5501 Scope

Delete *the second paragraph* ***and substitute*** *the following:*

All road markings shall be of the standard regulatory, warning and guidance markings in accordance with the SADC Road Traffic Signs Manual and/or as detailed on the Drawings.

Road markings are continuous or intermittent lines of different length and width, numerals, letters, arrows, figures or symbols, etc. which shall be well visible at day and at night, and shall have an adequate skid resistance. The road marking paint coat/layer shall well adhere to the road surface, shall be resistant to the prevailing weather conditions and shall be sufficiently wear-resistant to the expected traffic volume.

5502 Materials

(a) Paint

Add *the following paragraphs immediately at the beginning of Sub-Clause 5502(a):*

The material for road pavement markings includes waterborne or low-solvent content pavement marking paint and cold plastics & hot thermoplastics which shall comply with SANS 731 and BS EN 1871 respectively. With regards to environmental reasons high-solvent (volatile organic compounds, VOCs) content material shall not be used. Where the wording “glass bead” and “glass beads” is used it shall include “ceramic sphere” and “ceramic spheres”.

Road marking material is available in various levels of functional/service life (durability), luminance, reflectivity, skid resistance, etc. according to the intended use and the respective type of marking as determined in the respective item(s) of the Bill of Quantities.

The material for road markings shall be suitable for the intended use and the surface to be applied on as determined in the Bill of Quantities and in accordance with the Specification.

The material for road markings shall be of such composition that does not cause any damages to the road surface (e.g. cracking of bituminous pavements). It shall be suitable for applying by brush or mechanical means to give a chemically stable film of uniform thickness.

The material for road markings shall be supplied fresh and ready for use in sealed containers/bags bearing the name of the manufacturer, date of manufacture and/or date of expiry, the type of material and the reference(s) to the approval testing and related approval certificates. The material shall be supplied with the necessary manuals and all components that it can be prepared and applied according to the respective road marking manufacturer’s specifications/recommendation.

The road marking material shall be delivered, stored and handled in accordance with the manufacturer's instructions and so as to assure the preservation of the material quality and fitness for the Works.

Not less than one-hundred-forty (140) days prior to its proposed use in the works, the Contractor shall furnish the Engineer for approval with samples of road marking material including glass beads (ceramic spheres) specified for the Contract together with manufacturer’s specification/description of quality, test certificates, etc. The certification shall be of a recognized body or testing laboratory, having suitable and satisfactory evidence of technical and professional competence and independence. The certification shall have a validity of not less than twelve months from the Date of the Contractor’s submission. The Engineer may require examining the full record of testing.

Upon the Engineer’s approval of road marking material the Contractor shall provide the Engineer details of the manufacturer’s health & safety data and information providing detailed physical, ecological, toxicological and other safety-related data as well as instructions for the safe handling, storage and disposal of the road marking material.

Materials for road markings that do not comply with the requirements of the Specification shall be rejected by the Engineer and removed immediately from the Site. No rejected materials shall be used in the Works.

In addition to the applicable reference standards and general requirements stated above, the following technical specifications shall apply to the supply and application of thermoplastic road markings:

- **Thickness:** Thermoplastic road markings shall have a nominal thickness of 3.0 mm.
- **Glass Beads:** Drop-on glass beads shall be applied uniformly at a minimum rate of 350 g/m².
- **Retroreflectivity:** Completed road markings shall achieve an initial dry retroreflectivity of (RL > 250) $mcd \cdot m^{-2} \cdot lx^{-1}$
- **Colour and Luminance:** White and yellow markings shall comply with the applicable colour and luminance factor requirement. The minimum luminance factor shall be $\beta \geq 0.60$ for white markings and $\beta \geq 0.40$ for yellow markings. Colours shall meet the specified chromaticity limits and provide adequate daytime visibility. The Contractor shall provide test certificates upon request, and non-compliant markings shall be replaced at the Contractor's expense.
- **Skid Resistance:** Road markings shall meet the specified skid resistance requirements in accordance with the applicable standards. Minimum SRT value of 55.
- **Surface Preparation and Application:** Pavement surfaces shall be clean, dry and free from dust, oil, grease and other contaminants before application. Thermoplastic material shall be applied using suitable equipment and in accordance with the manufacturer's instructions.
- **Testing and Inspection:** The Contractor shall submit material certificates and test results for approval by the Engineer. The Engineer may inspect and test the materials and completed markings to verify compliance with the specifications.
- **Defect Liability:** The defect liability period shall be 36 months from the date of acceptance. During this period, the Contractor shall repair or replace, at no additional cost to the Employer, any markings that fail due to defective materials or poor workmanship.

