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Second edition

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Bitumen and bituminous binders —

Part 2: Specification for paving grade bitumen

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In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 395-2 was prepared by Technical Committee RSB/TC 55, *Roads and highway engineering.*

In the preparation of this standard, reference was made to the following standards:

1) BS 12591: 2009, *Bitumen and Bituminous Binders*

2) ASTM D673-16, *Standard Specification for Performance Graded Asphalt Binder*

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 395-1: 2018), [clauses 1 and 4] which has been technically revised.

DRS 395 consists of the following parts, under the general title *Bitumen and bituminous binders*:

— *Part 1: Terminology*

— *Part 2: Specification for paving grade bitumen*

— *Part 3: Specification for bituminous emulsion (under development)*

Committee membership

The following organizations were represented on the Technical Committee on *Roads and highway engineering* (RSB/TC 55) in the preparation of this standard.

ASTRIK International Ltd

EDITRACE LTD and General Reliance

JV CSC&EC(Property) and Fair Construction Ltd

MININFRA

NPD Ltd

Rwanda Inspectorate Competition and Consumer Protection Authority (RICA)

Rwanda Transport Development Agency (RTDA)

TCMF Ltd

University of Rwanda - College of Science Technology (UR-CST)

Rwanda Standards Board (RSB) – Secretariat

Introduction

This Rwanda Standard describes performance required for a number of properties of bitumen and bituminous binders. Some of the properties are required by regulators and some are included only for the benefit of industry to assist specifying appropriate performance for different end uses.

Bitumen and bituminous binders — Part 2: Specification for paving grade bitumen

1 Scope

This Draft Rwanda Standard provides a framework for specifying a range of properties and relevant sampling and test methods for bitumen, which is suitable for use in the construction and maintenance of roads, airfields and other paved areas, together with requirements for evaluation of conformity.

This Standard does not directly address 'cohesion, adhesion and setting ability'.

NOTE Paving grade bitumen specified in this standard can also be used for industrial applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

DRS 395-1, *Bitumen and bituminous binders — Part 1: Terminology*

RS ISO 2592, *Petroleum and related products — Determination of flash and fire points — Cleveland open cup method*

RS ISO 4259-1, *Petroleum and related products — Precision of measurement methods and results — Part 1: Determination of precision data in relation to methods of test*

RS ASTM D7042, Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)

RS ASTM D5, Standard Test Method for Penetration of Bituminous Materials

RS ASTM D140/D140M, Standard Practice for Sampling Asphalt Materials

RS ASTM D36, Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)

RS ASTM D2042, Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene

RS ASTM D2170/D2170M, Standard Test Method for Kinematic Viscosity of Asphalts (Bitumen)

RS ISO 2719, Determination of flash point — Pensky-Martens closed cup method

RS ASTM D1754, Standard Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)

RS ASTM D2872, Standard Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)

RS ISO 3170, Petroleum liquids — Manual sampling

RS ISO 9001, Quality management systems — *Requirements*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in DRS 395-1 apply.

4 Requirements

4.1 General

This Standard covers a large range of bitumen to facilitate during design and the application of bituminous road pavement. The bitumen used for road construction can be classified into various classes, and bitumen covered by this standard will be from any of natural rock bitumen, native bitumen or petroleum bitumen.

The variety of production techniques and applications makes it more practical to split bitumen into two grade tables (Clause 4.2) that are based on two grading system. Two methods, **viscosity** and **penetration** are commonly used to classify different grades of bitumen.

4.2 Properties

4.2.1 General

4.2.2.1 The properties of paving grade bitumen and related test methods shall be in accordance with Table 1A and Table1B, or Table 2A and Table 2B. When tested in accordance with the methods given in the Tables, the various paving grades shall conform to the limits specified. Specific grade shall be selected from tables provided by choosing a column representing the specified values or ranges.

