

GAM/MAT/21/145: Protective Coating Specification – Duvha Power Station
Chemical Off-Loading Bays – Acid Proof Brick Lining.

To be considered as Annexure D of 240-101712128: “Specification for the Internal Corrosion Protection of Water Systems, Tanks and Vessels and Associated Piping”	
Environment	<p>Concrete surfaces prone to possible accidental immersion to concentrated sulphuric acid, caustic soda and brine:</p> <ul style="list-style-type: none"> ➤ Sulphuric: Concentrated (96%) pH 0.6 ➤ Sodium Hydroxide: Concentrated (50%) pH 13 ➤ Brine/NaCl: (25%) pH 7
Material/Substrate	Concrete either new or existing. In the case of existing concrete these surfaces may still be coated/lined/tiled etc.
Surface Preparation: Pre-Cleaning of concrete	Removal of existing coating/lining shall be by mechanical means i.e. chopping, chisels, scrapers etc.
Surface Preparation: Post-Cleaning after repair/rehabilitation of concrete	<p>Remnants of adhesives, grouting, and linings/coating shall be removed by HP water washing/jetting or HP wet abrasive blasting. No grinding or dry abrasive blasting is permitted within any area of the Water Treatment Plant (WTP).</p> <ul style="list-style-type: none"> ➤ High Pressure Wet Cleaning: > 700 Bar and < 7m²/hour. ➤ Lime washing of the substrate. ➤ Low Pressure Water Abrasive Blast Cleaning: > 7 Bar and < 10m²/hour. ➤ Surface profile as specified by the lining manufacturer.
Vacuuming	On completion of steps above and a suitable drying period the surface shall be thoroughly vacuumed until no loose dust is evident.

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Concrete Primer	<p>Two component, low viscosity surface tolerant concrete penetrant primer applied by brush and roller. The primer to be specifically designed for concrete with additional moisture tolerant properties. The binder type to either be, or be compatible with a Solvent Free Vinyl-Ester or Poly-Ester intermediate coat.</p> <p>(Coating thickness as per the Manufacturer's Product Datasheet)</p>
Intermediate	<p>After allowing sufficient time for the primer coat to cure (the manufacturer's recommendations shall be adhered to in this regard both for minimum and maximum over-coating times), all surfaces shall be coated with a glass flake reinforced Solvent Free Vinyl-Ester or Poly-Ester by brush, roller or trowel.</p> <p>(Coating thickness as per the Manufacturer's Product Datasheet)</p>
Lining	<p>After allowing sufficient time for the intermediate coat to cure (the manufacturer's recommendations shall be adhered to in this regard both for minimum and maximum over-coating times), apply on all floor/wall surfaces a 450g/m² glass fibre bandage and saturate with a glass flake reinforced Solvent Free Vinyl-Ester or Poly-Ester.</p> <p>Total dry film thickness of all coats above 800 - 1200 µm.</p>
Mortar/Tiling/Brick Installation	<p>After allowing sufficient time for the intermediate/lining coat above to cure (the manufacturer's recommendations shall be adhered to in this regard both for minimum and maximum over-coating times), apply a Solvent Free Vinyl-Ester or Poly-Ester mortar/grouting and install Chemical resistant tile or fire clay brick, which shall conform to ASTM Specification C-279-88, Type III.</p>

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	<p>Dimensions of the tiles/bricks shall be as follows:</p> <ul style="list-style-type: none"> ➤ Length = 220 – 250mm ➤ Width = 110 - 120mm <p>Thickness of tile (15 – 40mm) / Thickness of brick (25 - 75mm)</p>
Grouting and pointing	Grout and point with a Solvent Free Vinyl-Ester or Polyester mortar/grouting.