***Delete** the entire text under '(ii) Retro-reflective road-marking paint' **and substitute** the following:*

Retro-reflective road marking paint shall comply with the requirements of Clause 5502, SANS 731 and SANS 51423 (glass beads/ceramic spheres), and the retro-reflective road markings shall comply with the Performance Requirements of Sub-Clause 5502(a)(iii) below with the exception of the retro-reflection at night during rain which may comply with **Class RR0** only (= No performance to be determined).

***Delete** the entire text under '(iii) Plastic road-marking material' **and substitute** the following:*

The white and yellow colour hot thermoplastic road marking material of the Contract shall comply with BS EN 1871 and the retro-reflective road markings shall, at a minimum, comply with the following performance classes/requirements according to BS EN 1436:

- Whiteness/daytime visibility of dry road markings specified by the luminance coefficient Q_d and the luminance factor β shall comply with **Class Q3** and **Class B3** [1] respectively.
- Retro-reflection at night of dry road markings specified by the coefficient of retro-reflected luminance R_L shall comply with **Class R3** [2].
- Retro-reflection at night of road markings specified by the coefficient of retro-reflected luminance R_L shall (i) during wetness comply with **Class RW3** and (ii) during rain comply with **Class RR3** [3].
- Skid resistance (SRT value) of the line markings shall comply with **Class S3**, and with **Class S4** [4] for markings of numerals, letters, arrows, figures, symbols and strips of block pedestrian crossing (zebra) markings for which the Engineer may approve

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[1] $Q_d \geq 130$ mcd/m²/lx and $\beta \geq 0.40$

[2] $R_L \geq 150$ mcd/m²/lx

[3] Both $R_L \geq 50$ mcd/m²/lx

[4] SRT ≥ 55 and SRT ≥ 60 respectively

luminance coefficients and/or coefficients of retro-reflected luminance to be one class lower than specified above.

Retro-reflective glass beads (ceramic spheres) shall comply with SANS 51423 or SANS 51424 as appropriate.

5503 Weather Limitations

***Delete** the entire text of Clause 5503 **and substitute** the following:*

Road marking materials shall only be applied when the relative air humidity is below seventy-five per cent (<°75%), at an air temperature above plus fifteen degrees Celsius (+15°C) and a road surface temperature between plus ten and forty-five degrees Celsius (+10°and°+45°C), and/or as specified/recommended by the manufacturer of the respective road marking material.

Sprayed road marking material shall not be applied when, in the opinion of the Engineer, the wind strength is such that it may adversely affect the application operation.

5504 Mechanical Equipment for Painting

***Delete** the first paragraph **and substitute** the following:*

The Contractor shall employ staff well trained and experienced in the application of road markings and in the operation of the pavement marking machine/equipment.

Application of road markings shall be done by a pavement marking machine specifically designed for pavement marking and capable of applying the road marking material determined in the Bill of Quantities and in accordance with the Specification.

The marking machine shall be capable of applying lines of different widths and, where required, capable of applying two lines simultaneously or by means of additional equipment attached to the machine. For special markings and/or where templates are used, the pavement marking machine may be equipped with all additional hand-operated equipment necessary or separate hand-operated equipment shall be used in addition.

The Contractor shall submit to the Engineer a not older than six (6) months certification (e.g. ISO Certification) for maintenance of the pavement marking machine including its control devices and all other equipment which will be used for the execution of the road marking work.

Where traffic is passing through the Works, the marking machine shall be provided with clearly visible amber warning flashing lights, which shall be installed at a minimum height of 2.0m above the road surface and which shall always be in operation when the machine is on the road.

The pavement marking machine shall be equipped with a device which automatically indicates and records the applied film thickness of the road marking. If the machine is without such automatic device, a calibration certificate of the machine manufacturer or an agent approved by the manufacturer shall be provided and which shall not be not older than two (2) months.

