SECTION A:

A1.0 SCOPE

This specification is to be used for all consumable items such as Alumino - thermic powder, crucibles, moulds etc. used for the Alumino – thermic welding of rails on PRASA railway lines.

The specification is divided into four (4) sections: -

- Section A: This section is applicable to all Exothermic welding consumables.
- Section B and C: These sections are applicable for Alumino – thermic welding using the long-life crucible method for rail welding.
- Section D: This section is applicable for Alumino thermic welding kits using the “SINGLE USE” crucible method for rail welding.



Figure 1



Figure 2



Figure 3



Figure 4

All the test methods and parameters relevant to each section are to be found in Appendix A of this specification.

A2.0 INTRODUCTION

A2.1 This Specification shall be a binding agreement between the Manufacturer/Supplier and PRASA.

A2.2 Any compliments to this Specification shall be conveyed to the Manufacturer in writing and the relevant clause/s affected by the amendment shall be completely rewritten, in order to provide an adequate safeguard against possible misinterpretation thereof. No verbal amendments shall be accepted.

A2.3 All reference in this Specification to the Engineer shall be taken to mean: - The Senior Engineer (Track: Super-structure) of PRASA Rail or a person lawfully acting on his behalf.

A2.4 All reference in this Specification to the Inspector shall be taken to mean: - A person appointed by PRASA to inspect goods and processes.

A3.0 GENERAL CONDITIONS

(a) The Alumino-thermic welding products and consumables shall be compatible with the following rail profiles normally used on PRASA railway lines:-

- UIC 60
- S 60
- SAR 57
- SAR48
- Rail steel chemistries and metallurgies of Head Hardened (350LHT), UIC grade 1100 (Chrome Manganese), and UIC grade 900 (R260).

(b) Gap sizes of “Small = 24 – 26 mm”, “Medium = 35 – 40 mm” and “Large = 40 – 50 mm” are to be catered for.

(c) All products and processes offered by the Manufacturer in his tender shall be pre-tested by PRASA to ensure compliance with PRASA requirements and this Specification. The tests shall comprise “X-ray” or “Gamma ray” tests, static bending tests, fatigue bending tests, rolling load tests, chemical analysis of weld metal and hardness and metallurgical tests amongst others, as detailed in Appendix A of this Specification.

A4.0 QUALITY CONTROL

A4.1 <u>General</u>

A4.1.1 The Engineer or his/her deputy will periodically inspect deliveries to ensure strict adherence to this specification. Any items, which are not to the specification, shall be rejected. No payment will be made for any rejected items.

A4.1.2 All instrumentation and tests described in Appendix A required for Quality Control shall be at the Manufacturer’s expense.

A4.1.3 Manufacturers shall state their quality assurance control measures that are employed during the manufacturing process of the Alumino–Thermic welding materials offered, as well as inspections and testing procedures.

A4.1.4 PRASA reserves the right to have access to all documentation and testing equipment pertaining to the quality assurance of all Alumino – Thermic welding materials on prior arrangement.

A4.1.5 The Manufacturer shall keep relevant proof documents of the tests performed on each batch and must be able to submit copies to PRASA whenever requested. These documents must be available to PRASA for a minimum period of five years after the date of manufacturing.

A4.1.6 In the event of material offered which has been approved by the SABS, the permit granted for use of their standardization mark shall be furnished to PRASA.

A5.0 TECHNICAL RQUIREMENTS AND TESTING

A5.1 Rails

A5.1.1 The dimensions of the above-mentioned rails shall be as shown on Drawings Z1153 Sheets 1 & 2 and shall be within the normal rolling and straightness tolerances laid down in the EN13674 Specification for new railway rails.

A5.1.2 The rails required to be welded shall be either new, worn or combinations of new to worn. The rails may contain existing fish-bolt holes and the products and process shall accommodate such holes. The Manufacturer shall advise with this tender, for approval by PRASA the maximum differences in rail height that can be accommodated in normal practice with his products and processes. In addition, the welding of rails with crown side wear of up to 26mm shall be satisfactorily accommodated by minor modifications to the alumino-thermic welding processes.

A5.1.3 The Manufacturer shall design all equipment, processes, and products to ensure safety of the welding operators and railway track, to prevent movement of or disruption to the joint set-up and to accommodate the temperature and environmental factors experienced by PRASA.

A5.1.4 All products and processes shall be suitable for and compatible with all aspects of alumino – thermic welding work found on PRASA railway lines. Typical although not exhaustive requirements are rail inclinations of 1:20 relative to the sleeper, track super-elevations of up to 100 mm on track gauge of 1065 mm, gradients of up to 1:30 and track radii as sharp as 90 meters or combinations of such instances.