NOTES:

- This specification is applicable to the Concentrated Chemical Off-Loading Bay/Apron and Bulk Storage Bunds.
- In the applications mentioned above (concentrated chemical environments) only chemical resistant brick/tiling systems shall be used. These systems are the most robust/durable and may therefore also be used as alternatives to organic coating and lining systems as would be used in less severe (lower concentration) applications i.e. plinths, structural column supports, spillways, trenches, channels, drain pits and sumps.
- This specification considers the steps/aspects to be followed on a sound concrete substrate i.e. surface preparation for corrosion protection. It does not consider or include any civil concrete repair, reinstatement or rehabilitation and assumes a sound existing or new concrete substrate after repair/rehabilitation according to and prescribed in the Duvha Power Station WTP Effluent Structures Repair Scope of Work.”
- Cleaning of any concrete surfaces/substrates by acid etching methods are strictly prohibited.
- Eskom shall witness all contract inspections/pre-assessments. With respect to aspects not mentioned in the above specification table (e.g. mixing ratios, pot life, straining, thinning, induction times, over-coating and curing times), the manufacturer’s recommendations shall be strictly adhered to.

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Specific Project Requirements

1. At all times care shall be taken to ensure adequate protection of any surfaces and parts of components or systems not requiring blast cleaning.
2. The selection of suitable resistant membrane and chemical resistant brick or suitable equivalents shall be resistant to the chemicals and environment as described in the table above. For the mortar and pointing material only Polyester or Vinyl-Ester, resins shall be used. The datasheets to indicate chemical resisting properties of all of the above.
3. Should the system supplier/applicator wish to propose alternative products and/or methods to the generic system as specified above he shall submit a detailed motivation. The motivation shall include the following:
 - Benefit to Eskom
 - Product licensor and technical back-up available
 - Detailed case histories/references/field studies
 - Relevant international standards which shall reference the generic
 - Product/s and chemical resistance limits.
 - Performance guarantee offered.
4. The system supplier/applicator shall supply individual product data sheets for **all** products comprising the system i.e. any concrete primer, adhesive, membrane, mortar, grout pointing material and brick/tile and construction joint system which shall contain the following as a minimum:
 - A description of the generic type of product of each component in the system.
 - Recommended and non-recommended uses.
 - Service temperatures and chemical resistance limits.
 - Specifically for tile and brick provide the mechanical/chemical resistance properties (in accordance with ASTM C 279-79 type 111 as follows:

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- Chemical Composition analysis
 - Water Absorption max % 1.5
 - Acid Solubility Test max % 8
 - Modulus of Rupture > 6.9 MPa
 - Adhesive Strength to Concrete > 1 MPa
5. The system supplier/applicator shall indicate the surface condition required by before chemical resistant lining application i.e. surface finish by wooden float/steel float, curing time for new concrete, % acceptable moisture, % slope of concrete.
6. Further surface preparation procedures, such as surface cleaning and profile of the above concrete substrate shall be for the responsibility of the applicator. The surface preparation methods to be provided in the method statement.
7. Application conditions and details of each of the components of the system including:
- Spreading rate of primers, adhesives and where appropriate membrane systems.
 - The thicknesses of the primer, intermediate lining, membrane and brick or tile.
 - Length, width and thickness of tile/brick.
 - Width of tile/brick joints.
 - Primer, adhesive and membrane over-coating times, compatibility, application temperatures, dilutions, application techniques and curing times.
 - Curing time of complete system.
 - Repair procedure for all application steps.
8. Individual components such as the concrete primer, adhesive, membrane, mortar, grout pointing material and brick/tile shall be supplied by the same supplier. The solvents used shall be those recommended and manufactured by the paint manufacturer. Where the recommended 'solvent' and 'clean-up thinners' for a material differs, the 'clean-up' solvent must not be added to the paint for dilution purposes.

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9. Corrosion Protection shall only proceed once all other mechanical repair activities of steel grinding, cutting, welding etc. have been completed and released in terms of the applicable Quality Control Plan (QCP).