Before the pavement marking machine is used on the Permanent Works, the satisfactory operation of the machine shall be demonstrated on a suitable location which is not part of the Permanent Works, where the type of application(s) included in the Contract and as determined by the Engineer shall be demonstrated. For the road marking trial the Contractor shall have available all required equipment to perform the specified ‘Quality Control during Application of Road Markings’ as well as to test the ‘Construction Tolerances’. Adjustments to the machine shall be followed by further testing. Only when the machine has been correctly adjusted and its use has been approved by the Engineer after testing, may the machine be used on the Permanent Works.

No specific pay item is provided as compensation for road marking trials and all such costs for compliance with the requirements this Clause shall be deemed to be included in the relevant work items.

5505 Surface Preparation

***Add** the following paragraphs:*

Preparation of surfaces for application of the road markings shall be according to the manufacturers’ specifications, which may include the application of a tack coat for bituminous surfaces.

The surface of stone and concrete pavements (e.g. precast concrete blocks/flags/tiles

pavings, bridge decks) including transverse texturing shall be thoroughly cleaned by appropriate means like wire brushing, mechanical broom, water jetting, smooth grinding/milling or the like in order to remove any detrimental curing compound, cement or grout coat. In order to avoid bubbling, stone and concrete pavements shall receive a primer coat according to manufacturers' specifications.

No specific pay item is provided as compensation for surface preparation and all such costs for compliance with the requirements this Clause shall be deemed to be included in the relevant work items.

5506 Setting-out the Road Markings

Add *the following immediately after the second paragraph:*

Unless instructed differently, the centreline markings shall be applied to the middle of the travelled way, which is in most cases given by the setting out data, but differs from those where the road has more than two lanes (for example where an auxiliary lane is provided for a climbing or turning lane) and where a widening of the travelled way in a curve applies, and for those cases the centreline markings shall be set out as shown on the Drawings and/or as instructed by the Engineer.

Lines in curves, whether broken or unbroken, shall NOT consist of chords but shall follow the correct radius.

Delete *the fourth paragraph* ***and substitute*** *the following:*

For special markings, others than longitudinal and transversal lines, templates shall be produced and the Engineer's approval obtained. The positioning of approved templates for marking shall be premarked on the finished road surface in chalk or by other appropriate means and are to be approved by the Engineer before painting is commenced.

5507 Applying the Paint

Delete *the entire text of Clause 5507* ***and substitute*** *the following:*

(a) Application Method for Road Markings

It is up to the Contractor to employ whichever method of application for road pavement markings he chooses (spray, screed or extrusion), provided the Contractor can apply/lay the determined type of material to the required thickness and the specified performance classes/requirements in compliance with the Specification and to the satisfaction of the Engineer. It is suggested from previous experience, however, that a thickness in excess of approximately 2.5 to 3.0mm can only be achieved by screed or extrusion methods.

(b) General Requirements on Application of Road Markings

The method of application of road pavement markings, the pavement marking machine/equipment and the operating staff shall be employed for the Permanent Works as has been approved by the Engineer after successful testing/trial.

With regards to the different application surfaces and the respective road marking manufacturer's specifications/recommendation, it shall be permissible to apply a tack coat to promote better adhesion of the markings. The application of a tack coat and its type shall be agreed with the Engineer in advance.

To achieve the determined performance in skid resistance it may be required to apply antiskid aggregates. The antiskid aggregates shall comply with BS EN 1423, and the type and application method shall be agreed with the Engineer in advance.

The road marking material shall be prepared (e.g. stirred, mixed, pre-heated) before application in accordance with the manufacturer's instructions.

Where painting is done by hand, it shall, if not differently specified/recommended by the manufacturer, be applied in two layers, and the second layer shall not be applied before the first layer has dried out sufficiently. As most road marking paint reacts with the bitumen surface of the road, the paint shall be applied with one stroke only of the brush or roller at any one point on the road.

Where the paint is applied by means of a machine, it shall be applied in one layer. Where the determined thickness of road marking paint requires an application in two passes, the second pass shall be in opposite direction.

Where two or three lines are required next to each other, the lines shall be applied simultaneously by the same machine.

