Sampling Methods for Road Construction Materials

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excellence in bituminous products

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Manual 36	Use of Reclaimed Asphalt in the Production of Asphalt
Manual 37	Sampling Methods for road construction materials
Manual 38	A Health and Safety Guide for material testing laboratories in the road construction industry
Manual 39	Laboratory testing protocols for binders and asphalt
Manual 40	Design and construction of surfacing seals (*Due for completion by year-end*)
TECHNICAL GUIDELINES	
TG 1	The use of modified binders in road construction
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TG 4	Water quality for use in civil engineering laboratories
DVDs	
DVD 100	Test methods for bituminous products
DVD 200	Training guide for the construction and repair of bituminous surfacing by hand
DVD 300	Manufacture, paving and compaction of hot mix asphalt
DVD 410	The safe handling of bitumen
DVD 420	Treatment of bitumen burns
DVD 430	Working safely with bitumen
DVD 440	Firefighting in the bituminous products industry
DVD 450	Safe loading and off-loading of bitumen
(*The following manuals have been withdrawn: 3, 4, 6, 9, 11, 14, 15, 16 and 21*)	

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SYNOPSIS:

Manual 37 gives detailed methods for taking samples of materials that need to be tested for road construction purposes. Methods of sampling natural materials, stockpiled material and pavement layers (both treated and untreated) are described. Procedures are also given for sample division using a riffler or by quartering. In the final chapters the background to sampling, i.e. the necessity for sampling, evaluation of test results and the reasons behind the methods used, are discussed. Sabita Manual 37 is a companion volume to SANS 3001 test methods. Other documents of relevance are Sabita's TG 1 *The Use of Modified Bituminous Binders in Road Construction*, TG2 *Bitumen Stabilised Materials*, and ASTM D140 *Standard Practice for Sampling Bituminous Materials* and SANS 3001 CO series.

OVERVIEW OF THE MANUAL

Manual 37 consists of two parts:

Part A – Sampling Methods (page 11 to 80), and

Part B – Background to Sampling as applied to Road Construction (page 81 to 108.

PART A: describes the sampling methods prescribed for specific applications. The intention is to supplement the methods in due course so that eventually all the important material types will be covered in this Part.

PART B is intended as a handbook which can be used:
(a) during the theoretical training of students.
(b) to develop a sampling plan in cases which are not covered by Part A.

As discussed in B.1 sampling sizes and methods are very often constrained by economic considerations. The sampling plans given in Part A do not therefore always comply with the principles stated in Part B as regards the number of samples needed. It needs to be borne in mind that should one reduce the number of samples as detailed, the results may well be less reliable.

However, it can be emphatically stated that the specified plans are tried and tested and will usually be found to be realistic when the sampling costs are weighed against the value of the information obtained.

GLOSSARY OF TERMS

"ALARP" means as low as is "reasonably practicable" having regard to-

(a) The severity and scope of the hazard or risk concerned;

(b) The state of knowledge reasonably available concerning that hazard or risk and of any means of removing or mitigating that hazard or risk;

(c) The availability and suitability of means to remove or mitigate that hazard or risk; and

(d) The cost of removing or mitigating that hazard or risk in relation to the benefits deriving therefrom.

"angle of repose" means the steepest angle of a surface at which a mass of loose or fragmented material will remain stationary in a pile on the surface, rather than sliding or crumbling away;

Proportionate mean sample: A sample consisting of a series of single samples taken according to a predetermined fixed pattern, the size of every single sample being in proportion to the quantity of material it represents out of the whole.

Asphalt: A mixture of aggregate, mineral filler and bituminous binder produced at an elevated temperature in an asphalt plant.

Completed layer: The completed road layer that includes compaction and, where appropriate, slushing operations.

Compound sample: A compound sample is composed of a number of single samples taken in a random or non-random manner and combined into a single sample. Such a compound sample could be reduced in size to make up an acceptable representative sample.

Concrete batch: A quantity of fresh concrete which is:

- Mixed in one cycle of operation of a batch mixer;
- Discharged during 1 min from a continuous mixer;

or

- Conveyed ready-mixed in a truck mixer when the load requires more than one cycle of a batch mixer or more than one minute of mixing in a continuous mixer.

Concrete composite sample: A quantity of concrete, consisting of a number of increments distributed through a batch or mass of concrete thoroughly mixed together.

Concrete increment: A quantity of concrete taken by the single operation of a scoop or similar sampling device.

CR: Construction Regulations, 2014

Construction work: means any work in connection with -
(a) the construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure; or
(b) the construction, erection, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system; or the moving of earth, clearing of land, the making of excavation, piling, or any similar civil engineering structure or type of work;

Determining characteristics of a material: These are measurable characteristics of a material which will determine its conformance to the specific use for which it is intended.
(*The colour of gravel has no direct influence on its performance as a road foundation material. The colour of the gravel is therefore an incidental or non-determining characteristic*).

DMR: Driven Machinery Regulations, 2015

EMR: Electrical Machinery Regulations, 2011

Ergo.R: Ergonomics Regulations, 2019

Excavation work: The making of any man-made cavity, trench, pit or depression formed by cutting, digging or scooping.

Fall arrest equipment: Equipment used to arrest a person in a fall, including personal equipment, a body harness, lanyards, deceleration devices, lifelines or similar equipment.

Fall prevention equipment: Equipment used to prevent persons from falling from a fall risk position, including personal equipment, a body harness, lanyards, lifelines or physical equipment such as guardrails, screens, barricades, anchorages or similar equipment.

Fall protection plan: A documented plan, which includes and provides for:
(a) all risks relating to working from a fall risk position, considering the nature of work undertaken;
(b) the procedures and methods to be applied in order to eliminate the risk of falling; and
(c) a rescue plan and procedures;

Fall risk: Any potential exposure to falling either from, off or into.

GMR: General Machinery Regulations, 1988

GSR: General Safety Regulations, 1986

Hazard/s: The potential to cause harm, ill health or injury, damage to property, plant, products or the environment, production losses or increased liabilities.

Increase of the number of tests: When the sample size as prescribed by the test method is too small to ensure a specified degree of accuracy, the number of tests must be increased to give greater confidence about the results obtained.

Maximum acceptable size of a sample: The maximum acceptable size of a sample is the largest sample size from which the desired degree of representation or accuracy can be obtained relative to the purpose for which the sample was taken

Mean sample: A mean sample consists of a series of single samples taken according to a predetermined fixed pattern, the size of every single sample being in proportion to the quantity of material it represents out of the whole.

Minimum acceptable size of a sample: This is the smallest quantity of material which can serve as a sample provided that the determining characteristics of the material can be measured with an acceptable degree of accuracy by means of such a sample. Normally this minimum sample size is provided in the applicable SANS 3001 test method.

MHSR: Mine Health and Safety Regulations.

Mobile plant: Any machinery, appliance or other similar device that is able to move independently, and is used for the purpose of performing construction work on a construction site.

NIHLR: Noise-Induced Hearing Loss Regulations, 2003.

OHS Act: Occupational Health and Safety Act (Act No. 85 of 1993 as amended.

PPE: Personal Protective Equipment.

Primary or field sample: This is the sample originally taken from the lot at the site, and its size is determined by the degree of representation or accuracy required relative to the purpose for which the sample was taken.

Representative sample: A representative sample is a portion or a combination of portions of a lot of a material whose degree of representation is important and is therefore specified by the Engineer.
(It is important to understand that the representation of a sample varies between the extremes of being poorly representative and absolutely representative. This simply means that the larger the sample in proportion to the lot, the more representative it becomes, until the whole lot is tested, and one may talk in terms of absolute representation.)

Reproducibility of a test result: This is the degree of agreement between the results of tests carried out by different testers repeating a test on a split sample of the same material in a different laboratory with different apparatus. This factor measures the human influence or human error in the execution of a test, the variability in the apparatus calibration and validation between the different laboratories and the variability of the sample material. It measures the ability of laboratories and testers to replicate the test results of other operators. This can only be achieved through the correct sampling and splitting of the field sample materials.

Repeatability of a test result: This is the degree of variation between the results obtained by the same testers repeating a test on the same material (often a split sample) in the same laboratory with the same apparatus under the same conditions. Repeatability will have a smaller variability than reproducibility.

Risk: means *the probability* that personal injury, illness or the death of the employee or any other person or damage to property will occur;

Risk assessment: The process of evaluating the risks to an employee's health and safety from workplace hazards and is a systematic assessment of all aspects of work that considers:
(a) a complete *hazard identification;*
(b) *identification of all who may be affected* by the hazard;
(c) *how the person is affected;*
(d) *the analysis and evaluation* of the risks; and
(e) *prioritisation* of risks.

Risk management: The identification and mitigation of risks by the application of appropriate control measures;

Sample: A sample is a portion or a combination of portions of a lot of a material which material, which represents the whole.

Sample lot: A lot of material means a discrete specific quantity of material which can for all practical purposes be regarded as a separate entity and which does not inherently vary disproportionately in respect of the determining characteristics.

The size of a lot is usually determined by:
(a) The consignment or delivered quantity.
(b) The way in which it is stored when the sample is taken.
(c) Any visual variation of the characteristics of the material.

A sample lot is therefore the specific heap, load, tank, drum or quantity of material which can be represented by a specific sample.

Secondary sample: This is a sample split down by a standard method from the field sample which is then used to extract the test samples. A field sample is divided up to provide the secondary sample and is usually obtained by division of the field sample on site and its size is determined by the specific tests for which it is needed.

Single sample: A single sample is a sample taken from a heap, a container or the completed road layer in a random or non-random manner.

Sample with constant characteristics: A sample with determining characteristics that normally remain constant, unless they are artificially changed e.g. ACV or 10 % FACT.

Sample with changing characteristics: A sample with determining characteristics that are normally in the process of changing, unless they are artificially kept constant e.g. concrete strength.

Sample with changed characteristics: A sample with determining characteristics that have changed externally e.g. prime after curing or emulsion after breaking.

Shoring: A system used to support the sides of an excavation and which is intended to prevent the cave-in or the collapse of the sides of an excavation;

Test sample: This is obtained from the laboratory sample using a reduction process for a specific test. The sample is extracted from the laboratory sample and its quantity depends on the quantity prescribed in the test method for which it is to be carried out.

Test specimen: The actual briquette or other item used in the actual testing itself. Sometimes it is the same mass as the test sample; sometimes it is less depending on the test method.

PART A

SAMPLING METHODS FOR NATURAL MATERIALS

CONTENTS

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HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS FOR SAMPLING ACTIVITIES

The essence of this publication is to assure standardisation, accuracy and repeatability, and ultimately to ensure acceptable quality in sampling. It therefore follows that unintended deviations and disruptions must be avoided to achieve these objectives. Unwanted HSE incidents have the potential to produce detrimental effects that could disrupt and delay project completion. This manual would therefore not be complete without due consideration of HSE aspects. It must however be emphasised that it is not practicable to include a comprehensive discussion on HSE related hazards, potential impacts and control measures in this publication. Users of this manual are reminded that, in accordance with Section 8 of the OHS Act, task (sampling method) specific Risk Assessments should be in place and available for inspection. In addition, whereas the activities described in this manual are performed in connection with "construction work", a baseline risk assessment and site-specific health and safety specification must be in place in accordance with CR 5 (1) (a) and (b).

Note on applicable legislation:
The activities associated with the methods described in this manual may take place across operational sites that are governed by different sets of legislation, essentially, either the OHS Act or the Mine Health and Safety Act and applicable Regulations. The Mine Health and Safety Act may not necessarily address a specific set of circumstances and in such cases the recommendations contained in the manual are based on the minimum requirements of the OHS Act or industry best practice.

The following should also be borne in mind when using the HSE information provided here:

- The information provided here is based on the methods as described in this manual. No on-site observations were performed to check or verify actual conditions under which sampling activities are performed;
- Prevailing conditions, when sampling takes place, could vary and users should not rely entirely on the information provided in this manual. Potential Ergonomic Hazards feature prominently in the methods described here and users must ensure that assessment and analysis of these are included in workplace risk assessments and hazard analysis. (See Regulation 6 of the Ergonomic Regulations).

Therefore, the aim is to provide a general overview of hazards associated with sampling activities, as described in this manual, to ensure that potential HSE risks are highlighted for due consideration and further on-site hazard analysis before sampling activities commence. In pursuit of this objective the following process was applied:

- Potential hazards associated with the task steps of each test method is identified and briefly described;
- Using a Qualitative Risk Assessment Matrix each test method is allocated an overall inherent Risk Rating in a Low, Medium or High-risk range. The overall rating is based on the worst-case consequence likelihood anticipated for the specific test method;
- A brief description of minimum expectations for control measures is provided for each test method. (Note: Minimum expectations are based on the minimum requirements for Legal Compliance.)

This process was applied to each Test Method and the information inserted in each method description under the following headings:

Potential Hazard/s	**Risk Rating**	**Minimum Control Requirements**

A.1 NATURAL MATERIALS

A.1.1 MA1: SAMPLING A NATURAL ROCK MASS

A.1.1.1 SCOPE

This method describes the taking of samples from a test pit in a natural rock mass when the rock is to be crushed for use in concrete, surfacing, bases, subbases, (layer works).

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Personnel and Equipment at Height and below grade (Excavation in preparation for sampling) • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling) • Flying objects (Breaking stone with sledgehammer) • Hazardous Tools (Core drilling)	HIGH	Compliance with: (a) CR 4, 5, 9,10,13, 23 (b) Ergo.R 6 (c) Wear appropriate PPE (d) For practical guidance refer to SAICE publication "The safety of persons working in small diameter shafts and test pits for geotechnical engineering purposes - Code of Practice First edition 2007"

A.1.1.2 APPARATUS

i. For taking samples from test pits blasted with explosives, the following will be required:

- A prospecting pick.
- A suitable tape measure or range rod.
- A spade.
- A pick.
- A sledgehammer with a mass of approximately 5 kg.
- A suitable crowbar.
- Suitable canvas sheets approximately 2 m x 2 m.
- Suitable containers for rock samples such as strong canvas bags.
- Suitable weigh bridge for the weighing of the sample mass including the vehicle transporting the sample.
- TLB, front end loader or excavator.
- Camera device (can be a cell phone camera).

ii. For taking cores obtained with the aid of a core drill, the following will be required:

- A suitable tape measure.
- Suitable containers for the packing of cores such as a wooden box with partitions in which the cores can be firmly packed to retain them in their original order as drilled. The partitions must prevent the various cored section from sliding together or becoming mixed up during transport and handling of the box.

A.1.1.3 SAMPLE SIZE

i. Samples from test pits blasted with explosives:
Weigh empty dump truck. Load from centre of blast. Load at least five scoops of rock. Weigh loaded truck to determine the size of total sample. Tip sample off dump truck unto a clean platform. Separate the rocks into different aggregate sizes with 1 metre measuring stick. Weigh each fraction separately. At least 70 kg of each rock type that is separately identified and sampled, should be obtained.

ii. Cores obtained with the aid of a core drill:
Where possible at least 70 kg of each rock type that is identified and sampled, should be obtained. If the quantity of material that can be obtained from one borehole is insufficient, more pits must be drilled adjacent to the first hole. Alternatively, the cores can be used simply as indicators and larger test pits can be blasted with explosives and sampled at a later stage.

A.1.1.4 METHOD

i. Test pits blasted with explosives which are to be opened manually, must be done under supervision of a qualified person to ensure that the required safety precautions have been taken. Refer to: *The safety of persons working in small diameter shafts and test pits for geotechnical engineering purposes* : **Code of Practice 2007.**
Inspect the sides of the test pit to their full depth and record any observable changes in the rock as well as the depths between which such changes occur. Take a picture of the full depth of the various materials with some form of measuring device (range rod or tape measure) preferably in good light to assist with analysis once back in the office.

Characteristics which should be considered are rock type, colour, hardness, texture, and all identifiable characteristics.

Use a crowbar or pick to loosen pieces of each type of rock from each wall of the test pit and place each type in a separate container. If the pieces are too large for the containers, they may be broken down with the aid of the sledgehammer. If there is not a large variety of rock types, some of the loosened material taken from the test pit can be selected outside of the pit and each type can be placed in a separate container.

Any loose earth or gravel layers on top of the rock mass or which occur in seams between the layers of rock must be sampled separately in accordance with sampling method MA2 if it is to be used for some or other purpose. Any overburden is to be sampled before blasting.
The sample containers must all be clearly and indelibly marked so that the samples can be identified when

they arrive in the laboratory. *(See B.4.4 in Part B*).

ii. Cores taken with the aid of a core drill:
Place the cores in a suitable box with partitions so that they are in order from the shallowest to the deepest part of the borehole and can be identified and measured as such when they arrive in the laboratory. The partitions in the box must be narrow enough to ensure that the cores remain in position and do not become mixed up in the box.

A.1.1.5 REPORTING

The samples must be sent to the laboratory under cover of a properly composed report or a suitable borrow pit data form. The report or form must contain the full particulars of every sample including:

- Test pit number;
- Sample number;
- Depths of each samples taken;
- Description of the material type;
- What sort of containers were used to send the samples to the laboratory; and
- How many containers there are of each sample.

A sketch of the rock mass and its environment and of the position of each test pit must accompany the report or borrow pit data sheet. The landform of the rock mass must be determined according to the definitions in TRH2 and must be indicated on the sketch with the necessary symbols.

A.1.2 MA 2: SAMPLING FROM A SAMPLING PIT IN NATURAL GRAVEL, SOIL AND SAND

A.1.2.1 SCOPE

This method describes the taking of samples from a test pit with vertical sides, at least 1 m square and which has been excavated in a natural deposit of gravel, soil or sand by means of a pick and shovel or any mechanical excavator or large auger. The samples may be needed for the road centre line survey of the natural information or for any of the following proposed uses:

- Gravel for subgrade, selected layer, subbase, basecourse, and coarse aggregate for use in asphalt and concrete.
- Soil for subgrade, selected layer, subbase and binder.
- Sand for subgrade, selected layer, as a stabilizing agent for clayey materials and as fine aggregate for concrete and bituminous mixes.

This sampling method may be used for:

- Contractor Quality (Process) Control
- Samples for process control of the product at the source of manufacture or storage, or on site of use, are obtained by the Manufacturer, Contractor or any other parties responsible for accomplishing the test analysis work.

Quality (Acceptance) Control Assurance

Samples taken for tests to be used in the acceptance or rejection decisions by the client are obtained by the client or their authorized representative.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Personnel and Equipment at Height and below grade (Excavation in preparation for sampling) • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling) • Hazardous Hand Tools (Pick and spade used for sampling)	HIGH	Compliance with: (a) CR 9, 10,13, 23 (b) Ergo.R 6 (c) Wear appropriate PPE: • Suitable eye protection • Gloves

A.1.2.2 APPARATUS

- A prospecting pick.
- A suitable tape measure or range rod.
- A spade.
- A pick.
- Suitable sample containers such as strong canvas or plastic bags.
- Suitable canvas sheets approximately 2 m x 2 m.

- A riffler with openings approximately 25 mm wide, with six matching pans.
- A 20 mm sieve with a recommended diameter of 450 mm.
- A basin approximately 500 mm in diameter.
- Camera device (can be a cell phone camera).

A.1.2.3 SAMPLE SIZE

The size of each sample will depend on what tests are to be undertaken on the sample. A 70 kg sample will usually be enough but if the material is to be tested for more than one possible use, the size of each sample will have to be increased (Part B: B.3). A sample will usually, consist of more than one bag of material and needs to be label in such a manner as to ensure the various sample bags can be identified as such.

