

EUROPEAN ASSESSMENT DOCUMENT

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COMPOUND FOR BITUMEN AND BITUMINOUS MIXTURES BASED ON CRUMB RUBBER POWDER

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The product in the scope of this EAD is “Compound for Bitumen and Bituminous Mixtures Based on Crumb Rubber Powder” [product] which consists of recycled tyres powder (57 % ± 8 %) (in weight), bitumen (16 % ± 5 %), lime (30 % ± 10 %) and other additives. The product is a powder with maximum grain size of 1,0 mm.

The product is based on crumb rubber powder obtained from ELT (end life tyres), which is heated and then coated with bitumen to complete the digestion process of the crumb rubber powder. After this, lime and other additives are added.

The product is not covered by a harmonised technical specification.

Harmonised standards for bitumen (i.e. hEN 14023¹ and hEN 12591) do not apply for the product as such for the following reasons:

- The product is not a bitumen.
- The assessment methods of hEN do not apply to the product alone.
- Factory production control defined in these hEN are not suitable to ensure constancy of performance of the product.

However, the performance of the product can mainly be established when it is tested in the mixture with a bitumen. Therefore, some of the harmonised assessment methods specified in hEN 14023 and hEN 12591 are applicable. The performance stated in the ETA are valid only for the mixtures tested.

The mixtures tested (product + bitumen) contribute to the bituminous mixtures as the binders, alike bitumen does in “non-modified” bituminous mixtures. For this reason, the product is assessed under the characteristics of mixtures of the product with bitumen. The assessed characteristics are taken from the harmonised standards of bitumen EN 14023 and EN 12591.

Moreover, this EAD allows assessment of granulometry (clause 2.2.1), flash point (clause 2.2.5) and behaviour at low temperatures with the bending beam rheometer (clause 2.2.9) which are not considered in annex ZA of hEN 14023 and hEN 12591. Flash point and behaviour at low temperatures with the bending beam rheometer are indicative of behaviour of the mixture (product + bitumen) at high and low temperatures respectively.

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

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

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

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

1.2.1 Intended use(s)

The product is intended to be used to modify bitumen and bituminous mixtures used for the construction and maintenance of roads, airport runways and other paved areas.

¹ All undated references to hEN or standards at prEN stage, EOTA report, etc. in this EAD are to be understood as references to the dated versions listed in clause 4.

The product (compound) mixed with bitumen, aggregates and other additives produces a modified bituminous mixture (see Figure 1.2.1.2).

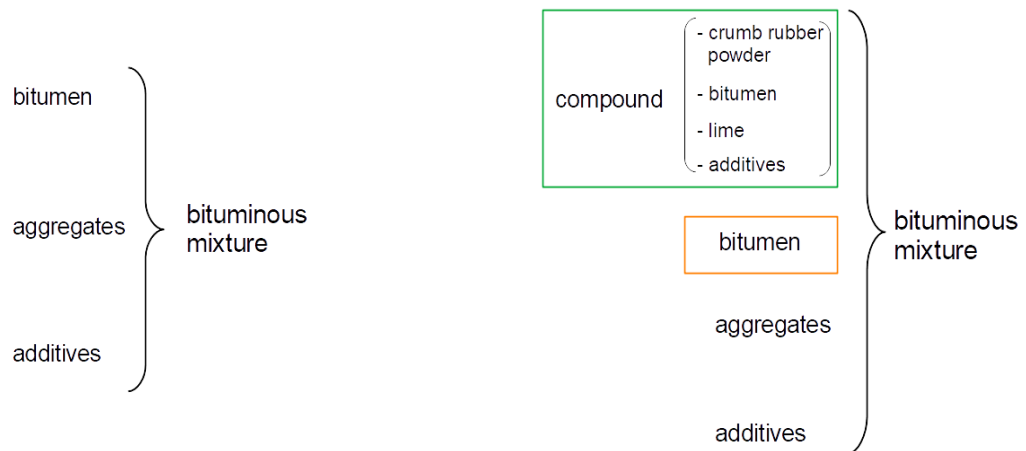


Figure 1.2.1.1: Typical bituminous mixture composition (for mixtures under harmonized standards).