Table 1A — Paving grade bitumen specifications for grades from 30 x 0.1 mm to 100 x 0.1 mm penetration — Properties applying to all paving grade bitumen

Property	Unit	30/45	40/50	50/70	60/70	80/100	Test method
Penetration at 25 °C	0.1 mm	30 – 45	40 – 50	50 – 70	60 – 70	85–100	ASTM D5
Softening point	°C	52 – 60	50 – 58	46 – 54	48 – 56	43 – 51	ASTM D36
Resistance to hardening at 163 °C	-	-	-	-	-	-	ASTM D2872
Retained penetration	%	≥ 53	≥ 53	≥ 50	≥ 50	≥ 46	

Increase in softening point, - *Severity 1 or* Increase in softening point, - *Severity 2* [a]	°C °C	≤ 8 *or* ≤ 11	≤ 8 *or* ≤ 11	≤ 9 *or* ≤ 11	≤ 9 *or* ≤ 11	≤ 9 *or* ≤ 11	
Change of mass [b] (absolute value)	%	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.8	
Flash point	°C	≥ 240	≥ 240	≥ 230	≥ 230	≥ 230	RS ISO 2592
Solubility	%	≥ 99.0	≥ 99.0	≥ 99.0	≥ 99.0	≥ 99.0	ASTM D2042

[a] When Severity 2 is selected it shall be associated with the requirement for Fraass breaking point or penetration index or both measured on the un-aged binder (see Table 1B)

[b] Change in mass can be either positive or negative.

Table 1B — Paving grade bitumen specifications for grades from 30 x 0.1 mm to 100 x 0.1 mm penetration – Properties associated with regulatory or other international requirements

Property	**Unit**	**30/45**	**40/50**	**50/70**	**60/70**	**85/100**	**Test method**
Penetration index [a]	–	-1.5 to + 0.7 *or* NR [c]	-1.5 to + 0.7 *or* NR [c]	-1.5 to + 0.7 *or* NR [c]	-1.5 to + 0.7 *or* NR [c]	-1.5 to + 0.7 *or* NR [c]	Annex A [b]
Dynamic viscosity at 60 °C	Pa · s	≥ 260 *or* NR [c]	≥ 225 *or* NR [c]	≥ 175 *or* NR [c]	≥ 145 *or* NR [c]	≥ 90 *or* NR [c]	ASTM D7042
Fraass breaking point [a]	°C	≤ - 5 *or* NR [c]	≤ - 5 *or* NR [c]	≤ - 7 *or* NR [c]	≤ - 8 *or* NR [c]	≤ - 10 *or* NR [c]	ASTM D36
Kinematic viscosity at 135 °C	mm^2/s	≥ 400 *or* NR [c]	≥ 370 *or* NR [c]	≥ 325 *or* NR [c]	≥ 295 ≥ 230 *or* *or* NR [c] NR [c]		ASTM D2170

[a] When Severity 2 is selected it shall be associated with the requirement for Fraass breaking point or penetration index or both measured on the un-aged binder.

[b] Reference to normative Annex A in this document dealing with the calculation of penetration index.

[c] NR. No Requirement may be used when there are no regulations or other regional requirements for the property in the territory of intended use.

Table 2A — Paving grade bitumen specifications – Soft bitumen: bitumen designated and specified by kinematic viscosity at 60 °C – Properties applying to all paving grade bitumen

Property	Unit	V1500	V3000	V6000	V12000	Test method
Kinematic viscosity at 60 °C	mm^2/s	1000 – 2000	2000 – 4000	4000 – 8000	8000 – 16000	ASTM D2170
Resistance to hardening at 120 °C	-	-	-	-	-	ASTM D1754
Change of mass [a] (absolute value)	%	≤ 2.0	≤ 1.7	≤ 1.4	≤ 1.0	
Flash point	°C	≥ 160	≥ 160	≥ 180	≥ 180	RS ISO 2719
Solubility	%	≥ 99.0	≥ 99.0	≥ 99.0	≥ 99.0	ASTM D 2042

[a] Change in mass can be either positive or negative.

