



TRANSNET SOC LTD

**DCT BERTHS 203 TO 205 - RECONSTRUCTION, DEEPENING AND
LENGTHENING**

PORT OF DURBAN

SPECIFICATION – CORROSION PROTECTION

1785-CO-000-C-SPC-0017 Rev T-01

12 OCTOBER 2023



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1.0 SCOPE

1.1 Project

This specification is a project specific technical specification for the DCT Berths 203 to 205 Reconstruction, Deepening and Lengthening Project in the Port of Durban.

1.2 Scope

The scope of this specification covers the *Employer's* requirements for the provision of corrosion protection in the form of Epoxy glass flake coatings and sacrificial aluminium anodes for the Berth 205 circular straight steel sheet pile return quay.

The specification details the requirements of Materials, Equipment and Procedures to be adopted by the *Contractor* to supply, apply and install the corrosion protection for the return quay.

2.0 NORMATIVE REFERENCES

2.1 Reference Documents

The following *Employer* and industry standardized specifications are referenced in this specification and form part of the Works Information. Standard specifications referenced within the specifications listed below also form part of the Works Information.

The *works* shall be carried out as specified in the following documents:

- a) This Specification.
- b) Industry Codes, Standards and Specifications as listed in Section 2.2.
- c) Project Drawings:
 - 1785-CO-070 series of drawings – Return Quay
 - 1785-CO-020 series of drawings – Dredging and Reclamation (anodes installed after completion of local basin dredging).
- d) *Employer's* Project Specific Technical Specifications as listed in Section 2.3.
- e) Method Statements prepared by the *Contractor*, as described in Section 4.1.

2.2 Standard Specifications

The *Contractor* shall provide and maintain current copies of all the standard specifications referred to herein below on the site for reference by both parties.

Corrosion protection shall comply with the following standard specifications:

- a) Recommended Practice DNV-RP-F103 – Cathodic Protection of Submarine Pipelines by Galvanic Anodes, 2010
- b) Recommended Practice DNV-RP-F106 – Factory Applied External Pipeline Coatings for Corrosion Control, 2011
- c) SANS ISO 15589-2: 2009, Edition 1 (ISO 15589-2:2004, Edition 1) – Petroleum and Natural Gas Industries – Cathodic Protection of Pipeline Transportation Systems – Part 2: Offshore Pipelines
- d) SANS 53509:2009, Edition 1 (EN 13509:2003, Edition 1) – Cathodic Protection Measurement Techniques
- e) Isinyithi Cathodic Protection - 5690/130999 Port of Durban Berths 203 to 205 Return Wall Steel Piles External Coating Specification
- f) Isinyithi Cathodic Protection – 5890/130999 Port of Durban Berths 203 to 205 Return Wall Steel Piles Galvanic Anode Specification

2.3 *Employer's* Project Specific Specifications and Standards

Corrosion protection shall also comply with the following Project Specific Specifications and Standards:

- a) 1785-CO-000-C-SPC-0009 – Steel Sheet Piling.
- b) Project Environmental Specifications (PES) as contained in the Works Information and annexures.



3.0 DEFINITIONS

All definitions of responsibilities shall be in accordance with the NEC Engineering and Construction Contract (ECC) for the construction of the *works*.

Where the standard specifications referenced in this specification refer to the “Client”, replace this term with the term “Employer”.

Where the standard specifications referenced in this specification refer to the “Engineer”, replace this term with the term “Supervisor”.

For the purpose of this specification, the technical definitions and abbreviations given in SANS 15589-2:2009/ISO 15589-2:2004, (approved 2009) together with the following definitions shall apply:

3.1 Chart Datum Port

Chart Datum Port refers to the reference level used in the Port of Durban, which is 0,900 m below Mean Sea Level. All levels referred to in this document are relative to Chart Datum Port (CDP).

3.2 Co-ordinate System

The co-ordinate system to be used for all setting out and survey shall be World Geodetic System 1984 (WGS84), LO31, referred to as WG31.

3.3 Tidal Levels

The Astronomical Tide Predictions as defined by the SA Navy Hydrographer and Chart SAN 2006 are as follows:

Table 3.1 – Tide Data

Tide	Abbreviation	Level m, Chart Datum Port
Highest Astronomical Tide	HAT	2.287
Mean High Water Springs	MHWS	1.997
Mean Level	ML	1.097
Mean Low Water Springs	MLWS	0.197
Lowest Astronomical Tide	LAT	-0.013

3.4 Method Statements

Method statements shall be compiled by the *Contractor* for all activities. The method statements shall be submitted to the *Supervisor* for acceptance three weeks in advance of the particular activity being undertaken. Full details of all proposed Equipment (including temporary works) and methods shall be provided for acceptance by the *Supervisor*.

No activity shall commence until the method statement has been accepted by the *Supervisor*.

Further details of the requirements of particular method statements are provided in Section 4.



4.0 REQUIREMENTS

4.1 Method Statement

The *Contractor* shall prepare method statements that shall include, *inter alia*:

- a) Supply and application of corrosion protection in the form of Zip-E Epoxy glass flake coatings for the Berth 205 circular straight steel sheet pile return quay.
- b) Fabrication, Supply, installation and commissioning of corrosion protection in the form of sacrificial aluminum anodes for the Berth 205 circular straight steel sheet pile return quay.
- c) Quality Plans.

4.2 Equipment

The *Contractor* shall take full and entire responsibility for the sufficiency of his Equipment to Provide the *works*. The *Contractor* shall submit details of all Equipment to be used to the *Supervisor* for acceptance at least 3 weeks prior to dredging and reclamation *works* commencing.

4.3 Methods and Procedures

4.3.1 Coatings

4.3.1.1 Extent of work

- a) The extent of work, corrosion protection and levels are as shown on the 1785-CO-070 series of drawings. The following corrosion protection measures shall be undertaken in accordance with the specifications:
 - Isinyithi Cathodic Protection specifications: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5690/130999 External Coating Specification and
 - Isinyithi Cathodic Protection specifications: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5890/130999 Galvanic Anodes Specification
- b) Where the *Contractor* proposes using alternative proprietary coating systems to those specified in Annexure 1, the coating system proposed shall be designed in accordance with the design report provided in Annexure 3.
- c) The piles will be fully coated on the sea face to reduce CP current requirements and enable the 50-year design life without anode replacement.
- d) The top section of all piles shall be coated on both faces to 1m below the level of the capping beam to provide supplementary protection in the intertidal zone and prevent localised corrosion of the steel adjacent to the encasement of the capping beam.
- e) The anodes shall only be installed after dredging of the basin (1785-CO-020 series of drawings) using bolted mounting brackets with the welded connections above the water line.
- f) All electrical connections between anodes and the pile SHALL be welded. NO bolted connections to the pile may be employed.