General

1. A detailed visual inspection shall be carried out by the supplier to inspect the concrete surfaces to ensure that they are suitable for receiving his proposed system. Any area found to be unacceptable shall immediately be indicated to the Eskom.
2. During the visual inspection (site visit) the supplier shall inspect the concrete surfaces to ensure that they are suitable for receiving his proposed system. Any area found to be unacceptable shall immediately be indicated to the Eskom.
3. The supplier/applicator shall satisfy himself that the systems he proposes shall be suitable for use in the expected environments.
4. The system supplier/applicator shall compile a detailed application procedure/method statement in respect of concrete surface preparation, membrane laying, tile bedding, joint formation and pointing application. The procedure/method statement shall include a repair procedure in the event of system damage during application. These recommendations shall be strictly adhered to during the application of all systems and will form the basis of quality control steps, testing and interventions.
5. The detailed application procedure for the works shall prescribe the filling of defects in the concrete substrate, sealing of joints and cracks and construction joint systems with a detailed description of bond breaker system/laminate/fibreglass systems etc. for these areas.
6. For unavoidable concrete/steel interfaces such as piping/laterals penetrations in the bund area the system supplier/applicator shall propose suitable jointing systems/sealants. Viscous-elastic, poly-isobutene mastic paste or tape with an outer wrap of polyester or Vinyl-Ester is recommended. The joint configuration shall be described by drawing and shall be compatible with the environment and the suppliers lining system.

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7. The QCP shall include all testing, inspection and required interventions as is required to monitor all recommendations and criteria in the method statement and product datasheets. The QCP shall be subject to review and approval after tender award. The supply and cost of all testing, inspection and specialized testing equipment shall be the applicator's responsibility. QC shall be performed by the applicator and/or system supplier and the Quality Assurance inspection shall be conducted by Eskom.
8. The system manufacturer/supplier shall provide technical surveys during the execution of the project. The contractor shall commit to this requirement in the Method Statement.
9. The applied lining system shall be guaranteed jointly by the lining manufacture and applicator. This guarantee with proposed terms and conditions to be submitted at the time of tender.
10. At the end of the curing period the full cure of the applied lining system shall be verified by the applicator and/or lining supplier.
11. The applicator shall be responsible for any tiling/brick and lining system damage caused during the execution and completion activities and will be required to perform the required repairs.
12. The contractor shall be responsible for all site clearing activities such as removal of rubble, debris, empty product tins, used and un-used grit.

Surface Preparation for Concrete

1. pH testing of the finished substrate shall be performed to establish pH levels. pH levels should be between 9 and 10.
2. All new concrete shall be suitably cured prior to the commencement of any surface preparation or lining procedures. This is essential to allow for completion of the hydration reaction in the concrete. The lining applicator/manufacturer to provide recommendations with respect to concrete curing.
3. Sufficient testing shall be conducted to measure any residual concrete moisture and confirm that the residual moisture levels detected conform to the system supplier's minimum requirements.

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4. All concrete surfaces shall be thoroughly cleaned of all dust, laitance, loose particles, oils, greases, curing compounds and any other deleterious matter. Cleaning shall be carried out by HP abrasive/water blasting. Followed by vacuum cleaning once the prepared surfaces have dried.
5. The maximum permissible deviation from flatness of 5mm under a 3m straight edge supported on blocks of equal thickness is grade II as per SABS 1200 G. abrupt changes from a plane flat surface such as ridges, grooves and steps are not acceptable.
6. Power and hand tool cleaning is only applicable to localised touch ups or patch repairs. Specific requirements for patch repairing a coating system are defined in section 4.8.6 of 240-101712128.
7. Hand-tool cleaning for isolated/localised areas may be utilised provided the required standard of finish is achieved. Cleaning by means of hand or power-tools, i.e. wire brushes, chipping hammers, scrapers, grinders, sanders, needle descenders, bristle blasters etc. may only be used where accepted by the Eskom engineer. Where abrasive blast cleaning cannot be avoided in the WTP then only steel grit/ vacuum blasting equipment shall be used.
8. Prior to full-scale cleaning, test patches shall be prepared and the level of cleanliness, roughness and dust and debris shall be agreed by Eskom and the contractor.
9. Voids, air pockets, omegas, cracks etc., shall be filled with a suitable filler or mortar.

Application of primer, membrane and chemical resistant bricks

1. The applicator shall ensure that during surface preparation and lining activities the relative humidity (RH) in open, undercover environments is less than 80% RH. Ambient temperatures shall be between 15°C and 30°C or as per the manufacturer recommendations, whichever is the more stringent. The maximum/minimum substrate temperature at the time of coating application shall be strictly in accordance with the product data sheet. During stable weather conditions, environmental parameters shall be measured and recorded at least 4 times per shift.