Figure 1.2.1.2: Bituminous mixture composition with the product (compound) assessed in this EAD.

The product (compound) is added in the mixer with the aggregates, before adding the bitumen (see Figure 1.2.1.3). To countervail that the product is added at ambient temperature, aggregates and bitumen are heated above the normal temperature of these types of bitumen mixtures. The resulting bituminous mixture has modified rheological and mechanical properties.

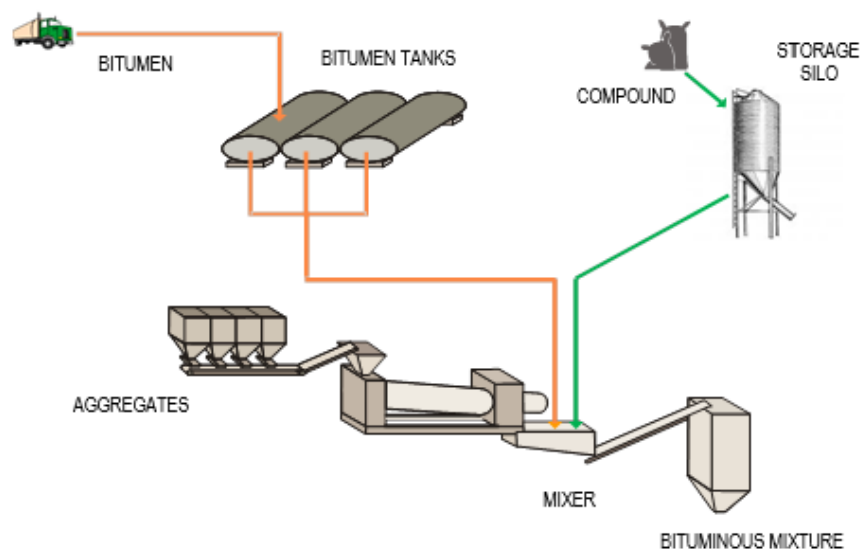


Figure 1.2.1.3: Bituminous mixture production scheme using the assessed product (compound).

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer’s request to take into account a working life of the product for the intended use of 15 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works².

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

² The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the product is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

| No | Essential characteristic | Assessment method | Type of expression of product performance |
|---|---|-------------------|---|
| Basic Works Requirement 1: Mechanical resistance and stability | | | |
| 1 | Granulometry | 2.2.1 | Level |
| 2 | Penetration at 25 °C | 2.2.2 | Level |
| 3 | Softening point | 2.2.3 | Level |
| 4 | Cohesion: Force-ductility | 2.2.4 | Level |
| 5 | Flash point | 2.2.5 | Level |
| 6 | Elastic recovery at 25 °C | 2.2.6 | Level |
| 7 | Elastic recovery at 10 °C | 2.2.7 | Level |
| 8 | Resistance to hardening: Change of mass | 2.2.8.1 | Level |
| 9 | Resistance to hardening: Retained penetration | 2.2.8.2 | Level |
| 10 | Resistance to hardening: Increase of softening point | 2.2.8.3 | Level |
| 11 | Resistance to hardening: Drop of softening point | 2.2.8.3 | Level |
| 12 | Resistance to hardening: Elastic recovery at 25 °C | 2.2.8.4 | Level |
| 13 | Resistance to hardening: Elastic recovery at 10 °C | 2.2.8.5 | Level |
| 14 | Behaviour at low temperatures with the bending beam rheometer | 2.2.9 | Level |

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

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

Except of the granulometry, which relates to the product itself, all other essential characteristics can only be established on the mixture of the product with bitumen. For these characteristics, performance stated in the ETA are valid only for mixtures (specimens) as tested.

