



TRANSNET SOC LTD

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

PORT OF DURBAN

SPECIFICATION – CRANE RAIL WELDING

1785-CO-000-C-SPC-0005 Rev T-00

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CONTENTS

1.0	INTRODUCTION	1
1.1	Project	1
1.2	Scope	1
2.0	NORMATIVE REFERENCES	1
2.1	Reference Documents	1
2.2	Standard Specifications	1
2.3	Reference Employer's Project Specific Specifications and Standards	1
3.0	DEFINITIONS	1
3.1	Method Statements	1
4.0	REQUIREMENTS	2
4.1	General	2
4.2	Method Statement	2
4.3	Arc Welding of Crane Rail Joints	2
4.3.1	General	2
4.3.2	Preparation	2
4.3.3	Welding	2
4.3.4	Finishing	3
4.3.5	Tolerances	3
4.4	Exothermic Welding of Crane Rail Joints	3
4.4.1	Preparation	3
4.4.2	Fitting of half moulds and sealing	3
4.4.3	Preheating of joint	3
4.4.4	Loading the crucible	4
4.4.5	Pouring	4
4.4.6	Removing mould and trimming	4
4.4.7	Finishing	4
4.4.8	Acceptance Standards	4
4.4.9	Tolerances	4
5.0	COMPLIANCE WITH REQUIREMENTS: RECORDS AND TESTING	5
5.1	Records	5
5.2	Tests	5

1.0 INTRODUCTION

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 welding of crane rails into continuous lengths. The *Contractor* may make use of either an arc welding or exothermic welding process. Requirements for both welding procedures are covered herein.

2.0 NORMATIVE REFERENCES

2.1 Reference Documents

The following industry standardised specifications are referenced in this specification and 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) *Employer's* Project Specific Technical Specifications as listed in Section 2.3.
- d) Project Drawings:
 - 1785-CO-110-C-DWG-0009-01, Crane Rails & Cable Protector Details and Installation.
- e) Method statement prepared by the Contractor, as described in Section 4.

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.

The welding of crane rails shall comply with the following standard specifications:

- a) SANS 532: 2009 Standard and Specifications for Industrial, Medical, Propellant, Food and Beverage Gases, Refrigerants and Breathing Gases.
- b) SANS 1774: 2007 Liquefied petroleum gases.
- c) AWS D1.1/D1.1M:2015, American Welding Society - Structural Welding Code – Steel.

2.3 Reference *Employer's* Project Specific Specifications and Standards

The welding of crane rails shall also comply with the following Project Specific Specifications and Standards:

- a) 1785-CO-000-C-SPC-0003 – Cope, Service Tunnels, Quay Furniture and Services.
- 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 "Engineer", replace this term with the term "*Supervisor*".

For the purpose of this specification, the definitions and abbreviations given in AWS D1.1/D1.1M:2015, shall apply.

3.1 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 General

Welding of joints shall be by either the exothermic or by the arc welding process.

Only welders who are qualified in the approved welding procedure in accordance with the tests laid down in the relevant AWS standard, or who have attained a similar standard, shall be employed on the Works.

4.2 Method Statement

At least a week before any joint is welded the *Contractor* is to supply the *Supervisor* with a welding method statement which must include, but is not limited to the following:

- a) Proof of welders' proficiency.
- b) A detailed joint design.
- c) Proposed heating and cooling control factors to achieve required hard facing specification (cooling rates and conditions).
- d) Proposed methods for determining that the rail ends are at the correct/specified temperature.
- e) Proposed method for determining that the rail crown is of the correct contour after being ground down.
- f) Proposed method for determining whether the required standards specified in Section 4.4.8.

The *Contractor* shall submit with his tender a detailed health and safety plan, indicating the safety and precautionary measures to be adopted for storage of flammable substances, prevention of explosions from working in close proximity to open flames and/or sparks, protective clothing for welders, fire fighting plans, dealing with toxic fumes from igniters, etc.

4.3 Arc Welding of Crane Rail Joints

4.3.1 General

Crane rails of any quality steel with not more than 2% Mn, may be arc welded into continuous lengths, provided that the welders are certified and qualified as stipulated in Section 3.

Completed welds must be certified by a certified welding inspector.

4.3.2 Preparation

Before a joint is welded:

- a) The gap between the rail ends shall be adjusted to 16 mm.
- b) An 8 mm thick copper plate shall be placed under the gap and the rail ends upset approximately 2 mm.
- c) The rail ends shall be aligned.
- d) The rail ends must be cleaned of all foreign matter, scale etc. by grinding

Electrodes for initial welding shall be low hydrogen, 5 mm diameter class R, either Superweld LH 56 or Supercito. For hardfacing the following electrodes are to be used:

Superweld 300; OK83-28; OK Hardtrode 2, Various LH, Citro-rail or Gridur 42.

Approximately 100 mm of each rail end at the joint shall be heated to 350°C before welding starts.

4.3.3 Welding

The weld shall be built up in layers approximately 5 mm thick using stringer beads. The top 5 mm shall be hardfaced to the rail supplier's specification.

4.3.4 Finishing

After welding is complete, the copper plate, the U-shaped copper strips, packing plates and wedges shall be removed and discontinuities restored and the joint heated to 500° C to relieve stresses.

4.3.5 Tolerances

After the rail has cooled to ambient temperature the joint shall be ground to the following tolerances:

On the crown, a 0.4 m feeler shall not enter anywhere between the top of the rail and a 1.5 m straight edge placed centrally over the joint and parallel to the rail axis.

On the running edge (or edges if the crane wheels are double flanged) a 1 mm feeler shall not enter between the running edge and a 1.5 m straight edge placed centrally to the joint and parallel to the top of the rail.