A.1.2.4 METHOD

i. Inspect the sides of the test pit to their full upper edge of the test pit. Take a picture of the sampling pit with the measuring device in place to the full depth of the pit showing the various material depths for record purposes. Now sample every distinguishable gravel, soil or sand layer by holding a spade or canvas sheet at the lower level of the layer against the side of the pit and by cutting a sheer groove to the full depth of the layer with a pick a or spade. Place the material obtained in this way in sample bags. Ensure no contamination occurs from other layer surrounding the one being sampled.

ii. The canvas sheet may also be spread out on the floor of the test pit. At least twice the amount of material needed for the final sample must be loosened from each layer. Once all the layers have been sampled, each layer of material must be combined on either a clean, hard, even surface or on a canvas sheet and properly mixed with a spade.

iii. Now quarter or riffle out a representative sample of the layer as explained in methods MD1 or MD2. (See note A.1.2.6 below).

- It is customary to fill one small sample bag which can hold about 10 kg, and two or three larger bags each holding about 30 to 40 kg. When numerous test pits are made in a deposit and the materials differ very little, it is only necessary to fill large bags of each material type at every second or third test pit. Here the sampler must be guided by their discretion and experience.

- The sample bags (or other containers) must all be clearly and indelibly marked so that the samples can be identified in the laboratory. The identifying reference must agree with that given in the covering report or form. (See B.4.4)

A.1.2.5 REPORTING

The samples must be sent to the laboratory under cover of a properly composed report and data sheet(s) (see soil survey form TMH5-1). Full particulars about every sample must be given including:

- Stake value or GPS co-ordinates (whichever is applicable);

- Sample number;
- Depths between which the samples were taken;
- Description of the material;
- Type of containers used to send the samples to the laboratory; and
- How many containers there are of each sample.

In the case of a proposed borrow pit, a direction-orientated sketch of the environment in which the deposit occurs must accompany the report and borrow pit data sheets.

All noteworthy landmarks must be indicated on the sketch. Every test pit must be clearly shown and the distance of the proposed source from the centre line of the road must be given in kilometres, to the nearest 0,1 km. The landform in which the proposed source occurs must be determined according to the definitions in TRH2 and must be indicated on the sketch with the necessary symbols.

A.1.2.6 NOTES

i. Since one is often working with rather large quantities of material in this type of sampling, the capacity of the riffling pans may often be too small to contain half of the material obtained after the first split. If insufficient pans are available, another heap must be made on a clean, hard, even surface or canvas sheet. This heap must then be mixed and divided with a spade as before. (See paragraph 1 of B.4 - Part B and Methods MD1 and MD2 in Part A.)

Form 1: Sabita Manual 37 / TMH 5

Customer: **Project:** **Job Card No:** **Offset:**

Profiled by: **Date:** **Stake Value:** **TP No:** **Excavation method:**

DEPTH / COLOUR	MOISTURE		CONSISTENCY				STRUCTURE		SOIL TYPE	ORIGIN				SAMPLES
Depth:	Dry		Very loose		Very soft		Intact			Transported		Aeolian		***Number:***
	Slightly moist		Loose		Soft		Slickensided			Colluvial		Residual		
Colour:	Moist		Medium dense		Firm		Shattered			Fluvial		Engineered		***Analysis:***
	Very moist		Dense		Stiff		Micro-shattered			Alluvial		Imported		
	Wet		Very dense		Very stiff		with depth			Lacustrine		Pedogenic		
Depth:	Dry		Very loose		Very soft		Intact			Transported		Aeolian		***Number:***
	Slightly moist		Loose		Soft		Slickensided			Colluvial		Residual		
Colour:	Moist		Medium dense		Firm		Shattered			Fluvial		Engineered		***Analysis:***
	Very moist		Dense		Stiff		Micro-shattered			Alluvial		Imported		
	Wet		Very dense		Very stiff		with depth			Lacustrine		Pedogenic		
Depth:	Dry		Very loose		Very soft		Intact			Transported		Aeolian		***Number:***
	Slightly moist		Loose		Soft		Slickensided			Colluvial		Residual		
Colour:	Moist		Medium dense		Firm		Shattered			Fluvial		Engineered		***Analysis:***
	Very moist		Dense		Stiff		Micro-shattered			Alluvial		Imported		
	Wet		Very dense		Very stiff		with depth			Lacustrine		Pedogenic		
Depth:	Dry		Very loose		Very soft		Intact			Transported		Aeolian		***Number:***
	Slightly moist		Loose		Soft		Slickensided			Colluvial		Residual		
Colour:	Moist		Medium dense		Firm		Shattered			Fluvial		Engineered		***Analysis:***
	Very moist		Dense		Stiff		Micro-shattered			Alluvial		Imported		
	Wet		Very dense		Very stiff		with depth			Lacustrine		Pedogenic		
Depth:	Dry		Very loose		Very soft		Intact			Transported		Aeolian		***Number:***
	Slightly moist		Loose		Soft		Slickensided			Colluvial		Residual		
Colour:	Moist		Medium dense		Firm		Shattered			Fluvial		Engineered		***Analysis:***
	Very moist		Dense		Stiff		Micro-shattered			Alluvial		Imported		
	Wet		Very dense		Very stiff		with depth			Lacustrine		Pedogenic		
Depth:	Dry		Very loose		Very soft		Intact			Transported		Aeolian		***Number:***
	Slightly moist		Loose		Soft		Slickensided			Colluvial		Residual		
Colour:	Moist		Medium dense		Firm		Shattered			Fluvial		Engineered		***Analysis:***
	Very moist		Dense		Stiff		Micro-shattered			Alluvial		Imported		
	Wet		Very dense		Very stiff		with depth			Lacustrine		Pedogenic		
NOTES	**Near-refusal**		**Groundwater Level**	Y	**Depth of**				**Photo** Y **Ease of Excavation**	Soft		Hard		**Duration of Ex**
	No refusal			N					N	Medium				
COMMENTS														

Form 2: Sabita Manual 37 / TMH 5

SOIL SURVEY DATA REPORT

MATERIAL INVESTIGATION AND TESTING FOR

POSITION	DATE OF PROFILE				JOB CARD NO.
CO-ORDINATES	SAMPLING METHOD	According to TMH 5			REFERENCE NO.

INDICATOR / CBR RESULT SUMMARY

SIEVE ANALYSIS : SANS3001-GR1					
	SAMPLE NR				
% PASSING	DEPTH (mm)				
100.0	mm				
75.0	mm				
63.0	mm				
50.0	mm				
37.5	mm				
28.0	mm				
20.0	mm				
14.0	mm				
5.00	mm				
2.00	mm				
0.425	mm				
0.075	mm				

SOIL MORTAR ANALYSIS : SANS3001-PR5					
COARSE SAND	%				
COARSE FINE SAND	%				
MEDIUM FINE SAND	%				
FINE FINE SAND	%				
PASSING 0.075mm	%				
GRADING MODULUS					

ATTERBERG LIMITS : SANS3001-GR10				
LIQUID LIMIT				
PLASTICITY INDEX				
LINEAR SHRINKAGE				

MDD & CBR : SANS3001 - GR30 & GR40				
MDD (Kg/m³)				
O.M.C. (%)				
C.B.R. @ 100% COMPACTION				
C.B.R. @ 98% COMPACTION				
C.B.R. @ 95% COMPACTION				
C.B.R. @ 93% COMPACTION				
C.B.R. @ 90% COMPACTION				
SWELL (MDD) %				
Indicator & CBR results comply to COLTO 1998 Edition				

	Water Table	Soil Legend	Depth (mm)	Insitu CBR	SOIL DESCRIPTION Moisture; Colour; Consistency; Structure; Soil Type; Origin
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					
650					
700					
750					
800					
850					
900					
950					
1000					

Remarks :
1. Excavated Electric Breaker, Pick and Shovel.
2. No Ground Water Conditions.
3. Near Refusal.

PHOTO

REMARKS

A.1.3 MA3: SAMPLING BY AUGER

A.1.3.1 SCOPE

This method involves in-situ sampling of natural gravel, soil or sand by means of hand or power augers. Such sampling is done for a centre line survey of the natural formation or for borrow pit surveys for subgrade, selected layer, subbase, base, or coarse or fine aggregate for concrete or asphalt.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling) • Hazardous Power Tools (Power auger) (Pneumatic Drill) • Hazardous Hand Tools (Hand auger pick and shovel)	LOW	Compliance with: (a) NIHLR & Ergo.R 6 (b) Wear appropriate PPE: - Eye protection - Suitable gloves - Hearing protection

A.1.3.2 APPARATUS

- Hand augers approximately 50 mm to 300 mm in diameter.
- Power augers approximately 600 mm in diameter.
- A prospecting pick.
- A suitable tape measure to measure the sampling depth in millimetres.
- Shovels.
- Picks.
- Suitable sampling bags made of canvas or plastic.
- Suitable canvas sheets approximately 2 m x 2m.
- A riffler with 25 mm openings with six matching pans.
- A 20 mm sieve with a recommended diameter of 450 mm
- Containers approximately 500 mm in diameter.

A.1.3.3 SAMPLE SIZE

The size of the sample will depend on the tests for which it is required, but usually a sample of 70 kg is enough.

A.1.3.4 METHOD

i. The work is done by drilling into the ground with the auger to the required depth, withdrawing the auger, and then removing the soil for examination and sampling. Reinsert the auger in the hole and repeat the process.

   Where various types of soil or horizons occurs. When the smaller auger's (50 mm) are used, the information gathered is simply used to record the soil profile. Once enough material is removed by drilling, a laboratory sample is obtained by quartering or riffling as described in Methods MD1 or MD2.

ii. In the case of harder rock, when the power auger may cause pulverization, it is preferable to use the following procedure. Drill a hole, usually about 600 mm in diameter, to the full depth required. Drill a second hole approximately 0,5 m to 1,0 m away from the first hole, depending on the quantity of material needed for the sample, to the depth of the 1st horizon which is to be sampled.

iii. Remove all the material between the two holes up to this depth and place it on a hard, clean soil surface or on a canvas sheet. Drill the second hole to the depth of the second horizon which is to be sampled and removed all the material between the two holes as described above, placing it on a separate canvas sheet. Repeat the process to the full depth of the first hole. Alternatively, samples may be taken from a single hole by cutting a groove in the material from the side of the hole as described in Method MA2.

A.1.3.5 REPORTING

as per Method MA2.

REFERENCE

ASTM-D1452

A.1.4 MA4: SAMPLING OF WATER FOR CHEMICAL AND/OR BACTERIOLOGICAL TESTS

A.1.4.1 SCOPE

This method describes the procedure which should be followed when samples of water are taken for chemical and/or bacteriological tests. The compliance requirements are described in Sabita TG4 – *Water Quality for use in Civil Engineering Laboratories*.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Working on, in or over water (Drowning when taking samples for bacteriological tests). • Corrosive Substances (Nitric acid).	MEDIUM	Compliance with CR 26 & GSR 2 as applicable. (a) Perform on-site risk assessment and provide Waders and Personal Floating Devices as necessary. (b) Wear appropriate corrosion resistant gloves and eye protection when handling nitric acid.

A.1.4.2 APPARATUS

- Containers for samples for chemical tests: Clean glass bottles with a capacity of approximately 2 ℓ with close-fitting clean stoppers or covers, preferably also of glass.
- Containers for samples for bacteriological tests: Only suitable sterilized containers supplied by the test laboratory may be used.
- Spirit burner or similar.
- Hand sanitizer.

A.1.4.3 SAMPLE SIZE

i. Samples for chemical tests

- At least 10 ℓ per sample.

ii. Samples for bacteriological tests

- Volume and number of samples:
  Each sample must consist of at least 250 mℓ and the minimum number of samples that may be taken at one place will depend on the number of users to be served. (*No more than one sample per day may be taken*.)

A.1.4.4 METHOD

i. Samples for chemical tests (see A.1.4.6)

(a) Preparation of glass bottles

- Clean the bottles and their stoppers or covers thoroughly before use. If possible, the bottles should be washed with a nitric acid solution and then thoroughly rinsed out with water to remove the acid. Half-fill each bottle with the water from which a sample is to be taken, shake thoroughly and then empty it. Repeat this procedure three more times before taking the sample.

(b) Sampling

- From a tap: Turn the tap on fully and allow the water to flow for two minutes before taking the sample. To prevent unnecessary aeration while the sample is being taken, turn the tap so that it is only partially open while the sample is being taken and fill the bottle to within 15 mm of the top of the neck. Close with the stopper or cover to make a tight seal and label the bottle properly with the name of the sender, the date and the time of sampling, and any special identifying mark.
- From a borehole or well: If samples are being taken from a borehole or well it is preferable to take them from a pump outlet pipe through which water has been pumping continuously for at least 24 hours. Thereafter follow the method described in the previous point.
- From a stream, lake or fountain: Remove the stopper from the sample container and completely immerse the container in the water, holding it at the base so the samples not taken at the surface. Allow it to fill by tilting the container upstream in running water or moving it slowly forward in standing water. Do not disturb the sediment or collect any of it in the sample. If walking in the water cannot be avoided, the sampler should keep walking upstream while taking the samples. If it is necessary to use a boat to obtain a sample at a suitable depth from a lake or dam, the boat should be propelled with as little disturbance as possible to the sampling site. The sample container can then be attached to a suitable rod and be carefully filled by immersing it in the water and moving it slowly forward as described above. As soon as the container is full, it should be closed with the stopper and must then be properly labelled.

ii. <u>Samples for bacteriological tests</u>

(a) General

Only containers supplied by the test laboratory and which are sterile and suitable for immediate use may be used. Before each sample is taken the sampler must wash their hands thoroughly. While the sterile sample container is being handled, no surface of the cover or stopper may come into contact with the sample or with the hand or any other object; under no circumstances may the covers be laid down.

(b) Sampling from a tap or pump

Allow the water to flow for at least two minutes so that the pipe supplying the tap is thoroughly flushed out, then stop the flow. Heat the mouth of the tap or pipe with a spirit burner (or other suitable type) until it is really hot. Open the tap to its fullest and allow the water to flow again until the tap has cooled down. Now fill the container with water from the running tap until it is full and close with the stopper or cover to form a tight seal. Label the sample clearly with the name of the sender, the date and time of sampling, and any special identifying mark.

(c) Sampling from a stream, reservoir or dam

Hold the box of the container in one hand, remove the cover with the other hand and immediately immerse the container about 300 mm below the surface of the water. In running water, the container must be held with its mouth pointing upstream and in standing water it must be moved so that no water which has come into contact with the hand gets into the container. Once the container has been filled, remove it from the water and seal it tightly with the stopper or cover. Label the container clearly with the name of the sender, the date and time of sampling and any special identifying mark.

A.1.4.5 REPORTING

Every sample must be accompanied by a report containing the following particulars:

- Name and address of the organization or person requesting the tests.
- Name and number of the farmer, plot or erf and the magisterial district.
- Type of test required (bacteriological or chemical or both).
- Date and time at which the sample was taken.
- Date and time at which the sample was dispatched.
- Name of sampler.
- Description of the place at which samples were taken, i.e. the storage container (reservoir, tank, etc.), well, borehole, spring or stream, as applicable.
- The date on which the last rain fell and whether it was heavy or not.
- Whether the water has an unpleasant smell or taste.
- The approximate number of persons who receive (use) water from the source or supply.

A.1.4.6 NOTES

i. Samples must be sent to the laboratory as soon as possible, since immediate chemical analysis (or stabilization) of the samples is essential.

ii. The water should be sampled at least four times every year at the following times:

- at the beginning of the rainy season:
- in the middle of the rainy season;
- at the end of the rainy season;
- in the middle of the dry season.

REFERENCE

SABITA TG4 WATER QUALITY FOR USE IN CIVIL ENGINEERING LABORATORIES

A.2 STOCKPILED MATERIALS

UNTREATED MATERIALS

A.2.1 MB1: SAMPLING OF STOCKPILES

A.2.1.1 SCOPE

This method describes the procedure to be followed when stockpiles are sampled (see A.2.1.6). The stockpiles may consist of:

- Natural gravel, soil or sand;
- Crushed rock for base or subbase;
- Screened-out crusher dust;
- Crushed single-sized aggregate;
- Reclaimed asphalt – either already crushed and screened or as the raw product straight from the road after having been milled out;
- BSM that has been manufactured in a plant and stockpiled for future use.

Note: Stockpiles are normally formed in layers.

Care should be taken when sampling due to the inherent occurrence of segregation on stockpiled material. Sampling a stockpile formed under a conveyor belt should preferably not be sampled until it is thoroughly mixed. Incorrect sampling procedures from stockpiles is one of the most common occurrences of material disputes.

HSE CONSIDERATIONS

Potential Hazard/s	**Risk Rating**	**Minimum Control Requirements**
• Personnel and Equipment at Height and below grade (Excavation in preparation for sampling). • Mechanical Energy (Runovers/back-overs when working in close proximity to moving mobile plant and equipment). • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling). • Hazardous Hand Tools (Pick and shovel).	HIGH	Compliance with: (a) CR 9, 13 & 23 (b) Ergo.R 6 (c) Wear appropriate PPE

A.2.1.2 APPARATUS

- Shovels.
- Picks.

- A mechanical loader or excavator.
- Suitable sample bags (or other containers).
- Suitable canvas sheets.
- A riffler with matching pans.
- Steel plate with handle 750 mm x 550 mm (applicable for coarser graded material).
- Steel pipe with handle (approximately 32 mm in diameter x 1.8 m in length). (For fine aggregates only).

A.2.1.3 SAMPLE SIZE

The sample size will depend on the proposed use of the material and the tests which must be carried out on it. Refer to the applicable test methods for sample size verifications. The following table give an indication of the minimum secondary sample sizes for every type of material.

Table A1: Minimum Secondary Sample Sizes for Every Type of Material

PROPOSED USE	MASS
Pavement and formation layers (Gravels, soils and crushed stone)	Grading and constants: 15 kg: MDD & OMC and California Bearing ratio: 80 kg
Fine aggregate for concrete and bituminous mixes	30 kg
Single sized coarse aggregate for concrete mixes and bituminous surfacing.	40 kg

A.2.1.4 METHOD

i. <u>Sampling while stockpile is being formed by the off-loading of material (Production Control)</u>

- Collect at least two samples per layer at random while the stockpile is being formed.
  Refer to the method for sampling from a tipped load.

- Make a vertical test hole through the layer (or as deep as is practically possible) with the pick and shovel. Place a canvas sheet in the bottom of the hole and cut a groove in the side of the hole from top to bottom, letting this material fall onto the canvas sheet. Gather enough material by cutting successive grooves, frequently raising the canvas sheet from the hole and tipping its contents onto another canvas sheet on the surface. Mix the material on the canvas sheet and divide it, by means of the riffler and/or the quartering method (refer to paragraph 1 of Chapter 8 and Methods MD1 and MD2), into the minimum size required so that each sample bag or container contains a representative sample of the material taken from the test hole.

ii. <u>Sampling from an already completed stockpile</u>

- Select an appropriate number of sampling positions in a random manner. Approximately half the positions may be on top of the stockpile if its surface is large. (Also see paragraph 2 of B.3 in Part B).