4.3.1.2 Coating and supply and application methodology

Coatings supply and application methodology shall be in accordance with the requirements of Isinyithi Cathodic Protection specification: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5690/130999 External Coating Specification.

Where this specification states in Section 3.10 Material Supplier: “No alternative products or Suppliers will be considered”, replace this with “*use of alternative products or Suppliers will be subject to the approval of the Supplier*”.

4.3.1.3 Anodes fabrication, supply and application methodology

Anodes fabrication, supply and application methodology shall be in accordance with the requirements of Isinyithi Cathodic Protection specification: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5890/130999 Galvanic Anodes Specification



4.3.1.4 Repair of damaged coatings

Repair of damaged coatings during transportation and installation shall be in accordance with the requirements of Isinyithi Cathodic Protection specification: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5690/130999 External Coating Specification.

4.3.1.5 Quality Assurance Requirements and Quality Control

Quality Assurance and Control shall be undertaken in accordance with the specifications:

- a) Isinyithi Cathodic Protection specifications: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5690/130999 External Coating Specification; and
- b) Isinyithi Cathodic Protection specifications: Port of Durban Berths 203 to 205 Return Wall Steel Piles 5890/130999 Galvanic Anodes Specification.

4.4 Tolerances

The *Contractor* shall ensure that cumulative tolerances meet with tolerance requirements as defined within this specification.



**ANNEXURE 1: ISINYITHI CATHODIC PROTECTION SPECIFICATIONS: PORT OF
DURBAN BERTHS 203 TO 205 RETURN WALL STEEL PILES 5690/130999[2]
EXTERNAL COATING SPECIFICATION**

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SPECIFICATION

CLIENT : ZAA Engineering Projects & Naval Architecture

PROJECT : Port of Durban. Berths 203 – 205 Return Wall

SCOPE : Specification for Protective Coatings for Steel Piles.

DATE : OCTOBER 2023

REF : 5690/130999[3]

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Internal Review:


V Sealy-Fisher

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Quality Verification

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DOCUMENT SIGN OFF




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Document title Specification for Protective Coatings for Steel Piles

Project Number 130999

Document Reference 5690

Organisation	Name	Signature	Date
Isinyithi Cathodic Protection (Pty) Ltd	N C WEBB		13/10/2023
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1. PURPOSE and BACKGROUND

The deepening of Pier 2 at Durban Harbour for berths 203 – 205 incorporates the installation of steel caissons to form the return wall. The tubular and sheet piles will be driven into existing ground prior to the excavation of the seaward face to form the berth.

The top section of the steel piles will be encased in concrete to form the pile cap and pier.

The immersed surface of the piles will be provided with cathodic protection by means of sacrificial anodes installed on the piles below water level and will be coated for the full length.

The encased/buried face of the piles is required to be coated to the extent indicated on the project drawings.

The protective coating is therefore required to be abrasion resistant, compatible with cathodic protection and suitable for immersion in sea water.

The atmospheric environment is a combination of marine exposure and industrial influence. Storm conditions and heavy rains contribute to the severity of the environment, although the rains are beneficial in washing exposed surfaces.

The severity of corrosive environments is classified in SANS / ISO 12944 - 2. Classification ranges from non-corrosive (C1) to severe (C5) and also includes marine / industrial sub-categories. In terms of this classification, the site is rated C5 I/M, in other words highly corrosive with both industrial and marine influence.

Coating systems have been selected in line with the recommendations given in SANS / ISO 12944 - 5, and the specific systems are listed in this document.

Immersed conditions are designated Im2.

Buried environments are designated Im3.

This specification details the requirements for the protective coating systems for tubular and sheet piles and covers the selection and application of protective coating systems and the requirements for labour, equipment and quality control.

2. GENERAL REQUIREMENTS

The requirements of SANS 12944 shall apply as a minimum to all coating application activities. Supplementary requirements are given in this document. In the event of conflict between this document and the SANS standard, the requirements of this document will prevail.

The application contractor shall be responsible for ensuring that he is fully conversant with the requirements of this specification and the relevant coating systems

2.1 Qualified Staff

2.1.1 The application contractor shall ensure that there are at all times sufficient suitably qualified, experienced and skilled staff to carry out and supervise all activities.

2.1.2 Staff shall be qualified in terms of the South African Qualification and Certification Committee for Corrosion {SAQCC(Corrosion)} as follows:

- Applicators: General Heavy Duty Coatings Applicator (PA1)
- Supervisors: General Paint Supervisors (PS1)
- Inspectors: Coating Inspectors (Level 2) or NACE CIP 1

2.1.3 Alternative qualifications from recognised international institutions may be considered for approval by the Engineer subject to submission of detailed syllabus for review. Courses submitted for consideration must be examined and have unique certification traceability

3. REFERENCES and DEFINITIONS

All national and international standards referred to in this document shall form part of this specification. Where reference is made to a code, specification or standard the reference shall be taken to mean the latest edition at the date of tendering of the code, specification or standard, including addenda, supplements and revisions thereto.

3.1 South African Bureau of Standards (SANS)

SANS 1217	Internal and external organic coating protection for buried steel pipelines
SANS 2409	Paints and varnishes – Cross-cut test.
SANS 2808	Paints and varnishes – Determination of film thickness.
SANS 4624	Paints and varnishes – Pull-off test for adhesion
SANS 5772	Profile of blast cleaned surfaces for painting (determined by a micrometre profile gauge)
SANS 10064	The preparation of steel surfaces for coating
SANS 12944	Paint and varnishes – Corrosion protection of steel structures by protective paint systems. Parts 1 to 8.

