South African Road Federation

Standard Specifications for Road and Bridge Works

CHAPTER 9. ASPHALT LAYERS

COTO 2020

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South Africa
COTO
Committee of Transport Officials

Standard Specifications for Road and Bridge Works for South African Road Authorities

Draft Standard (DS)
CHAPTER 9: ASPHALT LAYERS
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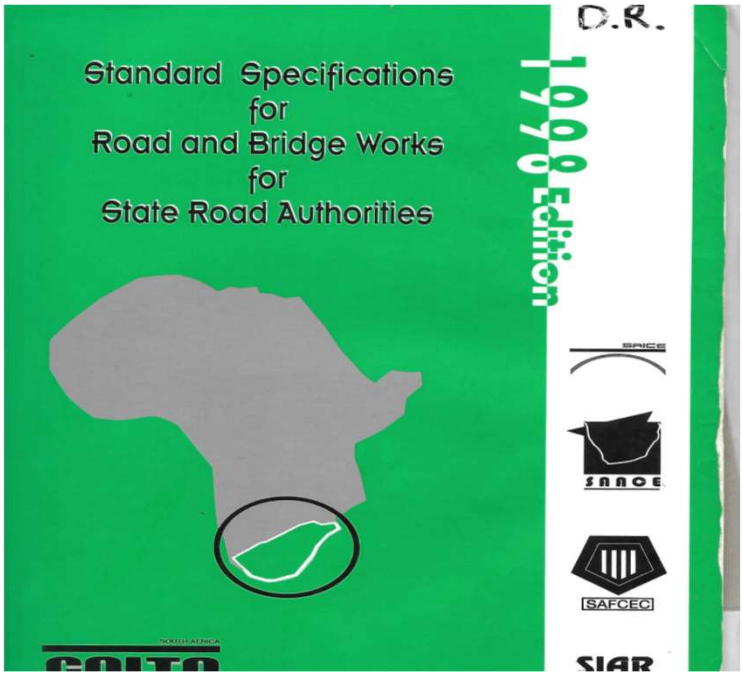
Contract Specifications

- 1987 – CSRA (Orange book)
- 1998 – COLTO (Green Book)
- 2020 – COTO (Green)



Specifications!
Why change?

- Keep up with technology development
- Keep up with social/political/procurement developments
- Close any “loop-holes” and manipulation by contractors?

Specifications

Before compiling a specification we must have a design (not product design)

- Deformation resistance
- Fatigue/Durability resistance
- Impermeability
- Cannot have best of all in a single layer!

A balance of performance/demand weighting or "multi-layers"

SPECIFICATIONS

- What do we want? (Selection & Design)
- How do we order it? (Specifications)
- How do we know that we have got what was ordered? (QA- Chapter 20)

Types of specifications

- End-product specification
- Method specification
- Performance-based specification

NEW COTO Chapter 9 refers extensively to SABITA and other Manuals/Guidelines

Manual 1	Technical guidelines: Construction of bitumen rubber seals (TRH3 ?)
Manual 2	Bituminous binders for road construction and maintenance (CD)
Manual 3	(Withdrawn)
Manual 4	(Withdrawn)
Manual 5	Guidelines for the manufacture and construction of hot mix asphalt
Manual 6	(Withdrawn)
Manual 7	SuperSurf – Economic warrants for surfacing roads
Manual 8	Guidelines for the safe and responsible handling of bituminous products (CD)
Manual 9	(Withdrawn)
Manual 10	Bituminous surfacing for low volume roads and temporary deviations (CD)
Manual 11	Labour enhanced construction for bituminous surfacings (Chapter 10 Part B?)
Manual 12	Methods and procedures – Labour intensive construction for bituminous surfacings (CD)
Manual 13	LAMBs – The design and use of large aggregate mixes for bases
Manual 14	(Superseded by TG2)
Manual 15	(Withdrawn)

Manual 16	Withdrawn
Manual 17	Porous asphalt mixes: Design and use
Manual 18	Appropriate standards for the use of sand asphalt (Manual 35?)
Manual 19	Guidelines for the design, manufacture and construction of bitumen rubber asphalt wearing courses
Manual 20	Sealing of active cracks in road pavements (Chapter 8 ?)
Manual 21	(Superseded by TG2)
Manual 22	Hot mix paving in adverse weather
Manual 23	Code of practice: Loading bitumen at refineries (CD)
Manual 24	(Withdrawn)
Manual 25	Code of practice: Transportation, off-loading and storage of bitumen and bituminous products
Manual 26	Interim guidelines for primes and stone pre-coating fluids

Manual 27	Guidelines for thin hot mix asphalt wearing courses on residential streets
Manual 28	Best practice for the design and construction of slurry seals (Chapter 8 ?)
Manual 29	Guide to the safe use of solvents in a bituminous products laboratory (Chapter 1 ?)
Manual 30	A guide to the selection of bituminous binders for road construction
Manual 31	Guidelines for calibrating a binder distributor to ensure satisfactory performance
Manual 32	Best practice guideline and specification for warm mix asphalt
Manual 33	Design procedure for high modulus asphalt (EME)

Manual 34	(A) Guidelines to the transportation of bitumen and (B) Bitumen spill protocol (CD and Booklets)
Manual 35/ ~~TRH8~~	Design and use of Asphalt in Road Pavements
Manual 36	Use of reclaimed asphalt in asphalt mixes (TRH 21 !!)
Manual 37	Sampling of road construction materials (TMH 5)
Manual 38	Surfacing Seals (TRH3) ??????

Technical Guidelines

TG1	The use of modified binders in road construction (NCRT ?)
TG2	Bitumen stabilised materials
TG3	Asphalt reinforcement for road condition

DVDs

DVD100	Test methods for bituminous products
DVD200	Training guide for the construction and repair of bituminous surfacings by hand
DVD300	Manufacture, paving and compaction of hot mix asphalt
DVD410	The safe handling of bitumen
DVD420	Treatment of bitumen burns
DVD430	Working safely with bitumen
DVD440	Firefighting in the bituminous products industry
DVD450	Safe loading and off-loading of bitumen

Selection and design = critical component

Permanent deformation (rutting)

- Dependant on degree of expected traffic loading
- Dependant on mix type
- Dependant on layer thickness

Poor performance

WHO'S TO BLAME????

Selection and design = critical component

Fatigue

- Dependant on expected traffic loading
- Dependant on supporting layer stiffness
- Dependant on mix type
- Dependant on layer thickness

Selection and design = critical component

Impermeability

- Dependant on supporting pavement layer (granular, bound – asphalt, concrete etc.)
- Dependant on mix type compactability (pre-coated chippings and joints)
- Dependant on layer thickness (maximum particle size, ease of orientation)

Selection and design = critical component

Durability

- Dependant on binder content (richness of mix etc.)
- Dependant on climate (UV ageing)
- Dependant on layer thickness (top down cracking)
- Dependant on layer permeability (ingress of air/moisture)

Poor performance!

WHOS TO BLAME????

Selection and design = critical component

Texture

- Micro texture (low speed skid resistance)
- Macro texture (high speed skid resistance – reduce aquaplaning) characteristics

Selection and design = critical component

Impermeability

- Dependant on supporting pavement layer (granular, bound – asphalt, concrete etc.)
- Dependant on mix type compactability (pre-coated chippings and joints)
- Dependant on layer thickness (maximum particle size, ease of orientation)

TABLE OF CONTENTS

CHAPTER 9: ASPHALT LAYERS 9-1

9.1 ASPHALT LAYERS 9-1

PART A: SPECIFICATIONS 9-1

PART B: LABOUR ENHANCEMENT 9-20

PART C: MEASUREMENT AND PAYMENT 9-22

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES 9-28

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

A 9.1.1 SCOPE

A 9.1.2 DEFINITIONS

A 9.1.3 GENERAL

A 9.1.4 DESIGN BY CONTRACTOR

A 9.1.5 MATERIALS

A 9.1.6 CONSTRUCTION EQUIPMENT

A 9.1.7 EXECUTION OF THE WORKS

A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

Definitions

Asphalt mix types –

A mixture of aggregate, with or without active filler, and an appropriate bituminous binder proportioned in such a manner as to produce a final product conforming to all the relevant mix, and or, performance properties as specified. Asphalt mixes are classified into two fundamental mix types and may incorporate either standard, homogenous modified or non-homogenous (bitumen-rubber) bitumen.