(a) Sampling with a mechanical loader or excavator

From the sides of a stockpile (preferred method for single size aggregates and with a loader):

- Remove at least three scoops from the side of the stockpile and deposit it back on the stockpile away from the opening. Scooping from the sides of the stockpile from the bottom towards the top, filling the bucket of the loader with material from the full height of the stockpile and deposit the material next to the stockpile. Repeat this process at least three times in random positions around the stockpile and deposit each scoop on top of the previous load. Once all 3 positions have been dumped into a pile, mix the material thoroughly with the loader.
- Using the loader bucket flatten the mixed material to approximately 500 mm layer thickness.
- Using a pointed shovel, insert the shovel vertically into the layer and remove all the material to the full depth of the layer.
- Deposit this material into a sample bag. Repeat the above process at random points on the surface for the flattened material until the required sample size is obtained from the minimum number of points. If necessary, the sample can be reduced using an appropriate reduction method

From the sides of a stockpile (preferred method for crushed granular material and with a loader or excavator:

- Remove at least three scoops from the side of the stockpile and deposit it back on the stockpile away from the opening. Scooping from the sides of the stockpile from the bottom towards the top, fill the bucket of the loader or excavator and deposit the material next to the stockpile. Repeat this process at least three random positions around the stockpile and deposit each scoop on top of the previous load Mix the material thoroughly. Using the bucket flatten the mixed material to approximately 500 mm layer thickness.

- Using a pointed shovel, insert the shovel vertically into the layer and remove the material. Deposit this material into a sample bag. Repeat the above process until the required sample size is obtained from the minimum number of points. If necessary, the sample can be reduced using an appropriate reduction method

(b) Sampling with a steel plate and shovel (preferably on single sized aggregates, crushed granular and fine-grained materials on small stockpiles up to 50 m^3)

***From the sides of a stockpile*:**

- Select a minimum of six random sample positions around the heap within the middle 2/3rd of the stockpiles height.
- Insert the steel plate as deep as possible above the position where the sample is required. This will assist in preventing material from falling onto the cleared areas from where the sample is to be taken.
- Remove all the material in front of the plate, continuously pushing the plate deeper into the stockpile. Once the plate is fully embedded remove a sample from the platform created in front of the plate in the form of one or two shovelfuls taken vertically into the surface prepared in front of the embedded plate. Place the material into the sample bag. Repeat the process at each of the other sample positions. If necessary, the sample can be reduced using an appropriate reduction method

(c) Sampling with a tube (preferably on fine grained materials (<7 mm) on small stockpiles up to 50 m^3)

From the sides of a stockpile:

- Select a minimum of six random sample positions around the heap within the middle 2/3rd of the heap's height.
- Dig out with your gloved hands or shovel a vertical face at the sampling position. The material should hold its form and not cascade down to cover the areas as in the case of coarser more graded material. Once a vertical face is obtained, insert the tube as far as possible horizontally into the stockpile with a single thrust.
- Do not repeatedly ram the pipe into the stockpile.
- Rotate the tube and extract the tube containing the sample.
- Place the material into the sample bag. Tap the side of the tube to assist in discharging the sample into the sample bag. If necessary, re-insert the tube into the same hole to obtain a sample from the full depth of 1.8 m. Repeat the process at each of the other sample positions. If necessary, the sample can be reduced using an appropriate reduction method

(d) Sampling with a shovel (on any material on single heaps less than 15 m^3)

From the top of the heap

- Flatten the top of the heap with the shovel to approximately half its original height. Vertically insert the shovel and remove enough material from a minimum of four random positions.
- Place the material into the sample bag. If necessary, the sample can be reduced using an appropriate reduction method.

A.2.1.5 REPORTING

Samples taken from stockpile are often tested in field laboratories. In such cases a proper record must be kept of the sample number, date of sampling, position in the stockpile, description of the material, depth of test hole, and all relevant information as per TRH 2.

When samples from a stockpile are sent to a central laboratory, they must be sent under cover of a properly composed report in which full details of the stockpile and samples are given. Important particulars about the sample are the sample number, the position at which sampled, depths between which the sample was taken (record the side from which it was taken), description of the material, number and type of bags (or containers) in which the samples are contained and the proposed use of the material. (See also Part B: B.3). A sketch of the stockpile showing the positions of the sampling points at which the various samples were taken must be included with the report.

A.2.1.6 NOTES

i. Sampling from a stockpile should, if possible, be done while the stockpile is being formed. Whenever a layer has been completed sampling points should be taken by making test holes in the layer and taking samples from them. However, stockpiles are often formed with bulldozers especially when it's a naturally occurring gravel in a borrow pit, in which case it is better to wait until the stockpile has been completed before taking samples.

ii. The number of samples will depend on the size of the stockpile. In general, one sample is taken for every 1 000 m^3. The minimum recommended numbers of sample points are as follows:

Table A2: Minimum Recommended Numbers of Sample Points

Minimum recommended numbers of sample points	
Up to 4 000 m^3	4 samples
5 000 m^3	5 samples
7 000 m^3	6 samples

The primary sample should consist of at least 300 kg for coarse and 50 kg for fine materials. However, since it is impractical to transport such large quantities, the material is immediately divided up into the secondary sample size as shown in Table A1. The tertiary sample size is determined by the test method when the sample is in the laboratory.

Front end loader flattening the stockpile

Front end loader tipping bucket of granular material away from stockpile

Front end loader levelling first load of granular material

Front end loader levelling second (adjacent) bucket load

Samples of granular material being taken

REFERENCES

AASHTO T2

A.2.2 MB2: SAMPLING FROM CONVEYOR BELT

A.2.2.1 SCOPE

This method describes the procedure to be followed when samples are taken from a conveyor belt for the following purposes:

- Crushed or natural material for use in gravel layers in a road (basecourse, subbase or selected layer);
- Crushed and/or sieved-out single sized aggregate for bituminous or concrete work;
- Fine aggregate for bituminous or concrete work.

***Note*: This method is not suitable if the crushers of a stone crusher first have to be emptied.**

HSE CONSIDERATIONS

Potential Hazard/s	**Risk Rating**	**Minimum Control Requirements**
• Mechanical Energy (Working on, or close to equipment with moving and/or rotating parts) • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling) • Hazardous Hand Tools (Spade/Shovel)	LOW	Compliance with: (a) CR 9 & Ergo.R 6 (Risk assessments); MHSR 8.9 (1) (b) or GMR 4 (5) (b) Apply Lock-out/tagging to prevent conveyor from being started during sampling (c) Wear appropriate PPE: - Suitable gloves - Eye protection - Safety boots

***Note:* The procedures may involve hazardous materials, operations and equipment. This method does not address all the safety and health issues associated with their use. It is the responsibility of the sampler to consult and establish appropriate safety and health practices and to determine the applicability of the regulatory limitations prior to the taking of samples.**

A.2.2.2 APPARATUS

- A suitable spade.
- A 100 mm paintbrush.
- Suitable containers for samples such as strong canvas or plastic bags.
- Two templates formed to correspond to the shape of the conveyor belt.
- Suitable metal pans such as riffling pans in which to catch the material when it is taken off the conveyor belt.
  - Could also be a loader bucket- Care must be taken to avoid segregation.
- A riffler as described in section A.4.1.
- A 20 mm sieve with a recommended diameter of 450 mm.

- A basin approximately 500 mm in diameter.

A.2.2.3 SAMPLE SIZE

The size of each single sample taken from the conveyor belt will depend on what tests are to be carried out and how homogeneous the material is.

The following table gives the minimum masses of the compound sample which should be aimed for.

Table A3: Minimum masses of the compound sample

Maximum Aggregate Size (mm)	Minimum compound secondary size (kg)
75	150
63	125
50	100
37.5	75
25	50
20	25
14	15
10 and smaller	10

A.2.2.4 METHOD

- Decide during production, in a random manner, when a single sample should be taken.
- Where a conveyer belt is concerned it is convenient to work on a time basis, in other words to decide to take samples at say 3 hours, 5.5 hours and 6.5 hours after production has started.
- At the designated time the conveyer belt is stopped.
- Two templates are then placed in position on the belt such that the material between the two templates will yield a single sample which when mixed and riffled will yield a compound sample of the size specified in Table 3. The material between the templates is then carefully scraped off the conveyor belt into metal pans held next to the belt, and the dust and fines are brushed off the belt into pans with the 100 mm paintbrush.
- The belt is started again, and the above procedure repeated two more time at the predetermined times.
- The material sampled is now thoroughly mixed to form the compound sample and divided according to Methods MD1 or MD2 to yield a sample of the desired minimum size.

A.2.2.5 REPORTING

Samples from the conveyor belts are often tested in production laboratories. In such cases a proper record must be kept of the source, the sample number, the date of sampling, a description of the material, as required per TRH2. A form similar to TMH5-2 may be used.

When samples are sent to a central laboratory, they must be accompanied by a properly composed report giving full details about the samples. Important particulars are the location and proposed – or approved source, a description of the material of which the sample is composed, the number and type of containers of each sample, the date and time of sampling and the number. (See also Part B: B.4).

A.2.2.6 NOTES

i. The primary single samples must be large but nevertheless in a form which makes practical handling of the compound sample possible. Because of the size, the secondary compound sample as indicated in Table A1 must be divided up immediately to facilitate the transport thereof. The tertiary sample size is determined by the test method.

Shovel and Sample template (in shape of conveyor belt

Material on conveyor belt

Sampling templates placed in position on halted conveyor belt

Commencement of sample extraction from conveyor belt

Brushing all fines remaining on conveyor belt

A.2.3 MB3: SAMPLING OF CEMENT AND LIME

A.2.3.1 SCOPE

The method describes the procedures that should be followed when samples of cement or lime are taken from:

- Bulk stock or consignments;
- Containers such as 50 kg bags of cement; or
- 25 kg bags of lime.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Exposure to cement and lime dusts causing irritation to the eyes and respiratory tract and hands	LOW	(a) Wear appropriate PPE (b) Dust mask or respirator (c) Eye protection (d) Suitable gloves

A.2.3.2 APPARATUS

- Suitable, clean containers such as tins with tightly fitting lids which can be hold 5 kg of cement or lime.
- Suitable equipment for taking samples such as a grooved sampling device for taking samples from large containers, and a tube type sampling device for small containers such as bags. The former apparatus must be about 1.7 m long with an outer diameter of about 35 mm. It must consist of two brass telescopic tubes with corresponding grooves that can be opened and closed by turning the inner tube. The outer tube must have a sharp point to facilitate penetration into the cement or lime.

A.2.3.3 SAMPLE SIZE

- Cement: Minimum of 2.0 kg for each 12 single samples.
- Lime: Minimum of 0.5 kg for each single sample.

A.2.3.4 METHOD

i. Cement or lime in bulk containers

- If the stock of cement or lime is less than 2 m deep (see **Note** iii below) single samples can be obtained with slotted samplings device.
- Take single samples at as many different depths and well-spaced points in the container as possible and place each sample in a separate sample container.
- Close the sample container properly to prevent moisture or air getting to the sample.

ii. Cement or lime in bags

- Choose the number of bags to be sampled from the consignment or stock in a random manner. Push a sampling device into the opening of the bag. Place a thumb over the airhole of the sampling device and withdraw the device. Empty the contents of the sampling device into a sample container.

- Repeat the procedure until the required quantity has been obtained.
- Close both the sample container and the hole made by the sampling device in the mouth of the bag tightly so that no air or moisture can get in.
- Mark or label each sample, showing clearly what consignment or stock it was taken from, the date of sampling, the sample number and from where in the stock the sample was taken.

A.2.3.5 REPORTING

The samples must be sent to the laboratory under cover of a full report. The report must give, amongst others, the number of each sample, particulars of the stock or consignment from which the samples were taken, and the position of each sample in the stock or consignment.

A.2.3.6 NOTES

i. All types of cement and lime.

ii. When the stock is deeper than 2 m, a more sophisticated apparatus such as a sampling pipe which works on an air current should be used. Such an apparatus is capable of taking separate samples at various depths of lime and cement.

iii. Samples must not be taken from broken bags.

iv. The number of samples taken will depend on the size of the consignment or stock, but at least 12 single samples must be taken from each consignment or stock.

REFERENCES

ASTM: C 183-86 (a)

SANS 471

SANS 626

SANS 831

SANS 824

A.2.4 MB4: SAMPLING OF BITUMINOUS BINDERS

A.2.4.1 SCOPE

The methods and procedures that cover the sampling of bituminous binders, are detailed in:

- ASTM D140. Standard Practice for Sampling Bituminous Materials – for bitumen and bitumen emulsions (as per SANS 4001 – BT series).
- Method MB 1 in Sabita TG 1 – *The Use of Modified Binders in Road Construction* - for modified binders (homogenous and non-homogenous).

These methods cover the procedures to be followed when the sampling of bituminous binder occurs at the various locations they describe. The **relevant sampling procedure**, with the applicable apparatus and protective measures, should be followed as required when samples for performance and/or other testing are taken.

The method for extracting cores of bitumen stabilised materials can be found in Sabita TG 2 *Bituminous Stabilised Materials* where it is detailed under Appendix D.4 - *Obtaining Core Specimens for Testing.* Sabita Manual 8 – *Guideline for the Safe and Responsible Handling of Bituminous Products* should also be consulted.

Bituminous binders include:

- Bitumen
- Cut-back bitumen
- Emulsions
- Homogenous modified Binders
- Non-Homogenous modified binders

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Personnel and Equipment at Height (When sampling from Tank or Road Tanker manhole). • Hot Surfaces and Liquids.	MEDIUM	(a) GSR 6. Work in elevated positions must be done from a safe work platform. (b) Wear appropriate PPE: • Overall • Hard hat with face shield • Safety glasses • Heat resistant apron • Heat resistant gloves • Safety boots

A.2.5 MB5: SAMPLING OF ROAD MARKING PAINT

A.2.5.1 SCOPE

This method deals with the procedure to be followed when sampling road marking paint.

A.2.5.2 APPARATUS

- Clean, dry sample containers which have an air-tight seal.
- Sampling tube or thief sampler (optional).
- Cleaning material.
- Stirring device e.g. ladle.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
NOTE: If a solvent based product- • Extremely flammable liquid and vapour. • Harmful if inhaled or swallowed. • May cause irritation of the eyes and skin.	MEDIUM	(a) Read relevant product SDS before sampling commences. (b) No smoking and keep away from heat, sparks, open flames and hot surfaces. (c) Perform sampling in a well- ventilated area. (d) Wear appropriate PPE: • Chemical-resistant, impervious gloves. • Eye or face protection. • Respiratory protection if ventilation is not good.

A.2.5.3 SAMPLE SIZE

A single or compound sample of at least 2 L is taken.

A.2.5.4 METHOD

Use the following procedure to ensure that the sample is representative of the batch:

- The container must be undamaged and sealed. Examine the contents to ensure that the paint has not been contaminated or diluted.
- Stir the contents of the container thoroughly until a homogeneous product is obtained. Use a clean ladle to stir the contents to prevent contamination.
- Decant a sample (or use a sampling tube or thief sampler in the case of the large containers) into the sample container. The sample must have a volume of at least 2 ℓ. The 2 ℓ may be a compound sample from various tins provided the paint is all of the same production batch and type. Divide the sample when necessary as explained in B.4 in Part B.
- Seal the container and clean the outside of it.
- Mark the container properly with the name of the paint, the colour, the name of the manufacturer, the brand name and the production batch identification.

A.2.5.5 REPORTING

Dispatch the sample with a covering letter.

A.2.5.6 NOTES

Make sure that the sample containers will not come open or leak during transit.

A.2.6 MB6: SAMPLING OF STEEL FOR CONCRETE REINFORCEMENT

A.2.6.1 SCOPE

This method describes the taking of samples of reinforcement bars for determining the tensile strength and other characteristics as specified in SANS 920. The method can also be applied to the taking of samples for determining the strength of welded joints.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Excessive noise. • Infrared Radiation (Skin burns). • Ejected Parts/Fragments (Grinder cutting disc failure). • Hot work in hazardous environments.	LOW	(a) Compliance with GSR 9; CR 29 (f); EMR 10 & DMR 9 (b) Wear appropriate PPE: • Eye protection, overalls, gloves, safety boots, apron, hearing protection as indicated by the risk assessment. (c) Ensure the cutting equipment is used by competent persons. (d) Ensure that cutting does not take place near flammable materials.

A.2.6.2 APPARATUS

- Steel cutting apparatus e.g. hacksaw or oxy acetylene cutting torch.

A.2.6.3 SAMPLE SIZE

The sample size will depend on the test which are to be done on the steel. At least three rods, each about 1 m long, are needed for one series of tests done according to SANS 920. For repeat or duplicate testing, it is recommended that at least six rods, each approximately 1 m long are sampled from each batch.

A.2.6.4 METHOD

i. <u>Definition</u>

A lot is considered rods of the same type, normal size, cross-section, grade and mould number, from one manufacturer, and which are simultaneously considered for inspection and acceptance.

Table A4: Required Sample Mass for Reinforcing Bars

Nominal size of bars, (mm)	Maximum batch size, (kg)
10	2 000
12	5 000
16 to 20	10 000
25 to 32	15 000
over 32	20 000

A bundle is regarded as rods of the same type, nominal size, cross-section, grade and mould number which are bound together for delivery purposes.

ii. Taking of samples

- Take a rod, at random, from each lot so that when they have been sawn, the desired number of samples is obtained. If more than one rod is needed, they must be taken from different bundles from the same lot.
- Using a hacksaw or a cutting torch, cut off as many 1 m pieces from the sampled rod/s as are needed for the test.
- When welded joints are being sampled, the joint must be in the middle of the rod. Tie the cut pieces from each lot together with wire and mark properly.

A.2.6.5 REPORTING

Every bundle of steel samples must be identified with a proper label and be sent to the laboratory under cover of a sample data form giving:

- Type of steel
- Nominal size
- Cross-section
- Grade and mould number
- Test to be done on the samples.

REFERENCE

SANS 920

TREATED MATERIALS

A.2.7 MB7: SAMPLING OF PLANT MANUFACTURED ASPHALT

A.2.7.1 SCOPE

i. This part of the Manual describes the procedure for sampling plant manufactured asphalt.

ii. Sampling of all plant-manufactured asphalt is as important as the testing procedure. It is the responsibility of the sampler to ensure that the sample taken is representative of the asphalt material being produced, delivered, paved and compacted on site.

iii. This sampling method may be used for:

a. Contractor/manufacturer Quality (Process) Control
Samples for process control of the product at the source of manufacture or storage, or on site of use, are obtained by the Manufacturer, Contractor or any other parties responsible for accomplishing the test analysis work.

b. Quality (Acceptance) Control Assurance
Samples taken for tests to be used in the judgement of compliance scheme by the client are obtained by the Client or their authorized representative.

c. Investigations

iv. Samples may be taken at any of the following points:

a. From the hot storage bin, using a front-end loader which has a bucket capacity of at least two (2) m^3.
b. From the delivery truck either at the mixing plant location before or at dispatch, or when the truck is on site before tipping into the paver.
c. Immediately after it has been applied to the road by the paver, but before the start of the compaction process.

***Notes*:**

1. For quality assurance traceability purposes, it is recommended that sampling behind the paver be carried out in conjunction with sampling from the truck, before tipping into the paver.

2. Sampling from the paver's hopper and in front of the augers is not permissible due to various HSE issues as well as possible segregation occurring at these locations

3. The procedures may involve hazardous materials, operations and equipment. This method does not address all the safety and health issues associated with their use. It is the responsibility of the sampler to consult and establish appropriate safety and health protocols and to determine the applicability of the regulatory limitations prior to the taking of samples.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Hot asphalt (>100°C). • Mechanical Energy (Runovers/back-overs when working in close proximity to moving mobile plant and equipment). • Hazardous hand tools (Shovel).	MEDIUM	(a) Compliance with: CR 9, & 23 • (Good communication between sampler and equipment operators is vital during sampling methods i. and ii). (b) Wear appropriate PPE: • Overall, and heat-resistant safety boots. • Heat-resistant gloves. • Eye protection.