3.2 International Organisation for Standardisation (ISO)

ISO 4628-3	Paints and Varnishes – Evaluation of Degradation of Paint Coatings – Designation of Intensity, Quantity and Size of Common Types of Defects. Part 3: Designation of Degree of Rusting
ISO 8501-1	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness
ISO 8502-3	Preparation of steel substrates before application of paint and related products – Tests for the assessment of surface cleanliness -Part 3: Assessment of dust on steel surfaces prepared for painting (pressure sensitive tape method).
ISO 9001:	Quality Assurance Systems

3.3 DEFINITIONS

Technical term abbreviations are expanded in the text of the document.

APPROVED shall mean approved in writing by the Engineer.

OWNER is TNPA or their authorised representative

ENGINEER is ZAAEPNA or any other such company appointed in this role by the OWNER

(APPLICATION) CONTRACTOR is the company appointed as the main contractor or a sub-contractor to undertake the surface preparation and application of coatings, linings or wrappings for corrosion protection of the project.

4. EQUIPMENT

4.1 Measuring and Testing Equipment

- 4.1.1 The application contractor shall have a surface profile gauge, wet film comb, and a dry film thickness gauge at the shop/site at all times. The contractor shall also have at the shop/site instrumentation to measure the psychrometric conditions and the substrate temperature.
- 4.1.2 The electronic dry film thickness gauge shall conform to the requirements of SANS 2808 and shall be calibrated using the smooth calibration disc supplied by the instrument manufacturer.
- 4.1.3 All test equipment shall have current calibration certificates.

4.2 Spray Equipment

- 4.2.1 The spray equipment used shall be capable of properly atomising the material and shall be equipped with suitable pressure regulators and gauges. Air caps, needles and nozzles shall be of the type recommended by the coating manufacturer.
- 4.2.2 All spray painting equipment shall be fitted with suitable oil and moisture traps.

4.3 Blast Cleaning Equipment

- 4.3.1 Effective oil and water separators shall be utilised on all airlines used for abrasive blast cleaning. The separators shall be of the 'cartridge' type.

4.4 Power Mixers

- 4.4.1 All coatings shall be mixed with power mixers. Low speed mixers which do not induce air into the coating shall be utilised.

5. COATING MATERIALS

- 5.1 Only approved coating materials as detailed in the relevant specifications shall be used.
- 5.2 All coating systems used shall be suitable for the intended service in terms of environmental classifications of SANS 12944 C5 I/M and Im3/Im2
- 5.3 The coating manufacturer shall be responsible for ensuring the suitability of the proposed coating materials and their compliance with the guarantee requirements given in section 9.
- 5.4 The Engineer's approval shall not exonerate the coating manufacturer or coating applicator from any liability, should the coatings fail within the guarantee period.
- 5.5 Coating materials from different manufacturers shall not be mixed in the same coating system.
- 5.6 Coatings shall only be supplied by the approved coating manufacturers. The application contractor shall obtain a copy of the coating Batch Certificate, the Product Data Sheet and the Material Safety Data Sheet from the coating manufacturer prior to using the material.
- 5.7 Where the required thickness of any coating exceeds the manufacturers recommended maximum thickness, multiple coats may be used to achieve the specified thickness.
- 5.8 The solvents used shall be those recommended and manufactured by the coating manufacturer. Where the recommended 'solvent' and 'clean-up thinners' for a material differ, the 'clean-up' solvent must not be added to the coating for dilution purposes.
- 5.9 Excessive dilution of paints is not permitted. Solvent additions for application purposes shall be in strict accordance with the coating manufacturer's Product Data Sheet. The maximum capacity of containers shall be 25 litres.
- 5.10 The coating manufacturer's shelf life and other storage requirements shall be met.
- 5.11 No coated items shall be dispatched to site until they have been inspected and cleared and a certificate issued that the work has been carried out to specification.
- 5.12 All paints and coatings shall be brought to site in new unopened containers. All containers shall be clearly marked with the manufacturer's material batch numbers.

6. SURFACE PREPARATION

6.1 General

- 6.1.1 Sharp edges shall be dressed to a radius of not less than 2mm, but no more than half of the wall thickness. All burrs, rags and weld spatter shall be removed as per the requirements of SANS 12944-3.
- 6.1.2 Welds should be free from imperfections (e.g. asperities, undercutting, blowholes, craters, spatter) which are difficult to cover effectively with a protective paint system.

6.2 Pre-cleaning

- 6.2.1 Pre-cleaning shall be carried out in accordance with section 4 of SANS 10064.
- 6.2.2 Oil and grease shall be removed by high pressure water washing with detergent solution and rinsing with clean water prior to abrasive blast cleaning and application of coatings.
- 6.2.3 Chemical contamination shall be removed by means of neutralising or flushing or both prior to additional surface preparation.

6.3 Mechanical and Hand Cleaning

- 6.3.1 Mechanical cleaning shall be in accordance with the procedure specified in Clause 4.3 of SANS 10064.
- 6.3.2 The standard of surface preparation shall be in accordance with ISO 8501-1 and as specified in the relevant coating system.

6.4 Abrasive Blast Cleaning

- 6.4.1 Abrasive blast cleaning shall be carried out in accordance with Clause 4.3 of SANS 10064 and the degree of cleanliness achieved shall be in accordance with ISO 8501-1 as specified in the relevant coating system.
- 6.4.2 The profile, peak to valley, when measured by SANS 5772, shall be as specified in the relevant manufacturer's Data Sheet for the primer coating being used.
- 6.4.3 The abrasive may be any abrasive material (except silica sand) which meets the following requirements. It shall be composed of clean, sound, hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter and water soluble salts. It shall be capable of producing the surface profile as specified for the relevant coating system.

6.5 Surface Cleanliness

- 6.5.1 Surface cleanliness shall comply with the requirements of ISO 8501-1 and the relevant coating system.
- 6.5.3 Freedom from dust and debris shall be rating 2 or better when tested in accordance with ISO 8502-3.
- 6.5.4 If the blast cleaned surface changes colour, or rust bloom begins to form, the surface shall be reblasted.

6.6 Soluble Salts

- 6.6.1 Soluble salts shall be removed by cleaning and flushing with fresh potable water. Persistent salt deposits may be removed by proprietary solutions with the prior approval of the Engineer.
- 6.6.2 Soluble salts levels shall be measured using Weber Reilly Soluble Salts Test Kits or equivalent approved methods. The level of salts (ISO total salts) shall not exceed 50 mg/m².