Definitions

Sand skeletal mixes:

Where the loads on the layer are carried by a continuous matrix of the finer aggregate fraction. There is no meaningful contact between the individual coarse aggregate particles and only provide bulk while not compromising the continuity of the finer fraction. Examples include:

- Semi-gap graded asphalt (AS), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Gap-graded asphalt (AG), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Fine/medium continuously graded asphalt mixes (AC), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Bitumen-rubber gap-graded (BRAGG), as further defined in Sabita Manual 19; Design and Use of Asphalt in Road Pavements

Definitions

Stone skeletal mixes:

Where a continuous matrix (skeleton) of coarse aggregates carries the imposed loads. In dense mixes the spaces between the coarse aggregate fractions are filled by the finer aggregate fractions to an extent that assures that the skeleton is not dilated, and contact between the coarser aggregate particles is maintained. In porous mixes, the spaces between the coarse aggregates are void. Examples include:

- Coarse continuously graded (AC), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Stone mastic (SMA), as further defined in Sabita Manual 35; Design and Use of Asphalt in Road Pavements
- Ultra-thin friction course (UTFC)
- High modulus base (EME), as further defined in Sabita Manual 33; Design Procedure for High Modulus Asphalt (EME)
- Porous (AP), as further defined in Sabita Manual 17; Design of Porous Asphalt Mixes
- Bitumen-rubber gap graded (BRAGG), as further defined in Sabita Manual 19; Guidelines for the Design, Manufacture and Construction of Bitumen-Rubber Asphalt Surfacings.
- Bitumen-rubber open graded (BRAOG). as further defined in Sabita Manual 19; Guidelines for the Design, Manufacture and Construction of Bitumen-Rubber Asphalt Surfacings
- Proprietary mixes, such as UTFC, which have been independently certified as fit-for-purpose.

The particular mix type, and or, any additional requirements, shall be as specified in the Contract Documentation.

Definitions

Asphalt mixes:

Hot mix asphalt (HMA) – asphalt produced in the traditional manner at mixing and placing temperatures appropriate to the inherent rheological properties of the binder incorporated.

Definitions

Asphalt mixes:

Warm mix asphalt (WMA) – as per a standard hot mix asphalt type and requirements, with the exception that an appropriate agent is introduced to enable mixing and placement of the specific product at reduced temperatures.

Definitions

Asphalt mixes:

Cold mix asphalt (CA) – asphalt, generally including a proprietary agent that has been pre-mixed in a mixing plant, packaged and stored for future applications at ambient temperatures. The specific mix, performance and application requirements of such mixes are not prescribed in this Chapter but shall be as specified in Chapter 8, or in the Contract Documentation. Cold mix products may also be prescribed as being fit for purpose for specific applications as certified by an approved independent certification agency.

Definitions

Asphalt mixes:

Recycled asphalt – as per any standard asphalt mix type, with the exception that a proportion of the mix, as may be prescribed or otherwise, shall consist of asphalt reclaimed from existing layers and appropriately processed and included in the mixture together with an approved rejuvenating agent if required.

Definitions

Asphalt mixes:

Certified asphalt mixes - asphalt mixes, such as UTFC or cold-mix products that have been certified as being fit for purpose for the required functional, and or, structural properties as required. Such Certification Agency may be Agrèment SA, or any other accredited facility, as approved by the Employer. Such products may be constructed with, or without, extended performance guarantees, and shall be constructed as prescribed in Part D, or any other Chapter of these specifications.

Definitions

Aggregate

Course aggregate – all aggregate > 5,0 mm as further defined in the latest SANS 1083 specification for the specific class of aggregate and nominal maximum particle size as specified.

Definitions

Asphalt mixes:

Nominal maximum particle size (NMPS) – designated as one sieve size larger than the largest sieve to retain a minimum of 15 percent of the aggregate particles as defined in SANS 1083.

Definitions

Asphalt mixes:

Fine aggregate – all aggregate fractions ≤ 5,0 mm > 0,075 mm and which may consist of clean material derived from crushing competent parent rock, or naturally occurring sand conforming to good practice and any further specified requirements.

Definitions

Asphalt mixes:

Filler – material predominantly < 0,075 mm which may consist of natural rock flour, extracted bag-house fines, or a manufactured active filler such as hydrated lime or cement.

Definitions

Asphalt mixes:

Reclaimed asphalt (RA) – asphalt that has been appropriately milled off existing pavement layers, as well as asphalt discarded at the mixing plant that is crushed, screened and tested in accordance with the requirements contained in the latest version of TRH 21: Use of Reclaimed Asphalt in the Production of Asphalt.

Definitions

Bond coat – an appropriate bituminous product applied to an existing surface, (prime, spray seal, asphalt, or concrete pavement surface), in order ensure adequate bonding with the underlying substrate layer.

Definitions

Prime coat – an appropriate low viscosity bituminous product applied in a single application for the purposes of sealing and protecting the surface of granular or cemented base layers. The general requirements relevant to these products are covered in Chapter 8 of this document.

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

A 9.1.1 SCOPE
A 9.1.2 DEFINITIONS
A 9.1.3 GENERAL
A 9.1.4 DESIGN BY CONTRACTOR
A 9.1.5 MATERIALS
A 9.1.6 CONSTRUCTION EQUIPMENT
A 9.1.7 EXECUTION OF THE WORKS
A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

Nominal Mix Proportions

Table A9.1.3-1: Nominal Mix Proportions of Stone Skeletal Mixes for Tender Purposes

MIX TYPE	High Modulus Base (EME)		Continuous graded base and surfacing: conventional and homogenous modified bitumen			Stone Mastic Asphalt (SMA)		Continuous graded surfacing: Bitumen-rubber:		Gap graded surfacing: Bitumen-rubber:		Mixes containing reclaimed asphalt
Nominal maximum particle size (mm)	20	14	20	14	10	14	10	20,0	14,0	20,0	14,0	Refer to Note* 2 below and Contract Documentation
Aggregate (%)	93.0	92.0	94,0	93,5	93,0	92,5	92,0	92,0	91,5	91,5	91,0	
Bitumen (type and grade according to Contract Documentation) (%)	6,0	7.0	5,0	5,5	6,0	6,5	7,0	7,0	7,5	7,5	8,0	
Active filler*1 (%)	1.0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
Cellulose fibre (%)	N/A	N/A	N/A	N/A	N/A	0,5	0,5	N/A	N/A	N/A	N/A	

*Note 1: Active filler for tender purposes shall be hydrated lime

*Note 2: The nominal proportions for mixes containing reclaimed asphalt shall be as specified in the Contract Documentation dependent on the percentage of reclaimed asphalt or binder replacement limits specified or permitted. If no such amendments are specified, the standard nominal mix proportions tabled above shall apply.

Table A9.1.3-2: Nominal Mix Proportions of Sand Skeletal Mixes for Tender Purposes

MIX TYPE	Continuous graded base and surfacing: standard and homogenous modified bitumen			Gap and semi-gap mixes using standard and homogenous modified bitumen		Mixes containing reclaimed asphalt
Nominal maximum particle size (mm)	20	14	10	14	10	Refer to Note* 2 below and Contract Documentation
Aggregate (%)	94,0	93,5	93,0	92,5	92,0	
Bitumen (type and grade according to Contract Documentation) (%)	5,0	5,5	6,0	6,5	7,0	
Active filler*1 (%)	1,0	1,0	1,0	1,0	1,0	

*Note 1: Active filler for tender purposes shall be hydrated lime

*Note 2: The nominal proportions for mixes containing reclaimed asphalt shall be as specified in the Contract Documentation dependent on the percentage of reclaimed asphalt specified or permitted. If no such amendments are specified, the standard nominal mix proportions tabled above shall apply.