Continuous markings lines exceeding 1 mm thickness to be applied on a cross-sectionally sloping road surface (e.g. not located at the road central high point in case of a camber road profile) shall be broken into segments of five metres (5m) length with an unpainted gap of ten millimetres (10mm) for surface water drainage.

(c) Quality Control during Application of Road Markings

During application of road markings, the Contractor shall be responsible for sampling and tests, and submitting the results to the Engineer. The testing and sampling shall include number of sample, date and time of sampling, location of sampling (for example road chainage, centreline marking, edge marking), name of sampler, identification of the materials (manufacturer's name, date of manufacture, production number/code, etc.), geometry of markings, wet film thickness, distribution and embedding of glass beads (ceramic spheres), visual appearance of markings.

At each day of road marking the Contractor shall take a sample of the road marking materials including the glass beads. Additional samples shall be taken when the production number/code of the material changes. The sample of road marking paint shall be minimum one kilogram (≥ 1 kg) and in case of plastic road marking material of minimum half a kilogram (≥ 0.5 kg) of each component. The paint sample shall be taken directly from the spraying nozzle of the road-painting equipment and in case of plastic material from the storage container(s) of the road-painting equipment. The glass bead sample shall be of minimum half a kilogram (≥ 0.5 kg). The samples shall be kept in appropriate containers, which shall be properly labelled for identification and well sealed so that the condition of the material does not change, and which shall be stored in the Engineer's office.

For the testing of the wet film thickness the Contractor shall use and have always available at the work site for possible Engineer's additional testing during marking operations, two (2) numbers approved steel or aluminium or plastic test plates with the dimension of 300mm x 250mm and 1.0mm thickness as well as an adequate device to measure the wet film thickness. The application on the test sheet shall be done during the operation of the

road-painting equipment without changing the speed or any other setting. The wet film thickness shall be tested at the beginning of the marking works and after each interruption of more than thirty (30) minutes, but at least twice a day.

If results of any tests on materials used or the application are outside the specified tolerances, the application of road markings shall cease until the necessary adjustments are effected and the Engineer's written approval to restart operations has been given.

5508 Applying the retro-reflective Beads

***Delete** the entire text of Clause 5508 **and substitute** the following:*

Unless otherwise specified in the Bill of Quantities, all road markings shall be reflectorised by the application of glass beads (ceramic spheres) to the surface of the marking material.

For road markings of pavement marking paint the application of the glass beads shall be onto the wet paint film by means of a pressure sprayer (applicator gun) in one continuous operation, concurrently with/immediately after the application of the paint. The glass beads so sprayed shall give uniform cover and immediate reflectivity over the whole surface of the marking. Application of the glass beads by means of gravity only shall not be permitted.

In the case of cold plastic or hot thermoplastic markings, glass beads shall be applied by pressure concurrently with the laying of the line/marking with sufficient velocity to ensure retention in the surface of the line/marking. The glass beads so sprayed shall give uniform cover and immediate reflectivity over the whole surface of the marking. On screed-applied markings where pressure application may not be practicable, gravity application may be approved by the Engineer. It should be noted that the afore-mentioned glass beads, which are to be applied to the surface of the cold plastic or hot thermoplastic markings, are in addition to the minimum glass bead content for incorporation within the body of the mix for reflectorised markings.

Surface application of glass beads shall be at a typical rate of four-hundred to five-hundred grams per square metre (400 to 500 g per m²) or as specified/recommended by the manufacturer of the respective road marking material to achieve the specified retro-reflective performance class.

5509 Roadstuds

***Delete** the entire text of Clause 5509 **and substitute** the following:*

Permanent retro-reflective Road Studs

Permanent road studs shall be of forged aluminium designed not to deform under the passage of traffic complying with SANS 1463 (**Class P & A**) with a compression resistance (load capacity) of not less than thirty metric tons (≥ 30t) and shall have an anchor or stem/spigot of not less than seventy millimetres (≥ 70mm) length for installation/anchorage in the road surface. The studs shall be of about 100mm x 100mm squared size (**Class H1** or **H2** and **HD1**). The uni-/one-directional or bi-directional retro-reflecting portion of road studs and the colour of the retro-reflectors are specified in the Contract and/or shown on the Drawings. The material of the reflectors shall be glass (**Class 1**) or plastic with an abrasion resistant surface (**Class 3**) and the retro-reflective performance shall comply with **Class PRP 1** and **Class NCR 1**.