7. COATING APPLICATION

7.1 Approval

No work shall be performed until the Quality Control Plan is approved by the Engineer.

7.2 Mixing

7.2.1 The application contractor shall ensure that all paints are mixed in accordance with the coating manufacturer's instructions.

7.2.2 During application, containers shall be agitated as required to keep pigments in suspension.

7.3 Coating

7.3.1 All surfaces shall be coated as specified. Surfaces which do not require coating shall be suitably protected as per clause 7.4.8

7.3.2 The coating shall be applied as soon as possible after the surface preparation operation and at least during the same shift as the blast cleaning operation, but under no circumstances may the primer be applied over rust bloom or over surfaces that have changed colour due to humidity or other contamination.

7.3.3. Where applicable, successive coats shall be of distinctly different colour to the previous coat to ensure correct coverage. Special attention shall be given to cracks, crevices and edges to ensure complete coverage and paint thickness.

7.3.4 On pre-coated surfaces all traces of soluble salts and other corrosive airborne contaminants shall be removed with potable water and surfaces shall be allowed to dry prior to further paint application. Refer to section 6.6.

7.3.5 Concealed surfaces shall be completely coated. Suitable sponges may be used for application of coating to concealed surfaces.

7.3.6 All edges, corners, bolt holes, cut ends and weld beads shall be stripe coated by brush application, prior to the application of the coating. In order to assist in its identification, the stripe coat shall be a different colour to the finishing coat.

7.3.7 The stripe coat is not intended to increase the overall specified dry film thickness of the system but to ensure that the minimum thicknesses required are actually achieved at edges.

7.4 Application

- 7.4.1 Unless otherwise specified, all coatings applied in the shops or on site shall be spray applied.
- 7.4.2 In instances where spray application is considered not to be possible, practical or feasible, this must be brought to the attention of the Engineer at the time of tendering.
- 7.4.3 The application contractor should note that the high build coatings specified are only capable of achieving their recommended film thicknesses by spray application. Other application methods such as brush and roller can result in lower film builds being achieved per coat. The application contractor must take cognisance of this in his tender. If during the course of the project the application contractor is instructed to change his method of application any labour cost implications must be brought to the attention of the Engineer before any such costs are incurred.
- 7.4.4 All application work shall be carried out in strict accordance with the recommendations and instructions given in the most current Product Data Sheet supplied by the coating manufacturer. This includes required climatic conditions, methods of surface preparation, substrate temperatures, blast profiles, over-coating times, application equipment and methods to be utilised and pertinent requirements not listed in this specification. The Product Data Sheet shall be deemed to be part of this specification.
- 7.4.5 Prior to the application of any coating material, the selected manufacturer's Product Data Sheet for the material being used shall be obtained by the application contractor. A copy of the data sheet shall be signed by the coating manufacturer. This is to ensure that the latest product data sheet has been provided to the contractor, that the coating manufacturer is aware of the relevant coating specification and the conditions under which the material will be applied and to allow for technical back-up where required in support of the joint guarantee as detailed in Section 12.
- 7.4.6 All coatings shall be evenly applied to form a smooth, continuous, unbroken coating free from tears, runs, sags, wrinkles, blisters, mud-cracking, changes in colour or gloss, orange peel, visible pin-holes, dirt, dust or fluff occlusions or any other visible defects.
- 7.4.7 Coated steel to be embedded in concrete or soil shall be coated to the extent indicated on the project drawings.
- 7.4.8 Where surfaces are to be welded, no paint shall be applied within 50 mm of the weld and the subsequent coats (where applicable) shall be stepped at 25 mm intervals to produce a feathered edge for patch repairs after welding. The steps may be achieved by using masking tape at the time of surface preparation and coating applications. The masking tape on the blast cleaned surface adjacent to the weld area shall be left in place to provide temporary protection until the welding is carried out.

- 7.4.9 All shop coated surfaces shall be inspected and examined for mechanical damage on arrival on site. Transport damage must be repaired prior to installation.
- 7.4.10 The shop applied coats must be thoroughly washed to remove all traces of dust, dirt, grease, salts or any other forms of surface contamination. Where deemed necessary, detergent cleaners, as recommended by the respective coating manufacturers, may be used.
- 7.4.11 After cleaning, all areas of damaged coating shall be patch repaired as detailed in 7.6.1.
- 7.4.12 Where more than one coat is being applied on site, washing as per 7.4.10 shall be carried out between coats.

7.5 Ambient Conditions

Coatings shall not be applied under the following conditions:

- When the surface may become damaged by rain, air borne dust, chemical fall-out, fog or condensation. When it is anticipated that these conditions will prevail during the drying period, suitable enclosures shall be provided to protect the surfaces.
- When the ambient air temperature or the steel temperature is outside the coating manufacturer's recommended range.
- When the steel temperature is less than 3°C greater than the dewpoint.
- When the ambient relative humidity exceeds 85%.

7.6 Patch Repairs to Transport and Erection Damage

- 7.6.1 Prior to installation, all areas of coating damage shall be patch repaired by brush application. The extent of the damage shall be carefully inspected to assess which coats in the system have been damaged. When the damage extends to the steel substrate, the full system thickness shall be re-instated. Areas to be coated shall be cleaned of dust, dirt, grease, salts or other deleterious matter and mechanically cleaned to grade St 2 of ISO 8501-1. All edges of existing coatings shall be feathered back to a hard edge. The patch primer used shall be in accordance with the requirements of the relevant coating system.
- 7.6.2 Field joints on tubular piles shall be blast cleaned as for shop application. Field joints may be coated by spray or use of squish-packs using the same material as the shop application.

8. HEALTH, SAFETY AND ENVIRONMENTAL COMPLIANCE

8.1 General

- 8.1.1 The application contractor shall ensure that he complies with all statutory regulations, municipal by-laws, etc. concerning pollution and the health and safety of his personnel and members of the public who may be affected by his work.
- 8.1.2 The application contractor shall provide for all necessary safety precautions and risk assessments.
- 8.1.3 The application contractor shall advise the Engineer of all hazardous materials to be brought on site.