Table A9.1.3-3: Nominal application rates for bond coats and rolled-in chippings

Product	Nominal application rate	Bitumen %	Filler*1 (%)
Bond coat			
(a) Pavement	0,55 l/m²		
(b) Bridge decks	0,40 l/m²		
Rolled in chippings			
20 mm	8 Kg/m²	1,5	1,0
14 mm	6 Kg/m²	1,7	1,0
10 mm	4 Kg/m²	2,0	1,0

*Note 1: Active filler for tender purposes shall be hydrated lime

The nominal rates for tender purposes for the bond coat are based on 30 % stable grade emulsion. Nominal application rates for other bond coat products shall be as specified in the Contract Documentation.

The actual application rate for rolled-in chippings shall be as determined and approved by the Engineer based on the relative density of the aggregate and the target texture depth to be achieved.

Trial sections

Where so provided for under Measurement and Payment, the Contractor shall construct a trial section for each layer, and relevant mix type, specified. The purpose of the trial is for the Contractor to demonstrate that the equipment and processes that he proposes to use will enable him to construct the particular asphalt layer in accordance with all the specified requirements. Evaluation and monitoring of the trial section shall include all items listed in the South African Pavement Engineering Manual (SAPEM) Chapter 12, Table 11 and Chapter 12: Appendix – Asphalt Trial Section Check List.

The Contractor shall calibrate the equipment and refine the mix design and construction process at his own cost.

Trial sections: cont

The Engineer may require that up to 3 different binder contents be incorporated in one such trial section to verify the laboratory, and or, plant design phase and its behaviour/properties at the specified layer thickness being constructed.

The Contractor shall only commence with construction of the permanent work when such a trial section has been satisfactorily constructed and complies with all the specified requirements.
If the Contractor should make any alterations in the methods, processes, equipment or materials used and approved, or if he is unable to comply consistently with the specifications, the Engineer may require that a new trial section be constructed, at the Contractor's cost, before allowing the Contractor to continue with any permanent work. The intention of this clause is to avoid any experimentation by the Contractor on the permanent work.

Trial sections: cont.

The trial sections shall be laid where indicated by the Engineer. The Contractor shall prepare the surface on which to lay the trial section and shall also, if required, remove the trial section after completion and restore the surface on which it was constructed, all at the Contractor's cost.

Provision is made for payment of the first approved trial section of any particular mix type, but subsequent trial sections that may be required for the same mix type shall be at the Contractor's own cost. Payment will be made for the specified area of each approved first trial section for any particular mix type.

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

A 9.1.1 SCOPE
A 9.1.2 DEFINITIONS
A 9.1.3 GENERAL
A 9.1.4 DESIGN BY CONTRACTOR
A 9.1.5 MATERIALS
A 9.1.6 CONSTRUCTION EQUIPMENT
A 9.1.7 EXECUTION OF THE WORKS
A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

Mix designs

9.1.4.1 Mix designs

The fundamental mix type, stone or sand skeletal, as well as the associated sub-group and design level requirements, shall be as specified in the Contract Documentation. The asphalt design shall be reported on the latest version of the D3 Design form (Asphalt Mix Design) as listed in Appendix A of the South African Pavement Engineering Manual (SAPEM) published by the South African National Roads Agency Ltd (Sanral). No asphalt layers shall be constructed unless the specified, or other appropriate and accepted, mix design process has been carried out by the Contractor and submitted to the Engineer on the above form for assessment and approval.

A9.1.4.2 Mix design requirements

Unless otherwise specifically approved, the mix design methodology to be followed, appropriate mix volumetric properties, as well as all other relevant performance property criteria, shall conform to the relevant listed requirements as contained in the latest published version, at the time of tender, of the appropriate Sabita Manuals, for the following specific mix types as listed.

• Stone skeletal mixes:

- Continuous graded mixes: The latest version of Sabita Manual 35; Design and Use of Asphalt in Road Pavements. The design processes may consist of up to four levels as appropriate for the mix type as specified and relevant to the expected performance demands/risks. The level of design required shall be as stated in the Contract Documentation. The final mix proportions and properties shall conform to the requirements as tabled in Sabita Manual/35 for the specific mix type and design level prescribed.
- Stone mastic asphalt (SMA) mixes: The latest version of Sabita Manual 35, Appendix B
- High Modulus Asphalt (EME) mixes: The latest version of Sabita Manual 33: Design Procedure for High Modulus Asphalt (EME) for the specific class prescribed.
- Gap/open graded asphalt mixes incorporating bitumen-rubber: The latest version of Sabita Manual 19: Guidelines for the design, manufacture and construction of bitumen-rubber asphalt surfacings.
- Porous asphalt mixes: The latest version of Sabita Manual 17: Design of Porous asphalt mixes.

• Sand skeletal mixes

- Continuous, semi-gap and gap graded mixes: The latest version of Sabita Manual 35
- Any other specific mix types shall be designed in accordance with the Contract Documentation requirements.
- Independently certified as being fit for the intended purpose, such as Agrément SA, or any other independent certification authority as approved by the Engineer.

In all instances the mix properties shall conform to the latest requirements as listed in the relevant publications above for the specified mix type and design level.

The following shall, in all instances, be indicated in the Contract Documentation:

- Mix type (stone or sand skeletal mix)
- Specific mix type within the above category
- Level of design required, as appropriate for the specific mix type specified
- Nominal Maximum Particle Aggregate Size of the aggregate
- Binder type
- Nominal layer thickness

Where the incorporation of warm mix asphalt technology has been prescribed in the Contract Documentation, provision has been made in Part C: Pricing Schedule, for any extra over/under rate as may be applicable.

A9.1.4.4 Mix design period

As different design methodologies or levels have minimum time periods for completion, assessment and approval, the contractor shall ensure that he commences the specified design processes for the specific mix type and design level timeously to ensure that there are no delays to his construction program. The minimum time that shall be allowed for in the construction program is:

Sabita Manual 35: Level 1: 6 weeks

Sabita Manual 35: Level 2: 10 weeks

Sabita Manual 35: Level 3: 16 weeks

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

A 9.1.1 SCOPE
A 9.1.2 DEFINITIONS
A 9.1.3 GENERAL
A 9.1.4 DESIGN BY CONTRACTOR

A 9.1.5 MATERIALS

A 9.1.6 CONSTRUCTION EQUIPMENT
A 9.1.7 EXECUTION OF THE WORKS
A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

A9.1.5.2 BITUMINOUS BINDERS

- Penetration grade: Normal bitumen of standard grades and properties as specified in SANS 4001-BT1
- Performance grade: As specified in SATS 3028 – which covers standard bitumen or modified bitumen
- Homogenous modified binders: Penetration grade bitumen modified with appropriate polymers to achieve the specific class and relevant properties as listed in the latest version of Technical Guideline (TG1) - (Modified Binders for Road Construction) as published by the SA Asphalt Academy.
- Non-homogeneous modified binders (bitumen-rubber): A blend of penetration grade bitumen, rubber crumbs and any extender oils to achieve the specific class/grade and relevant properties as listed in the latest version of TG1 (Modified Binders for Road Construction –as published by The Asphalt Academy)
- Bitumen emulsion: A mixture of normal penetration grade bitumen which has been suitably emulsified with water to achieve the specific class/grade as specified. The relevant requirements and properties pertaining to a specific class/grade shall be as listed in SANS BT4001-BT4 to BT6.
- Modified bitumen emulsion: A mixture of normal bitumen and appropriate polymer that has been suitably emulsified with water to achieve the specific class/grade and properties as listed in the latest version of Technical Guideline TG1 (Modified Binders for Road Construction) as published by the SA Asphalt Academy

A9.1.5.4 Nominal Maximum Aggregate Size

•**Coarse aggregate grading**

•(i) The coarse aggregate component of any asphalt mix shall comprise of nominal single aggregate sizes conforming to the specific aggregate grading class and appropriately blended in the mixing plant. The blend shall be relevant to the mix type and layer thickness specified. The nominal maximum particle size (NMPS) utilised in any mix shall not exceed the maximum limits listed in Table A9.5.1-2 below.