Solar Road Studs

Permanent solar road studs shall be of forged aluminium and shall comply with the requirements on compression resistance (load capacity), stem/spigot, reflector colour and material, retro-reflective performance, etc. of the other parts of this Clause.

Solar road studs shall be equipped with two (2) Light-Emitting Diodes of at least five millimetre diameter (≥ 5mm LED). The electric power storage shall be a capacitor type sized to provide not less than twelve (≥ 12) hours continuous LED operation without recharging. Rechargeable battery types shall not be used.

Solar road studs shall be equipped with a photoswitch for automatically turning the LEDs on at dusk and off at dawn. Where flashing LEDs are specified in the Contract, flashing frequency shall be as instructed by the Engineer.

Approval of Road Stud Manufacturer and Samples

Not less than one-hundred-forty (140) days prior to the proposed use in the works and prior to placing any order, the Contractor shall furnish the Engineer for approval with two samples of each type of permanent road stud specified for the Contract together with three (3) copies of manufacturer's specification/description of quality, test certificates (retro-reflective performance), installation, etc. Within twenty-eight (28) days after receipt the Engineer will check and return with his comments or his approval one (1) copy of the same to the Contractor. In case of comments the Contractor shall do the necessary corrections in accordance with the Engineer's comments within fourteen (14) days after notification of these comments, and the corrected or/and modified information on permanent road studs shall be again submitted for approval to the Engineer following the same process.

No specific pay item is provided as compensation for the Contractor's obligation for approval of permanent road studs including the provision of sample road studs for which compensation shall be included in the rates of the various items of work to which this obligation applies.

Installation and Tolerances

Permanent road studs shall be installed according to manufacturer's specification. The position of permanent road studs is shown on the Drawings and/or instructed by the Engineer. The studs shall be protected against impact until the glue/resin or other material of the anchorage has hardened according to manufacturer's specification.

Before installing road studs, the surface shall be thoroughly cleaned as specified in Clause 5505. Road studs shall be protected during painting of any lines and application of any surface treatments.

The position of installed permanent road studs shall not deviate from the true position specified or, where installed as supplement to road traffic markings, the line of road markings by more than five millimetres (≤ 5mm). The spacing of permanent road studs shall not deviate from the specified length by more than ten millimetres in twenty-four metres (≤ 10mm in 24m).

5510 Tolerance Requirements

Delete *the entire text of Clause 5510* ***and substitute*** *the following Sub-Clauses (a) to (h):*

(a) General Requirements on Construction Tolerances for Road Markings

Road markings shall be free from raggedness at their edges, they shall be uniform and free from streaks. Markings of centreline, edge and other lines shall be laid to a regular alignment and the horizontal alignment of the applied markings shall be to the satisfaction of the Engineer in respect to straightness of line and smoothness of curvature.

Road markings shall be applied/constructed within the tolerances listed below. According to the road marking material specified in the Contract, the Contractor shall provide, maintain and jointly use with the Engineer appropriate and calibrated portable road marking measuring and test equipment (for example: steel or aluminium or plastic test plates, electronic balance 0 to 2000 grams, calliper/wet film thickness scale, digital marking thickness gauge with 25 μm increments, 6x magnifying glass with scale, visual reflectometer, skid resistance tester) for the determination of, but not be limited to, geometry of the markings, the dry and wet film thickness, amount as well as embedding of drop on materials, luminance and retro-reflectivity, skid resistance.

No specific pay items are provided as compensation for the Contractor's obligations for measuring tolerances of road pavement markings, including the provision of the necessary personnel as well as the measuring and test equipment, for which compensation shall be included in the rates of the various items of work to which these obligations apply. The measuring and test equipment shall remain the property of the Contractor.

(b) Width Tolerance of Road Markings

The width of the lines and other markings shall not deviate from the specified width by more than five per cent (≤ 5%).

(c) Position Tolerance of Road Markings

The position of numerals, letters, figures, arrows, symbols and other markings shall not deviate from the true position specified by more than twenty millimetres (≤ 20mm).

(d) Alignment Tolerance of Road Markings

The alignment of any edge or a longitudinal line or a transverse line shall not deviate from

the true alignment by more than ten millimetres in fifteen metres (≤ 10mm in 15m).