The tested specimens shall be defined as follows:

- Product assessed in the ETA:
 - o Percentages in weight of crumb rubber powder, bitumen, lime and additives, as defined in clause 1.1.
 - o Granulometry as assessed in clause 2.2.1.
- Bitumen:
 - o Type and class of bitumen and reference to its hEN (i.e. paving grade bitumen 50/70 according to EN 12591)
 - o Penetration of xx mm at 25 °C
 - o Softening point xx °C
- Percentage in weight of product into bitumen (xx %)
- The specimens' mixing is performed at the temperature xx °C, for xx minutes under rotational velocity of mixing xx rpm.

It is to be noted that the specimen (mixture) shall be fully homogeneous and proportion of the product in the mixture shall not be higher than 50 %.

Per each mixture assessed, the following characteristics shall be determined by testing at least the minimum number of repetitions indicated in Table 2.2.2.

Per each characteristic, when more than one test is performed, only the mean value shall be stated in the ETA.

Table 2.2.2: Minimum number of repetitions of tests to be performed per each assessed characteristic.

| Assessed characteristic | Minimum repetitions |
|--|---------------------|
| Penetration at 25 °C | 5 |
| Softening point | 5 |
| Cohesion: Force-ductility | 3 |
| Flash point | 3 |
| Elastic recovery at 25 °C | 3 |
| Elastic recovery at 10 °C | 3 |
| Resistance to hardening: change of mass | 1 |
| Resistance to hardening: retained penetration | 1 |
| Resistance to hardening: change of softening point | 1 |
| Resistance to hardening: elastic recovery at 25 °C | 1 |
| Resistance to hardening: elastic recovery at 10 °C | 1 |
| Behaviour at low temperatures BBR | 1 |

2.2.1 Granulometry

Purpose of the assessment

The assessment is required to provide the granulometry of the product.

Assessment method

Granulometry shall be determined according to EN 14243-2, clause 5.5. Sieves used shall be chosen from annex F of EN 14243-2 taking into account the provisions stated in clause 5.5.2 of the standard.

Expression of results

Results shall be shown in a table and in a histogram or graphic as figures 3 or 4 of EN 14243-2.

2.2.2 Penetration at 25 °C

Purpose of the assessment

The assessment is required to provide the penetration at 25 °C of the product mixed with bitumen.

Assessment method

The penetration at 25 °C shall be determined by testing according to EN 1426.

Expression of results

The penetration at 25 °C shall be expressed in the ETA by means of a level.

2.2.3 Softening point

Purpose of the assessment

The assessment is required to provide the softening point of the product mixed with bitumen.

Assessment method

The softening point shall be determined by testing according to EN 1427.

Expression of results

The softening point shall be expressed in the ETA by means of a level.

2.2.4 Cohesion: Force-ductility

Purpose of the assessment

The assessment is required to provide the cohesion: force-ductility of the product mixed with bitumen.

Assessment method

The cohesion: force-ductility shall be determined by testing according to EN 13589.

Expression of results

The cohesion: force-ductility shall be expressed in the ETA by means of a level.

2.2.5 Flash point

Purpose of the assessment

The assessment is required to provide the flash point of the product mixed with bitumen.

Assessment method

The flash point shall be determined by testing according to EN ISO 2592 and stated in the ETA.

Expression of results

The flash point shall be expressed in the ETA by means of a level.

2.2.6 Elastic recovery at 25 °C

Purpose of the assessment

The assessment is required to provide the elastic recovery at 25 °C of the product mixed with bitumen.

Assessment method

The elastic recovery at 25 °C shall be determined by testing according to EN 13398. The conditioning of the specimens in the water bath shall be done at 25 °C following the procedure of clause 6.3 of EN 13398.

Expression of results

The elastic recovery at 25 °C shall be expressed in the ETA by means of a level.

2.2.7 Elastic recovery at 10 °C

Purpose of the assessment

The assessment is required to provide the elastic recovery at 10 °C of the product mixed with bitumen.