A.2.7.2 APPARATUS

This is in respect of:

- Primary sample - for splitting / reducing between interested parties.
- Secondary sample – for splitting / reducing for secondary tests.
- Tertiary sample – for test-size portions for:
    - Marshall or gyratory Briquettes
    - Maximum Voidless Density
    - Determination of the binder content and combined grading

i. A spade with built-up sides (shovel) see figures 1 and 2.

Figure A1: Sampling Shovel with Pointed Tip and Flat Spade with Flat

Figure A2: Large, Medium and Small Scoop Shovels

ii. Insulated sample containers such as hot boxes (when transferring from paver site to laboratory). Capacity approx. 20 kg of asphalt per hot box.

iii. Non-absorbent robust bags not affected by high temperatures or sacks with a capacity of at least 20 kg

iv. For sampling behind the paver, metal plates with a hole drilled in each corner. Dimensions to be determined based on the sample mass required as well as the mix type being sampled. Typically, the sizes would be:

- 300 mm wide x 500 mm long x minimum 3 mm thick for sand skeleton mixes.
- 500 mm wide x 600 mm long x minimum 3 mm thick for stone skeleton mixes

  These plates must have a flexible steel cable lead wire attached to at least two of the holes for location and recovery of the asphalt-covered plates from the paved layer. A non-petroleum release agent must be used to lightly lubricate the plates prior to covering with asphalt.

v. Suitable non-petroleum release agent for plate samples (diesel is not permitted)
vi. A canvas sheet of enough size to hold all the asphalt recovered from the plates.
vii. Suitable Riffler with openings as per Table A8:
viii. Cleaning material such as diesel, brushes, cloths, hand cleaner
ix. One square sample treatment/cooling table with chute, at least 1 m square with up-stands around the edges to prevent material loss or spillage.
x. Sample testing containers, aluminium pans (flat and round bottomed), 2 L flasks, bottles.
xi. Robust scoops, small, medium and large.
xii. Robust steel spatulas, small, medium and large
xiii. Dial gauge or digital thermometers with a range of 0°C - 250°C,

A.2.7.3 SAMPLE SIZE

Table 5 below serves as a guideline for quantities required for various maximum stone sizes:

Table A5: A Guideline for Quantities Required for Various Maximum Stone Sizes

	Max Aggregate size in mix	**Bitumen Content**	**MVD**	**Marshall briquette**	**Gyratory**	**Duplicate**	**Total**
Asphalt		**Sample sizes in grams (g)**					
Design Level IA a	7.1 mm	700	1 000	8 000	0	5 000	14 700
	10 mm	1 000	1 500	8 000	0	5 000	15 500
Design Level IB, II & III	10 mm	1 000	1 500	0	15 000	15 000	32 500
	14 mm	1 300	1 500	0	15 000	15 000	32 800
	20 mm	1 500	1 500	0	15 000	15 000	35 000
Aggregates		**Sieve Analysis**					
	20 mm	2 500					
	14 mm	1 500					
	10 mm	1 000					
	≤ 5 mm	500					

The quantities specified in Table 5 above depend on the type and number of tests to which the material is to be subjected, and enough material must be obtained to provide for the proper execution of these tests. Standard control and acceptance tests are covered by SANS and specify the mass required for each specific test.

The number of field samples required, depends on the design level, variation in and the properties to be measured. The number of field samples from the lot should be enough to give the desired confidence in test results.

A.2.7.4 METHOD

<u>Notes</u>:

1. ***For the sake of operator safety and sample integrity, samples should NOT be taken from the paver's augers, the paver hopper, the material transfer vehicle (MTV) or from patches where handwork is being carried out.***
2. ***Safety precautions must always be adhered to during the sample procurement process.***
3. ***Each individual sampler must have proof of adequate training and be deemed competent to procure samples.***

i. <u>Sample to be obtained from the typically loaded delivery truck (see the figures below) either at the mixing plant location before dispatch, or when the truck is on site before tipping into the paver</u>

a. The sample should be taken from at least 6 random spots across the truck area: top, centre left, centre right, front, middle and rear. For larger truck loads (>10 T) the number of sample spots should be increased. Remove at least 200 mm of the "crust" of the asphalt then take one shovel-full at each point, transferring each shovel into the same sample bags or containers. Depending on the number of tests required on each specific sample additional shovel loads can be taken at each sample point. Ensure sufficient sampling bags or containers are available for the total sample mass required.

Figure A3: Typically Loaded Asphalt Delivery Vehicle (Three Piles from the Asphalt load-out hopper)

Figure A4: Setting the Crust of the Asphalt Aside and Digging into the Pile

Figure A5: Dial-Gauge Temperature Device in Sample Hole

b. A temperature is taken in at least 3 of the samples' hole spread out over the trucks length after the sample has been extracted and transferred the sample container. Record the temperature once the gauge reading is stable. Average the temperature from these points and record as the load's temperature. Alternatively, a hole may be drilled in the side of the delivery truck into which the dial gauge thermometer may be inserted. This will only provide a temperature at that point in the truck load & will not be representative of the entire truck load.

c. Place the samples in suitably marked sample containers (a heat-insulated container when compacted specimens are to be made) and dispatch it immediately to the laboratory.

Figure A6: Using a Scoop-Type Shovel, the Sample is Procured

Figure A7: Asphalt Sample being Placed in a Sample Bag

ii. Sample to be obtained immediately after the asphalt has been applied on the road by the paver, but before the start of the compaction process. (Applicable to determine the correct operational capability of the paver to spread the mix acceptably into position)

a. Place the metal plates in positions as determined across the path of the on-coming paver. The positions should be to the left, right and centre of the pavers screed width. Ensure the positions are at least 200 mm from outer edge of the screed & to either side of the central pillar of the screed.

b. Mark the position of the plate outside of the screeds width and allow the asphalt to be paved over the plate. Use the cables attached to the plate corners to locate the plate and lift the front edge up to allow one to lift the plate and sample. Carry the plate and sample off the road and tip the asphalt from the plate onto the canvas sheet, or directly into sample containers, taking care not to lose any sampled material.

Obtain a further 2 samples in the same manner & either combine & split on the canvas sheet to the required sample size or place directly into sample containers, seal the container & dispatch them immediately to the laboratory.

Notes:

1. ***The material may not be suitable for stability and flow tests due to the asphalt having cooled to below compaction temperature.***
2. ***Should the plate shift or move under the screed, the sample must be discarded, and new samples taken.***
3. ***One can test the left- and right-hand sides separately to check on the ability of the paver to spread the mix homogenously across the full width of the lane as paved. Various combinations can be done in this manner to check on the mechanical suitability of the paver laying operation. Should the mix fail on any aspects of the mix design the fault would lie with the contractor & not the supplier if the grading and binder contents as determined from the truck sample are found to be compliant.***

iii. Sampling Asphalt with the use of a Front-End Loader

a. Storage or Surge Bins

- Ensure the loader bucket is clean. Raise the bucket to the discharge hopper such that it sits just below the hopper.
- Fill the bucket with hot asphalt (***Note: Do not use the first sample, always discard***). Refill the bucket and use the second sample. Samples from at least 3 points in the bin should be taken to ensure that the sample is representative of the bin's content.
- On a clean prepared area, lower the bucket to approx. 300 mm above surface. Slowly tilt the bucket forward and raise as required (to prevent segregation) to empty the hot mix asphalt onto the prepared area. Place the additional 2 loads on top of the 1st load. Mix the 3 loads together to obtain as homogeneous sample as possible and form the sample back into heap.
- Lift the bucket, position the cutting blade facing downward and lower the cutting blade in front of the heap

to approx. 300 mm from the surface.

- Push the bucket through it to create a spread-out flat heap approx. 300 mm high.
- Verify temperature.
- Take at least 6 shovel loads from different positions spread out over the load to the full depth of the sample.

iv. The Waste Drop Point

- There usually is a waste drop point. However, if there is no such drop point and the loader cannot get in, drop mixed asphalt in a bucket.
- Thereafter, follow the procedure as described in (a) above.

Notes:

1. ***When a sample is being taken for making briquettes for Marshall stability and flow tests, it is important that it should not be reheated in the laboratory. In such a case, the sampler will have to decide, depending on the circumstances, at what stage they will take the sample so that it does not arrive at the laboratory once it has cooled to below the compaction temperature. In cold weather it may be advisable to take these samples at the mixing plant before the mix is transported to the paver. It should be noted that some modified binders gradually stiffen, even when kept at a constant temperature. Therefore, the time between manufacturing of the mix and the manufacturing of briquettes must be limited as much as possible.***

2. ***Riffling / reduction of material intended for the making of briquettes should be done as quickly as possible and with as little heat loss as possible. See methods MD1 and MD2 for the correct method of reduction.***

3. ***The plate method can be regarded as the most reliable method when the aim is to sample the finished product with a view to determining the ability of the paver to deliver uniform quality. The position of the plates can be determined in advance in accordance with a random sampling plan.***

4. ***The mix can be prevented from adhering to the plates by wiping the plates first with a cloth dampened with non-petroleum-based release agents (reference to apparatus of release agent). Only a very light application is required so as not to change the characteristics of the sample being taken.***

A.2.7.5 REPORTING

The material sent from the site to the laboratory must be accompanied by written documentation containing full details of the sample. Important details would include but are not limited to:

- Contract / Road number.
- Delivery note number.
- Temperature of the mix when the sample was taken.
- Sample number.
- Mix type.
- Date and time sample taken.

- Name of sampler.

Other important information required:

- Asphalt supplier.
- Location at which the sample was taken, where the material represented by the sample was paved.
- Truck number.
- Tonnage on truck.
- Cumulative tonnage on delivery note.
- Date and time of manufacture and sampling.
- Thickness of the layer.
- In-house laboratory if applicable.
- Commercial laboratory if applicable.
- Retained sample required yes/no.

A.2.8 MB8: SAMPLING OF BITUMINOUS SLURRY MIXES

A.2.8.1 SCOPE

This protocol specifies the method for sampling bituminous slurry mixture from the slurry paving unit at the paving site.

A.2.8.2 APPARATUS

The following apparatus is required:

i. Metal ladle capable of holding at least 1 kg of bituminous slurry.

ii. Plastic sample container with water-tight lid and of sufficient capacity to contain 1 kg of sample.

***Note*: Rectangular, robust and clean plastic food containers of approximate dimensions 155 mm x 105 mm x 40 mm have been found to be suitable for collection of 1 kg samples of bituminous slurry.**

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Material at elevated temperature. • Moving equipment	MEDIUM	(a) Work must be done from a safe work platform (b) Wear appropriate PPE: • Overall • Hard hat with face shield. • Safety glasses. • Heat resistant apron. • Heat resistant gloves. • Safety boots.

A.2.8.3 SAMPLE SIZE

Samples shall be taken near the start, middle and towards the end of the paving run so that a minimum of three 1 kg samples are collected during the run.

A.2.8.4 METHOD

The procedure for obtaining a sample from a paving unit is as follows:

i. Using a clean ladle, carefully take a sample of the bituminous slurry mixture from the outflow of the pugmill to the spreader box and immediately pour into the sample container.

   ***Note*: The samle should be representative of the bituminous slurry coming from the pugmill. If the sample does not appear homogenous or does not have the same appearance of the bituminous slurry coming from the pugmill, then the sample should be discarded and a new sample taken.**

ii. Place the sample container on a flat, level surface and leave it with the lid off until the bituminous slurry has set. If required, decant residual water taking care to ensure that no binder or aggregate is lost. Seal the sample container with the lid.

iii. Identify sample container as per A.2.8.5 below.

A.2.8.5 REPORTING

For each sample, record the following information:

- Identification mark;
- Date of sampling;
- Type of mix and nominal size;
- Location of pavement site and paving run where the sample was taken;
- Manufacture's name;
- Sampling procedure used;
- Name of sampling operator;
- Sampling time (i.e. start, middle or end of run); and
- Name and affiliation of the person submitting samples.

A.2.9 MB9: SAMPLING FRESHLY MIXED CONCRETE

A.2.9.1 SCOPE

This section describes the methods to be used on site for obtaining and preparing representative samples from a batch of fresh concrete for testing and making specimens.

A.2.9.2 APPARATUS

i. Scoop, or similar sampling device, made from non-absorbent material not readily attacked by cement paste, suitable for taking increments of concrete.
ii. Container(s) made from non-absorbent material not readily attacked by cement paste, for receiving increments of the concrete.
iii. Thermometer, (optional), to measure the temperature of the fresh concrete to an accuracy of 1°C.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Exposure to wet Cement can cause irritant contact dermatitis, allergic contact dermatitis and caustic burns	LOW	(a) Wear appropriate PPE: • Overall (long sleeves and pants) • PVC waterproof jacket and pants • Long PVC gloves • Gum boots • Eye protection

A.2.9.3 SAMPLE SIZE

Depending upon the intended use of the sample, decide whether a spot sample or a composite sample is to be taken. Take at least 1.5 times the quantity estimated as being required for the tests.

A.2.9.4 METHOD

i. Obtaining a composite sample

- Clean all the apparatus prior to use. Using the scoop take the required number of increments uniformly distributed throughout the batch.
- When sampling from the discharging stream of concrete from a stationary batch mixer or ready-mixed concrete truck, disregard the first part and the last part of the load.
- Take the increments in such a way as to represent the whole width and thickness of the stream.
  Note: When obtaining a composite sample from a ready mixed concrete truck a minimum of four increments is recommended.
- If the batch has been deposited in a heap or heaps of concrete, take the increments, wherever possible, distributed through the depth of the concrete, as well as over the exposed surface, at a minimum of five different places.
- Deposit the increments into the container(s). Record the date and time of sampling.

ii. Obtaining a spot sample

- Clean all the apparatus prior to use. Using the scoop take the increment(s) from the required part of a batch or mass of concrete. When sampling from a falling stream, take the increment(s) in such a way as to represent the whole width and thickness of the stream. Deposit the increment(s) in the container. Record the date and time of sampling.

iii. Measuring the temperature of the sample

- If required, the temperature of the concrete in the container(s) shall be measured.

iv. Transporting, handling and care of samples

- At all stages of sampling, transport and handling, protect the fresh concrete samples against contamination, gaining or losing water and extreme variations of temperature.
  ***Note:* The properties of fresh concrete change with time after mixing, depending upon the environmental conditions. This should be considered in deciding the time when tests are carried out or specimens made.**

Take care when the concrete is taken from the container(s) to ensure that no more than a light covering of mortar is left adhering to the container(s).

8.2.9.5 REPORTING

Each sample shall be accompanied by a report from the person responsible for taking the sample. The report shall include:

- Identification of the sample;
- Description of where the sample was taken;
- Date and time of sampling;
- Type of sample (composite or spot);
- Any deviations from the standard method of sampling;
- Declaration by the person technically responsible for the sampling that it was carried out in accordance with this document, except as noted in the last point detailed in B.2.3 (Part B).

The report may include:

- Ambient temperature;
- Weather conditions;
- Temperature of the concrete at the time of sampling.

REFERENCE

SANS 5861-2:2006

EN 12350-1:2009 (E)

SANS 3001-CO1-2:2018

A.2.10 MB10: SAMPLING OF STABILISED GRANULAR MATERIAL FROM AN UNCOMPACTED LAYER TO DETERMINE PERCENTAGE STABILISING AGENT (LIME and CEMENT)

A.2.10.1 SCOPE

This sampling procedure covers the sampling of uncompacted stabilised granular layers for the purpose of determining the percentage of stabilizer used and its distribution throughout the entire depth of the layer. This method is to be used for stabilisation with lime and cement only.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Mechanical Energy (Runovers/ back-overs when working in close proximity to moving mobile plant and equipment)	MEDIUM	(a) Compliance with CR 9: • Agree and apply Work Zone Safety measures for sampling activities with Principle Contractor (i.e. traffic accommodation) (b) Proper communication between site personnel and sampler is vital to ensure mobile plant does not operate in close proximity of sampling points

A.2.10.2 APPARATUS

- A suitable tape measure approx. 5 m in length.
- A flat spade (not a pointed shovel with tapered edges).
- A hand brush or 100 mm paint brush.
- Suitable containers for samples such as tins or plastic containers with air-tight lids to prevent moisture loss.

Note*: *Canvas bags are not permitted for these samples as the determining characteristics can be changed if used e.g. loss of both fines and moisture content.

- A small garden spade with a sawn-off point.

A.2.10.3 SAMPLE SIZE

- Number of samples required based on the lot under construction – minimum 10.
- Minimum sample size – A minimum 1 Kg per point tested is required for Back-titration method.

Note*: *A smaller sample may be used for finer material, but it is advised to take the 1 kg sample back to the lab and reduce the size at the laboratory.

A.2.10.4 METHOD

i. Preparation of sampling hole

- Before final compaction of the layer, after thorough mixing in of the stabilizing agent and prior to the final cut by the grader, excavate a hole with one vertical side at the predetermined sampling position through the full depth of the layer.

ii. Sampling for stabilizer content in full layer depth

- Using the garden spade, push it in level with the layer bottom, remove the full depth on the vertical face and place in the sampling container to provide enough material as detailed in Table A1.
- Trim the sides of the hole and ensure all the material from the full depth is removed and placed in the sample container.
- Use the brush to collect the fines and add them to the sample container.

  Note: Ensure no material is removed that is part of the previous layer.
- Close and seal the container immediately on completion of the sampling operation.

iii. Sampling for distribution of stabilizing agent in top and bottom portion of a layer

- Prepare the sampling point in the same manner as for the full depth process point.
- Determine the depth of half the layer and ensure enough material is obtained from each of these halves.
- Using the garden spade, push the spade into the top portion of the layer to the depth determined above (e.g. 50 % of the layer depth). Ensure the spade remains parallel to the floor of the hole.
- Place the material on the spade into the sample container.
- Trim the sides vertically and add the material from the trimming operation to the 1st sample container.
- Close and seal the container immediately on completion of the sampling operation.
- Remove the remaining 50 % below the position of the 1st sample down to the underside of the layer in the same manner adding the trimmed material to the 2nd sample container.
- Use the paint brush to sweep the fines together and add them to the 2nd container.

  Note: Ensure no material is removed that is part of the previous layer.
- Close and seal the 2nd container immediately on completion of the sampling operation.

iv. Labelling of sample containers

Every sample container (not the lid) must be clearly and indelibly marked so that it can be identified in the laboratory. The label or reference must concur with the reference in the covering report of the sample data form which notifies the laboratory of the arrival of the samples.

Include the following additional information on the label:

- Time at which the addition and mixing of the stabilizer and water commenced.
- Time when sample was taken.
- Method of mixing used – e.g. CIR, grader, plough disc.

A.2.10.5 REPORTING

A sample report/label shall include where relevant:

- Reference to sampling method.
- Date & time of sampling.
- Data to identify and describe the sample (e.g. number, amount, name).
- Identification of person taking the sample.

- Identification of the equipment used.
- Environmental or transport conditions.
- Diagram or other equivalent means to identify the sampling location.
- Deviations, additions to or exclusions from the sampling methods and sampling plan.