Table A9.1.5-2 NMPS versus nominal layer thickness requirements

NMPS [mm]	Minimum layer thickness (mm))	
	Absolute minimum	Preferred minimum
7,0	20	25
10	30	35
14	45	50
20	80	90
28	110	120

Aggregate Grading Class

Course aggregate grading class.

Unless otherwise specifically permitted, the coarse aggregate components of any asphalt mix shall comply with the grading limits tabled in Table A9.1.5.-3 below for the relevant grading class and NMPS as listed. The grading class applicable to the relevant mix type shall be as follows:

i) **Grading class 1:**
- Continuously graded: stone skeletal
- High modulus asphalt (EME)
- Gap graded: stone skeletal mixes
- Ultra-thin friction courses (UTFC)
- Stone mastic asphalt (SMA)
- Porous asphalt

i) **Grading class 2:**
- Continuously graded: sand skeletal
- Semi-gap mixes
- Gap graded: sand skeletal mixes

Table A9.1.5-3: Grading limits for nominal single size coarse aggregate

	Nominal maximum particle size (NMPS) (mm)											
	28,0		20,0		14,0		10,0		7,1		5,0	
Grading grade	1	2	1	2	1	2	1	2	1	2	1	2
Sieve size (mm)	Percentage passing sieve size by mass											
37,5	100	100	-	-	-	-	-	-	-	-	-	-
28,0	85-100	85-100	100	100	-	-	-	-	-	-	-	-
20,0	0-20	0-35	85-100	85-100	100	100	-	-	-	-	-	-
14,0	0-5	0-5	0-20	0-35	85-100	85-100	100	100				
10,0			0-5	0-5	0-20	0-35	85-100	85-100	100	100		
7,1					0-5	0-5	0-20	0-35	85-100	85-100	100	100
5,0							0-5	0-5	0-20	0-35	85-100	85-100

Once the target grading has been fixed for each individual coarse aggregate fraction, the allowable tolerances shall not exceed 10% of that agreed for the target grading for each specific nominal maximum aggregate particle size. The contractor shall note that commercial suppliers may not be able to consistently supply all the required nominal single size aggregate to the specified tolerances. In such instances additional on-site screening may be necessary, for which no additional payment shall be made. The use of run of crusher type materials shall not be permitted.

Table A9.1.5-4: Fine aggregate grading limits for relevant mix type

Grading Grade	Grade 1	Grade 2	Stockpile Tolerance
	Percentage passing by mass		
Sieve Size (mm)	Class 1 Percent Passing	Class 2 Percent Passing	
	Stone skeletal mixes as defined	Sand skeletal mixes as defined	
7,1	100	85 - 100	5 %
5	90 - 100	70 - 90	5 %
2	65 - 90	45 - 70	5 %
1	45 - 70	28 - 50	5 %
0,6	30 - 50	19 - 34	5 %
0,3	18 - 30	12 - 25	4 %
0,15	10 - 21	7 - 18	3 %
0,075	5 - 15	5 - 15	2 %

When determined in accordance with SANS 3001-AG1, the Fineness Modulus (FM) of both the crushed and natural fine aggregates shall not deviate by greater than 0,2 from that determined on the fine aggregate incorporated in the approved design mix.

Table A9.1.5-5: Aggregate grading control points for a continuously graded sand skeletal mix (Sabita Manual 35)

	Sieve size (mm)	Nominal Maximum Particle Size (NMPS)			
		28.0	20.0	14.0	10.0
% passing sieve size by mass	37,5	100			
	28	80 - 100	100		
	20	< 85	80 - 100	100	
	14		< 85	80 - 100	100
	10			< 85	80 - 100
	7,1				< 85
	5				
	2	19 - 45	23 - 40	28 - 58	32 - 67
	1				
	0,600				
	0,300				
	0,150				
	0,075	4,0 – 7,0	4,0 – 8,0	4- 10	4 - 10

The grading control points shown in Table A9.1.5-5 shall be considered as a guideline only and not a specification grading envelope.

Bitumen rejuvenators

Where the use the use of reclaimed asphalt is permitted or prescribed, the percentage, and existing binder properties, of such material incorporated into the final mix as well as the limits of binder replacement shall dictate whether a bitumen rejuvenating agent is required to be added, or not. No specific product, or quantity thereof, is prescribed. The contractor shall however follow the generally accepted good practice guidelines contained in TRH21: Asphalt Recycling. The contractor shall provide the Engineer with sufficient proof that the product intended for use has a proven capability of producing a final bitumen product meeting all the requirement of the binder type specified, and that the final asphalt mix meets all the relevant properties as specified. No additional payment shall be made for including these products, the cost of which shall be deemed to be included in the relevant unit rates tendered for the specified constructed asphalt layers.

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

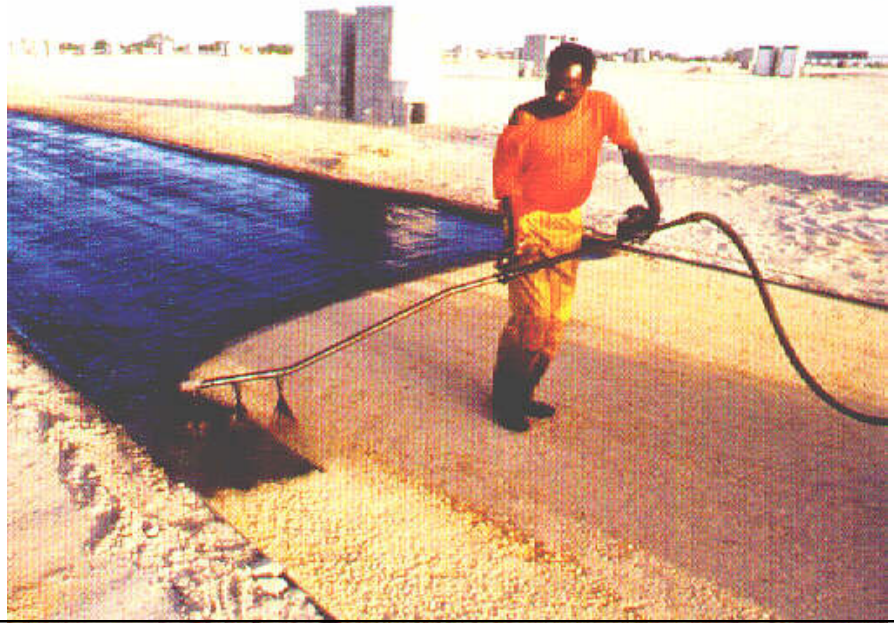
A 9.1.1 SCOPE
A 9.1.2 DEFINITIONS
A 9.1.3 GENERAL
A 9.1.4 DESIGN BY CONTRACTOR
A 9.1.5 MATERIALS
A 9.1.6 CONSTRUCTION EQUIPMENT
A 9.1.7 EXECUTION OF THE WORKS
A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

A9.1.6.6 Binder distributors

The bituminous binder bond coat shall be applied either by means of a “self-tacking” paver or by an approved binder distributor as follows:

Comply with SANS 3001-BT20 and shall be covered by a valid certificate of compliance with SANS 3001-BT20, not older than 12 months, issued by an accredited testing organisation

Not have any fuel, oil or binder leaks: etc.etc



Appropriate Standard

A9.1.6.8 Material transfer vehicle

Where so specified, and provision thereof is included in the pricing schedule, asphalt shall be transferred from the haul trucks into the paver hopper by means of a materials storage and transfer vehicle and no material shall be tipped directly from the truck into the paver with the exception of paving in restricted areas.