Assessment method

The elastic recovery at 10 °C shall be determined by testing according to EN 13398. The conditioning of the specimens in the water bath shall be done at 10 °C following the procedure of clause 6.3 of EN 13398.

Expression of results

The elastic recovery at 10 °C shall be expressed in the ETA by means of a level.

2.2.8 Resistance to hardening

Purpose of the assessment

The assessment is required to provide the resistance to hardening of the product mixed with bitumen.

Assessment method

The resistance to hardening shall be determined by testing change of mass, retained penetration, increase and drop of softening point and elastic recovery at 25 °C and at 10 °C after an ageing in accordance with EN 12607-1 (RTFOT method). Assessment defined in clauses 2.2.8.1 to 2.2.8.5 apply.

Expression of results

The resistance to hardening, per each test (clauses 2.2.8.1, 2.2.8.2, 2.2.8.4 and 2.2.8.5), shall be expressed in the ETA by means of a level.

For increase and drop of softening point (clause 2.2.8.3):

If the softening point increases, the value is given in the essential characteristic increase of softening point. In the essential characteristic drop of softening point the information “The softening point does not drop” shall be specified.

If the softening point decreases, the value is given in the essential characteristic drop of softening point. In the essential characteristic increase of softening point the information “The softening point does not increase” shall be specified.

2.2.8.1 Change of mass

The change of mass shall be determined by testing according to EN 12607-1.

2.2.8.2 Retained penetration

The retained penetration after an ageing in accordance with EN 12607-1 shall be determined by testing according to EN 1426.

2.2.8.3 Increase and drop of softening point

The change of softening point after an ageing in accordance with EN 12607-1 shall be determined by testing according to EN 1427.

2.2.8.4 Elastic recovery at 25 °C

The elastic recovery at 25 °C after an ageing in accordance with EN 12607-1 shall be determined by testing according to EN 13398. The conditioning of the specimens in the water bath shall be done at 25 °C following the procedure of clause 6.3 of EN 13398.

2.2.8.5 Elastic recovery at 10 °C

The elastic recovery at 10 °C after an ageing in accordance with EN 12607-1 shall be determined by testing according to EN 13398. The conditioning of the specimens in the water bath shall be done at 10 °C following the procedure of clause 6.3 of EN 13398.

2.2.9 Behaviour at low temperatures with the bending beam rheometer

Purpose of the assessment

The assessment is required to provide the behaviour at low temperatures with the bending beam rheometer of the product mixed with bitumen.

Assessment method

The behaviour at low temperatures with the bending beam rheometer (BBR) shall be determined by testing according to EN 14771.

The temperature at which a flexural creep stiffness of 300 MPa is reached shall be stated in the ETA. The temperature value shall be interpolated from the temperatures tested and the flexural strengths obtained. Based on previous experience, tests at -10 °C, -16 °C and -25 °C are useful. At least three different temperatures shall be tested.

Also calculate the m-value at 300 MPa after 60 s of loading in accordance with EN 14771 clause 8.4. The m-value is a measure of the relaxation capacity of the bitumen at low temperatures.

Expression of results

The behaviour at low temperatures with the bending beam rheometer shall be expressed in the ETA by means of a level.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is: Decision 98/601/EC, amended by Decision 2001/596/EC.