8.2 Safety Plan

The loss control or safety officer shall prepare a safety plan for the area to be worked in, which plan will be adhered to by the application contractor.

8.3 Fire Hazards

The application contractor shall ensure that adequate precautions are taken to avoid fire hazards.

8.4 Storage of Hazardous Materials

- 8.4.1 Oily or solvent rags shall be kept segregated in closed containers and in minimum quantity. Any spillage of volatile material shall be wiped up immediately.
- 8.4.2 Solvents and volatile materials shall be stored in designated areas.

8.5 Scaffolds and Rigging

- 8.5.1 The application contractor shall provide and erect such scaffolds and rigging as may be required. All scaffolds and rigging shall comply with the requirements of the Occupational Health and Safety Act.
- 8.5.2 Temporary welded support elements are not permitted except where written approval has been granted by the Engineer.

9 INSPECTION AND TESTING

9.1 Surface Preparation

The blast profile shall be measured in accordance with SANS 5772.

Surface cleanliness shall be evaluated in terms of ISO 8501-1

9.2 Visual Inspection

Visual inspection for paint film defects shall be performed after each coat is applied. All defects including pinholes, runs, sags, dry spray etc shall be corrected.

9.3 Dry Film Thickness (DFT)

9.3.1 DFT shall be measured in accordance SANS 2808 and instruments shall be calibrated using the smooth calibration disc supplied by the instrument manufacturer.

9.3.2 The frequency of dry film thickness readings shall be a minimum of one reading per square metre of coated surface or as agreed between the application contractor and the Engineer at the start of the coating applications.

9.3.3 The DFT is given in the relevant coating system, This is the required minimum average thicknesses. No individual thickness shall be less than 90% of the specified minimum thickness and not more than 10% of thickness measurements taken shall be less than the specified thickness.

9.3.4 Where excessive film thickness can be detrimental to the integrity of the coating, the manufacturer's recommended maximum thickness shall apply.

9.3.5 All deficient film thicknesses shall be rectified to the approval of the Engineer at the application contractor's expense.

9.3.6 Actual readings and not averages shall be recorded.

9.4 Adhesion Tests

9.4.1 Random pull-off adhesion tests shall be carried out on the applied coatings using the SANS 4624 test method. No adhesion break to the substrate (A/B) shall be allowed unless pull-off values are 10 MPa or more.

9.4.2 The number and location of tests shall be agreed with the application contractor at the start of the works.

9.4.3 Repairs to the coating damaged by the tests shall be carried out in accordance with clause 7.6.1.

10. QUALITY ASSURANCE

10.1 Application Contractor Qualification

- 10.1.1 The Engineer may, at his discretion, require a Quality Audit of the application contractor to ensure that he has the management, facilities and skilled staff to carry out the work in accordance with the specification.
- 10.1.2 The application contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by the Engineer.

10.2 Quality Control

- 10.2.1 The application contractor shall have the necessary equipment and qualified staff to carry out the quality control required to ensure compliance with the specification.
- 10.2.2 Quality control shall be carried out by a qualified inspector who is independent of the application activities. Quality control cannot be carried out by the site supervisor or any member of staff involved in production and programming.
- 10.2.3 The application contractor shall keep at least the following records
- Material batch records
 - Product Data Sheets
 - Psychrometric records (including steel temperatures)
 - Records of surface preparation
 - Records of dates and times of the application of each coat
 - Dry film thickness measurements per coat
 - Records of specific tests as required by the Engineer
- 10.2.4 These records shall be kept in a format that meets the approval of the Engineer.
- 10.2.5 The cost of quality control shall be included in the application contractor's tender price.
- 10.2.6 Before the commencement of the contract, the application contractor shall prepare a Quality Plan detailing each activity to be carried out during the execution of the works. Each activity shall be supported by a detailed Coating Procedure Specification for that activity. The Quality Plan will also detail the inspection requirements of each specific activity, listing whether it be a review, witness or hold point, and defining the responsibilities of the various parties at each stage of the works.

- 10.2.7 The application contractor shall provide the necessary documentation to be used during these inspections. Such documentation shall be reviewed and approved by the Engineer beforehand.

10.3 Quality Surveillance

- 10.3.1 The Engineer may employ an independent technically qualified organisation to carry out Quality Surveillance of the work on his behalf. In the event of dispute, the decision of the Engineer shall be final.
- 10.3.2 For the purpose of carrying out quality surveillance, the Engineer or his authorised representative shall be granted access to any part of the application contractor's premises relevant to the work being carried out, at any reasonable time. The application contractor shall provide, at his own cost, any equipment or labour necessary to gain access to surfaces which are coated, to be coated or are in the process of being coated.
- 10.3.4 The Engineer or his authorised representative may remove any reasonable samples of materials to be used in the coating application. Rejection of the samples will place a hold on the use of material of the same batch number and may lead to rejection of all that batch of material and the reworking of any components that have already been coated with rejected material.
- 10.3.5 The Engineer or his authorised representative may carry out reasonable destructive tests to ascertain compliance with the specification. Areas thus damaged shall be repaired by the application contractor to the satisfaction of the Engineer at no additional cost.
- 10.3.6 The cost of quality surveillance will be borne by the Engineer, except where surveillance results in rejection of the work or when notice by the application contractor results in a fruitless trip, in which cases the cost of surveillance shall be carried by the application contractor.
- 10.3.7 A report shall be compiled by the surveyor for each visit. A copy of the report will be given to the application contractor on completion of each surveillance visit.

10.4 Release Certificate

- 10.4.1 The coatings applied in the shops will be inspected by the Engineer or his authorised representative at the application contractor's premises before releasing the coated items for delivery. A clearance certificate will be issued authorising the release.
- 10.4.2 The application contractor shall notify the Engineer or his authorised representative at least 48 hours in advance of the date on which the coating activities will be complete and ready for inspection.

- 10.4.3 The coatings applied on site will be inspected by the Engineer or his authorised representative. A final acceptance certificate will be issued after the completion and final inspection and acceptance of each area of the installation.