The materials storage and transfer vehicle shall be capable of storing and transferring the asphalt from truck to paver to ensure continuous paving. It shall contain an anti-segregation auger that remixes the asphalt just prior to delivery to the paver hopper in order to ensure a mix of uniform temperature.

Primes/bond coats:

Are we getting what is being paid for?

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

A 9.1.1 SCOPE
A 9.1.2 DEFINITIONS
A 9.1.3 GENERAL
A 9.1.4 DESIGN BY CONTRACTOR
A 9.1.5 MATERIALS
A 9.1.6 CONSTRUCTION EQUIPMENT
A 9.1.7 EXECUTION OF THE WORKS
A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

A9.1.7.5.Bond coat

NOTE:

The thinner the asphalt layer being placed, the more important the function/effectiveness of the bond layer becomes. (Adhesion to the substrate!)

A9.1.7.5.Bond coat

In all instances, unless otherwise, specified, a bond coat shall be applied to the surface to be paved. Concrete kerbing and channeling, as well as any other adjacent structure or completed pavement shall be protected against staining by bitumen being sprayed or asphalt being placed. Where any bitumen is to be sprayed, all such work shall be completely covered with polyethylene sheeting at least 0,25 mm thick, specially reinforced paper, or other approved material adequately secured to prevent the sheeting from lifting during windy conditions. Any permanent work stained by bitumen shall be broken down and replaced, unless all such bitumen is completely removed so as not to show any stains. Painting over stained work is strictly prohibited.

A9.1.7.5.Bond coat- cont

Unless otherwise specified in the Contract Documentation, the bond coat shall consist of a stable-grade bituminous emulsion, diluted to have a 30 % net bitumen content, and shall be applied at a nominal rate of 0.55 (l/m^2), or as directed by the Engineer. For bridge decks the bond coat shall be applied to the surface at a nominal rate of 0.4 (l/m^2). The bond coat shall not be applied more than 24 hours before the paving is to commence, and shall be fully cured prior to paving.

A9.1.7.5.Bond coat- cont

Before a new layer is placed adjacent to an existing layer, except in the case of open-graded or stone mastic mixes, the cut edge of the existing layer shall be hand painted with a bond coat of bituminous material of the same type used for the substrate bond coat. The bond coat shall fully coat the vertical face of the joint.

The use of hand-operated equipment for the application of bond coats, other than in restricted areas, shall be at the sole discretion of the Engineer, and his approval shall be timeously obtained.

Construction Joints

- Weakest link in the “chain” !!!!!
- G1 Base
- Asphalt surfacing

A9.1.7.9 Cutting of joints

All joints between adjacent sections of the work shall be formed by cutting back the edges of the paved layer in a straight line, either parallel or at right angles to the centerline, by a minimum of the width of the layer thickness being paved. Joints shall be neat and shall have the same texture and compaction level as the adjacent asphalt layer.

All joints shall be delineated by means of chalk lines prior to cutting. For sand skeleton mixes, such as semi-gap and fine continuously graded mixes, a cutting wheel may be utilized only if the layer is less than 50 mm in thickness and was paved within 24hours. For all other mix types, layers in excess of 50mm, or that have been left for longer than 24hours, the joints shall be formed either by means of saw cutting, using carborandum blades, or by an appropriate milling machine. All material emanating from preparing the joint shall be removed and transported to an approved site for possible recycling or other appropriate use or disposal. No payment for any such removed asphalt shall be made.

A9.1.7.9 Cutting of joints – cont

On completion of preparing the joint, the adjacent surface shall be inspected to ascertain that there has been no damage caused to the adjacent layer. Any identified damage shall be appropriately repaired prior to commencement of paving any adjacent asphalt layer.

Whenever the paving operation ceases due to lack of supply of mix, and the temperature of the mat has reduced to below the appropriate compaction temperature, the contractor shall form a proper transverse construction joint as specified.
Unless otherwise provided for, joints in the final layer of the surfacing shall correspond with the intended lane markings. Joints in lower layers shall be offset by not less than 150 mm from either side of the edges of any underlying substrate joint.

The allowable tolerances for joints shall be as specified in A9.1.8.3.

Air permeability test results

Stratified random positions	Selected positions adjacent to longitudinal joint
0,283 ($x10^{-8}cm^2$)	1,623 ($x10^{-8}cm^2$)
0,470	11,471
1,342	8,343
0,457	2.317
0,242	2,514
1,291	16,686
0,680	7,16
No Problem!	**Problem!**

Asphalt Construction Joints

New COTO Chapter 9

- All joints shall be cut back by at least the minimum of the paved layer thickness
- Using a 3 metre straight edge
- Measured every 1m interval on transverse joints and every 10 m on longitudinal joints

When measured along the level plane, the edge of the paved mat shall not deviate by:

- More than 3 mm over 80% of measurements
- More than 4 mm over 100% of measurements

A9.1.7.12 Asphalt temperature before opening to traffic

Newly paved asphalt shall not be opened to traffic until its surface temperature, as measured using a digital thermometer, has decreased to 50°C or less.

CHAPTER 9 : ASPHALT LAYERS

PART A: SPECIFICATIONS

A 9.1 Asphalt layers

A 9.1.1 SCOPE
A 9.1.2 DEFINITIONS
A 9.1.3 GENERAL
A 9.1.4 DESIGN BY CONTRACTOR
A 9.1.5 MATERIALS
A 9.1.6 CONSTRUCTION EQUIPMENT
A 9.1.7 EXECUTION OF THE WORKS

A 9.1.8 QUALITY OF MATERIALS AND WORKMANSHIP

A9.1.8.1 Dimensional tolerances – new construction

The completed sections of asphalt base and surfacing shall comply with the requirements for grade, width, thickness and cross section as stated below.

a) Level and grade

The level tolerances shall be as follows:

H90 ± 15 mm

Hmax ± 20 mm

Deviation from the specified longitudinal grade due to deviations from the specified levels shall not exceed the values given in Table A9.1.8-1.

Table A9.1.8-1: Maximum Deviation from Specified Grade

Length of deviation of grade (m)	Maximum variation from specified grade (%)
2	0,354
5	0,224
10	0,158
20	0,112
30	0,091

In the case of surfacing bridge decks, the difference in level between the new asphalt and any existing adjacent bridge joint or nosing shall not exceed 3,0 mm

b) Width

The average width of both asphalt base and surfacing shall be at least equal to that shown on the drawings and nowhere shall the outer edge of the layer be inside the lines shown on the drawings by more than 15 mm for both asphalt base and asphalt surfacing layers.

c) Thickness

The thickness tolerances shall be as listed in Table A9.1.8-2.

Table A9.1.8-2: Thickness Tolerances

Allowable Tolerances	Asphalt Base (mm)	Asphalt Surfacing (mm)
D 90	15	5
D Maximum	20	8
D Average	5	2

A.9.1.5.8 Sampling

a) Component and mix sampling:

Sampling of aggregates, bitumen and manufactured asphalt mix for testing shall be in accordance with the relevant methods prescribed in Sabita Manual 36: Sampling Methods for Road Construction Materials.

a) Routine inspection and tests

Routine inspection and tests will be carried out by the Engineer to determine the quality of the materials and workmanship for compliance with the requirements of this Chapter.

Test results and measurements shall be assessed in accordance with the provisions of this chapter as well as the applicable statistical judgment principles specified in Clause A20.1.7 of Chapter 20.

The contractor shall keep accurate records of:

- The position where every truckload of asphalt is paved (stake value, lane, date and time).
- The temperatures of the asphalt in the trucks both at the mixing plant and at the paving equipment immediately prior to discharging the load into the paver.
- The truck and load number from which test samples are taken. All samples taken shall be appropriately labelled and submitted to the Engineer for further testing and assessment.