A.3 PAVEMENT LAYERS

A.3.1 MC1A: SAMPLING OF UNSTABILISED GRANULAR MATERIAL FROM A COMPLETED LAYER

A.3.1.1 SCOPE

This sa7mpling procedure covers the sampling of completed un-stabilised granular layers for the determination of all or some of the following methods - grading, soil constants, MDD/OMC and CBR. This will be after compaction and slushing if required by the contract specification.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Mechanical Energy (Run-overs/back-overs when working in close proximity to moving mobile plant and equipment). • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling). • Hazardous Hand Tools (Pick/Shovel/Hammer/Chisel).	MEDIUM	(a) Compliance with CR 9 and ErgoR 6: • Agree and apply Work Zone Safety measures for sampling activities with Principle Contractor (i.e. traffic accommodation) (b) Proper communication between site personnel and sampler is vital to ensure mobile plant does not operate in close proximity of sampling points (c) Ensure adequate assistance to handle heavy sample containers or consider providing mechanical lifting devices (d) Wear appropriate PPE: • Reflective vests • Eye protection • Leather gloves • Safety boots • Overall and protective knee-pads

A.3.1.2 APPARATUS

- A suitable tape measure e.g. 5 m.
- A shovel.
- A pick for use on subbase layer & lower.
- Use a 2 kg hammer & chisel for crushed stone base.

  ***Note*: Pneumatic power tools may be used but due care is required to minimize the potential damage to the coarse aggregate fractions.**
- Suitable canvas sheets.
- Carpenters crayons, chalk dust or spray canisters to mark out sample locations.

- A hand brush.
- A metal basin approximately 500 mm in diameter.
- Soft broom.
- Sample bags.
- Moisture content containers as per SANS 3001-GR20.
- A riffler with suitable openings and at least 4 matching pans (If reduction of the field sample is to be undertaken on site).

A.3.1.3 SAMPLE SIZE

Table A6: Minimum Sample Size for Sampling of Un-stabilised Granular Layers

Test	**Mass (min kg)***
Moisture content (mc) - Confirmation to prime (top 50 mm of layer) - Full layer check (normally 150 mm deep)	 0.5 kg 2 kg
Indicator tests	15 kg
MDD determination	40 kg
California Bearing Ratio & MDD/OMC & Indicator	80 kg
BD & AD for crushed stone base	15 kg

Note* These values need to be added together as required to get the total sample mass required and taken as a single field sample besides the moisture content samples. Once back at the laboratory the full samples will be split down into the required laboratory samples for the various tests.

A.3.1.4 METHOD

i. Preparation of a moisture content sampling hole (50 mm depth) for confirmation of priming

a. Sweep the area with a soft broom to remove all excess dust on the surface.

b. Prior to excavation of the sampling hole, use chalk or spray paint to mark out the position and size of the sample hole.

Notes

1. ***An area of 100 mm square by 50 mm deep should suffice to confirm the moisture content in the upper 50 mm.***
2. ***Prior to excavation, record the position in terms of traffic direction, wheel path, LHS, RHS, and condition of the surface.***
3. ***Prior to loosening the material, perform a nuclear gauge density tests on the exposed layer as per SANS 3001-NG5.***

c. Using either the pick or hammer and chisel and shovel, carefully dig a hole up to 50 mm in depth. The hole should be large enough to yield the required sample size. (See Table A6 for guidance on mass requirements).

d. Trim the sides of the excavation vertically to loosen all the material in the marked area to the required depth.

e. Remove all the loosened material to be able to obtain the minimum quantity required in Table 6.

NOTE: If a moisture content determination is required the loosening process needs to be done as quickly as is practically possible so as not to lose too much moisture due to evaporation during the loosening process.

ii. Preparation of sampling hole (full layer depth normally 150 mm) for either indicators and MDD/CBR or full depth moisture content

a. Sweep the area with a soft broom to remove all excess dust on the surface.

b. Use chalk or spray paint to mark out the position and size of the sample hole required.

c. Record the position in terms of traffic direction, wheel path, LHS, RHS, record the condition of the surface.

Note: Prior to loosening the material, perform nuclear gauge density tests on the exposed layer as per SANS 3001-NG5.

d. Using either the pick or hammer and chisel and shovel, dig a hole through the entire layer which is to be sampled. The hole should be large enough to yield the required sample size.
(See Table 6 for guidance on mass requirements).

e. Trim the sides of the excavation vertically to loosen all the material in the marked area.

Note: The material should be loosened carefully so that material from the underlying layer is not accidentally loosened and mixed in with the required material.

f. Remove all the material to obtain the minimum quantity required in Table 6.

Note: If the layer to be sampled is covered by another layer, the upper layer should first be removed. This area needs to be larger than the area required for the sample hole in the underlying layer by at least 200 mm on all sides. The sides of the test hole in the underlying layer must the not be vertically in line with the sides of the hole in the upper layer so that no material from the upper layer gets mixed with the material from the sampled layer when the latter is being loosened.

iii. Sampling

a. Should moisture content (mc) determinations be required, quickly mix the loosened sample in the excavation and remove at least 2 samples for moisture content determinations.

Note: Samples that are taken for the determinations of the moisture content of a material must be placed in a water-tight container as soon as they have been loosened, for example a bottle with a wide neck and a screw-cap and sealing ring, or a plastic flask with a top which forms a tight seal as detailed in SANS 3001-GR20.

b. Non-corrodible containers, each of which are numbered, and of at least 1 l capacity with an airtight lid for field samples. Enough material for the moisture content determination is required with at least 2 samples per point. For coarser material a 1 000 g sample is required whereas for finer material a 500 g sample will suffice.

c. The loosened material can then be transferred to suitable sample containers.

Note: The mass placed in each bag should not exceed 35 kg from an HSE perspective.

d. A small brush must be used to sweep all the fine material together. The fines are then collected and added to the sample in the containers.

Notes:

1. ***If the field sample is too large and needs to be reduced in size, it should be done on site with the use of a suitable riffler and pans or by coning and quartering before being transferred to the sample containers.***
2. ***This process is not recommended for moisture content samples due to the time los of reducing the sample to an acceptable mass.***
3. ***The canvas sheet can be used to store the material once removed from the excavated sample point to prevent contamination.***
4. ***Riffling or coning and quartering on site is to be done in such a manner as to ensure the representivity of the original field sample is not compromised or altered as detailed in Methods MD1 & MD2 respectively.***

A.3.1.5 REPORTING

Every sample bag or container (not the lids) must be clearly and indelibly marked so that it can be correctly identified in the laboratory. The label or reference must concur with the reference in the covering report of sample data form which notifies the laboratory of the arrival of the samples.

A label/Sample report should, where relevant, include the following:

- Reference to sampling method.
- Date & time of sampling.
- Data to identify and describe the sample (e.g. number, amount, name).
- Identification of personnel taking the sample.
- Identification for the equipment used.
- Environmental or transport conditions.
- Diagram or other equivalent means to identify the sampling location.
- Deviations, additions to or exclusions from the sampling methods and sampling plan.

Figure A8: Typical Compacted Unstablised Granular Layer from which a Sample will be taken, marking the Sampling Position

Figure A9: Using a Pick to Loosen the Material and Dig through the Entire Layer

Figures A10 (a) and (b): Extracting all Loose Material and Transferring to Containers

Figure A11: Brushing all Remaining Fines for Collection

A.3.2 MC1B: SAMPLING OF STABILISED GRANULAR MATERIAL FROM AN UNCOMPACTED LAYER

A.3.2.1 SCOPE

This sampling procedure covers the sampling of uncompacted stabilised granular layers including lime, cement and BSM layers for the determination of all or some of the following methods – grading, UCS, ITS, MDD, CBR and Atterberg limits. As far as bitumen stabilized materials are concerned the scope should be aligned to Sabita's TG2 *Bitumen Stabilised Materials* and the apparatus and sampling checked for suitability.

This method is to be undertaken once the material has been fully mixed & either spread into its initial final position before compaction or left in a windrow. This method is used to determine conformity to the specification of the material as delivered to site before compaction. This is the point at which the responsibility of the material changes from the supplier to the contractor.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Mechanical Energy (Run-overs/back-overs when working in close proximity to moving mobile plant and equipment). • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling). • Hazardous Hand Tools (Pick/Shovel/Hammer/Chisel).	MEDIUM	(a) Compliance with CR 9 and ErgoR 6: • Agree and apply Work Zone Safety measures for sampling activities with Principle Contractor (i.e. traffic accommodation). (b) Proper communication between site personnel and sampler is vital to ensure mobile plant does not operate in close proximity of sampling points. (c) Ensure adequate assistance to handle heavy sample containers or consider providing mechanical lifting devices. (d) Wear appropriate PPE: • Reflective vests • Eye protection • Leather gloves • Safety boots • Overall and protective knee-pads

A.3.2.2 APPARATUS

- A suitable tape measure e.g. 5 m.
- A shovel.
- A pick.
- A hand-brush.
- Sealed containers of sufficient capacity for the sample mass as detailed in Table A6.
- Moisture content containers conforming to SANS 3001-GR20.

A.3.2.3 SAMPLE SIZE

TG2 – Appendix B, Table B.3 details the number of samples required for BSM testing.

Table A7: Minimum Sample Size of Stabilised Granular Material

Test	Minimum sample Mass (kg)*
Moisture content (mc)	0.5
% stabilizer	1
Indicator tests	15
MDD determinations	40
California Bearing Ratio	30
Unconfined compressive strength	30
Indirect Tensile Strength	30

Note* These values need to be added together as required to get the total sample mass required and taken as a single field sample besides the moisture content samples. Once back at the laboratory the full samples will be split down into the required laboratory samples for the various tests.

A.3.2.4 METHOD

i. Preparation of sampling hole

a. Measure out the position and size of the sample hole required and mark the opening required.

b. Using a pick and shovel, dig a hole through the entire layer which is to be sampled. The hole should be large enough to yield the required sample size. (See Table A6 for guidance).

c. Trim the sides of the excavation vertically to loosen all the material in the marked area.

Notes:

1. The material should be loosened carefully so that material from the underlying layer is not accidentally loosened and mixed in with the required material.

2. There are time limits related to this sampling method and the related methods (SANS 3001-GR51) to be undertaken in the laboratory that need to be strictly adhered to.

ii. Sampling

a. The loosened material can then be transferred to suitable sampling container.

b. A small brush must be used to sweep all the fine material together. The fines are then collected and added to the sample in the containers.

Note: Samples that are taken for the determinations of the moisture content of a material must be placed in an air-tight container as soon as they have been loosened, for example a bottle with a wide neck and a screw-cap and sealing ring, or a plastic flask with a top which forms a tight seal as detailed in SANS 3001-GR20.

iii. Labelling of sample containers

a. Every sample container (not the lids) must be clearly and indelibly marked so that it can be identified in the laboratory.

b. The label or reference must concur with the reference in the covering report of sample data form which notifies the laboratory of the arrival of the samples.

A.3.2.5 REPORTING

The report shall, where relevant, include the following:

- Reference to sampling method.
- Date & time of sampling.
- Data to identify and describe the sample (e.g. number, amount, name).
- Identification of personnel taking the sample.
- Identification for the equipment used.
- Environmental or transport conditions.
- Diagram or other equivalent means to identify the sampling location.
- Deviations, additions to or exclusions from the sampling methods and sampling plan.
- Record the position in terms of direction, wheel path, LHS, RHS, make comments regarding the surfacing condition.
- Record the time the stabilising agent was added & when sampling commenced for record purposes based on the time limits for the laboratory testing.

REFERENCES

SANS 3002-GR20

SANS 3001-GR51, 53 & 54

SABITA - TG2 BITUMEN STABILISED MATERIALS

A.3.3 MC2A: SAMPLING OF ASPHALT FROM A COMPLETED LAYER AS A CORE OR SLAB

A.3.3.1 SCOPE

The purpose of this sampling method is to ensure that best practice is achieved in the process of procurement of cored and cut slabs specimens of asphalt materials after construction with the use of a diamond core drill or a power saw. The method is relevant for layers not thicker than 200 mm but not less than 30 mm. It is the responsibility of the technician taking the sample to ensure that the sample is representative of the asphalt material as paved in order that all parties (Client, Engineer, Contractor, Supplier) are continuously and accurately informed of the process quality control and acceptance quality control of the mixed product.

This method covers the procedures to be followed when a core or cut slab of asphalt is required for the purposes of determining the following from a constructed layer:

- Cores layer thickness and BD only
- Slabs layer thickness, BD, grading and binder content.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Mechanical Energy (Runovers/ back-overs when working in close proximity to moving mobile plant and equipment) • Ergonomic Hazards (Handling heavy samples: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling) • Hazardous Hand Tools (Pick/Shovel/Hammer/Chisel) • Hazardous portable power tools (Power drill/Saw)	MEDIUM	Compliance with CR 9; CR 23; ErgoR 6; DMR 4 Agree and apply Work Zone Safety measures for sampling activities with Principle Contractor (i.e. traffic accommodation) (Proper communication between site personnel and sampler is vital to ensure mobile plant does not operate in close proximity of sampling points) Ensure adequate assistance to handle heavy sample containers or consider providing mechanical lifting devices Wear appropriate PPE: - Reflective vests - Eye protection - Leather gloves - Safety boots - Overall and protective knee-pads

A.3.3.2 APPARATUS

i. <u>Core extraction</u>

A power drill capable of drilling out cores at right angles to the surface and which can be held firmly and perpendicularly in place while in use, equipped with a diamond bit to produce a 150 mm or 100 mm diameter specimen (as required), a core barrel at least 300 mm long and a water supply under pressure to cool the bit.

ii. Slab extraction

A power saw equipped with a high-speed carborundum, diamond or similar blade 300 mm in diameter for layers of less than 100 mm. A blade with a larger diameter must be used for thicker layers.

iii. Suitable containers in which to transport the cores, such as plastic bags and/or a container with a flat storage surface.

Note: Cores must not be stacked in the container & must be restrained to prevent them from rolling around while being transported back to the laboratory.

iv. Core extraction tool.

v. Slab extraction tools to remove the slab while keeping the slab intact as much as possible.

vi. Surface thermometer.

vii. Slab removal tool – e.g. flat spade or 300 mm wide plate.

A.3.3.3 SAMPLE SIZE

i. Cored samples

A minimum diameter of 100 mm is recommended, depending on what tests are to be undertaken on the sample, the maximum aggregate size in the asphalt and layer thickness. For thin layers, or when the grading, binder content is to be determined, a minimum core diameter of 150 mm is recommended.

ii. Slab samples

The sample size will depend on the tests to be done on the sample. For BD determinations, MVD, binder content and grading determinations, a slab across the full paving width is required with a slab width of 300 mm.

Beams of asphalt that are sawn out for the determination of fatigue life must be at least 150 mm wide and 300 mm long.

A.3.3.4 METHOD

i. Drilled out (cored) samples:

- Place the drill, equipped with the required bit, in position.
- Support the frame of the drill so that its weight is not resting on the wheels if it is mounted on a trailer or park the frame such that it rests solidly on the surface if it has no wheels.
- Let down the drill bit until it rests on the surface and then adjust it so that it is exactly perpendicular to the surface.
- Turn on the water supply and start the drilling.
- The rate at which the drill penetrates the material will depend on the hardness of the material and on the condition of the drill bit.
- The rate must be such that the drill does not lose speed, but neither must it turn too fast.
- The water supply must be under enough pressure to wash out the borings and to cool the bit.
- Drill down to just beyond the desired depth. This is normal observed by a change in the colour of the borings.

As soon as the desired depth has been reached, the drill must be withdrawn slowly while it is still turning.)

- Once fully extracted, turn off the drill.
- Leave the water running until the core is extracted.
- If the core comes away inside the barrel, it must be carefully removed by tapping the sides of the barrel lightly, taking care that the core does not suddenly fall out of the barrel.
- Should the core remain in the hole, it must be carefully loosened by inserting the core extractor into the drilled groove, clamp the core and wiggling the core free, taking care that the core extractor does not damage the sides of the core.
- To ensure that the core will come away easily, it is preferable to drill just beyond the level of separation between layers, e.g. the level between an asphalt layer and a granular layer. If, for example, a sample of an asphalt surfacing overlying an asphalt base is required, it would be better to drill through the base as well and then to separate the two asphalt layers in the laboratory using a diamond saw.
- Once the core has been removed, it must be packed carefully into a tin or wooden box, surface side facing downwards and restrained so that it will not break or deform during transportation.

\- Protocol developed for steep slopes when drill is attached to the back of a bakkie or on a trailer.

- Coring process to ensure acceptable cores extracted from the road surface.
- Coring should be done early in the morning when the layer temperature is still cool. The road surface temp should not exceed 30 oC throughout the drilling process. This temperature needs to be recorded at the beginning & end of the process.

<u>Note</u>: This ensures that the binder is not softened in the day's heat making it difficult to extract the core/slab without building in possible cracks and resultant erroneous lower densities.

<u>The following needs to be checked on the trailer to ensure that drilling takes place perpendicular to the surfacing</u>:

- The trailer must be unhitched from the tow bar
- Secure the safety chain around the ball on the bakkie so that the trailer does not move downhill while coring due to the vibration of the motor.
- The bakkie must pull the chain tight before drilling commences
- The bakkie must be pointed slightly uphill to keep trailer steady in one place. This may not be in line with the lane in which the core is being extracted. Traffic accommodation is critical in this regard as more than 1 lane may be obstructed as a result.
- The trailer must be set up parallel to the surfacing
  - ➢ Measure the height on the 4 corners of the trailer to ensure it is parallel to the road surface.
  - ➢ Use this height each time the trailer is set up to ensure a parallel setup.
- Use just enough water to lubricate the drilling operation.
- If drilling from the back of a bakkie the tyre pressures is to be checked to ensure both tyres are the same height.
  - ➢ This assists in ensuring that the bakkie is parallel to the surfacing.
- Wheels can be chocked to assist in keeping the trailer/bakkie steady without slowly moving downhill during the drilling process.

- Bakkies to be left in gear with the handbrake engaged to further assist in not having the bakkie slide down the hill during the drilling operations.
  - Preferably rubber chocks under the wheels to prevent slippage.
- Do not use a screwdriver or other sharp instrument to remove the core from the hole.
  - use a core extractor to assist in removing the core in an undamaged state. Any damage introduced in removing the core will result in an incorrect result & the cared specimen will have to be discarded.
- Core holes need to be filled before leaving the site or moving on to the next core site using either hot mix of cold mix asphalt rammed into place with at least 50 blows with a hand-held Marshall hammer.
  - A tack coat is required to painted onto the exposed sides of the drilled area to help seal the vertical sides from water ingress.
  - the surface should then also be painted with emulsion & dusted with sand to seal off the area to prevent water ingress.

ii. <u>Cut samples</u>

- Use either a hand-held power saw, or when necessary to saw in deeper than 100 mm and the larger blade size is required, a saw equipped with wheels and a high-speed cutting or diamond blade. If a diamond saw is used, it should be cooled by a constant stream of water.
- Mark out a section 300 mm wide across the full width of the pavers screed. Saw out the block of asphalt. Remove the outer 300 mm from each side in the laboratory and do not use these sections for any tests.
- If a hand-held power saw is used, take care that the cut surfaces are straight and vertical without irregularities or steps.
- ***NOTE: Ensure that adequate PPE & HSE protocols are in place during this operation.***
- Once the sides have been sawn through, blocks of a maximin of 500 mm must be carefully loosened from the lower layer. The 500 mm block divisions also need to be sawn. Care is to be taken not to build in cracks in the individual samples extracted. Each portion to be marked as to its location in the sample.
- The block must then be laid flat carefully in a wooden sample box. The blocks must lie perfectly flat in the box, surface side facing downwards, to prevent deformation and restrained to prevent any damage for movement during transportation back to the laboratory.