A5.1.5 The crucibles shall be designed and manufactured to avoid splashing of liquid steel and be safe to use.

As a special, a crucible design for containment or elimination of noxious gases when welding in confined areas such as tunnels shall be supplied with the tender.

A5.1.6 The welding process shall be designed, and the kits and products manufactured to produce a complete and satisfactory Alumino – thermic weld by one PRASA trained welder and two assistants in a maximum of 45 minutes total track occupation.

A5.1.7 The Manufacturer/Supplier shall supply full details with this tender of all ancillary equipment needed for the safe and correct performance of an Alumino – thermic weld using the materials and processes for which he is tendering. The kits shall be as complete as possible for automatically ensuring the satisfactory completion of one Alumino – thermic weld and avoid as far as possible the need for ancillary equipment.

A5.1.8 All process and products shall be compatible with and suitable for the satisfactory and safe welding of the above-mentioned rail profiles with the following rail steel chemistries: -

(a) UIC grade 1100 (Chrome Manganese)

(b) UIC grade 900 A

(c) UIC grade 700

In addition, small quantities of head hardened rails of the following types are required to be satisfactorily and safety welded: -

(a) Voest Alpine manufactured 350 HT

(b) Thyssen Manufactured 350 HT and 350 LHT

(c) Sogerail manufactured 350 LHT and Micro alloy.

(d) Nippon Steel Corporation Micro alloy

(e) NKK Corporation low and Micro alloy

A5.1.9 The Manufacturer shall specify in his tender the recommended preheating and post heating processes and equipment for use with his product and processes. The post heating requirements of UIC grade 1100 rail shall be specifically required from the Manufacturer.

A5.1.10 Specific details of the rise-ring system and process as pertains to the removal of the risers and the application of post heating requirements shall be submitted by the Manufacturer with his tender.

A5.1.11 The welds produced using the Manufacturers products and processes shall not contain any Micro – Shrinkage porosity larger than 0.2 mm. Should any micro shrinkage porosity be present, it's from shall be rounded and uniformly distributed throughout the rail steel. Chains of porosity and sharp forms shall be unacceptable. The tenderer shall advise with his tender the maximum size, concentration and disposition of micro shrinkage porosity expected with the use of his products.

A51.12 The Manufacturer's products and processes shall not create any adverse or deleterious effects in welded track and on the environment.

A6.0 PERFORAMNCE RQUIREMENTS

A6.1 <u>Hardness of welds</u>

1. The Manufacturer shall submit with his Tender the following details for approval by PRASA:
    a. Details of the harness of the welds in "As Cast" condition without any work hardening
    b. The minimum hardness (Vickers) expected in the spheroidised zones of a typical weld of the type tendered for. Measurement to be made on a smooth ground surface in "as cast" condition.
    c. Explicit details of expected hardness profiles of the spheroidised zones of the weld. Such hardness profiles shall be produced using a Vickers hardness testing machine and shall consist of readings taken longitudinally along the centre line of the running surface of the rail crown at 1 mm intervals. The hardness profiles shall be for "as cast" condition subject to the normal and required post heating for the requisite rail steel type.
    d. The maximum and minimum hardness in the spheroidised zone.

e. The maximum width of spheroidised zones as seen when etched with Ammonium persulphate solution.

The following goals should be aimed for by the Manufacturer: -

- Maximum width of visible spheroidised zone when revealed by surface etching to be 6 mm.
- Minimum harness in the spheroidised zones to be 280 Hardness Vickers for Head Hardened rail welds, 270 Hardness Vickers for UIC grade 1100 rail welds, and 220 Hardness Vickers for UIC grade 900A rail welds.
- No martensite at all shall be permitted in the Alumino – thermic weld.

A6.2 Mechanical and fatigue properties

(a) The minimum breaking loads and deflections for static bend tests performed as per Appendix A.

(b) The Alumino – thermic welding products and processes for UIC 60 profile, UIC grade 1100 rail welds shall produce a welded rail joint having the following fatigue capabilities: -

- The Alumino – thermic weld shall achieve a minimum fatigue life of 10 million cycles without failure when loaded cyclically to 160 MPa tension in the foot followed by 33 MPa tension in the crown when loaded in a cyclical manner at approximately 6 cycles per second.

A7.0 PACKAGING AND MARKING

A7.1 PACKAGING: The Manufacturer's disposable, single use crucibles shall be packaged in the same cardboard container with the appropriate, matched, and metallurgical compatible, Alumino – thermic welding portion for use with that specific crucible type.