Table 2B — Paving grade bitumen specifications – Soft bitumen: bitumen designated and specified by kinematic viscosity at 60 °C- Properties associated with regulatory or other regional requirements

Properties	Unit	V1500	V3000	V6000	V12000	Test method
Resistance to hardening at 120 °C TFOT	–	–	–	–	–	ASTM D1754
Viscosity ratio at 60 °C	–	≤ 3.0 *or* NR [a]	≤ 3.0 *or* NR [a]	≤ 2.5 *or* NR [a]	≤ 2.0 *or* NR [a]	

[a] NR. No Requirement may be used when there are no regulations or other regional requirements for the property in the territory of intended use.

4.2.1.2 There is a subdivision of properties into two groups in the tables. The properties in Table 1A and Table 2A shall be specified for all paving grade bitumen. They are associated with regulatory requirements. The properties in Table 1B and Table 2B are required to meet specific climatic conditions. They are associated with regulatory requirements.

4.2.1.3 Two severity levels for resistance to hardening are stated as alternatives as, under specific conditions, a larger increase in softening point after Rolling Thin Film Oven Test (RTFOT) may be allowed (i.e. Severity level 2) without detrimental effect if this increase is associated with requirements for Fraass breaking point or penetration index (Ip) or both

4.2.1.4 The properties in Table 1A shall be specified for all paving grade bitumen listed in this Table. They are associated with Health, safety and Environment requirements and shall be included in all specifications.

4.2.1.5 The grades are designated by the nominal penetration or viscosity ranges as appropriate.

4.2.2 Consistency at intermediate service temperature

Consistency at intermediate service temperature shall conform to the requirements for penetration value in Table 1A.

4.2.3 Consistency at elevated service temperature

Consistency at elevated service temperature shall conform to the requirements for softening point in Table 1A (penetration graded), or kinematic viscosity in Table 2A (kinematic viscosity graded).

4.2.4 Brittleness at low service temperature

Brittleness at low service temperature may be required to meet specific areas susceptible to extreme cold in some regions of Rwanda. Where required, paving grade bitumen shall conform to the requirements for Fraass breaking point in Table 1B.

4.2.5 Temperature dependence of consistency

Temperature dependence of consistency may be required to meet specific climatic conditions in the country. Where required, paving grade bitumen shall conform to the requirement for dynamic viscosity or penetration index (Ip) or both in Table 1B.

4.2.6 Durability – Resistance to hardening

4.2.6.1 Durability is demonstrated by compliance with the required surrogate characteristics of “Resistance to hardening”, defined in Table 1A, Table 2B.

4.2.6.2 Resistance to hardening, rutting and fatigue shall be tested according to the Rolling Thin Film Oven Test (RTFOT) in accordance with ASTM D 2872 for binders from Table 1A.

4.2.6.3 Resistance to hardening, rutting and fatigue shall be tested according to the Thin Film Oven Test (TFOT) in accordance with ASTM D1754 for binders from Table 2A.

4.2.6.3. The durability is related to applied temperature during heating. During any application heating of bitumen shall not be more than 160 °C to 170°C.

4.2.7 Other properties

4.2.7.1 Density

When necessary, density of paving grade bitumen shall be determined in accordance with ASTM D70-17 and ASTM D342 for cutback.

4.2.7.2 Flash point

Flash point shall be determined by the Cleveland open cup method in RS ISO 2592 for binders in Table 1A and by the Pensky-Martens closed cup method, RS ISO 2719, for binders in Table 2A.

NOTE For bitumen in Table 1A, the Pensky-Martens closed cup method is often used to investigate possible contamination but is likely to give lower values than the Cleveland open cup method.

4.3 Release of dangerous regulated substances

Materials used in products shall not release any dangerous substances in the environment.

4.4 Precision

In cases of uncertainty, the procedures described in RS ISO 4259 for interpretation of the results based on test method precision shall be used.

5 Sampling

5.1 Samples of bulk products shall be taken as described in ASTM D140.

5.2 Test samples shall be taken from the laboratory samples, and prepared for testing, as described in ASTM D140, RS ISO 4259 and RS ISO 3170.

6 Evaluation of conformity

6.1 General

The compliance of paving grade bitumen with the requirements of this Standard and with the stated values (including grades) shall be demonstrated by:

a) Initial Type Testing (ITT); and

b) Factory Production Control (FPC).