A.3.3.5 REPORTING

The samples must be properly labelled. A form containing the following information must accompany them:

- Number of the road, structure or layer.
- Contract identification.
- Position of the core/slab.
- Description of the core/slab.
- Date of sampling.
- Name of the sampler.
- Tests to be done on the samples.

Figure A12: Wooden Sample Boxes with Samples carefully placed

A.3.4 MC2B: SAMPLING METHOD SAMPLING OF CONCRETE FROM A COMPLETED LAYER OR STRUCTURE

A.3.4.1 SCOPE

This method covers the taking of cores from hardened concrete, preparing them for testing and determining their compressive strengths.

Note**: Before drilling of cores for testing in compression is started, agreement should be reached by all parties on the necessity of the test, and its aims. Reference should be made to SABS 0100-2 and to the latest specialist literature.***

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Equipment with moving/ rotating parts (Use of potentially hazardous power tools)	LOW	(a) Compliance with DMR 4 (b) Wear appropriate PPE: • Reflective vests (If sampling adjacent to a roadway) • Eye protection • Leather gloves • Overall and Safety boots

A.3.4.2 APPARATUS

i. Concrete core drill, that is diamond-tipped, of the required diameter and capable of taking a core from hardened concrete.

ii. Concrete saw, that is diamond-tipped, and capable of cutting the ends of a core square to the axis of the core to within 25 mm.

iii. Grinder, that is capable of grinding the ends of a core plane to within 0,5 mm/m and square to the axis to within 12.5 mm.

A.3.4.3 CORE SIZE

The preferred core diameter is 100 mm, but cores of a smaller diameter may be used, provided that the diameter is at least 65 mm and at least three times the maximum size of the aggregate.

NOTE - If necessary, non-standard core sizes may be considered, to avoid cutting reinforcing steel. However, the diameter should be at least 65 mm or at least three times the maximum size of the aggregate.

A.3.4.4 METHOD

i. Coring Position

Take cores in accordance with SANS 10100-2:2014.

ii. Orientation

The orientation of the cores will, to a large extent, be dictated by the shape, size and position of the member or section. Take the core perpendicular to the outer surface of the concrete and, where practicable, with the longitudinal axis of the core horizontal. If possible, take the core without cutting through reinforcement. (A cover meter may be used to determine the position of reinforcement, and in some cases, it might be advisable to expose the steel by chipping away the concrete cover).

iii. Drilling - Vertical / Horizontal

- Ensure that the drilling machine is firmly positioned that damage to the core by movement or vibration is prevented.
- Drill to a sufficient depth to ensure that after the outer 20 % (with a maximum of 50 mm) of the core length (i.e. the portion that contains the surface layer of the concrete member or section) has been cut off, the remaining length of core is sufficient for testing.

iv. Marking

- After extracting the cores, mark each core to indicate its position in the concrete member or section and note any unusual features such as honeycombing, segregation, reinforcement, signs of lateral stresses exerted during the drilling operation.

A.3.4.5 REPORTING

Each sample shall be accompanied by a report from the person responsible for taking the sample. The report shall include:

a) Identification of the sample;
b) Description of where the sample was taken;
c) Date and time of sampling;
d) Type of sample (composite or spot);
e) Any deviations from the standard method of sampling;
f) Declaration by the person technically responsible for the sampling that it was carried out in accordance with this document, (except as noted in item e).

The report may include:

g) Ambient temperature and weather conditions;
h) Temperature of the concrete sample at the time of sampling.

REFERENCE

SANS 5865-2:2006

SANS 3001-CO3-5

SANS 10100-2:2014

A.4 GENERAL METHODS

A.4.1 MD1A: DIVISION OF GRANULAR AND AGGREGATE SAMPLES USING A RIFFLER

A.4.1.1 SCOPE

This method describes the division or reduction of a sample of granular material and aggregate by means of a riffler.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Ergonomic Hazards (Handling heavy sampling equipment: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling).	LOW	(a) Compliance with ErgoR 6 (Hazard analysis required to determine appropriate method of handling the equipment). (b) Wear appropriate PPE as indicated by the risk assessment/hazard analysis).

A.4.1.2 APPARATUS – See Figures A13(a) & A13(b)

Both riffler & pans are to be made from sufficiently robust material to withstand the rough working the apparatus will be exposed to in the normal line of duty.

i. <u>Riffler</u>

- All rifflers must have an equal number of chutes.
- For the smaller openings, a maximum of 20 chutes are required and for the larger opening sizes, a maximum of 14 openings.
- This is to limit the mass that can be placed in each pan due to HSE limitations of lifting a maximum mass of 35 kg.
- A side plate or flap is required to redirect the material as it leaves the last chute on each side & redirect it into the pans.

ii. <u>Pans</u>

- At least 4 per riffler.
- The pan opening width at the discharge end needs to be equal in dimension to an even number of openings to match the riffler chute opening size.
- Handles are required on the ends of the pans to assist in lifting & discharging the material into the riffler.
- Pans are to be fixed to the riffler frame to ensure that the pans move with the riffler during the riffling process.

Figure A13(a) - open system

Figure A13(b) - closed system

Both the images above illustrate acceptable requirements besides in figure A13(b) where the pans would require handles & the pans need to be fixed to the frame in some manner.

A.4.1.3 METHOD

i. Choice of opening width

- Choose the opening width of the riffler as shown in the table below:

Table A8: Riffler Opening Adjustment

Maximum size of aggregate (mm)	Opening width (mm)	Number of opening in riffler	Pan discharge width (mm)
Greater than 37.5	Sample to be sieved off – use cone & quarter method		
37.5	53	14	318
28	37.5	20	225
14 – 20	25 -28	20	200 - 224
7 – 10	20	20	160
less than 7	7	20	70

ii. Preparation of the sample

- Ensure that any agglomerations have been suitably broken down into individual fractions.
- Sieve sample through the next largest sieve size to ensure no oversize in going to block the riffler openings. Cone and quarter any retained material to the same portion size as the riffling process and add to the reduced riffled sample.

iii. The riffling method

- The sample is placed in one of the riffler's catch pans to a maximum 20 kg or 2/3rd of the depth of the catch pan. If it is a large sample, the sample will have to be added in acceptable portions till the entire sample has been split in half.
- Spread the material evenly along the length of the pan to ensure that the catch pan is not overfilled.
- Lift up the catch pan and position it vertically over the feeder tray allowing it to rest on the edge of the riffler.
- Slowly move the catch pan lengthwise from side to side slowly tipping the top of the pan towards the feeder tray so as to ensure a continuous even flow of material onto the openings without any spillage over the edges of the riffler. The pan is to remain in a vertical position by using the riffler edge as a level. Discharge the material in such a way as to allow the material to land in the centre of the openings to allow it the best chance of passing through without causing a blockage. A slight tapping of the pan against the riffler edge will assist in allowing most of the more flaky particles tend to bridge over the openings to find their slot and pass through. The material must not be dumped onto the opening causing them to be blocked. The material needs to be discharged in such a manner as to allow the material to immediately pass through the opening as against lie on the surface of the openings. If blockages occur continuously check if the correct opening size has been selected. If the wrong opening size has been selected restart the process with the correct riffler.
- Should blockages occur the riffling process must be stopped until the blockage is clear before restarting the process.
- Replace one or both pans in which material has been caught after riffling with an empty pan(s). Take the divided material from one of the two pans and repeat the process.
- Spillages should be avoided. If it does occur, reintroduce the material into the pans.
- Repeat the procedure until a sample of the required size is obtained. (***Note**: To assist in determining the numbers of splits required to obtain the required mass it would be helpful if the initial mass of the sample was known.)*
- The final sample needs to be made up of a portion from both halves of the initial split, similar to the way the alternate quarters are recombined in the coning & quartering process.

A.4.1.4 NOTES

i. The importance of the opening widths is discussed in Part B: B.4.1 i (a). When graded material is being divided and it is very important that the sample be representative, the sample may be divided into the fractions indicated in Table A.8 by means of sieves and then riffled through the appropriate opening widths. Ensure that the same number of splits is taken when dividing each fraction.

ii. There must be an even number of slots.

iii. At least four catch pans per riffler.

REFERENCE

AASHTO T248

ASTMC702

A.4.2. MD1B: DIVISION OF ASPHALT MIXES USING THE RIFFLER

A.4.2.1 SCOPE

For fine graded mixes such as14 mm 10 mm and 14 mm/10 mm UTFC.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• Ergonomic Hazards (Handling heavy sampling equipment: Physical Effort [push, pull, lift, carry] and Awkward Posture during sampling) • Caught between/pinching (When handling sampling equipment)	LOW	Compliance with Ergo R6 (Hazard analysis required to determine appropriate method of handling the equipment) Wear appropriate PPE: - Suitable gloves to protect hands against pinching - Consider safety boots with metatarsal protection to protect against dropped objects

A.4.2.2 APPARATUS

A riffler with an even number of suitably sized openings and complete with at least four catch pans. (See Method MD1A)

A.4.2.3. METHOD

i. The sample is placed in one of the riffler catch pans and spread evenly along the length of the pan so that when the pan is inverted over the 28 mm feeder tray, all the openings receive an equal quantity of material in an even stream. Shake the pan lengthwise. One half of the sample is placed in marked sample bag and stored as a duplicate. Replace the other pan in which material has been caught after riffling with an empty pan and add the divided material from the remaining pan to the feeder tray again in the same manner as before. Repeat the procedure until a sample of the requires size is obtained. (Photo 3).

ii. As the binder could become more viscous at increased temperature and thus cause sample particles to stick together, these activities must be conducted as expeditiously as possible. The application of release agents on the feeder tray should be considered in this light.

iii. <u>For asphalt mixes with aggregates greater than 14 mm nominal aggregate size, the following method should be used</u>:

- Problems can arise in the case of samples containing coarse aggregates greater than 14 mm especially for grading and binder content testing. As these will lodge in or on the openings of the riffler, they should first be removed by sieving (Photo 2). before the material is passed through the riffler. In such cases, the following procedure should be used:

- The sample is poured onto the 300 mm diameter, 20.0 mm opening sieve which is placed in a 400 mm basin (Photo 2).
- The material passing the sieve is then split down using a riffler as described above.
- The aggregate retained on the sieve (Photo 4) is sieved through 53 mm, 37.5 mm 28 mm and 20 mm sieves and each fraction is then sub-divided by the method of coning and quartering. This is accomplished by forming the material into a cone (Photo 5) which is pressed flat (Photo 6) and by dividing into four quadrants (Photo 7), rejecting the two opposite quadrants (Photo 8) and continuing the process of coning and quartering until a portion of the required split is obtained (Photos 9,10,11,12) that matches the splits undertaken on the -20 mm fraction by riffling.
- If the material passing the 20.0 mm sieve is divided by the riffler to obtain a portion of approximately a quarter of the field sample, the coarse aggregate is divided an equal number of times. That portion of the coarse aggregate is now added to the portion passing the 20.0 mm sieve and this then constitutes the test sample (Photo 13) which is considered to be representative of both the coarse and fine sample fraction of the sample as received.

iv. <u>For larger aggregate mixes, the following methods should be used:</u>

- The same procedure is followed as iii. (above) but instead of coning the retained 20 mm fraction, a reduction factor is calculated and the mass retained on the 20 mm sieve for each fraction is computed, weighed and added to passing material after riffling.

RF is reduction factor

a is the mass expressed in grams, of the fraction of the material passing the 20 mm sieve after riffling.

b is the mass expressed in grams, of the material passing the 20mm sieve

RF = a/b

<u>Note</u>: It is imperative that these methods are used to eliminate tester bias which is likely due to the minus 28 mm fraction and retained 20 mm containing coarser size stones. If only the smaller size aggregate is selected for coarse aggregate to be added to the minus 20 mm fraction, this will yield a higher binder content due the larger surface area. The opposite will happen when only larger aggregate is selected. Reduction Factor calculation can be used to verify masses obtained from the Coning Method

Photo 1 - Splitting the material in two equal halves

Photo 2 - Sieving extra-large particles

Photo 3 - Second splitting procedure

Photo 4 - Extra-large size particles on sieve being prepared for sub-dividing by coning and quartering

Photo 5 - Forming the material into a cone, then pressed flat

Photo 6 - Pressing the coned material flat

Photo 7 - Dividing material into four quadrants

Photo 8 - Rejecting the two opposite quadrants

Photos 9 (a), (b), (c) and (d) - Continuing the process of coning and quartering

Photo 10 - The test sample

A.4.3 MD2: SAMPLING BY QUARTERING

A.4.3.1 SCOPE

This method describes the division of a sample of granular material by quartering.

HSE CONSIDERATIONS

Potential Hazard/s	Risk Rating	Minimum Control Requirements
• No significant hazards to report on. Manage for continuous improvement and re-evaluate when method or operating circumstances change.	NA	NA

A.4.3.2 APPARATUS

- A flat spade or flat nosed shovel.
- A canvas sheet.
- A 2 m straight edge to assist in dividing the material into quarters (optional).

A.4.3.3 METHOD

The method is illustrated in Figure A14. In this method the material is first thoroughly mixed on a hard, clean surface or on the canvas sheet and then formed into a cone in the centre of the surface.

If the material is inclined to segregate, reform the cone so that the material is thoroughly mixed. Now flatten the cone and divide it into four equal quarters and separate these from each other. Remove two opposite quarters and mix the two remaining quarters together again. Repeat this process until a sample of the required size is obtained. (See notes i. and ii. below). It is helpful to know the approximate mass of the sample so as to determine how many times one needs to cone a quarter to get to approx. the correct sample mass.

A.4.3.4 NOTES

i. If a hard, clean surface is not available, the quartering may be done on a canvas sheet. Mix the material on the canvas sheet with a spade or mix it by picking up each corner of the sheet and pulling it over towards the opposite corner. Form a cone with the material and then flatten the cone in such a manner as to not induce uneven segregation around the edges of the flattened pile. This can be done by starting at one point and working in the same direction in even larger circles while flattening the pile to the required height. Divide into four quarters using the spade or a straight edge if available.

   If the surface under the sheet is too uneven, a pipe or rod can be inserted under the sheet directly beneath the middle of the cone. Both ends of the rod are then lifted, leaving the sample divided into two equal parts. Leave a fold of canvas between the two halves. Now repeat the process by inserting the rod at right angles to the previous division and lifting it so that four quarters are formed. Remove two opposite quarters and mix together the two remaining ones. Repeat the process until a sample of the required size is obtained.

ii. If the material contains excessive dust, the surface on which the quartering is done should be such that the dust will not be lost.

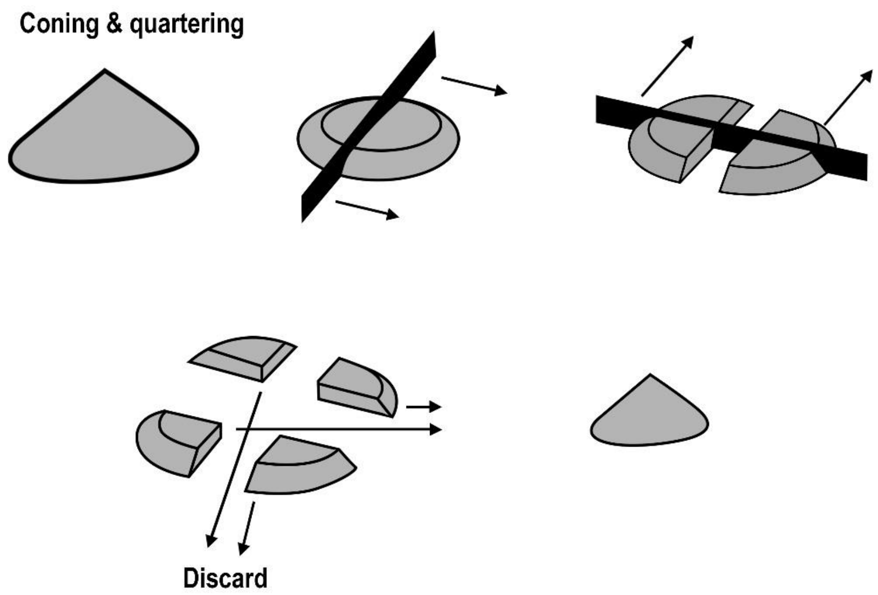

Figure A14: Quartering on Even Hard Clean Surface

Note: The spade can also be used to divide the sample.

PART B

BACKGROUND TO SAMPLING AS APPLIED TO ROAD CONSTRUCTION

CONTENTS

LIST OF TABLES

B.1 RANDOM SAMPLING FOR ROAD CONSTRUCTION

B.1.1 SCOPE

A random sampling method is one in which the choice of a particular item or sample location for inclusion in the sample is left entirely to chance. This choice is in no way influenced by the person doing the sampling at any stage in the sampling process. Once a location or item has been picked there is no way of knowing which spot or item will be picked next.

For practical reasons the procedure described here can only be applied to the location of samples taken from a completed layer of a road.

B.1.2 SAMPLE SIZE

An important question is: *How large should a sample be in any specific situation*? If a sample is used which is larger than necessary, resources are wasted; if the sample is smaller than required, the risk of wrongful decisions may be increased and the objectives of the analysis not be achieved.

For a sampling plan to be mutually acceptable to the client and producer, the risks of accepting "bad" material (termed an ***α risk***) and rejecting "good" material (termed a ***β risk***) must be made suitably small. Small lots present difficulties since usually only a very few samples can be tested. This means that it is not possible to design a sampling plan with superior levels of discrimination between good and bad lots.

Perhaps the most important practical consideration in the selection of a sampling plan is cost. The cost of drawing items from the lot, of testing the items, and in some cases the cost of the items themselves must be balanced against the risks of wrong decision regarding the lot. This problem is largely economic in nature and, ultimately the cost of sampling should be weighed against the potential losses or damages of wrongful acceptance of a defective lot.

To illustrate the effect of sample (or lot) size on the risk of wrongful acceptance of defective product, consider a statistical acceptance plan based, typically, on an acceptable, percentage defectives of 10 %, and a fixed α risk of 5 % to the producer. For a sample size of 3, the client would be faced with a *β risk* (of accepting defective material) of 72.2%, which is very high. When the sample size is increased to 8, the *β risk* is reduced to only 6.4% which is quite acceptable. Thus, the principle of "safety in numbers" should be given due consideration in developing sampling plans.

B.1.3 CHOICE OF LOT SIZE

By definition 'a lot' is a discrete specific quantity of the material which can for all practical purposes be regarded as a separate entity and which does not inherently vary disproportionately in respect of the determining characteristics. (*See Definition of Terms*)

In the case of a pavement layer, the lot size will therefore depend on the characteristic to be tested. For density control, a section which has been processed and compacted in a single operation will count as one lot. Visually the surface of the layer must look uniform it can be classified as a lot. If, for example. segregation of visible on the edges the pavement layer due to poor mixing and placement, it may need to be divided in two potions – the finer, more dense portion as one lot and the coarser more segregated portion as a second lot as the gradings would be different. With asphalt, a day's work can count as a lot. If the days asphalt was mixed on two separate batches, it could be split into 2 lots or combined into one depending on how similar the results are. The choice of a lot size will therefore depend on the sampler's judgement but must comply with the requirements set out in the definition.

B.1.4 PROCEDURE

i. Once the lot size has been decided on, determine the length and width, L1 and W1 respectively. Determine the number of samples to be taken by using the specified sampling frequencies or by referring to Part B: B.3 and B.4.

