM D6140-00, *Standard test method to determine asphalt retention of paving fabrics used in asphalt paving for full-width applications*

[9] AASHTO M288, *Durability considerations in standard specification documents*

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BSI Group
Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/
standards