10.5 Data Book

- 10.5.1 Upon completion of the works, the application contractor shall provide the Engineer with a Data Book containing all the relevant Quality Control documents and records pertaining to the works.
- 10.5.2 This data book shall contain, as a minimum, the following:
- The Quality Plan
 - Copies of the relevant coating specifications
 - Copies of all Batch Release Certificates, Product Data Sheets and Material Safety Data Sheets from the paint manufacturer
 - All relevant QC Records listed in clause 10.2.3
 - All release certificates
- 10.5.3 The application contractor shall submit to the Engineer the number of copies of the Data Book as required by the contract. In addition, the application contractor shall keep a copy of the Data Book for his own records.

11. ALTERNATIVE COATING MATERIALS

Should the application contractor or coating manufacturer wish to propose alternative products or coating materials he shall submit a detailed motivation to the Engineer. The motivation shall include, but not be limited to, the following:

Benefit to the client;

- 11.1 Product licensor and technical back-up available;
- 11.2 Location, experience and ISO quality rating of the production facility;
- 11.3 Detailed case histories;
- 11.4 Performance guarantee offered;
- 11.5 Manufacturer's data sheets for each product.

12. PRE-QUALIFICATION TRIAL

- 12.1 The Contractor shall undertake a material and application procedure qualification test program at least one month prior to commencement of coating work to satisfactorily demonstrate that the proposed material will meet the requirements of this Specification when applied to the steel piles.
- 12.2 Prior to commencement of the coating operations the Contractor shall submit to the Engineer all necessary details of the proposed coating material and procedures for approval and evidence of its experience of applying the selected coating material. The testing shall verify the properties of the applied coatings as detailed in the relevant sections of this specification, in particular the cathodic disbonding characteristics of the applied coating.
- 12.3 The test program shall be proposed by the Contractor and witnessed by the Engineer. It shall be based on the consistent successful application of the coating to a pile section and to steel test plates for evaluation, to confirm the properties of the applied coatings. Approval of the material and procedures shall be based on the application procedure the Contractor proposes to use. The results shall be recorded by the Contractor and submitted to the Engineer for approval.

13. GUARANTEES

- 13.1 The Engineer requires performance guarantees for the applied coating systems. Such guarantees shall be provided jointly by the coating manufacturer and application contractor at the time of tender.
- 13.2 The minimum guarantee period will be 10 years for all systems. The criteria for failure must not exceed Ri 3 of ISO 4628-3.
- 13.3 Although visible coating defects such as blistering, cracking, flaking and peeling are not always associated with visible rusting, they indicate defects that could either lead to substrate corrosion or are shielding substrate corrosion that has already taken place beneath the coating. Any such defects noted during the guarantee period shall be repaired.
- 13.4 At the end of the coating work a performance guarantee document shall be developed by the application contractor and coating manufacturer and co-signed by the Engineer and client.

14. HANDLING AND STORAGE

The following precautions shall be taken for the site storage of coated items.

14.1 Handling

All coated components shall be handled using soft slings.

14.2 Loading

All coated components to be transported shall be loaded with support blocks, packing between pieces and tight lashing to avoid chafing.

14.3 Off-loading

Off-loading at site shall be conducted using the same care and precautions for on-loading. Components shall not be tipped off the transportation.

14.4 Cover

Coated items shall be stored under cover where possible. Items not stored under cover shall be stored in such a manner as to avoid retention of water and allow good air circulation. Items shall be stored on baulks of timber to raise the lowest level above the rain splash zone.

14.5 Stacking

Items shall be stacked using timber packing's or other approved means to avoid coating to coating contact. Sufficient bearing area of packing shall be used to avoid damage to coatings.

15. COATING SYSTEM

System 1		
Environment	Atmospheric/immersed/buried – Industrial / Marine SANS 12944 C5-I/M and Im3/Im2	
Material	Carbon steel	
Temperature	Ambient	
Typical Applications	External/exposed surfaces of tubular and sheet piling.	
New Works	Abrasive blast clean to Grade Sa 3	
Surface preparation	Surface profile as specified by the primer coating manufacturer	
Generic System	Coating	
	Glass flake reinforced epoxy. 1200 micron Total DFT	
International Paints	Interzone 485 single coat	
Jotun	Marathon XHB	
Hempel	Multistrength 35842 single coat	
Sigma	Sigmashield 880	
Stoncor	Polyclad 975 single coat	
Corrocoat	Zip-E single coat	
Notes: <ol style="list-style-type: none"> 1. This specification applies to external surfaces of tubular steel piles and the seaward face of sheet piles. The return face of sheet piles is coated within the pile cap as designated on the project drawings. 2. Total DFT required is 1200 microns minimum average (see section 9.3.3). Depending on coating manufacturer and application procedure, this may require multiple coats. 3. If required, multiple coats must be applied “wet on wet” in strict accordance with the coating manufacturers requirements 4. After the coating has cured sufficiently, it shall be tested for Electrical Insulation Defects (pin holes) in accordance with SANS 1217 Clause 8.12.1 5. Any defects found shall be patch repaired and retested. 6. The coating shall not be put into immersed service until it has fully cured and has been tested and certified by the coating manufacturer. 		



ANNEXURE 2: ISINYITHI CATHODIC PROTECTION SPECIFICATIONS: PORT OF DURBAN BERTHS 203 TO 205 RETURN WALL STEEL PILES 5690/130999 GALVANIC ANODES SPECIFICATION

Isinyithi Cathodic Protection

Company Reg # : 2002/002423/07
VAT# : 4570234502
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CONFIDENTIAL REPORT

CLIENT : ZAA Engineering Projects & Naval Architecture

PROJECT : Port of Durban Berths 203 - 205 Return Wall

SCOPE : SACRIFICIAL ANODE SPECIFICATION

DATE : June 2016

REF : 5890/130999[01] For construction

Responsibility rests with the reader to verify that this is the latest revision

Report by: 

N C Webb

Internal Review: 

V Sealy-Fisher

Directors : N.C Webb, V.J Sealy-Fisher





Quality Verification

This report / document has been prepared under the quality controls established by Isinyithi's Quality Management System, which meets the requirements of the ISO 9001:2015 standard which has been certified by SACAS Certification under Certificate Number QMS00169.

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All work is considered proprietary property of the client and is maintained by Isinyithi as such.