NOTE The information from evaluation of conformity is often available for audit as provided in a manufacturer's quality plan.

6.2 Type testing

6.2.1 Initial Type Testing (ITT)

Initial type tests shall be performed to show the conformity of the bitumen/bituminous binder with this Standard. Tests previously performed in accordance with the provisions of this Standard (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc…) may be taken into account. All the characteristics required in the Standard shall be subject to initial type testing except dangerous substances, which may be declared by control of the raw materials, and characteristics where NR is chosen.

6.2.2 Further Type Testing

Whenever a change occurs in the base materials or the production process, which would change significantly one or more of the characteristics, the further type test shall be repeated for the appropriate characteristic(s).

6.2.3 Sampling, testing and compliance criteria

6.2.3.1 Sampling shall be taken as specified in Clause 5.

6.2.3.2 The results of all type tests (initial and further type tests) shall be recorded, held by the manufacturer for at least five years from the date of the test and be available for inspection.

6.2.4 Durability test for bitumen

Durability of bitumen shall be tested according to annex B.

6.3 Factory Production Control (FPC)

6.3.1 General

6.3.1.1 The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform to the stated performance characteristics. The FPC system shall consist of procedures, regular inspections, tests or assessments and the use of the results to control the quality of the finished product.

6.3.1.2 An FPC system conforming to the requirements of RS ISO 9001 and made specific to the requirements of this standard shall be deemed to satisfy the above requirements.

6.3.1.3 The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded and retained for the period specified in the manufacturer's FPC procedures.

6.3.2 Equipment

6.3.2.1 In accordance with testing, all weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

6.3.2.2 In accordance with manufacturing, all equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures on equipment identified by the manufacturer as necessary to achieve or maintain product quality and the records retained for the period defined in the manufacturer's FPC procedures.

6.3.3 Base materials

The acceptance criteria for all incoming base materials shall be documented, as shall the inspection scheme for ensuring their conformity.

6.3.4 Product testing and evaluation

6.3.4.1 The acceptance criteria for all incoming base materials shall be documented, as shall the inspection scheme for ensuring their conformity.

6.3.4.2 The manufacturer shall establish procedures to ensure that the stated values of all the characteristics are maintained. The characteristics and the means of control are:

a) all characteristics shall be subject to the tests described in 6.2 and a minimum of once per year; and

b) routine control of product quality shall be on a basis of checks, of a type and a frequency to be defined and documented, to ensure that properties do not change significantly from those subject to type testing.

6.3.4.3 The tests for consistency at intermediate and elevated service temperatures, and for durability, shall be carried out on a representative sample of product for supply to customers.

Where batch production is carried out, the sample should be taken from the batch, which is considered as the quantity of bitumen produced and stored in one tank once the production run into tank has been completed.

The batch is considered to remain the same as long as no new production has been added.

6.3.4.4 In case of loading through an in-line blender, the routine quality control may be carried out on the feeder tanks and a procedure for checking the performance of the blender shall be in place.

6.3.4.5 The appropriate testing frequencies vary with individual supply facilities, throughput and processes. Minimum frequencies shall be:

a) consistency at intermediate service temperature: daily; if product is supplied directly from a tank that has not received new production then the minimum test frequency may be extended to a batch;

b) consistency at elevated service temperatures: monthly; and

c) durability, brittleness at low service temperature, temperature dependence of consistency: annually.

6.3.5 Traceability and marking

Individual product batches shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability information and/or markings are inspected regularly in compliance with RS ISO 9001.

6.3.6 Non-conforming products

The manufacturer shall have written procedures which specify how non-conforming products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures in compliance with RS ISO 9001.

6.3.7 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of nonconformities in order to prevent recurrence in compliance with RS ISO 9001.

6.3.8 Handling, storage and packaging

The manufacturer shall have procedures providing methods of product handling and shall provide storage areas that can prevent damage or deterioration.

Annex A
(normative)

Calculation of the penetration index, Ip

A.1 General

Penetration Index Ip is the indication of the thermal susceptibility of a bituminous binder. This Annex specifies the procedure to be used for calculating the penetration index, Ip, of paving grade bitumen when required by the designer, client or any other user.