The number of samples required is recorded as N. Starting with the first column of the attached table of random numbers, write down the first N pairs of figures:

Calculate L = L1 – 0,40 m

W = W1 – 0,40 m

Now multiply the length L by every number in the first column, and the width W by every number in the second column of the N pairs of random numbers.

ii. Now arrange the product in column 1 in numerical sequence, keeping the pairs of numbers together. These numbers give the test points measured from a point 0,20 m from the beginning of the section along its length, and the corresponding distances measured from a point 0,20 m from the side of the section over the width. (See paragraph 4.).

iii. If only the distances along the length are required for a specific sample, only one column is used at a time.

iv. When the next section is to be sampled, the next N pairs of figures are used, and so on until the whole table has been worked through. Thereafter begin again with the first column. The table is used from the beginning again from each sample type.

B.1.5 EXAMPLES

Suppose that five MDD samples must be taken and that five field densities must be measured at the same places on a section of subbase 725 metres long and 12,8 metres wide.

Now take the first five pairs of random numbers per the example below.

0,397	*0.040*	
0,420	*0,366*	
0,631	*0,507*	
0,290	*0,081*	
0,210	*0,414*	
L	*= 725 – 0,4*	*= 724,6m*
W	*= 12,8 – 0,4*	*= 12,4m*

Multiply the first column of figures by L
and the second column by W. This gives:

287,7	*0,5*
304,3	*4,5*
457,2	*6,3*
210,1	*1,0*
152,2	*5,1*

The tests are now done, and samples taken at:

Distance from beginning of section*	Distance from side*
152,2	5.1 m
210,1	1,0 m
287,7	0,5 m
304,3	4,5 m
547,2	6,3 m

Note **Measured in both cases from 0,2 m from the beginning of the side of the section***

Table B1: Example of Random Numbers

Rx	Ry	Rx	Ry	Rx	Ry
0.9382	0.1974	0.1816	0.1308	0.8038	0.7468
0.9692	0.8352	0.5755	0.5277	0.2194	0.3679
0.0031	0.5427	0.5255	0.9595	0.7420	0.6207
0.2824	0.0921	0.2175	0.3737	0.2825	0.2732
0.0029	0.3959	0.4083	0.9840	0.5795	0.6093
0.8135	0.0074	0.9436	0.7691	0.6999	0.9282
0.3164	0.6203	0.2410	0.9739	0.5388	0.0448
0.5667	0.5692	0.7944	0.6084	0.3193	0.7897
0.5727	0.3291	0.6811	0.9487	0.0927	0.5091
0.7958	0.0158	0.0532	0.0362	0.2384	0.5648
0.6505	0.8856	0.6415	0.1780	0.9638	0.8343
0.0046	0.8355	0.2551	0.4469	0.8047	0.2107
0.6789	0.9031	0.2813	0.1812	0.1247	0.1025
0.9472	0.7666	0.1854	0.4851	0.6159	0.9342
0.0366	0.2449	0.0109	0.7280	0.7982	0.6456
0.6273	0.7974	0.8792	0.0453	0.5197	0.1924
0.3527	0.0242	0.4902	0.8378	0.4569	0.0458
0.2990	0.1661	0.6217	0.2721	0.6138	0.6924
0.5060	0.6044	0.6295	0.7802	0.8232	0.1349
0.4661	0.3611	0.9479	0.5600	0.2458	0.3912
0.6254	0.5987	0.5890	0.0748	0.8701	0.9951
0.8826	0.1206	0.6431	0.5535	0.0133	0.4959
0.0898	0.8705	0.7787	0.4909	0.8202	0.9584
0.5522	0.4329	0.7424	0.1472	0.7640	0.4634
0.5282	0.5329	0.8589	0.0483	0.1461	0.6068
0.7291	0.5362	0.5310	0.4856	0.5957	0.0007
0.8194	0.9492	0.7396	0.0163	0.5704	0.7724
0.9169	0.9189	0.5440	0.9632	0.8559	0.0650
0.0924	0.7329	0.5812	0.9146	0.0658	0.5372
0.8697	0.3193	0.5665	0.2245	0.1421	0.8632
0.7260	0.7470	0.7936	0.5216	0.8549	0.2331
0.4914	0.7255	0.6339	0.1642	0.3023	0.8524
0.3492	0.1050	0.0371	0.8300	0.4105	0.4423
0.3358	0.3760	0.0311	0.9266	0.4340	0.7397
0.8409	0.1700	0.2218	0.1362	0.4552	0.9968
0.6070	0.7590	0.2934	0.9064	0.8849	0.4819
0.3299	0.5554	0.5079	0.9507	0.9616	0.9786
0.1586	0.6127	0.2058	0.7481	0.2524	0.2863
0.1952	0.1245	0.3056	0.0432	0.1524	0.7198
0.9948	0.9254	0.8037	0.3462	0.3845	0.6097

B.2 ASSESSMENT OF TEST RESULTS THROUGH EVALUATION AND UNDERSTANDING OF THE SAMPLE TAKEN

B.2.1 INTRODUCTION

This section is intended to give the theoretical background to sampling, and to enable the user to determine the real value of a test result.

B.2.2 THE DEGREE OF REPRESENTATION OF A SAMPLE

- A sample of a material is usually a part of the relevant material. When a material needs to be tested, it would be ideal if all the material could be tested. However, this is impractical for most materials, and therefore only a sample is tested. (See Definition.)

- For example, it would be possible to dig up a spade full of soil and to declare that it is a sample of the earth's surface. Of course, that is true, but the degree of representation of such as sample would be insignificant and unacceptable.

- It is theoretically impossible to take a representative sample of the earth's surface because there are too many differences between the various types of material. However, it is possible to single out a certain portion whose characteristics do not vary so greatly and to take a representative sample of this portion (lot). For example, it would be relatively easy to take a representative sample of desert sand from a desert because the determining characteristics of a desert sand do not differ greatly. (See Definitions.)

- It should be clear from this paragraph that a sample is not automatically representative and that it is extremely important always to be aware of the degree of representation of a sample.

B.2.3 CHANGES IN A SAMPLE

- A representative sample is a part of the relevant material whose characteristics one has ensured will be representative of the characteristics of the whole lot or quantity of material from which the sample is taken.

- It is logical that the method of sampling should not change the determining characteristics of the material. If an auger was used to take a sample of gravel, it could break up the material to such an extent that the grading of the material would be completely changed.

- At the same time, it is very important to bear in mind that not only the method of sampling but also the way in which the sample is packed and transported can affect the determining characteristics of a sample.

<u>It is also important to realize that there are determining characteristics of a material</u>:

i. There are those that may remain constant over a period of time. Such a sample is said to have constant determining characteristics. (See Definition).

ii. There are those that may always be in the process of changing despite all normal precautions. This applies, for example, to a concrete cube or other stabilized material. Such a sample is said to have changing characteristics. (See Definition).

iii. There are those that may normally remain constant but may have been changed artificially or by some external influence, and therefore are no longer as they were originally. (See Definition 19.) Such a sample is termed a changed sample. This applies, for example, to a sample of bitumen emulsion. Although it is a changed sample, we accept it if it can be tested quickly enough for the determining characteristics to have remained essentially constant. If, however, it is kept too long, it becomes a changed sample because its determining characteristics have changed too greatly in the course of time.

It should be clear from the above paragraph that:

- One should always consider whether any action could affect the determining characteristics of the sample;
- In the case of a changed sample, it is important to establish the period within which the sample's characteristics should be determined, and to take this fact into account when evaluating the test results.

B.2.4 MIXING OF MATERIAL LOTS

- The greater the inherent variation in a material's characteristics, the larger the number of single samples that need to be taken to obtain a compound sample which can be regarded as truly representative. The more continuous and homogenous the characteristics of a material, the smaller the relative size of a representative sample will need to be.

- The more the inherent characteristics of a lot of a material vary, the more single samples will have to be taken to cover all the variations in the characteristics. For example, a material such as steel whose characteristics vary very little will only need a simple chemical and physical analysis from which practically all its characteristics can be predicted. It is therefore easier to determine the characteristics of a homogeneous material, and a smaller sample can be accepted as being representative.

- A sampler should always be aware that, in a large quantity of material, there is nearly always a mixture of materials. This fact always must be considered when natural road construction materials are sampled. It is usually impossible to take a wholly representative sample of such a mixture of materials. If every different type of material in the mass could be marked off or separated, it would be possible to take a representative sample of every aspect or type of material. We term this sample of every type in a large quantity of material (such as gravels from a borrow pit) a single sample. (See Definition)

<u>When unknown masses or quantities of different materials are mixed with each:</u>

i. Sometimes regard a point in the material as a lot, and sample, test and evaluate it;
ii. Sometimes take an approximate mean sample and test and evaluate it, accordingly, bearing in mind that such a method inherently yields a poor degree of representation;
iii. Where possible, mix the total mass of material thoroughly, thus obtaining a new lot which – because of the new artificial homogeneity of characteristics – can now be sampled, tested and evaluated on a better basis.

B.2.5 INFLUENCE OF CHARACTERISTICS AND STORAGE ON SAMPLING

- The material characteristics that are important or determining for our purposes usually establish the manner in which a representative sample is taken. For example, when the moisture in a layer being compacted must be determined, the loss of moisture through evaporation must be kept to an absolute minimum during sampling and transport of the sample.

- It is quite meaningless to take a sample if the sampler does not know what characteristics of the material are to be tested or what the determining characteristics of the material are.

- If drinking water was to be tested for bacteria, for example, the test would be quite useless if an unsterilized container was used for the sample. Similarly, if the moisture content of a soil core was to be determined, it would be foolish to transport the core in a core box.

- The type, position or manner of storage of the material involved may affect the choice of sampling method. For example, compare the method used for sampling aggregate from a stockpile with the method used for sampling it from the conveyor belt of a crusher.

- It is therefore important to know what tests are going to be done on the sample, and to know in what quantity and manner the material is stored before a sampling plan can be worked out.

B.2.6 SAMPLING SIZES

- The size of the sample to be taken is important and sometimes leads to insurmountable problems if it is not approached with a proper plan in hand. The sampler will gain little by working out the size of the sample they intend to take by some complex formula if the test which to be done will only use a very small quantity of that material.

- It is therefore very important to find out not only the required size of the initial sample, but also the number tests which will need to be done to ensure that the sample is representative.

- The physical characteristics of the type of material being sampled also affect the sample size. For example, a liquid can usually be adequately represented by a small sample because its components can easily be well mixed.

- A plan for determining what size sample needs to be taken always includes determining the minimum and maximum sample sizes. (See Definitions)

<u>The minimum sample size and the number of tests that need to be done are determined by</u>:

i. The variation of the determining characteristics of the material.
ii. The relative importance of the material in the construction and the costs involved.
iii. The lot size of the material.
iv. The quantity of material needed for the tests to be carried out.

v. The necessary accuracy of the test results, which in turn is determined by the relative importance of the material and the costs involved.

The maximum sample size is usually limited by practical considerations, such as those below.

i. Ease of handling which may influence the accuracy of testing outcomes.
ii. In virtually every test the quantity of material used is fixed and predetermined. Depending on the number of tests to be done, the quantity required is also more or less fixed. Usually enough material is taken for the test to be repeated, unless the sample becomes too large for this to be practical.
iii. It must, however, be realized that the size of the original sample taken is determined by the degree of representativeness required. Usually the initial sample is a very large quantity of material which is divided up on site into a manageable laboratory sample. (See Definitions).

To sum up, it is clear that:

i. The field sample size is determined by the degree of representation required;
ii. The size of the secondary (laboratory) sample is determined both by the practical considerations and by the size of the test sample as well as the number of tests to be done;
iii. The size of the test sample is usually laid down by the test standard;
iv. It is critically important to ensure representativeness when a test specimen is obtained from the laboratory sample;
v. When a test sample consists of only a small quantity of material, representativeness can be improved by testing more samples from the secondary sample; and
vi. Before a sample is taken, the sample size needed should be well thought through, planned and agreed to by all parties involved.

B.2.7 DESTRUCTIVE METHODS

- Tests done on material may be destructive or non-destructive. Sometimes a destructive test is not wholly, but only partially, destructive with the result that the material is still usable after the test.
- Non-destructive testing is ideal because the determining characteristics of the material are tested without any weakening effect. For example, the use of X-rays to test a welding joint in a pressure tank makes it possible to test the entire lot (that is all the welding joints) without in any way damaging the tank.
- In non-destructive testing, the sampling process is also non-destructive. Any designer of sampling and test methods will always aim at implementing non-destructive methods. However, it is usually impossible to design methods which do not do any damage.
- It is very important in any situation where destructive methods are to be applied, to consider whether, the amount of damage done does not outweigh the knowledge that can be gained from the tests.
- Repairs must be done immediately after destructive sampling to prevent further damage.

B.2.8 REPRODUCIBILITY AND REPEATABILITY

- When different operators test or sample a material according to a set of instructions, the results obtained always differ to some extent because of human interpretation or human error. The more difficult and complicated the test, the greater the opportunities for errors of human judgement. This inherent deficiency in every test or sampling method is measurable and is known as the reproducibility of the method. (See Definition).

- When the same operator repeats a method on the same material, the results obtained may also differ. Since it is statistically possible to accept that in these circumstances the human influence remains the same (although not always true), it can be accepted that his/her result gives an indication of the accuracy of that method. This accuracy of a method is measurable and is known as the repeatability of the method. (See Definition).

B.2.9 ACCURACY AND PRECISION

Although the two words can be synonymous in informal use, they are deliberately contrasted in the context of the scientific method. A measurement system is called valid only if it is both accurate and precise.

<u>In the fields of science, engineering, industry and statistics</u>:

i. The accuracy of a measurement system is the degree of closeness of measurements of a quantity to its actual (true) value.

ii. The precision of a measurement system, also called reproducibility or repeatability, is the extent to which repeated measurements under unchanged conditions show the same results.

iii. A measurement system can be accurate but not precise, precise but not accurate, neither, or both. For example, if an experiment contains a systematic error, then increasing the sample size generally increases precision but does not improve accuracy. Eliminating the systematic error improves accuracy but does not change precision.

B.2.10 SUMMARY

The benefit gained from the knowledge made available to the investigator by sampling and testing is usually not measurable, yet it is valuable. We would today be lost without sampling techniques (consider e.g. blood tests). The greater the variations in the determining characteristics of a material, however, the larger the compound sample will need to be, the more difficult it is to obtain a representative sample, the more expensive the testing process and the less accurate the deductions that can be made. Since the sampler is not the cause of these variations in the material, they cannot be blamed for the poor repeatability of tests on road construction materials. Where this variation is known, it must be provided for in the design of, and in the control over, the test. However, the sampler must be aware that they are carrying a great deal of responsibility when taking a sample.

B.3 DETERMINATION OF SAMPLE SIZE AND SAMPLE DENSITY

B.3.1 INTRODUCTION

This part of the manual is meant to be elucidate the more general ideas involved in sampling and is mainly intended for training purposes. The ideas which will be discussed here will, however, not normally be repeated in the straightforward methods given for every test.

B.3.2 SAMPLING FREQUENCY

Whenever samples are taken the sampling frequency must be determined beforehand and agreed to by all parties.

There are statistical methods by which one can determine what sample size (number of single samples) will be needed to ensure a specific level of confidence in the validity of the test results. These methods are not covered in this publication. SANS 3001-PR1 provides guidance on this topic.

However, it is not always possible to comply with the prescribed accuracy simply because it would be too expensive. In such cases the specified accuracy must be relaxed until the costs involved are justified in those circumstances.

<u>The sampling plan therefore consists of the following steps</u>:

1. Decide on the degree of accuracy required.
2. From this, decide on the sampling frequency needed.
3. Calculate the costs involved.
4. Adjust the specification to the degree of accuracy and recalculate the sampling frequency if the costs are too high.

B.3.3 CHOICE OF SAMPLES AND SAMPLE UNITS

i. If a particular characteristic (or characteristics) of a lot or process is to be evaluated by means of samples, these samples must be taken in a random manner. Randomness, however, does not imply that samples are taken in a haphazard manner. It is a definite attempt to prevent samples from being taken according to some predetermined or biased pattern. A random sample is usually taken according to a set of random numbers. Excel has this as a standard function.

ii. In order that a random sample may be taken, the lot must be divided into sample units. Drums of bitumen do not present a problem since each drum may be regarded as a sample unit. A pavement layer of a road can be theoretically divided into blocks of 1 x 1 m so that every square metre counts as a sample unit.

    When aggregate is stockpiled, the problem becomes much more difficult. The easiest solution would be to divide up the pile into segments, starting from the centre – as one would cut up a round cake from the middle. However, in all cases the lot has, unavoidably, to be divided into sample units in some way, and every unit has then to be represented by a number.

iii. The variation in characteristics determines whether a quantity of material can be represented by a mean sample. If, for example, a 30 000 L tankful of cutback bitumen has been well circulated and then divided up into sample units, the variation between the units will be so small that it would be acceptable to throw all the samples together and then test a mean sample. The position with stockpiled aggregate is quite different. When the pile is divided up into sample units, it will be found that the variation between the characteristics of the different units is so great that it is simply not justifiable to put together a mean sample. Since there is no way in which the pile can be mixed into a homogenous material, it is logical that every different variation needs to be evaluated separately because the aggregate will be used in the road in this condition. This idea will be easier to understand if one bears in mind that a pile of aggregate is formed by individual loads dumped next to one another, so that every load is still distinguishable.

Assume that every load is a sample unit. If one took several samples and put together a compound sample, the result of the test would tell one virtually nothing. However, if every sample unit (load) were tested separately, one would determine to what extent the aggregate complies with the specification as well as what degree of variation occurs. Then, when the loads are reloaded and used in the road one would know (at every specific point of the layer) whether the aggregate complied with the specification.

***Note*: Road construction materials can very seldom be represented by a single compound or mean sample.**

B.4 DIVISION, MARKING AND PROPOSED FREQUENCY OF SAMPLES

B.4.1 THE REDUCTION OR DIVISION OF A SAMPLE

When a sample is too large and it must be reduced for some purpose, this must always be done in a systematic manner. The same principle applies when a large sample must be divided into several smaller samples. Once a sample has been divided, one may not simply “round it off” to a convenient size.

The apparatus needed and the methods to be followed for division depend on the type of material to be divided and on the size of the sample.

i. The division of granular material.

Granular material must be as dry as possible to prevent the finer grains from sticking to one another.

There are two methods for division, namely the use of a riffler and the quartering method. The latter method is usually applied when a sample is larger than the quantity that can be contained in two riffler pans, otherwise it is preferred that the riffler always be used.

(a) The riffler method: This is an easy method requiring simple apparatus. Refer to Sampling Method MD2 for the procedure that should be followed.

(b) Quartering method: Quartering is done by dividing the thoroughly mixed sample into four equal parts. The two opposite quarters are discarded and the remaining two quarters are remixed and the process repeated until the desired sample size is obtained.

ii. The division of liquids

Liquids with high fluidity (low viscosity) usually mix very well, so that only a small error is made when the liquid is well mixed, and a sample is taken immediately after mixing.
However, these liquids may also be divided in a similar manner for liquids with a low fluidity. In the case of liquids with a low fluidity, such as bituminous binders, mixing is difficult, and it is not advisable to attempt division without mixing.
These liquids can usually be heated to a limited extent to decrease their viscosity and increase their fluidity to facilitate easier mixing.