			NO CHIPS			CHIPS			MONDLI		
DATE	#	XN T.M.R.D									
26-06-2010	1	2.637	2.515		95.4%	2.407		91.3%	2.505		95.0%
	2	2.637	2.541		96.4%	2.471		93.7%	2.486		94.3%
	3	2.637	2.529		95.9%	2.535		96.1%	2.367		89.8%
	4	2.637	2.511		95.2%	2.487		94.3%	2.468		93.6%
	5	2.637	2.521		95.6%	2.454		93.1%	2.528		95.9%
	6	2.637	2.537		96.2%	2.415		91.6%	2.494		94.6%
06-07-2010	7	2.657	2.497		94.0%	2.411		90.7%	2.534		95.4%
	8	2.657	2.509		94.4%	2.470		93.0%	2.451		92.2%
	9	2.657	2.487		93.6%	2.424		91.2%	2.463		92.7%
	10	2.657	2.502		94.2%	2.483		93.5%	2.42		91.1%
	11	2.657	2.450		92.2%	2.487		93.6%	2.447		92.1%
	12	2.657	2.571		96.8%	2.535		95.4%	2.508		94.4%
08-07-2010	13	2.646	29.10	2.45	92.6%	26.2	2.345	88.6%	31.2	2.306	87.2%
	14	2.646	29.70	2.475	93.5%	31.0	2.385	90.1%	31.1	2.465	93.2%
	15	2.646	38.10	2.494	94.3%	30.8	2.462	93.0%	34.4	2.441	92.3%
	16	2.646	32.80	2.401	90.7%	31.2	2.376	89.8%	31.6	2.41	91.1%
	17	2.646	27.40	2.499	94.4%	29.2	2.43	91.8%	33.3	2.478	93.7%
	18	2.646	27.80	2.488	94.0%	28.5	2.421	91.5%	29.4	2.457	92.9%
09-07-2010	19	2.645	30.40	2.488	94.1%	31.4	2.475	93.6%	27.2	2.503	94.6%
	20	2.645	31.60	2.507	94.8%	29.2	2.467	93.3%	33.4	2.476	93.6%
	21	2.645	27.40	2.471	93.4%	25.4	2.358	89.1%	32.6	2.436	92.1%
	22	2.645	30.80	2.508	94.8%	27.9	2.457	92.9%	27.9	2.418	91.4%
	23	2.645	30.20	2.517	95.2%	33.4	2.491	94.2%	38.0	2.485	94.0%
	24	2.645	29.40	2.496	94.4%	23.3	2.446	92.5%	29.8	2.502	94.6%
XN		2.646	30.392	2.499	94.42%	28.958	2.446	92.41%	31.658	2.460	92.7%
SN		0.007	2.933	0.034	1.37%	2.892	0.050	1.88%	2.978	0.051	2.0%
MAX		2.657	38.1	2.571	96.76%	33.4	2.535	96.13%	38	2.534	95.9%
MIN		2.637	27.4	2.401	90.74%	25.4	2.345	88.62%	27.2	2.306	87.2%
#		23	11	23	23	11	23	23	11	23	23

	DENSITY		COMPACTION		THICKNESS	
NO CHIPS	2.499		94.4%		30.392	
CHIPS	2.446		92.4%		28.958	
MONDLI	2.460	2.453	92.7%	92.5%	31.658	30.31
DIFFERENCE	2.499		94.4%		30.4	
	2.453		92.5%		30.3	
	0.046		1.9%		0.1	

A9.1.8.4 Surface regularity

a) Measured using inertial laser profilometers

For the lanes and surfaced shoulders wider than 2,0 m of the through road as well as interchange ramps and cross roads, the roughness of the surfacing will be determined by using an inertial laser profilometer as specified in Chapter 20, and capable of producing a Class 1 vertical measurement resolution, and a Class 3 longitudinal sampling distance as defined in ASTM standard (E950-09).

Surface shoulders less than 2,0 m wide, will be assessed according to measurements obtained from the adjacent trafficked lane.

The inertial laser profilometer shall be used to record the longitudinal profile in both wheel tracks (which shall be 1,75 m apart) of each traffic lane or shoulder wider than 2,0 m, as determent according to the final line markings that will be applied after construction. Should the two tracks not be measured simultaneously during the same pass, then procedures shall be implemented to ensure that the longitudinal profile data recorded for the two wheel tracks are at the same longitudinal profile data recorded for the two wheel tracks are at the same longitudinal location on the road.

a) Using a rolling straight-edge.

When the number of surface irregularities measured in accordance with Chapter 20 shall not exceed those given below (applicable to base and surfacing)

(i) Average number of irregularities per 100 m equal to or exceeding the specified value when taken over 300 m – 600 m lengths:

Freeways (3 mm irregularities)	
Asphalt with rolled-in chippings	5
Stone-mastic asphalt	4
Other asphalt layers	3
Other roads (5 mm irregularities)	
Asphalt with rolled-in chippings	4
Other asphalt layers	2

(i) Number of irregularities equal to or exceeding the specified value when taken over 100 m sections:

Freeways (3 mm irregularities)	
Asphalt with rolled-in chippings	8
Stone-mastic asphalt	6
Other asphalt layers	5
Other roads (5 mm irregularities)	
Asphalt with rolled-in chippings	6
Other asphalt layers	3

a) Three metre straight edge

The maximum value of any individual irregularity when measured with a 3 m straight-edge laid parallel to the road centre line and measured continuously in the individual wheel paths shall be:

Freeways

Asphalt surfacing	4 mm
Asphalt base	5 mm
Other roads	8 mm

A9.1.8.5 Grading

The combined aggregate and filler grading during production shall not deviate from the approved target grading by more than the tolerances given in Table A9.1.8-4. The mean grading of each lot of the working mix (minimum of 6 tests per lot) shall be determined from samples obtained in a stratified random sampling procedure. Consistent non-conformance to these limits shall require a new design process to be undertaken.

Table A9.1.8-4: Combined aggregate grading tolerances for sand skeleton mixes

Size of aggregate passing sieve size (mm)	Permissible deviation from target grading (%) for NMPS			
	7.1 mm	10 mm	14 mm	20 mm
28	0	0	0	0
20	0	0	0	± 5
14	0	0	± 5	± 5
10	0	± 5	± 5	± 5
7,1	± 5	± 5	± 5	± 5
5	± 4	± 4	± 4	± 4
2	± 4	± 4	± 4	± 4
1	± 4	± 4	± 4	± 4
0,600	± 4	± 4	± 4	± 4
0,300	± 3	± 3	± 3	± 3
0,150	± 2	± 2	± 2	± 2
0,075	± 1*	± 1*	± 1*	± 1*

*When Statistical methods are applied the permissible deviation for the 0,075 mm fraction is ± 2 %.

A.9.1.5.8 Sampling

a) Component and mix sampling:

Sampling of aggregates, bitumen and manufactured asphalt mix for testing shall be in accordance with the relevant methods prescribed in Sabita Manual 36: Sampling Methods for Road Construction Materials.

B9.1 ASPHALT LAYERS

PART B: LABOUR ENHANCED

CONTENTS

B9.1.1 SCOPE
B9.1.2 DEFINITIONS
B9.1.3 GENERAL
B9.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS
B9.1.5 MATERIALS
B9.1.6 CONSTRUCTION EQUIPMENT
B9.1.7 EXECUTION OF THE WORKS
B9.1.8 WORKMANSHIP

1. SCOPE

This section covers the labour enhanced activities associated with the placing of asphalt layers as specified in Part A.