The system(s) is: **2+**

3.2 Tasks of the manufacturer

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

Table 3.2.1 Control plan for the manufacturer; cornerstones

| No | Subject/type of control | Test or control method | Criteria, if any | Minimum number of samples | Minimum frequency of control |
|--|---|--------------------------------------|-----------------------------|---------------------------|------------------------------|
| Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan] | | | | | |
| 1 | Fulfilment of specifications of raw materials and components of the product | Check of raw material specifications | Manufacturer's Control Plan | All | Every delivery |
| 2 | Temperature and time of mixing | Manufacturer's Control Plan | Manufacturer's Control Plan | - | Every batch |
| 3 | Granulometry | 2.2.1 | Manufacturer's Control Plan | 1 | Every batch |
| 4 | Penetration at 25 °C | 2.2.2 | Manufacturer's Control Plan | 1 | Every batch |
| 5 | Softening point | 2.2.3 | Manufacturer's Control Plan | 1 | Every batch |
| 6 | Viscosity | EN 13302 | Manufacturer's Control Plan | 1 | Every batch |
| 7 | Cohesion: Force - ductility | 2.2.4 | Manufacturer's Control Plan | 1 | Annually |
| 8 | Elastic recovery at 25 °C | 2.2.6 | Manufacturer's Control Plan | 1 | Annually |
| 9 | Elastic recovery at 10 °C | 2.2.7 | Manufacturer's Control Plan | 1 | Annually |
| 10 | Resistance to hardening: change of mass | 2.2.8.1 | Manufacturer's Control Plan | 1 | Annually |
| 11 | Resistance to hardening: retained penetration | 2.2.8.2 | Manufacturer's Control Plan | 1 | Annually |
| 12 | Resistance to hardening: increase and drop of softening point | 2.2.8.3 | Manufacturer's Control Plan | 1 | Annually |
| 13 | Behaviour at low temperatures with the bending beam rheometer | 2.2.9 | Manufacturer's Control Plan | 1 | Annually |

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; cornerstones

| No | Subject/type of control | Test or control method | Criteria, if any | Minimum number of samples | Minimum frequency of control |
|---|---|------------------------|----------------------------|----------------------------|--|
| Initial inspection of the manufacturing plant and of factory production control | | | | | |
| 1 | <p>The notified body shall verify the ability for manufacturing the product in accordance with the control plan, taking into account the cornerstones for control plan of the manufacturer defined in table 3.2.1.</p> <p>It is relevant to control the granulometry of the product and temperature and time of mixing.</p> | See table 3.2.1 | As defined in control plan | As defined in control plan | When starting the production or after its modification |
| Continuous surveillance, assessment and evaluation of factory production control | | | | | |
| 2 | <p>It shall be verified that the system of factory production control and the specified manufacturing process are maintained in accordance with the control plan, taking into account the cornerstones for control plan of the manufacturer defined in table 3.2.1. It is relevant to control the granulometry of the product and temperature and time of mixing. The following should be dealt with:</p> <ul style="list-style-type: none"> - inspection of factory, of the production of the product and of the facilities for factory production control - evaluation of the documents concerning factory production control <p>issuing a report of surveillance</p> | See table 3.2.1 | As defined in control plan | As defined in control plan | Once per year |

4 REFERENCE DOCUMENTS

| | |
|------------------|---|
| EN 14023:2010 | Bitumen and bituminous binders. Specification framework for polymer modified bitumens. |
| EN 12591:2009 | Bitumen and bituminous binders. Specifications for paving grade bitumens. |
| EN 14243-2:2019 | Materials obtained from end of life tyres – Part 2: Granulates and powders – Methods for determining the particles size distribution and impurities, including free steel and free textile content. |
| EN 1426:2015 | Bitumen and bituminous binders – Determination of needle penetration. |
| EN 1427:2015 | Bitumen and bituminous binders – Determination of softening point – Ring and Ball method. |
| EN 13589:2018 | Bitumen and bituminous binders – Determination of the tensile properties of modified bitumen by the force ductility method. |
| EN ISO 2592:2017 | Petroleum and related products – Determination of flash and fire points – Cleveland open cup method (ISO 2592:2017). |
| EN 13398:2017 | Bitumen and bituminous binders – Determination of the elastic recovery of modified bitumen. |
| EN12607-1:2014 | Bitumen and bituminous binders – Determination of the resistance to hardening under influence of heat and air – Part 1: RTFOT method. |
| EN 14771:2012 | Bitumen and bituminous binders – Determination of the flexural creep stiffness – Bending Beam Rheometer (BBR). |
| EN 13302:2018 | Bitumen and bituminous binders. Determination of dynamic viscosity of bituminous binder using rotating spindle apparatus. |