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Job Title Port of Durban Berth 203 - 205 Return Wall – Cathodic Protection

Document title Sacrificial Anode Specification

Project Number 130999

Document Reference 5890

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			Prepared By	Checked by
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3	SELECTION OF APPLICABLE STANDARDS	7
4	DESIGN SUMMARY OF CORROSION PROTECTION SYSTEM	8

1 INTRODUCTION

The Return Wall for the Port of Durban Berth 203 - 205 deepening comprises cellular coffer dam type caissons formed from steel sheet piles. The majority of the piles will be driven through existing soils, after which the sea face will be dredged.

The caissons are 23m outer diameter, using 508mm straight sheet piles. The total pile length is 31m. The top 3,2m of the sheet pile will be encased in a concrete capping beam which extends to 500mm below LAT.

The corrosion protection system will comprise a combination of sacrificial steel corrosion allowance, glass flake reinforced epoxy coating and sacrificial anode cathodic protection.

This specification covers the supply of Aluminium - Zinc - Indium anodes for cathodic protection.

2 SUMMARY OF PARAMETERS

- a. The design life of the corrosion protection system is 50 years.
- b. Sacrificial anode material selection favours Aluminium anodes rather than Zinc anodes due to both cost and weight considerations.
- c. All electrical connections between anodes and the pile will be welded. Bolted connections are only for mounting purposes.
- d. As the anodes can only be installed after dredging, angle mounting brackets are proposed with a welded electrical connection above the water line.
- e. Anodes will be installed prior to casting of the pile cap.
- f. The piles will be fully coated on the sea face to reduce CP current requirements and enable the 50-year design life without anode replacement.
- g. The top section of all piles will be coated on both faces to 1m below the level of the capping beam to provide supplementary protection in the intertidal zone and prevent localised corrosion of the steel adjacent to the encasement of the capping beam.

3 SELECTION OF APPLICABLE STANDARDS

The cathodic protection design is based on the requirements of ISO 13174 for harbour installations and takes into consideration the requirements for protection against ALWC (Accelerated Low Water Corrosion)

For this application, bareness and breakdown factors are used for coated steel which has been subject to piling. This is an unusual requirement as the piles are being installed prior to dig-out. Although underwater coating repairs are possible, the extent and efficacy of these repairs cannot be predicted.

4 DESIGN SUMMARY OF CORROSION PROTECTION SYSTEM

Refer to drawing 1370-CO-070-C-DWG-0003-01

- a. Each anode is 2000mm long x 190/140mm wide (trapezoidal) x 120mm thick cast onto an offset steel "I" strap 50 x 6mm
- b. The anode straps are designed to bolt onto brackets welded to each sheet pile.
- c. A 50 x 6 x 4450mm continuity strap is welded to the top of the insert after casting the anode in order to provide electrical continuity to the pile.
- d. There is one anode per pile for each pile exposed to the sea.
- e. The anode is installed such that the top of the anode is 1m below the bottom of the capping beam.
- f. The rear face of the anode as well as the protruding steel sections shall be coated with the same epoxy/glass flake coating as the external surface of the pile.
- g. The total net anode mass requirement is 95kg per pile with a utilisation factor of 80%.
- h. Anodes will be manufactured in accordance with EN 12496
 - i. Electrochemical capacity: 2300 A.hrs/kg
 - ii. Driving potential: 1050mV_{Ag/AgCl}
- i. Quality control requirements will be:
 - i. Chemical analysis: each heat
 - ii. Dimensional tolerance: each anode
 - iii. Electrochemical testing: prequalification plus 1 per 15 tonnes
 - iv. Destructive testing: prequalification plus 1 per 15 tonnes.



ANNEXURE 3: DESIGN REPORT ZAA 1785-RPT-063



TRANSNET SOC LTD

DEEPENING OF BERTHS 203 TO 205 PIER 2, PORT OF DURBAN

CORROSION PROTECTION DESIGN REPORT

ZAA 1785 | RPT | 063 REV A

06 AUGUST 2019



REVISIONS					
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AUTHORISATION					
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DIRECTOR		J ZIETSMAN Pr Eng	<i>John Zietsman</i>	06 August 2019	

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Isinyithi Cathodic Protection

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CONFIDENTIAL REPORT

CLIENT : ZAA Engineering Projects & Naval Architecture

PROJECT : Port of Durban Berths 203 - 205 Return Wall

SCOPE : CATHODIC PROTECTION DESIGN REPORT

DATE : October 2015

REF : 5687/130999[3] For construction

Responsibility rests with the reader to verify that this is the latest revision

Report by: _____

N Webb

Internal Review: _____

V Sealy-Fisher

Directors : N.C Webb, V.J Sealy-Fisher





Quality Verification

This report / document has been prepared under the quality controls established by Isinyithi's Quality Management System, which meets the requirements of the ISO 9001:2015 standard which has been certified by SACAS Certification under Certificate Number QMS00169.

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		Signature		
Revision	Date	Revision Description	Disambiguation of Required Anode Quantities	
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		Name	F L Bradfield	N C Webb
		Signature		
Revision	Date	Revision Description	Glass flake epoxy thickness corrected	
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		Signature		



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1. INTRODUCTION

Isinyithi Cathodic Protection (Pty) Ltd (ICP) was requested by ZAA Engineering Projects & Naval Architecture (Pty) Ltd to undertake the corrosion protection design for the Return Wall steel caissons for the Port of Durban Berth 203 - 205 deepening.

The relevant aspect of the project comprises cellular coffer dam type caissons formed from steel sheet piles. The majority of the piles will be driven through existing soils, after which the sea face will be dredged.

The caissons are 23m outer diameter, using 508mm straight sheet piles. The total pile length is 31m. The top 3,2m of the sheet pile will be encased in a concrete capping beam which extends to 500mm below LAT.

Advanced Low Water Corrosion (ALWC) has been identified as a significant risk in harbour installations. The design therefore provides for protection against this form of corrosion by means of coatings and suitable cathodic protection polarisation levels. The presence of SRB can be assumed as the piles will be in the mud/silt, the South African coastal silts are known to have active SRB and the harbour environment will be relatively contaminated with organic matter and low in oxygen. ALWC was in fact first identified in Cape Town in 1934.

The corrosion protection system will comprise a combination of sacrificial steel corrosion allowance, glass flake reinforced epoxy coating and sacrificial anode cathodic protection.