PART C- MEASUREMENT AND PAYMENT

Item		Description	Unit
C9.1.1		**Asphalt mix designs**	
	C9.1.1.1	Stone skeletal mixes:	
	(a)	Continuously graded base or surfacing (state binder type and level of design).	Lump sum
	(b)	High modulus asphalt (EME) (state binder type and level of design)	Lump sum
	(c)	Stone Mastic Asphalt (SMA) (state binder type)	Lump sum
	(d)	Ultrathin Friction Courses (UTFC) (state binder type).	Lump sum
	(e)	Porous asphalt (state binder type).	Lump sum
	(f)	Bitumen rubber open and gap graded mixes (state mix type)	Lump sum
	(g)	Other – as stated and defined in the Contract Documentation	Lump sum

Item	Description	Unit
C9.1.2	**Construction of trial sections**	
C9.1.2.1	Asphalt layers (state mix type, layer thickness and placing technique (hand/paver))	square metre (m^2)
C9.1.2.2	Removal of trial section where so instructed by the Engineer.	square metre (m^2)

The unit of measurement for C9.1.2.1 shall be the square metre of asphalt placed in an approved trial section constructed for each mix type specified. The tendered rate shall include for all costs associated with constructing the trial in order for the Engineer to assess the in-place properties of the layer prior to commencing with permanent works. Assessment of the trial shall be as described in Clause A9.1.3.3. Any additional trial sections required as a result of the final product not meeting all the specified requirements shall not be subject to additional payment.

The unit of measurement for C.9.1.2.2 shall be the square metre of trial section removed to an approved site and the area reinstated as required.

Item	Description	Unit
C9.1.4	**Asphalt base**	
C9.1.4.1	New Construction	square metre (m^2)
(a)	Stone skeletal mix – continuously graded as defined (state layer thickness, binder type and design class/ level and placing technique)	
(b)	Stone skeletal mix – High Modulus (EME) as defined (state layer thickness, binder type, design class/ level and placing technique)	
(c)	Sand skeletal mix – continuously graded as defined (state layer thickness, binder type, design class/ level and placing technique)	
(d)	Any of the above mix types where the use of reclaimed asphalt has been specified (indicate maximum % reclaimed asphalt or binder replacement limits)	
(e)	Any mix certified for specific applications by an approved agency as being fit for the purpose and as specified in the Contract Documentation.	

In all cases state placing technique (hand/paver))

Item	Description	Unit
C9.1.6	**Extra over pay items C.9.1.4.1 and C.9.1.5.1 for placing small quantities of asphalt of less than 10 tons specially produced as specified in terms of Clause A9.1.7.1d)**	ton (t)

The unit of measurement shall be the ton of asphalt of a specific type and composition, less than 10 tons of which is produced on occasion, as specified, and measured in accordance with certified weighbridge tickets issued in regard to the mix type used.

The tendered rate shall be paid as extra over rates tendered for the relevant payment items listed above and shall include full compensation for all additional costs to produce and place small quantities of asphalt on instruction of the Engineer.

PART D- GUARANTEEES AND COMPLIENCE CERTIFICATES

D9.1 ASPHALT LAYERS

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

CONTENTS

D9.1.1 SCOPE
D9.1.2 GENERAL
D9.1.3 PERFORMANCE GUARANTEE REQUIREMENTS
D9.1.4 FUNCTIONAL PERFORMANCE ASSESSMENTS
D9.1.5 VISUALLY ASSESSED PROPERTIES
D9.1.6 INSTRUMENTALLY ASSESSED PROPERTIES
D9.1.7 EVALUATION FOR ACCEPTANCE
D9.1.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE
D9.1.9 NOTIFICATION OF REMEDIAL WORK
D9.1.10 REMEDIAL WORKS

D9.1.1 SCOPE

This Section covers the specifications related to the provision of functional and, or, structural layers of a road pavement structure comprising the asphalt surfacing, and, or the base layer (where specified) in terms of either a design and/or a performance guarantee to be provided by the Contractor. The duration of any such performance guarantees shall be as specified in the Contract Documentation and the issuing of a Taking-Over Certificate for the whole of the project. It includes performance parameters, field measurements, acceptance criteria and remedial work methodologies.

D9.1.2 DEFINITIONS

- Performance Period: The Performance Period shall be the number of years from the date of issue of the Taking-Over Certificate for the whole of the works as specified in the Contract Documentation.
- Taking Over Certificate: As defined in the General Conditions of Contract for the project.
- Performance Certificate: As defined in the General Conditions of Contract for the project.
- Performance Guarantee Period: The performance period shall be the number of years from the date of issue of the Taking-Over Certificate for the whole of the works as specified in the Contract Documentation.
- Performance Guarantees: Lodging of bank guarantees from an approved institution to the value and period as stated in the Contract Documentation.

D9.1.3 GENERAL

D9.1.3.1 Extended Performance Warranty

The work shall be constructed in terms of an extended warranty as specified in the Contract Documentation. The extended warranty, in the form of financial guarantees and in the format as prescribed by the Employer, shall be limited to the performance of the work. With the exception of de-bonding between the asphalt layers and the substrate, the Contractor shall not be held liable for any failures that might occur as a result of failure within the underlying layers. During the Extended Warranty Period, the Contractor shall also not be held liable for any damage to the layer/s resulting from external sources, including, but not limited to:

a) Traffic accidents

b) Spillage of fuel, oils, hazardous materials, etc. from public vehicles

c) Materials falling off public vehicles

d) Travelling of construction/tracked plant (other than his own) after completion of the Works.

Prior to the issuing of the Taking-Over Certificate, the Contractor shall provide two guarantees, each valued at 5 % of the cost of the layer/s (as per final constructed quantities measured under Part C of this Chapter (Measurement and Payment) for the performance of the layer/s. The guarantees shall be issued by a bank or other institution approved by the Employer and shall become effective on issue of the Taking-Over Certificate. They shall remain valid until released in terms of Table D9.1.3-1 and/or as specified in the Contract Documentation.

Table D9.1.3-1: Program of release of guarantees

Time	Activity
Completion of Works and issue of the Taking-Over Certificate	Provision of two guarantees (5 % & 5 %) Payment of 50% of retention (as per the relevant GCC)
Acceptable performance of Works one year after issuing of the Taking-Over Certificate	Payment of balance of retention to be released upon issuing of Performance Certificate (as defined in the GCC relevant to the Project)
Acceptable performance of layers (number of years as defined in the Contract Documentation) after issuing of the Taking-Over Certificate	Release of 1st guarantee (5%)
Acceptable performance of layers (number of years as defined in the Contract Documentation) after issuing of the Taking-Over Certificate	Release of 2nd guarantee (5%)

D9.1.4 DESIGN BY CONTRACTOR

It shall be the Contractor's responsibility to ensure that the information provided in the Contract Documentation is sufficient in order to carry out his own assessment of the condition of the road. The contract may carry out additional testing/assessment, after approval by the relevant road authority, in order to ensure that there is sufficient information for him to carry out an appropriate design in order for its performance to comply with the specified criteria.

In the event that a design is specified, the Contractor shall ensure that he has sufficient information to assess and accept the specified design and to ensure it shall perform to the specified criteria.

In order to achieve the design, or acceptance, of the specified design, the Contractor shall appoint a competent designer. The Contractor shall take full responsibility for the performance of the designer and no separate payment shall be made for any costs thereof, or for any additional testing deemed necessary.

Part D 5 - Materials

In most instances it would be expected that all materials would comply with the relevant requirements prescribed in PART A for that specific asphalt mix type proposed.

Any deviations require to be fully motivated as to reasons therefore – and included in the Quality Plan for the Project

Part D 6 - Construction Equipment

In most instances it would be expected that all construction equipment required would comply with the relevant requirements prescribed in PART A for that specific asphalt mix type proposed.

Any deviations require to be fully motivated as to reasons therefore – and included in the Quality Plan for the Project

Part D 7 - Execution of the Works

In most instances it would be expected that all execution of the works materials would comply with the relevant requirements prescribed in PART A for that specific asphalt mix type proposed.

Any deviations require to be fully motivated as to reasons therefore – and included in the Quality Plan for the Project

Part D 8 - Workmanship

D9.1.8.1 Contractor's obligation.