A7.2 MARKING: The packaging shall indicate in a clear, legible and non-coded language, on two of the exterior sides of the cardboard container the following: -

- he processes requirements applicable to the contents
- The top of the box
- The mass of the contents
- The maximum number of containers that may be staked one upon the other without damage to the contents.
- A clear, specific instruction regarding the mould and crucible requirements for the Alumino – thermic portion contained in the cardboard container.

A7.3 All packaging shall be colouring coded, robust, double walled cardboard boxes in accordance with PRASA specification CP1/1 and special packaging requirements as per each attached specification shall be complied with.

A8.0 TRAINING DOCUMENTATION AND MANUALS

A8.1 At commencement of the contract, the Manufacturer shall supply to PRASA, free of charge, 30 bound copies of the requisite "Alumino – Thermic Welding Procedures" to ensure compliance with the process by PRASA personnel. In addition, during the currency of the

Contract the Manufacturer shall supply PRASA with such additional copies of the requisite "Alumino –Thermic Welding Procedures" as PRASA requires to ensure compliance with the process.

A8.2 In the event of modifications and improvements to the products and processes by the Manufacturer during the currency of the Contract, the Manufacturer shall supply updated versions of the "Alumino – Thermic Welding Procedures" to ensure compliance with the modifications. No extra payment shall be entertained for these documents and the costs shall be considered as included in the tendered rates for Alumino – thermic products.

A9.0 MEETINGS

A9.1 The Manufacturer shall arrange, facilitate and attend regular liaison meetings in the Gauteng area of South Africa as follows: -

(a) Minimum of once per year with PRASA's procurement and materials logistics officials.

(b) Minimum of once every three months with PRASA's Infrastructure Maintenance/Engineering officials.

A9.2 No extra payment shall be made for these meetings and the cost shall be deemed to be included in the tendered rates for "Alumino – Thermic" welding products. The Manufacturer may be accompanied by his agent, but the Manufacturer as principle shall attend. A PRASA official shall chair the meetings. The meetings shall be conducted in the English language.

A10.0 DISTRIBUTION

A10.1 Prices tendered shall be for ex-works, loaded onto vehicles for the Gauteng PRASA Rail regions.

A11.0 IMPORTED CONTENT

A11.1 The Tenderer must state as in the table hereunder the value of the imported content as well as the country of origin in respect of each imported item tendered for:

TENDER ITEM NO.	**PORTION OF THE PRICE** **REPRESENTING** **IMPORTED CONTENT**	**COUNTRY**	**EXCHANGE RATE** **R 1.00 =**

Note: Where more than one country is applicable to one item, the Tenderer must furnish this information separately.

SECTION B:

THE SUPPLY OF ALUMINO-THERMIC WELDING KITS USING THE "SINGLE USE" CRUCIBLE METHOD FOR RAIL WELDING

B1. INTRODUCTION

B1.1 This section supersedes all previous documents and instructions relating to Alumino-thermic welding kits used for Rail Welding with the "SINGLE USE" crucible method by PRASA. The term "SINGLE USE" crucible is not specific to any one manufacturer's brand name or product and is used in this specification to describe a crucible system that can only be used for the casting of one Alumino-Thermic weld.

B2 SCOPE

B2.1 This section includes:

- Definitions and Requirements
- Manufacturing Processes
- Quality Control
- Packaging and Dispatch

B3. DEFINITIONS AND REQUIREMENTS

The following specific terms relating to Alumino-Thermic welding kits for the "SINGLE USE" method shall apply: -

B3.1 Alumino-Thermic Welding Kits

B3.1.1 A colour coded robust double wall cardboard box in accordance with PRASA's TRACK WELDING MANUAL containing Alumino-Thermic portions, "SINGLE USE" crucible, moulds, and all consumables necessary for the satisfactory completion of an Alumino-Thermic weld.

B3.1.2 The manufacturer shall specify with his tender all ancillary equipment needed for the safe and correct performance of an Alumino-Thermic weld using this kit.

B3.1.3 The kit shall be as complete as possible to avoid the need for ancillary equipment.

B3.1.4 The welding process shall be designed, and the kits manufactured to produce and complete a satisfactory Alumino-Thermic weld by one PRASA trained welder and two assistants in a maximum of 60 minutes total track occupation.

B3.1.5 The Manufacturer shall specify in his tender the recommended preheating and post heating processes.

B3.2 <u>Alumino-Thermic Welding Portion</u>

B3.2.1 An individually sealed plastic bag with a minimum thickness of 150 micron containing a quantity of Alumino-Thermic powder mixture used for the welding of rails together under field conditions. The portion shall be chemical, metallurgic, and physically compatible with the "SINGLE USE" crucible system.