Example In relation to the specification for resistance to hardening given in Table 1A for grades between 35/40 and 85/100.

A.2 Principle

The penetration index, Ip is calculated from the values of penetration at 25 °C, 100 g, 5 s, determined in accordance with ASTM D5 and the softening point, determined in accordance with ASTM D36.

NOTE 1 It is based on the following hypothesis of Pfeiffer and Van Doormael:

a) At the temperature of the softening point, the penetration of a bitumen is 800 x 0.1 mm.

b) b) When the logarithm (base 10) of penetration is plotted against temperature, a straight line is obtained, the slope A of which is defined by:

$$\frac{20 - PI}{10 + PI} = 50A$$

NOTE 2 A penetration index of zero is attributed to a bitumen with a penetration at 25 °C of 200 × 0.1 mm and a softening point of 40 °C.

A.3 Determination

Calculate the Ip from the following equation:

$$I_p = \frac{20 \times t_{RaB} + 500 \times \lg P - 1952}{t_{RaB} - 50 \times \lg P + 120}$$

Where:

t_{RaB} is the softening point, in degrees Celsius;

l_g P is the logarithm (base 10) of the penetration at 25 °C (in 0.1 mm)

A.4 Expression of results

Report the penetration index as the value, calculated according to A.3, rounded to the nearest 0,1 of a unit.

A.5 Precision

A.5.1 Repeatability

The difference between two successive test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material would exceed 0.3 in only one case in twenty.

A.5.2 Repeatability r

The difference between two single and independent results obtained by different operators working in different laboratories on identical test material would exceed 0.5 in only one case in twenty.

Annex B
(normative)

Durability test method for bitumen

B.1 Principle

Films of the test bitumen (1.0 mm thick) are oxidised at 600C under 2.069 kPa (300 psi) of air for 80 hours. The samples are removed after 80 hours and the dynamic shear modulus is measured at 5°C and 9 Hz and compared to standard values based on the behaviour of bitumen of the same penetration grade.

This test method can be used to assess the long-term field durability (resistance to oxidative hardening) of penetration grade bitumen.

NOTE This test method involves the use of hazardous operations and equipment. It does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use

B.2 Test method

B.2.1 Apparatus and Materials

B.2.1.1 Cylinder of industrial-grade compressed dry air, fittings and hose for connection to pressure vessel.

B.2.1.2 Pressure vessel system is comprising of:

a) pressure vessel certified for operation operation at 2069 kPa (300 psi) and 600C;

b) thermocouple, thermistor or platinum resistance thermometer, and temperature logging device accurate to +0.10C, to measure the temperature inside the vessel;

c) pressure release valve that prevents the pressure inside the vessel exceeding the maximum design pressure;

d) pressure regulator capable of controlling the pressure inside the vessel at 2,069 +34 kPa (300+5 psi);

e) pressure gauge readable to 10 psi and calibrated at 2069 kPa (300 psi); and

f) slow release bleed valve to allow depressurization of the vessel from the test pressure to atmospheric pressure over five to 10 minutes.

B.2.1.3 Stainless steel or aluminium sample holders capable of holding at least 1.0 g of bitumen as a uniform, 1.0 mm thick, horizontal film.

B.2.1.4 A metal rack or holder capable of supporting at least three sample holders in a horizontal position so that the bitumen film thickness within the sample holders remains uniform.

B.2.1.5 A metal rack or holder capable of supporting at least three sample holders in a horizontal position so that the bitumen film thickness within the sample holders remains uniform.

B.2.1.6 A stirred temperature-controlled fluid bath or forced- draft oven capable of maintaining the temperature inside the pressure vessel at 60.0 + 0.10C.

a) if a water bath is used it must be fitted with a water inlet and level control device so that a constant water level is automatically maintained over long periods; and

b) b) both the bath or oven must be sufficiently large to allow air or the bath fluid to freely circulate around the vessel, and contain a shelf or stand to allow the vessel to held in a horizontal (level) position.