Specifications regarding workmanship as detailed in Part A of this Chapter for asphalt layers shall apply. In the event that there is a variation to the workmanship requirements and conditions of construction, the Contractor shall clearly state this in his tender document. Failure to do this shall result in the Contractor having to comply with all the workmanship requirements as stated in Part A.

D9.1.8.2 Permissible deviations

Notwithstanding the above the following shall also apply:

a) **Working mix**

The permitted deviation of the working mix from the accepted target mix proportions shall be within the limits specified in Form E1: Quality Assurance but shall in no instance exceed the limits listed in Part A of Chapter 9.

Assessment Criteria

Table D9.1.9-1: Performance parameters for the slow lane of dual carriageways and the travelled lane of single carriageways

Visually Assessed Parameters	Instrumentally Assessed Parameters	Test Assessed Parameters
1. Cracking	1. Deflection	1. Air Permeability
2. Bleeding	2. Rutting	2. Water Permeability
3. Raveling	3. Roughness	3. Marvil Permeability
	4. Mean Profile Depth	

Assessment criteria cont.

Table D9.1.9-2: Performance parameters for the shoulders of dual and single carriageways and inner lanes of dual carriageways

Visually Assessed Parameters	Instrumentally Assessed Parameters	Test Assessed Parameters
1. Cracking	1. Deflection	1. Air Permeability
2. Bleeding	2. Rutting	2. Water Permeability
3. Raveling	3. Roughness	3. Marvil Permeability

Cracking shall be defined as either Surface Cracking and/or Longitudinal and/or Transverse and/or Crocodile Cracking as defined in TMH9 Manual for Visual Assessment of Road Pavements, Part A and Part B referred to in Clause A20.1.4.11 of Chapter 20.

D9.1.10.1 Visual Assessments

Visual assessment shall be carried out in accordance with the requirements of TMH9 as referred to in Clause A20.1.4.11 of Chapter 20. The visually assessed parameters as well as the calculated Combined Index Value shall meet the Acceptance Criteria listed in Table D9.1.10-1 below, which shall be applicable at the termination of the product Performance Guarantee Period, i.e. the performance period stated from the date of the issue of a Taking-over Certificate for the Works. Interim visual assessments shall be as specified in the Contract Documentation.

The visual assessments of the pavement during the Performance Guarantee Period shall be undertaken by means of an assessment panel comprising the following representatives:

- Employer: 2 representatives
- Contractor: 2 representatives
- Engineer: 2 representatives

Table D9.1.10-1: Acceptance criteria for visually assessed types of distress

Type of Distress	Maximum allowance					
	Degree[1]	CIV[2]				
		Class 1	Class 2	Class 3	Class 4	Class 5
Cracking	2	0,05	0,05	0,1	0,10	0,15
Bleeding (flushing)	2	0,1	0,1	0,1	0,15	0,2
Surface raveling	1	0,05	0,05	0,1	0,1	0,15

Notes:

1. *The degree of a visually assessed parameter as specified in TMH9 Manual for Visual Assessment of Road Pavements Part A and Part B, issued by the Committee of Transport Officials (COTO) May 2016.*
2. *Combined Index Value (CIV) per one kilometre length of lane or shoulder. The calculation for CIV is defined in Clause D10.1.5.3 of Chapter 10.*

D9.1.10.2 Deflection

Deflection measurements shall be carried out as specified in Clause A20.1.5.5e) of Chapter 20. Where so specified in the Contract Documentation, at the end of the Performance Guarantee Period, the structural capacity of the road pavement, as determined in terms of deflection measurements, shall conform to be acceptance criteria presented in Table D9.1.10-2 below. The acceptance criteria is specified in terms of the maximum deflection (Ymax), base layer index (BLI) and middle layer index (MLI) as calculated from FWD deflection measurements. Segment lengths of 1,0 km in length shall be identified for evaluation. The 90th percentile value per segment shall be used to judge acceptance.

Table D9.1.10-2: Acceptance criteria for deflection

Base type	Maximum 90th Percentile Value (Micron)	Class 1	Class 2	Class 3	Class 4	Class 5
Granular (G1)	Y_{max}	500	600	650	1 000	1 500
	BLI	190	240	250	420	800
	MLI	50	75	100	160	350
Asphalt	Y_{max}	420	510	680	NR	NR
	BLI	155	140	175	NR	NR
	MLI	30	50	100	NR	NR
Bitumen Modified	Y_{max}	450	500	600	650	NR
	BLI	170	190	240	250	NR
	MLI	40	50	75	100	NR
Cement Treated	Y_{max}	NR	NR	440	590	1 000
	BLI	NR	NR	85	110	290
	MLI	NR	NR	45	90	240

Notes:

1. *Class 1 to 5 are defined in TRH26 – South African Road Classification and Access Management Manual issued by the Committee of Transport Officials Version 1.0, August 2012.*
2. *NR – Not Recommended*

Table D9.1.10-3: Specification for rut depth criteria

Maximum length (%) of segment with rut depth worse than limiting value	Profilometer measurements: Limiting Rut Depth (mm)				
	Class 1	Class 2	Class 3	Class 4	Class 5
10 %	6	8	8	8	10
5 %	8	10	10	10	15
0 %	10	15	15	15	20

D9.1.10.4 Roughness

Roughness shall be measured in accordance with Clause A20.1.5.5c). At the end of the Performance Guarantee Period, as determined in terms of the Specified Methodology, the surface roughness as determined in accordance with Clause A20.1.5.5c), shall not exceed the values as specified in Table D9.1.10-4 below.

Table D9.1.10-4: Specification for roughness criteria

Maximum length (%) of segment with roughness worse than limiting value	Roughness measurements limiting IRI (mm)									
	Class 1		Class 2		Class 3		Class 4		Class 5	
	S	AC	S	AC	S	AC	S	AC	S	AC
10 %	2,2	1,8	2,5	2,0	3,0	2,5	3,6	3,0	4,4	3,5
5 %	2,5	2,1	2,7	2,2	3,5	3,0	3,9	3,5	4,7	4,0
0 %	2,7	2,3	3,0	2,5	4,0	3,5	4,8	4,0	5,0	4,5

Notes:

1. *S – Single or Double Seal Surfacing*
2. *AC – Asphalt Surfacing*

Remedial Work

Table D9.1.12-1: Remedial work

Type of Distress	Acceptance Criteria: Clause	Minimum Remedial Measures
Cracking	D9.1.10. 1	Mill out full depth of defective surfacing including pavement layers, if required, and reconstruct
Bleeding (flushing)	D9.1.10.1	Mill out full depth of defective surface and replace surfacing
Surfacing raveling	D9.1.10.1	Repair with AC or mill out full depth of defective surfacing and replace surfacing
Excessive deflection	D9.1.10.2	Mill out full depth of surfacing and pavement layers to pre-determined depth and reconstruct pavement layers and surfacing
Rutting	D9.1.10.3	Mill out full depth of defective surfacing including pavement layers if required, and reconstruct
Roughness	D9.1.10.4	Mill out to pre-defined depth and replace
Mean Profile Depth	D9.1.10.5	Mill out surfacing and replace
Air Permeability	D9.1.10.6	Fog spray surfacing with agreed emulsion or mill out surfacing and repave surfacing
Water Permeability	D9.1.10.7	Fog spray surfacing with agreed emulsion or mill out surfacing and repave surfacing
Marvil Permeability	D9.1.10.8	Fog spray surfacing with agreed emulsion or mill out surfacing and repave surfacing

D9.1.11.2 Evaluation at any time during the Performance Guarantee Period

The Employer shall be entitled to carry out an assessment of the Works at any time during the Performance Guarantee Period. Should any parameter/s fall into the remedial-work-required category, the Employer shall inform the Contractor who shall immediately propose a solution to rectify the problem/s and obtain the Employer's approval and rectify the problem/s in accordance with Clause D9.1.12.2. The remedial work shall commence within 28 days of being notified by the Employer.

QUESTIONS or any clarifications?

THANK YOU!