Division can be affected by placing four square containers of equal size together in a square within a larger, flat container or pan. The sample of liquid is then poured onto the centre of this square so that each container receives more or less an equal quantity of liquid. Thereafter the liquid in the two diagonally opposite containers is removed and that in the remaining two is poured together again to give a smaller sample. This process is repeated until a sample of the required size is obtained.

Notes:

1. ***It is important to remember that bituminous binders oxidize more quickly under such exposure to oxygen and heated conditions.***
2. ***The square containers may be replaced by round ones such as glass beakers, in which case the liquid must be poured in a thin stream, using a circular motion and a steady rate of movement, so that it just touches the points of contact between the beakers.***

   Emulsion and cutback binders also have the added issue of possible evaporation of the more volatile portion which will change the characteristics of the material before it is even tested.

B.4.2 SAMPLE CONTAINERS

- Generally sample containers must be chosen with care so that there is no risk that they will change the determining characteristics of the samples. Sample containers must always be clean. Often it is not worthwhile cleaning a sample container and it is usually justifiable to use a new container for each sample.
- Regarding cleanliness, the same comments apply to all equipment used for sampling including rifflers, hands, gloves, the covers and stoppers of containers.
- Volatile substances, hygroscopic substances and substances affected by air or light must be protected against the influence that they are susceptible to during and after sampling. Use airtight containers for such samples e.g. bituminous emulsions, paint & cutback binders.
- Sample containers must be such that a portion of the material cannot be lost from them. Transporting a sand sample in a hessian sack is just as senseless as trying to transport water in a sack.
- When a sample container is opened it must be closed again as soon as possible and care taken that the identification labels are not destroyed or made illegible in the process.
- Samples that are affected by moisture must always be kept in watertight containers.

B.4.3 PRECAUTIONS TO BE OBSERVED DURING SAMPLING

i. When a sample is being taken, the sampler must ascertain the following:
   - Is the material poisonous or narcotic in nature?
   - Is the material corrosive or does it stain?
   - Is the material easily flammable?
   - Is the material hot (or very cold)?
   - Does the material give off gasses that exhibit one or more of the characteristics mentioned above?
   - Is the material under great pressure?

ii. It is extremely important to realise that a container may have been accidentally filled with a substance other than that stated on the label. A sampler may therefore never be careless when opening a sample container.

iii. When large quantities of liquid are sampled, or when a hazardous or hot material is sampled, two people should be present in case of a mishap occurs when HSE protocols ned to be put into action e.g. first aid, firefighting or spill control.

iv. When sampling can only be done from a position on top of a vehicle it must be properly braked such that it is impossible for the vehicle to begin moving of its own accord while the sample is being taken. The driver or person in charge of the vehicle must be aware that sampling is taking place so that they do not begin to operate the vehicle. A clear protocol needs to be in place for such sampling operation especially due to the added HSE issue of the sampler being on top of the vehicle some distance from the ground.

v. When samples are taken near moving plant, or parts such as a crusher or rollers on a layer that is being compacted or loaders in a borrow pit, the sampler must make sure that the operators are aware of their presence. They must display common sense in keeping themselves and their assistants highly visible and out of danger through applying clear protocols, wearing the appropriate reflective PPE's and communication with those operating in the same facility as them.

vi. When a consignment appears suspect for one of the following reasons, receipt thereof must be postponed until it has been ensured that the product conforms to the specifications:

- When the container is damaged or defective.
- When it is not certain what is in the container because of the presence of old labels, incorrect labels or no labels at all.
- When there are noticeably suspect non-uniformities such as unexpected differences in colour, or a layer of water on some containers.
- When anything else is noticed that could indicate that something is wrong e.g. unusual smell or colour variations.

B.4.4 THE MARKING, LABELLING AND REFERENCE TO SAMPLES

i. A sample with no verifiable label is of absolutely no value. The golden rule here will be: Rather do not take a sample at all than mark it inadequately.

A sampler wastes both their own time and that of others if they dispatch unlabelled samples. Obviously, if the label or other identifying marks are lost or otherwise destroyed in transit, this is just as frustrating and futile.
<u>It cannot be overemphasized that the labelling of a sample must be</u>:

- Complete and clear;
- Neat and legible; and
- Lasting, substantial and indelible.

ii. <u>The sample container must be marked indelibly with a sample number</u>

- An appropriate letter or form must then be sent to the receiver of the sample that must provide all the necessary information with reference to the sample number, such as:
- Origin of the sample: the place, district, road or bridge and stake value.
- Name of the supplier, manufacturer or tenderer.
- Names of the dispatcher, sampler, supplier and requester of the sample.
- Reason for sampling: Is it routine checking? Is it suspected that the material does not comply with the specifications?

- Does the material behave in an unusual or unexpected manner? Is there a dispute about the quality of the material?
- Instructions to the recipient: Must the sample be stored for reference? What tests must be done on it? Is the matter urgent? Is the result important? Is there a deadline for the result?
- Are there any special circumstances regarding the material that the recipient should know of? For example, is this the only available sample? Has some or other chance occurrence changed the properties of the material? Has it been treated with any agent or contaminated by something? Has it been overheated? Has it been standing for a long time? Is it a new product? Have some of its properties changed since delivery?
- Indication of storage: Was it taken from a pile, truck, drum, a road layer or a borrow pit?

B.4.5 FREQUENCY OF SAMPLING IN ROAD CONSTRUCTION

The frequency with which samples are taken are closely related to the specific purpose for which the samples are required.

i. <u>Sampling frequencies for process control</u>

- Process control is the control exercised by the contractor over their manufacturing process, so that they can be sure that they will notice in time when something goes wrong with the process and will be able to rectify the situation with as little damage as possible.

- Process control therefore does not necessarily bear any relation to acceptance control (see point ii. below), although it is generally the case that the result of process control can be considered for acceptance control.

- Process control is essential because the onus is always on the contractor to ensure that the materials used in the road comply with the specifications.

- It is clear that process and acceptance control should overlap as little as possible, and that only the minimum number and the most necessary tests should be done during process control is normally in the interests of the contractor, the choice as to the type and amount of control they apply should be left largely up to individuals company polices related to process control.

- When a statistical plan is used for process control, more tests will normally be required to make the application of statistical principles possible. Normally the manufacturing process in road construction is such that process control cannot be done on a statistical basis due to is comprising too few results to analyse statistically.

ii. <u>Sampling frequencies for acceptance control</u>

- Acceptance control is the control exercised by or on behalf of the client to ensure that the product supplied to them complies with the specifications. The product will be accepted or rejected on the strength of this control.
- Acceptance control should be done on a statistical basis, particularly on large contracts where a large quantity of the product is presented simultaneously for evaluation.

- In the case of smaller contracts, it is often unrealistic to try to apply statistical principles although using too few test results to approve work due may increase the risk of incorrect decisions being made in such cases.

iii. Minimum sampling frequencies

- The minimum sampling frequencies given in Table B2 below are intended as a guide. It is impossible to make definite suggestions for every possible set of circumstances, and it will always be necessary to make some adjustments for each individual case. Note: that these are minimum frequencies – normally more samples will be needed.

Table B2: Laboratory Tests for the Constructed Selected Layer

Component	Aspect to be Controlled	Type of Control	Minimum Sample Size	Sampling Frequency	Test Method
Compaction	Maximum dry density	MDD	40 kg	2 samples per 500 m^3	SANS 3001–GR30
	Density	Sand replacement	N/A	1 sample per 1000 m^3 per 150 mm layer, minimum of 5 samples per layer per lot	SANS 3001–GR35
		Nuclear	N/A		SANS 3001–NG5
Moisture Content		Gravimetric analysis	1 x 1 to 1.5 kg	1 sample per test	SANS 3001–GR20
Layer Placement	Layer thickness	Measurement			
Material Properties	Grading	Sieve analysis GM, Soil mortar analysis	15 kg	1 sample per 1000 m^3 per constructed layer thickness, minimum of 5 samples per layer per lot	SANS 3001–GR1
	Atterberg limits	Plasticity Index Liquid limit Linear shrinkage			SANS 3000–GR10, 11 & 12
	Bearing strength and swell	CBR	70 kg (split into 2 – 3 bags)	1 sample per 2500 m^3, minimum of 3 per source	SANS 3001–GR30 & 40

Table B3: Laboratory Tests for the Constructed Non-Cemented Subbase Layer

Component	Aspect to be Controlled	Type of Control	Sample Size	Sampling Frequency	Test Method
Compaction	Maximum dry density	MDD	40 kg	2 samples per 500 m^3	SANS 3001–GR30
	Density	Sand replacement	N/A	Minimum of 6 samples per lot	SANS 3001–GR35
		Nuclear			SANS 3001–NG5
Moisture Content		Gravimetric analysis	1 x 1 to 1.5 kg	1 sample per test	SANS 3001–GR20
Layer Placement	Layer thickness	Measurement			
Material Properties	Grading	Sieve analysis Soil mortar analysis GM	15 kg	Minimum of 6 stratified random samples per lot	SANS 3001–GR1
	Atterberg limits	Plasticity index Liquid limit Linear shrinkage			SANS 3001–GR10, 11 & 12
	Aggregate shape	Number of fractured faces			SANS 3001–AG4
	Bearing strength	CBR	70 kg (split into 2 or 3 bags)	CBR assessed prior to compaction: 1 per km CBR not assessed prior to compaction: 3 per km	SANS 3001–GR30 & 40

Table B4: Laboratory Tests for the Base Layer Constructed with G1, G2, G3 and Waterbound Macadam Materials

Component	Aspect to be Controlled	Type of Control	Sample Size	Sampling Frequency	Test Method
Material Properties	Grading	Sieve Analysis	15 kg	Minimum 6 stratified random samples per lot – refer to Standard Specifications	SANS 3001–GR30
	Atterberg limits	Plasticity Index Liquid limit Linear Shrinkage			SANS 3001–GR10, 11 & 12
	Shape	Number of fractured faces		2 sample per lot	SANS 3001–AG4
Compaction	Maximum dry density	MDD	40 kg	2 samples per construction lot	SANS 3001–GR30
	Density	Sand replacement		Minimum of 6 stratified random samples	SANS 3001–GR35
		Nuclear			SANS 3001–NG5
Layer Placement	Layer thickness	Levels in test holes Measurement	N/A	Same as for density	Measurement
Layer Moisture Condition	Moisture content (full depth)	Gravimetric or by any other approved method	Mini-mum of 1 kg	Minimum of 1 test position per 100 m, selected randomly Sections: > 1 km: min of 10 tests < 1 km: min of 4 tests	SANS 3001–GR20
Surface Texture	Mosaic	Visual	Total Area	N/A	

Table B5: Laboratory Tests for the Base Layer Constructed with G4 Material

Component	Aspect to be Controlled	Type of Control	Sample Size	Sampling Frequency	Test Method
Material Properties	Grading	Sieve Analysis	15 kg	Minimum 6 stratified random samples per lot	SANS 3001–GR30
	Atterberg limits	Plasticity Index Liquid limit Linear Shrinkage			SANS 3001–GR10, 11 & 12
	Shape	Number of fractured faces		2 sample per lot	SANS 3001–AG4
	Bearing	CBR	70 kg	1 sample per lot	SANS 3001–GR40
Compaction	Maximum dry density	MDD	40 kg	2 samples per construction lot	SANS 3001–GR30
	Density	Sand replacement			SANS 3001–GR35
		Nuclear		Minimum of 6 stratified random samples	SANS 3001–NG5
Layer Placement	Layer thickness	Levels in test holes Measurement	N/A	Same as for density	Measurement
Layer Moisture Condition	Moisture content (full depth)	Gravimetric or by any other approved method	Minimum of 1 kg	Minimum of 1 test position per 100 m, selected randomly Sections: > 1 km: min of 10 tests < 1 km: min of 4 tests	SANS 3001–GR20
Surface Texture	Mosaic	Visual	Total Area	N/A	SANS 3001–NG5

Table B6: Laboratory and Field Tests for Stabilised layers

Component	Aspect to be Controlled	Type of Control	Sample Size	Sampling Frequency	Test Method
Compaction	Maximum dry density	MDD	40 kg	1 test of material from each density site	SANS 3001–GR51
	Density	Sand replacement	N/A	1 sample per 1000 m^3 per 150 mm layer, minimum of 5 samples per layer per lot	SANS 3001–GR35
		Nuclear	N/A		SANS 3001–NG5
Moisture Content		Gravimetric analysis	1 x 1 to 1.5 kg	1 sample per test	SANS 3001–GR20
Layer Placement	Layer Thickness	Measurement			
Material Properties	Grading	Sieve analysis Grading modulus Soil mortar analysis	15 kg	1 sample per 1000 m3 per constructed layer thickness, minimum of 5 samples per layer per lot	SANS 3001–GR1
	Atterberg Limits	Liquid limit Plasticity Index Linear shrinkage			SANS 3001–GR10, 11 & 12
	Strength	UCS, ITS	150 kg for each	1 sample per 800 m^2, minimum of 4 per layer lot	SANS 3001–GR51, 52, 53 & 54
Stabiliser Content	Distribution and quantity of added stabiliser	Laboratory determination of calcium content	6 kg	20 samples per lot, 10 at the top and 10 at the bottom of layer	SANS 3001–GR58

Table B7: Tests and Testing Frequencies for Aggregates Used in Asphalt

Property	Test	Quantity Per Test (Maximum)	Lot Size (Maximum)	Samples Per Lot (Minimum)	Test Number
Grading	Sieve analysis	1 000 m^3	Stockpile	4	SANS 3001–AG1
Shape	Flakiness index	1 000 m^3	Stockpile	4	SANS 3001–AG4
Resistance to crushing	Aggregate crushing value (ACV) 10% FACT (wet & dry)	5 000 m^3 5 000 m^3	Stockpile Stockpile	4 4	SANS 3001–AG10
Sand equivalent	Sand equivalent on fine aggregate	2 000 m^3	Stockpile	4	SANS 3001–AG10
Polishing	Polished stone value (PSV)	per source		1	SANS 3001–AG11
Adhesion	Adhesion test	5 000 m^3	Stockpile	4	TMH1 B11
Absorption	Absorption test	5 000 m^3	Stockpile	4	SANS 3001- AG20 & 21
Plasticity of added fines	Plasticity index	2 000 m^3	Stockpile	4	SANS 3001–GR10
Durability	Methylene Blue test	per source		1	SANS 3001–AG44

Table B8: Acceptance Control Tests on Reclaimed Asphalt (RA) in Asphalt Mixes

Property	Test	Quantity Per Test (Maximum)	Lot Size (Maximum)	Samples Per Lot (Minimum)	Test Number
Grading	Sieve analysis	1 000 m^3	Stockpile	4	SANS 3001–AG1
Recovered binder properties	Penetration of recovered binder Softening Point (R & B)	1 000 m^3 1 000 m^3	Stockpile Stockpile	1 1	EN 1426 ASTM D36

Table B9: Acceptance Control Tests on Fillers used in Asphalt Mixes

Property	Test	Quantity per Test (Maximum)	Lot Size (Maximum)	Samples per Lot (Minimum)	Test Number
Fineness	Percent mass passing 0.075 mm sieve	100 tons	per delivery	4	SANS 3001–AG1
Bulk density	Bulk density in toluene	100 tons	per delivery	1	BS 812
Void content	Void content in dry compacted filler	100 tons	per delivery	1	BS 812

Table B10: Test Frequencies for Conventional Bitumen

Property	Manufacturer	Haulier	Site Storage	Sprayer	Test Method
Before Ageing					
Softening point	Every batch	Every load	Every day	Every load	ASTM D36
Penetration	Every batch	Every load	Every day	Every 5th load	EN 1426
Dynamic viscosity @ 165°C	Every batch			Every 5th load	ASTM D4402
Flash point	Once, at start of project				ASTM D92
After Ageing (RTFOT)					
Mass change	Every 10th batch			Every 10th load	ASTM D2872
Difference in softening point[1]	Every 10th batch			Every 10th load	
Dynamic viscosity @ 165°C[2]	Every 10th batch				ASTM D4402

Notes:

1. ***This test is performed on a frequency basis, or when there is a change in the source of base bitumen or bitumen crude type.***
2. ***Only required if the binder is used for HMA.***

Table B11: Test Frequencies for Hot Polymer Modified Binders (From TG1)

Property	Manufacturer	Haulier	Site Storage	Sprayer	Test Number
Before Ageing					
Softening point	Every batch	Every load	Every day	Every load	MB–17
Elastic recovery @ 15°C	Every batch			Every 5th load	MB–4
Dynamic viscosity @ 165°C	Every batch			Every 5th load	MB–18
Storage stability @ 160°C[1]	Every 10th batch				MB–6
Flash point	Once, at start of project				ASTM D93
After Ageing (RTFOT)					
Mass change	Every 10th batch			Every 10th load	
Difference in softening point	Every 10th batch			Every 10th load	MB–17
Elastic recovery @ 15 °C	Every 10th batch			Every 10th load	MB–4
Dynamic viscosity @ 165 °C[2]	Every 10th batch				MB–18

Notes:

[1] This test is performed on a frequency basis, or when there is a change in the source of base bitumen or bitumen crude type.

[2] Only required if the binder is used for HMA.

Table B12: Testing Frequencies for Bitumen Rubber (From TG1)

Property	Spray Tanker	HMA Storage Tank	Test Number
Softening point	Every load	Every batch	MB-12
Dynamic viscosity @ 190°C	At the start of every load	At the start of every batch	MB-13
Compression recovery: 5 minutes 1 hour 4 days	Every 5th batch	Every 5th batch	MB-11
Resilience	Every load	Every batch	MB-10
Flow	Every load	Every batch	MB-12

Table B13: Test Requirements and Testing Frequencies on Asphalt Mix and on the Constructed Asphalt Layer

Property	Quantity Per Test (Maximum)	Lot Size (Maximum)	Samples Per Lot (Minimum)	Test Number
Grading and binder content	200 tons	A days' work	6	SANS 3001–AG1
Sand equivalent	5 000 tons	A week	1	SANS 3001–AG5
Marshall stability, flow and void content	500 tons	A days' work	2	SANS 3001–AS1, AS2, AS10
Relative compaction	2 000 m^2	A days' work	6	SANS 3001–AS11
Spread of rolled-in chips	2 000 m^2	A days' work	6	
Immersion index	Every change in aggregate or design			TMH1–C5

SEALS

Table B14: Pre-Delivery Aggregate Tests

Test	Method	Sample Size Required	Testing Frequency
Sieve analyses	SANS 3001–AG1	2.0 to 3.0 kg	3 per 100 m^3
Fines content	SANS 3001–AG1		
Dust content	SANS 3001–AG1		
Flakiness index	SANS 3001–AG4		
Aggregate crushing value	SANS 3001–AG10		
10 % FACT			
Polished stone value	SANS 3001–AG11	20.0 kg	1 only
Sulphate soundness test	AASHTO T04		
Freezing and thawing test	AASHTO T103		
Los Angeles abrasion test	AASHTO T96-45		
Deval abrasion rest	AASHTO T4–35		
Ethylene glycol test	SANS 3001–AG14		

Table B15: Post-Delivery Aggregate Tests

Test	Method	Sample Size Required	Testing Frequency
Sieve analyses	SANS 3001–AG1	2.0 to 3.0 kg	1 per 10 m3
Fines content	SANS 3001–AG1		
Dust content	SANS 3001–AG1		
Flakiness index	SANS 3001–AG4		
Aggregate crushing value1	SANS 3001–AG10		

REFERENCE

SAPEM, 2014