(e) Length Tolerance of Broken Line Road Markings

The length of segments of broken longitudinal lines shall not deviate from the specified length by more than fifty millimetres (≤ 50mm) and the length of a cycle/module of a broken line (= painted line segments and unpainted line segments) shall not deviate from the specified length by more than one-hundred millimetres (≤ 100mm).

(f) Thickness Tolerance of Road Markings

The wet film thickness shall be measured (using a suitable gauge or callipers) on samples of markings laid on steel or aluminium or plastic test plates placed beneath the application machine during the laying operations. The thickness laid on the plate shall be representative of the thickness of material laid on the road.

The wet film thicknesses exclusive of surface applied glass beads beads (ceramic spheres) to of road marking paint shall not be less than ninety per cent (≥ 90%) of the thickness specified in the Contract.

The wet film thicknesses exclusive of surface applied glass beads of cold plastic or hot thermoplastic road marking shall not be less than ninety per cent (≥ 90%) of the thickness specified in the Contract and shall not vary more than a quarter millimetre (≤ 0.25mm) of such specified thickness, whichever is the smaller deviation from the specified thickness.

(g) Luminance and Retro-reflectivity Tolerances of Road Markings

The luminance and retro-reflectivity shall not be less than ninety-five per cent (≥ 95%) of the specified values of BS EN 1436. The road marking shall be allowed to dry for a period recommended by the manufacturer before testing. The luminance coefficient Q_d and the luminance factor β for the daytime visibility of dry road markings, and the retro-reflected luminance R_L for the night visibility of dry road markings and of road markings during wetness and during rain as well as the chromaticity co-ordinates x and y, shall be measured according to BS EN 1436 Annexes A to C (using visual reflectometer). Upon the Contractor's detailed comparison of BS EN 1436 and SANS 6261/SABS SM 1261 luminance and retro-reflectivity measuring/testing methods submitted to the Engineer, the SANS 6261/SABS SM 1261 may be approved.

(h) Skid Resistance Tolerance of Road Markings

The skid resistance (SRT) shall not be less than ninety per cent (≥ 90%) of the specified values of BS EN 1436 and shall be tested according to the method referred to therein (BS EN 1436, Annex D). Upon the Contractor's detailed comparison of BS EN 1436 and SANS 6260/SABS SM 1260 skid resistance measuring/testing methods submitted to the Engineer, the SANS 6261/SABS SM 1261 may be approved.

5511 General

***Add** the following paragraphs immediately at the beginning of Clause 5511:*

Material related types of road pavement markings are distinguished between the following types:

(i) Marking Paint

Road marking paint is sprayed to pavement surfaces to thickness of 0.3mm to 0.6mm, 300µm to 600µm (wet film thickness).

(ii) Sprayed Cold Plastic or Hot Thermoplastic Marking

The cold plastic or thermoplastic road marking material is sprayed to pavement surfaces to thickness of 0.3mm to 3mm (wet film thickness).

(iii) Laid Cold Plastic or Hot Thermoplastic Marking

Cold plastic or hot thermoplastic road marking is laid with different application methods (screed, extrusion) to pavement surfaces to thicknesses of about 2.0mm to 6.0mm.

(iv) Profiled Line Marking

A specialist cold plastic or hot thermoplastic road marking is laid as a profiled line marking to enhance wet night visibility and which, when overrun, will provide a sensory and auditory impulse to the motorist. The base line is 2 to 3mm thick and the ribs of 6 to 8mm above the base line.

(v) *Drop-Line Marking*

Drop-Line Marking (agglomerate marking) is cold plastic or hot thermoplastic road marking material laid/applied as stochastic (random) or regular distributed points or blots to the designated width of the marking line and where about 60% of the line area is covered with the points/blots with a minimum thickness of 3mm.

Delete *the third paragraph of Clause 5511* ***and substitute*** *the following:*

De-marking / Obliteration of Road Markings

De-marking / obliteration of road markings or remains of road markings shall be undertaken in a manner that avoids damage to the road surface. Acceptable methods of removal include sandblasting, scrabbling, high pressure water jetting and milling. Burning off shall only be permitted when approved in advance by the Engineer.