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

4.4 Exothermic Welding of Crane Rail Joints

4.4.1 Preparation

The rail must be brought to line and level for 3 m on either side of the joint to be welded.

While the rail is being prepared, the welder must ensure that the crucible is clean and that all moisture is removed by heating the lining.

The rail ends must be cleaned of all foreign matter and a gap between 16 and 18 mm wide must be made either by moving the rails or by cutting.

The joint must be set-up approximately 2 mm as measured at the ends of a 1.5 m straight edge. The correct set-up for prevailing conditions must be established by the welder when he checks the first finished joint after grinding.

Special jacks or steel wedges must be used to support the rails in the set-up position during welding.

4.4.2 Fitting of half moulds and sealing

The half moulds must be placed in the mould shoes, fitted centrally to the rail joint, securely clamped into position and the edges sealed against the rail.

While the moulds are being sealed, the top must be covered so that nothing which can contaminate the weld can fall into the mould.

The pouring cup and slag tray must be fitted to the mould shoes and sealed. The face of the pouring cup must be sealed lightly. (If a heavy seal is applied to this face, the sealing compound will be carried into the mould and contaminate the weld.) The crucible stand and torch holder must then be clamped to the rail.

4.4.3 Preheating of joint

The rail ends must be heated with a torch using oxygen and liquefied petroleum gas. The most suitable pressures and flame for quick heating are as follows:

Liquefied petroleum gas:	35 to 45 kPa
Oxygen:	125 to 140 kPa
Types of flame:	slight excess L.P. gas

After the flame is adjusted, the torch must be clamped in the torch holder and set with the nozzle vertical and central over the gap approximately 16 mm from the rail surface.

The rail ends must be heated to approximately 1100°C - orange-red colour. This normally takes from 10 to 12 minutes. As the pressure of petroleum gas depends on the rate of evaporation, a constant watch must be kept and adjustments made to the flame to ensure correct heating.

Rail ends must not be melted because a layer of oxide will form between the parent metal and the weld metal causing incomplete fusion.

4.4.4 Loading the crucible

During the preheating period, the crucible must be placed in the crucible stand, the tapping bin, asbestos plug, sealing powder and thermit portion placed in the crucible ready for igniting and the crucible swivelled into position over the pouring cup.

When the rail ends are at the correct temperature, the thermit portion must be ignited by means of an igniter submerged approximately 20 mm into the thermit compound.

The heating torch must be released from its clamp and held by hand with the flame still directed onto the rail ends until the crucible is ready for tapping.

4.4.5 Pouring

When, after about 30 seconds, the reaction in the crucible is complete, the tapping pin must be given a sharp upward blow by means of the tapping spade and the melt run into the pouring cup from where it will flow into the mould through the pouring gate. The slag will run over the top of the mould and into the slag tray.

After each weld, any loose slag remaining in the crucible must be removed. After every fifth weld, the crucible lining must be cleared of all slag, since the presence of slag in the crucible is detrimental to the thermit metal.

The joint must be allowed to solidify without being disturbed.

4.4.6 Removing mould and trimming

After the joint has solidified, the top of the mould and the sealing compound must be removed. The mould shoes and toggle clamp must be left in position while the riser on the crown of the rail is cut away by means of a hot-set. After this is done, a period of 2.5 minutes must elapse before the toggle clamp, mould shoes and excess metal on the side of the crown are removed.

As soon as the excess metal has been removed, the joint must be rough-ground with a portable rail head grinder. Only weld metal must be ground away.

The jack or wedges must be removed and the joint left to cool.

4.4.7 Finishing

After the joint has cooled to the ambient temperature, all sand should be cleaned off the joint and final grinding done to conform to the standards set out hereinafter.

Welded joints shall be so ground that the rail crown will be smooth and of the correct contour. Rail burn due to excessive grinding speed must be avoided.

If the sides of the crown of welded joints are mismatched to a maximum of 1.0 mm, they must be ground so that the difference is run out over a distance of 150 mm.

If a finished joint is found to be beyond the tolerance allowed, it must be corrected by the application of heat or by the use of a jim-crow.

4.4.8 Acceptance Standards

The weld must be free of slag-inclusions and foreign matter, and there must be no cracks.

The weld must not be undercut or porous and it must be free of craters.

The reinforcing metal must be well formed and free of oxidation.

4.4.9 Tolerances

On the running top of the rail, a 0.4 mm feeler shall not be able to be inserted at any point along a 1.5 m straight edge placed centrally over the joint, it being understood that only a gradual sweep is permitted from the end to the center of the straight edge. (The thickness of the rail crown must now be reduced through grinding by more than 0.4 mm)

On the running edges of the rail, a 1.0 mm feeler shall not be able to be inserted at any point along a 1.5 m straight edge placed centrally over the joint on the side of the crown.



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

5.0 COMPLIANCE WITH REQUIREMENTS: RECORDS AND TESTING

5.1 Records

The *Contractor* shall punch a number at each weld on the field side of the railhead to uniquely identify the weld.

The *Contractor* shall record the following information for each joint made by welding:

- a) The unique consecutive weld number.
- b) The date of the weld.
- c) The location of the joint including:
 - The chainage distance of the joint relative to the rail chainages indicated on the drawings.
 - Whether in the land or seaside rail.
- d) The welder number who performed the specific joint.

The *Contractor* shall sign and date the record and hand it to the *Supervisor* on completion of the work for the day.

5.2 Tests

All welds shall be tested by means of ultrasonic, Non-Destructive Testing (NDT). The acceptance standard for the interpretation of non-destructive testing shall be the latest edition of API 5L.