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2. The maximum/minimum substrate temperature at the time of coating application shall be strictly in accordance with the product data sheet. The concrete substrate should:
 - Minimum compressive strength of 25N/mm² and
 - No more than 7% moisture content
3. During periods of inclement or cold weather conditions the environmental parameters shall be measured and recorded hourly. If the latest two readings of any of the parameters indicate a deteriorating trend which would likely exceed parameter/s limit then no final surface preparation or system application shall be permitted. All measurements shall be recorded at the surface. Dew point requirements shall be as per the Product Datasheet or 240-101712128.
4. When coating the concrete, the primer used must be a low viscosity penetrative primer and it shall totally soak into the concrete substrate. The primer must be applied by brush in a stippling motion to ensure total absorption.
5. The joints across corners and pipe connections and expansion/construction joints shall be suitably overlapped by the membrane so as to provide a continuous impermeable joint. The liner system shall overlap the wall/floor interface and shall be applied to the complete height on the vertical wall surfaces and then around onto the top wall surface or as otherwise instructed by the Eskom engineer.
6. Likewise, for corners and pipe connections the membrane section shall either be prefabricated or correctly cut and shaped to suite the geometry such that the joints are suitably overlapped to provide a continuous impermeable membrane after jointing.
7. The complete liner/membrane shall be visually inspected prior to tile/brick installation to ensure that there are no perforations, imperfections or joints that are not continuous or not correctly jointed. Any perforations or damage shall be repaired before tile/brick laying as per the repair procedure.

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8. The mortar shall be mixed in the exact proportions and manner indicated by the product data sheets and mixing instructions. Unless directed otherwise by the product supplier no water, aggregate, Portland cement or any other mortar shall be added to the mix.
9. Under no circumstances shall any attempt be made to reuse primer, mortar, grout or pointing material which has passed its useful application period, as per datasheet.
10. Tiling/bricks shall be buttered by trowel with the mortar on all contact faces while ensuring there are no air pockets or voids.
11. The complete liner/membrane shall be visually inspected prior to tile/brick installation to ensure that there are no perforations, imperfections or joints that are not continuous or not correctly jointed. Any perforations or damage shall be repaired before tile/brick laying as per the repair procedure.
12. The mortar shall be mixed in the exact proportions and manner indicated by the product data sheets and mixing instructions. Unless directed otherwise by the product supplier no water, aggregate, Portland cement or any other mortar shall be added to the mix.
13. Under no circumstances shall any attempt be made to reuse primer, mortar, grout or pointing material which has passed its useful application period, as per datasheet.
14. Tiling/bricks shall be buttered by trowel with the mortar on all contact faces while ensuring there are no air pockets or voids.
15. Tiling/bricks shall be staggered. The tiles/bricks shall be straight and flush, the slope of which to follow that of the concrete substrate to ensure no ponding of liquids.
16. Tiles/bricks shall be placed in a manner to remove air bubbles. This may be achieved by sliding or by light tapping.
17. The finished mortar joint shall be between 5 and 8 mm on all contact sides.
18. Completed and finished pointing shall not exhibit any shrinkage damage, porosity, bubbling or voids.

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Returnable in Tender document (If applicable/required)

1. Provide verifiable/auditable evidence that the product supplier and applicator have successfully supplied and installed 500m² chemical resistant tile lining systems within the last seven years. The listing shall include contact details for the listed reference projects.
2. Supply of the latest revisions of the specified Material Product Data Sheets and Material Safety Data Sheets for all products comprising the corrosion protection system including but not limited to primer, membrane, top coats, generic type, physical, chemical, service temperatures and chemical resistance limits. Both Manufacturer and Applicator shall sign the respective product data sheets.
3. The contractor shall provide a detailed method statement for;
 - Concrete surface preparation, membrane laying, tile bedding, joint formation and pointing application.
 - Repair procedure in the event of system damage during application.
 - Quality control steps, testing and interventions.
 - Filling of defects in the concrete substrate, sealing of joints and cracks and construction joint systems.
 - Ventilation management
 - Specified/required environmental conditions.
4. Quality Control Plans (QCP) shall be submitted at the tender stage specific to this project, and shall detail all inspections and tests with the listing of the relevant local (SANS) or international standards as well as the required acceptance criteria required to control the quality during the lining application process, as follows:

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- surface preparation,
 - environmental parameters,
 - paint and membrane properties/batch certificate i.e. thickness,
 - continuity and visual tests.
5. Detailed Program for the complete project (bar chart). Explanation of the sequence/order of work areas. The information to be detailed by narrative and to be indicated on drawings.
6. The contractor must provide a letter either stating no deviations or must state the deviations.
7. The applied lining system shall be guaranteed jointly by the lining manufacture and applicator. This guarantee with proposed terms and conditions shall be submitted at the time of tender.