B.2.1.7 It is recommended is that the position of the vessel relative to the sides of the bath or oven is kept fixed

B.2.1.8 A vacuum oven and pumping system capable of maintaining 100 °C ± 5°C and a vacuum of <6.9 kPa.

B.2.1.9 Dynamic shear rheometer or similar instrument capable of applying sinusoidal loading and measuring the dynamic shear modulus of bitumen at 9 Hz and 5°C.

B.2.1.10 Hotplate

B.2.1.11 Balance readable and accurate to +0.001 g.

B.3 Procedure

B.3.1 Initial Setup of Pressure Vessel

B.3.1.1 place the pressure vessel in the 60ºC water bath or oven to be used in the test, and pressurise to 2,069 ± kPa (300 ± 10 psi)

B.3.1.2 the thermocouple should be positioned near the vertical axis of the vessel and at approximately half height

B.3.1.3 after four hours, log the temperature inside the vessel at 15 min intervals for at least 24 h and adjust if necessary so that a temperature of 60.0 °C ± 0.1°C is maintained.

B.3.2 Preparation of Sample Bitumen Films

B.3.2.1 Weigh a sufficient quantity of bitumen onto the centre of the sample holder to achieve a 1.0 % ± 0.1 % mm film at 600°C. If the density of the bitumen is not known assume a density of 1.0 g cm-3 at 60.0 °C

B.3.2.2 Heat the sample holder on a hot plate at 90°C -110°C for three to four minutes to achieve an even film, and allow to cool to room temperature on a level surface.

B.3.3 Ageing the bitumen films

B.3.3.1 Before the test is begun, ensure that the pressure vessel (containing the sample holder rack) is maintained at 60.0oC for at least four hours

B.3.3.2 Remove the pressure vessel from the bath or oven and place the sample holders in the vessel

B.3.3.3 Return the vessel to the bath and pressurize the vessel to 2069 ± 34 kPa. The sample loading operation must be completed within five minutes and preferably as rapidly as possible to avoid cooling of the vessel

B.3.3.4 After 15-20 minutes, check the pressure in the vessel and re-adjust if necessary.

B.3.4 Removing the bitumen films from the pressure vessel

B.3.4.1 After 80 h (+15 min) allow the pressure vessel to depressurise slowly over about five minutes (to avoid excessive bubbling of the samples), and before removing the vessel from the bath

B.3.4.2 Remove a sample holder and scrape the oxidised film into a small vial. Heat the sample under vacuum (< 6.9kPa) at 100 °C ± 5°C for 30 min. Quickly release the vacuum, remove the vial and stir the sample. Store in a freezer.

B.3.5 Modulus measurement

Exact analysis details vary according to the type of rheometer used but analysis must be consistent from sample to sample.

a) The modulus measurement is carried out using an 8mm parallel geometry with a 1.0mm gap. Larger diameter plates can be used if it can be demonstrated that the compliance of the instrument is not significantly affecting the measured modulus.

b) A preliminary stress sweep may be necessary to ensure that the strain used lies within the linear viscoelastic region.

c) The bitumen is annealed at 1200C for 10 minutes before testing; and

d) The sample is brought to the test temperature of 5.0±0.10C and the modulus measured at 9 ± 0.1Hz.

B.3.6 Reporting

The following information is to be reported:

a) ample identification and testing date;

b) modulus (to the nearest MPa) of the untreated bitumen;and

c) modulus (to the nearest MPa) of the oxidised bitumen (the Durability value)

B.3.7 Precision

As a guide, based on measurements made on four different bitumen (ranging from 64 to 186 penetration at 250C), the single operator repeatability of the measured modulus is +7%.

Bibliography

[1] ASTM D979: 2015, *Standard Practice for Sampling Bituminous Paving Mixtures*

[2] ASTM D92 :2018, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Test*

[3] RS EAS 424: 2005, *Hydraulic road binders — Composition, specifications and conformity criteria*

[4] RS ASTM D3142, *Standard Test Method for Specific Gravity, API Gravity, or Density of Cutback Asphalts by Hydrometer Method*

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