The specification for the glass flake reinforced epoxy coating is reported under separate cover.

This report covers the corrosion protection design for the project.

2. SUMMARY OF PARAMETERS

- a. The design life of the corrosion protection system is 50 years.
- b. Impressed Current Cathodic Protection has not been selected as the method of cathodic protection for the piles, for the following reasons:
 - c. ICCP requires significantly higher maintenance than sacrificial anodes.
 - d. ICCP is more likely to cause interference with other structures and vessels.
 - e. Sacrificial anode material selection favours Aluminium anodes rather than Zinc anodes due to both cost and weight considerations.
- f. An SRB (Sulphate Reducing Bacteria) environment has been assumed to calculate the optimal anode sizes.
- g. Anode mass determines the life of the anode and the anode surface area determines the current output by the anode used in the cathodic protection process.
- h. The anode dimensions have been selected based on standard anode sizes available.
- i. All connections between anodes and the pile MUST be welded. Absolutely NO bolted connections to the pile may be employed.
- j. As the anodes can only be installed after dredging, slotted brackets are proposed with a welded connection above the water line.
- k. The piles will be fully coated on the sea face to reduce CP current requirements and enable the 50-year design life without anode replacement.
- l. The coating breakdown factors are based on the recommendations of EN 1374.
- m. The top section of all piles will be coated on both faces to 1m below the level of the capping beam to provide supplementary protection in the intertidal zone and prevent localised corrosion of the steel adjacent to the encasement of the capping beam.

3. SELECTION OF APPLICABLE STANDARDS

In general, there have been two (2) commonly accepted international standards on which cathodic protection calculations for marine application can be based. There are other company specific standards as well (e.g. Shell, BP, Saudi Aramco)

The DNV standards were amongst the first to be developed and have been in use in excess of 30 years. Recent reviews and industry experience agree that the DNV standards were overly conservative, particularly in the area of coating breakdown rates. The result has been operating systems extending significantly beyond their design life.

An ISO revision was undertaken in early 2000's which has less conservative design parameters.. South Africa has adopted the ISO standard for cathodic protection of offshore pipelines. Recently the EN document for harbour installations has been published which takes into account the more onerous and variable conditions of a harbour environment and specifically addresses sheet piling and ALWC.

The CP system design is determined from the standards, relative to the salinity, temperature and depth characteristics of the environment to which the steel will be exposed.

	DNV	ISO	EN
Initial current density	170		200
Final current density	110	140	100
Mean current density	80	80	130
Sediment current density	20	20	50/30
f1	0.02	0.005	.25
f2	.0120	0.0002	.001
Aluminium capacity	2000	2500	2500
Anode output	-1050	-1050	-1050

For this application, bareness and breakdown factors are used for coated steel which has been subject to piling. This is an unusual requirement as the piles are being installed prior to dig-out. Although underwater coating repairs are possible, the extent and efficacy of these repairs cannot be predicted.

4. DESIGN SUMMARY OF CORROSION PROTECTION SYSTEM

Design calculations are given in the appendix

- 4.1 Each anode is 2000mm long x 190/140mm wide (trapezoidal) x 120mm thick cast onto an offset steel Tee strap 50 x 6mm
- 4.2 The anodes straps are designed to slot into pockets welded to the pile prior to driving to facilitate underwater installation.
- 4.3 There is one anode per pile for each pile exposed to the sea.
- 4.4 The anode is installed such that the top of the anode is 1m below the bottom of the capping beam.
- 4.5 As each pile is fitted with an anode, no continuity welding is required between piles.
- 4.6 A continuity strap is fitted to the anode bracket which is brought above the water line and welded to the pile.
- 4.7 The full extent of the external surface of all piles exposed to seawater is coated with 1.2mm of glass flake reinforced epoxy.
- 4.8 The top 4.2m of all piles is coated on both sides to prevent corrosion due to tidal movement of the water table and the concrete/soil interface.
- 4.9 The 3 sections of the piles, being the submerged coated steel, the buried coated steel below the scour protection level and the steel encased in the capping beam are treated as a common cathode system, protected by the single anode located below the capping beam.
- 4.10 The current allocation per pile for each of these sections is as follows:
 - a. Coated submerged steel: 0.342A
 - b. Coated buried steel: 0.059A
 - c. Reinforced concrete: 0.002A
 - d. **Total (per pile) 0.434A**
- 4.11 The total net anode mass requirement is 95kg per pile with a utilisation factor of 80%. Thus, in total for the entire installation there will be 489 off 95kg zinc anodes.
- 4.12 The steel brackets of the bracelets will be coated to the same specification as the piles after fabrication.
- 4.13 Anodes will be manufactured in accordance with EN 12496

APPENDIX 1: Table of Calculations

	GRE submerged	GRE buried	GRE Encased
factor k1	0,25	0,25	0,25
factor k2	,00100	,00100	,00000
design life	50	50	50
Anode thickness	100	100	100
Anode frequency	1	1	1
length	16,5	11,3	3,2
width	0,58	0,58	1,16
wall			
coating	1,6mm	1,6mm	1,6mm
weight thick	0	0	0
temp			
design life	50	50	50
sea temp	18		
anode open/buried	open	open	open
sea resistivity	0,23	0,23	0,23
max anode sp	16,5	11,3	3,2
area per midp	10	7	4
factor k1	0,25	0,25	0,25
factor k2	,00100	,00100	,00000
av fact	0,275	0,275	0,25
final fact	0,3	0,3	0,25
mean current density	100	30	2
final current density	130	30	2
avge current	0,342	0,054	0,002
final current	0,373	0,059	0,002
An thick	0,12	0,12	0,12
length	1,691	0,267	0,009
width	0,165	0,165	0,165
Pot	-900	-900	-900
Anode	-1050	-1050	-1050
Driving	150	150	150
Capacity	2300	2300	2300
Util	0,8	0,8	0,8
Anode mass requd	81	13	0
Density	2700	2700	2700
Vol	0,030	0,005	0,000
Cross section	0,020	0,020	0,020
Calculated length	1,523	0,241	0,008
Applied length	1,967	0,44	
Anode dimension	1,066	0,370	
Resist	0,108	0,119	
final current	1,391	1,259	