Pre-job Method Statement and Quality Documentation review and acceptance

Before commencement of any work the following documentation/information shall be submitted to Eskom for review/approval or acceptance/rejection.

1. The manufacturer/applicator shall supply individual product data sheets for all products in the system. Application conditions and details of each of the components of the system including:
- A description of the generic type of product of each component in the system.
 - Recommended and non-recommended uses.
 - Service temperatures and chemical resistance limits.
 - Surface condition required by the system supplier/applicator before acid lining application i.e. surface finish by wooden float/steel float, curing time for new concrete, % acceptable moisture, % slope of concrete.
 - Spreading rate of primers and adhesives for the appropriate membrane systems.
 - The thicknesses of the primer and membrane and tiles.
 - Width of tile joints.
 - Specialised corner tiles for construction joints.

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- Primer, adhesive and membrane over-coating times, compatibility, application temperatures, dilutions, application techniques and curing times.
 - Curing time of complete system.
 - Repair procedure for all application steps.
2. Prior to the commencement of any work the Product Data Sheet/s shall be signed by the manufacturer and applicator. This is to ensure that the manufacturer is aware of this specification, the conditions under which it will be applied and to allow for technical back-up where required.
 3. The signed Product Data Sheet/s shall be deemed to be a binding reference document (as part of the QCP). It shall be specific to this project any further/other subsequent revisions of the Product Data Sheet/s shall be submitted to Eskom for reacceptance clearly stating the variations/deviations. No further use/application of the related product, for this project, is permitted until acceptance is granted by Eskom.
 4. A detailed Method Statement shall be submitted to Eskom for review and acceptance/rejection prior to the commencement of any work. Eskom reserves the right to request further revision, clarification, or additions in accordance with or as required by this specification sheet.
 5. The applicator shall submit a detailed, project specific QCP. The QCP shall be based on the detailed Method Statement and shall contain all intervention points and relevant criteria as per the information as described in the Product Data Sheet/s and this specification sheet. Eskom reserves the right to request further revision, clarification, or additions in accordance with or as required by this specification sheet.
 6. Under no circumstances shall any work be performed until the QCP and Method Statement have been accepted by the Eskom engineer

The supplier/contractor shall submit a statement with respect to variations/deviations. If there are none then a statement to such effect shall be submitted to Eskom.

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Safety Requirements and Considerations:

1. During the applications of all coatings/linings, care shall be taken to ensure adequate ventilation and lighting, to allow for good visibility and proper curing of the coatings and to avoid/minimise health and safety risks.
2. A confined spaces (CSs) may be defined as an enclosed, restricted, or limited space in which, because of its construction, location or contents, or any work activity carried on therein, a hazardous substance may accumulate and/or an oxygen-deficient atmosphere may occur, and/or in which a dangerous liquid or dangerous concentration of gas, vapour, dust or fumes may be present. It includes any chamber, tunnel, pipe, pit, sewer, container, valve, pump, sump, chute, bunker, silo, gearbox, tank, receiver, drum or any similar construction, equipment, machinery or object.
3. Flammable Atmospheres: Gases, vapours and dusts can become trapped in CSs and create flammable or explosive atmospheres, and include combustibles e.g. Hydrogen, Acetylene, Paint and thinning/cleaning solvents, etc.
4. Walking / Working Surfaces and Visibility: Poor lighting may add to hazards caused by an irregular, sloped, or constricted working surface.
5. Special care needs to be taken when working with all organic coatings. Prior to the use of any coating material, the Material Safety Data Sheets shall be obtained from the relevant coating manufacturer. The applicator shall be familiar with the contents of these safety data sheets and ensure that the necessary safety precautions are taken in order to comply with local and national safety and health requirements such as the OHS Act.
6. Any solid waste materials or liquids stripped or generated during the coating operations shall be discarded in accordance with the requirements of the appropriate national and/or local authorities or the requirements of Eskom.
7. The applicator shall ensure compliance with all statutory regulations, municipal by-laws, etc. concerning pollution and the health and safety of personnel and/or members of the public who may be affected by the work. The applicator shall provide the personnel with the appropriate required PPE.