If the existing marking has a thickness exceeding one millimetre (> 1.0mm) and/or has penetrated into the road surface, then the appropriate depth of milling shall be specified.

De-marked surfaces shall not show great differences in appearance and skid resistance to the surrounding surface. When markings are removed by milling, the depressions have to be refilled with approved material to provide the required surface drainage.

Prior to the start of the Permanent Works the satisfactory operation of equipment and method for de-marking shall be tested at an approved area of the Site. Adjustments to equipment and method shall be followed by further testing. Only when equipment and method have been approved by the Engineer after testing, large-scale operation for the Permanent Works shall commence.

Covering of road markings to be de-marked/obliterated with dark/black paint or by other means shall not be permitted, except where it is ordered by the Engineer as a temporary measure.

5512 Faulty Workmanship or Materials

Add *the following paragraphs to Clause 5512:*

Rectification of Road Markings outside permitted Tolerances

Any road marking disfigured by traffic during application or any road marking not complying with the specified materials or workmanship or tolerances of the Specification shall be obliterated in accordance with Clause 5511 and redone at the Contractor's expense.

If the alignment and geometry of an applied cold plastic or hot thermoplastic road marking is acceptable, the Contractor may, upon the approval of the Engineer who may require a trial section first, grind/mill away the surface of the deficient marking to reduce the thickness to one millimetre or less (≤ 1.0mm) to a remaining thickness of not more than thirty per cent (≤ 30%) of the specified thickness of the completed marking. Then the Contractor shall, according to the manufacturer's specifications/recommendation, apply first a tack coat and after that the additional cold plastic or hot thermoplastic material to the total thickness specified. All work and materials required shall be at the expense of the Contractor.

5513 Protection

Delete *the entire text of Clause 5513* ***and substitute*** *the following:*

The road markings shall be protected against damage by traffic or other causes when the application of road markings is in progress and after application for a time period according to manufacturer's recommendation or as instructed by the Engineer. Traffic shall not be allowed to pass over wet road markings and the Contractor shall be responsible for erecting, placing and removing all warning boards, flags, cones, barricades/barriers and other protective measures, which may be necessary in terms of any statutory provisions and/or as may be recommended in the SADC Road Traffic Signs Manual.

No separate payment shall be made for the cost of the Protection of Road Markings. All such costs shall be deemed to be included in the relevant work items for road markings.

Any road marking disfigured by traffic or any road marking not complying with the Specification shall be effaced in accordance with Clause 5511 and redone at the Contractor's expense.

5514 Measurement and Payment

Add *the following to Item 55.02:*

Gaps in continuous/unbroken lines specified/required for surface water drainage shall not be deducted.

Delete *the second sentence of the first paragraph of Item 55.06* ***and substitute*** *the following:*

Where two or more lines are to be painted on the same carriageway, the setting-out of lines shall be measured only once.

Add *the following Item 55.10, Item 55.11 and Item 55.12:*

Item	Description	Unit
55.10	Provision and application of approved retro-reflective 3.0mm thick hot thermoplastic road marking material for:	
(a)	Continuous/Unbroken or intermittent/broken single longitudinal solid 100mm wide white colour line.	km
(b)	Continuous/Unbroken single longitudinal solid 100mm wide yellow colour line.	km
(c)	Continuous/Unbroken double longitudinal solid 100mm wide each white colour no crossing lines.	km
(d)	Hybrid (double) longitudinal intermittent/broken and continuous/ unbroken solid 100mm wide each white colour lines.	km
(e)	Intermittent/Broken single longitudinal solid 200mm wide white colour continuity line.	km
(f)	Various areas like white colour numerals, letters, arrows, figures or symbols and strips.	m^2
(g)	Various areas of yellow colour arrows and yellow traffic island markings (bars in diagonal and chevron pattern).	m^2
	Payment under Item 55.10 shall be the full compensation for the provision and application of approved retro-reflective 3.0mm thick cold plastic or hot thermoplastic road marking material of white and yellow colour including the setting-out of traffic island markings, numerals, letters, arrows, figures and symbols markings, but excluding setting out and premarking the lines, and including surface preparation, provision of approved templates, quality control (testing and sampling), protection, and, if required, including the provision and application of tack coat for better adhesion and/or antiskid aggregates, and including all ancillary works and materials. Payment for Items 55.10 (a) through (d) shall be made per linear *kilometre (km)* of completed line marking of specified width and pattern, and after the Engineer's acceptance/approval, and the quantity paid for shall be the actual length of single, double or hybrid line applied, excluding the length of gaps in intermittent/broken lines. Gaps in continuous/unbroken lines specified/required for surface water drainage shall not be deducted. Payment for Item 55.10(e) and Item 55.10(f) shall be made per *square metre (m^2)* of completed marking, and after the Engineer's acceptance/approval, and the quantity paid for shall be the actual surface area of applied marking measured to the nearest one-hundredth square metre ($0.01m^2$).	
55.11	EXTRA OVER Item 55.02 and Item 55.10 for the provision and application of approved primer coat	m^2
	Payment under Item 55.11 shall be the full compensation for the provision and application of an approved primer coat to stone and concrete surfaces, including surface preparation, premarking, protection against damage, all staff, labour, superintendence, handling, tools, equipment, consumables, transport, ancillary work and materials, and everything necessary for carrying out the work. Payment for Item 55.11 shall be made per *square metre (m^2)* of net application area.	