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8. The applicator shall provide for all necessary safety precautions and risk assessments.
9. The applicator shall advise Eskom of all hazardous materials to be brought on site.
10. All painting materials on site shall be stored in designated areas in storage facilities that meet the storage requirements of the paint manufacturer and the safety requirements of the specific site. The contractor shall be responsible for the provision of appropriate storage/shipping containers as required. These containers shall include the appropriate refrigeration/conditioning systems for temperature control. This requirement shall be dependent on where the container will be located (indoors/outdoors), typical ambient temperature for the particular season of the year and the maximum storage temperature limits as per the manufacturer's recommendations.
11. The applicator's Safety File for the area to be worked it shall address all the hazardous activities of abrasive blast cleaning and spray painting. The applicator shall verify that the personnel carrying out these activities are suitably qualified.
12. The applicator shall ensure that the abrasive materials used conform to all National Health and Safety Standards.

Specifically with respect to CSs and based on the descriptions and definitions of safety risks as per the above points it is imperative that the contractor's/applicator's Method Statement shall describe in detail, the measures and mitigation steps for the risks and hazards as identified in this specification sheet.

It is compulsory that these safety risks/mitigation measures and any others as identified by the contractor/applicator be included in the Method Statement. Prior to the commencement of any work the Method Statement shall be submitted for review, acceptance/rejection by the respective Power Station Risk and Safety office/department.

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Reference Documents

The Eskom Standard 240-101712128: Standard for the internal corrosion protection of water systems, Chemical Tanks and Vessels and Associated Piping with Coatings was compiled in 2016 and is due for revision in 2020. Since 2016 there have been changes in terms of the referenced documents i.e. some documents have been withdrawn, replaced or superseded.

The following list of references shall apply in addition to the requirements of 240-101712128. The latest revision of the referenced standards shall apply. Where conflict exists between any of these documents the more stringent requirement shall apply.

1. 240-101712128: Standard for the internal corrosion protection of water systems, chemical tanks and vessels and associated piping with coatings.
2. 240-106365693: Standard for the external corrosion protection of water systems, chemical tanks and vessels and associated piping with coatings.
3. ISO 9001: Quality Management Systems - “is defined as the international standard that specifies requirements for a quality management system (QMS). Organizations use the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements.”
4. ASTM 4259: Standard Practice for Preparation of Concrete by Abrasion Prior to Coating
5. ASTM D4259 – 18: Standard Practice for Preparation of Concrete by Abrasion Prior to Coating
6. ASTM D4258: Standard Practice for Surface Cleaning Concrete for Coating
7. ASTM D4263: Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method.
8. ASTM D4414: Standard practice for measurement of wet film DFT by notch gauges.
9. ASTM D4541: Standard Method for Pull-off Strength of Coatings using Portable Adhesion Testers.
10. ISO 2409: Paints and varnishes – Cross cut test.
11. ISO 4624: Paints and varnishes – Pull-off test for adhesion.

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12. ISO 12944-3: Paint and varnishes – Corrosion protection of steel structures by protective paint systems. Part 3: Design considerations.
13. SANS 5772: Preparation of steel substrates before the application of paints and related products – Surface roughness characteristics of blast-cleaned steel surfaces – Profile of blast-cleaned surfaces determined by a micrometer profile gauge (Can be used as alternative to ISO 8503-4).
14. ISO 8503-4: Preparation of steel substrates before application of paint and related products – Surface roughness characteristics of blast-cleaned steel substrates. Part 4: Method for the calibration of ISO surface profile comparators and for the determination of the surface profile – Stylus instrument procedure. (May be used as an alternatives to SANS 5772).

<p>Submitted by:</p>  <p>.....</p>	<p>Accepted by:</p>  <p>.....</p>
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