Item	Description	Unit
55.12	Provision and application of approved paint system for visibility painting:	
	At kerbs, bridge deck kerbs and their approaches.	
(a)	At other areas where instructed.	m
(b)		m^2
	Payment under Item 55.12 shall be the full compensation for the provision of an approved paint system and the application to concrete or stone surfaces for visibility painting comprising a primer coat and black &white colour finish/top coats, including surface preparation, premarking, protection against damage, all staff, labour, superintendence, handling, tools, equipment, consumables, transport, ancillary work and materials, and everything necessary for carrying out the work. Payment for Item 55.12(a) shall be made per linear *metre (m)* of completed net black & white visibility painting length of kerbs and after the Engineer's acceptance/approval. Payment for Item 55.12(b) shall be made per *square metre (m^2)* of net black & white visibility painting area and after the Engineer's acceptance/approval.	

***Add** the following Clause 5515 and Clause 5516:*

5515 Wear and Tear

(a) Wear and Tear of Road Markings of Road Marking Paint

At the end of the Defects Notification/Liability Period not less than ninety per cent (≥ 90%) of the specified area of road markings of pavement marking paint shall be without any noticeable defects. If more than ten per cent (> 10%) of the specified area of the road markings is not in the specified condition and such defect or other fault is one for which the Contractor is liable, the Contractor shall in such case remedy such defect or other fault at his own cost in accordance with the provisions of the Contract.

(b) Wear and Tear of Road Markings of Cold Plastics and Hot Thermoplastics Material

At the end of the Defects Notification/Liability Period not less than ninety-five per cent (≥ 95%) of the specified area of road markings of cold plastics or hot thermoplastics material shall be without any noticeable defects. If more than five per cent (> 5%) of the specified area of the road markings is not in the specified condition and such defect or other fault is one for which the Contractor is liable, the Contractor shall in such case remedy such defect or other fault at his own cost in accordance with the provisions of the Contract.

5516 Visibility Painting

(a) General

Visibility Paintings are markings for improved visibility of road facilities (e.g. bridge rails, concrete barriers, kerbfaces) or other objects within or close to the roadway to warn motorists of the presence of those. Visibility Paintings consist of alternating sections or strips of black- and white-coloured paint as shown on the Drawings or as instructed by the Engineer.

The paint for visibility painting on concrete or stone shall be a paint system from one approved manufacturer.

(b) Materials

Not less than eighty-four (84) days prior to the planned ordering of the paint system the Contractor shall submit to the Engineer, but shall not be limited to, the following information:

- Name(s) of firm(s) from which he proposes to obtain the paint system(s) together with place of manufacture or fabrication.
- A description of the paint system items to be supplied with paint system manufacturer's specification/product data sheets with information on the paint materials, paint preparation, etc. together with respective reference standards and norms, for each paint, hardener, curing agent and thinner, etc.
- Manufacturer's application instructions including the mixing and thinning directions, recommended paint application procedure(s) & equipment, maximum/minimum film thicknesses for each coat, minimum and maximum drying/curing time between coats,