B3.2.2 Each Alumino-Thermic Welding Powder Mix shall be of sufficient quantity to liberate welding metal that will completely fuse into both rails ends, fill collars, risers and leave enough excess metal on the crown for directional solidification purposes, in accordance to the relevant rail section crucible and moulds used.

B3.2.3 The determination of individual portion weights for the various rail sections and relevant welding processes shall be the responsibility of the Manufacturer.

B3.2.4 Each portion bag must be identified by a computer printed colour label stating:

i) Batch and sequence number

ii) Portion quality, rail mass and relevant welding process

iii) Date of manufacture

iv) Total weight of the Exothermic Welding Powder Mix.

B3.3 "SINGLE USE" Crucible and Preformed Moulds

B3.3.1 The kit shall contain a compatible "SINGLE USE" refractory crucible compete with automatic tapping system, preformed refractory moulds, plugs, sealing compound and igniter.

B3.3.2 The "SINGLE USE" crucible shall be chemically inert and have no metallurgical effect on the Alumino-Thermic weld.

B3.3.3 The "SINGLE USE" crucible shall always fit automatically and firmly on the moulds during the preparation, ignition and casting of the Alumino-Thermic weld. The fit and alignment of the moulds on the rail's hall be checked closely by the welder, and must be firm and not influenced by the crucible, or the Alumino-Thermic welding process, reaction or casting.

B3.3.4 Tapping time of the "SINGLE USE" crucible shall be automatic after the reaction is initiated and shall be between 20-30 seconds. The manufacturer shall state the tapping time in his tender and all material supplied shall comply with this tapping time range. The tapping time shall allow for all metallurgical mixing of the liquid steel and separation of the slag. No deleterious metallurgies shall be permitted.

B3.3.5 The preformed Refractory Moulds shall fit onto a specified rail profile or profiles in the case of stepped moulds for worn rail profiles. They shall be strengthened by metal supports and can withstand temperatures of over 2000^{o}C.

B3.3.6 Each set of moulds is to be packed in a single wall cardboard box. The mould cardboard box shall be shrink-wrapped.

B3.3.7 For easy identification, colour coded labels must be used on the boxes indicating the date of manufacture, rail size and welding process.

B3.3.8 Patterns for the different rail profiles and various welding process used by PRASA are to be provided by the Manufacturer.

B3.3.9 The storage life of all the separate component parts of the “SINGLE USE” crucible Alumino-Thermic welding kit when kept under dry conditions, shall be at least three years from the date of manufacture. This shall include for all transport environments including shipping by sea.

B3.3.10 The outside texture and appearance of the moulds and plugs must be smooth and bonded in such a manner that disintegration of sand particles will not occur when rubbed by the fingers. The mould and riser design shall be such that no deleterious metallurgies or stress raisers are created at any stage in the Alumino-Thermic welding process. This includes the process of removal of the risers after casting of the welds. The design shall be such that no adverse metallurgies are created which may have an effect of reducing the fatigue life of the weld.

B3.3.11 The new moulds and “SINGLE USE” crucibles shall be devoid of cracks, cavities, air pockets or any other defects which may lead to loss of exothermic steel.

B3.3.12 Deformed, cracked, broken or disintegrating moulds or “SINGLE USE” crucibles shall not be accepted.

B3.4 Igniter

B3.4.1 Igniters are pyrotechnics that initiate the Alumino-Thermic reaction in a charged crucible.

B3.4.2 The flash point for this igniter shall be in excess of 200^0C.

B3.4.3 Igniters shall be packed separately from the Alumino-Thermic Weld portions in the welding kits.

B3.5 Sealing Method

B3.5.1 The Manufacturer shall state in his tender full details of the proposed method of sealing the moulds against the rails. Sufficient product and applicator for one complete weld including for waste shall be included in the kit. The sealing product shall be sealed separately in a hermetically sealed container inside the kit box. The sealing product shall not allow moisture into the weld and shall not allow any deleterious metallurgies to form inside or on the surface of the weld i.e. porosities, holes, gas bubbles. As prescribe in the Track Welding Manual, clause 11.12.1 – 11.12.10

B3.5.2 The acceptance of different types of sealing methods shall be subject to full agreement between the Engineer and Supplier.

B3.6 Batch

B3.6.1 A batch shall consist of several portions, not exceeding 1100. Test welds, using Alumino-Thermic welding portions from the production batch shall be performed and documented on each batch.

B3.6.2 These test samples shall be identified by a computer printed colour coded label conforming to the batch under production.

B4. MANUFACTURING PROCESSES

B4.1 The Alumino-Thermic welding portions

B4.1.1 The Alumino-Thermic welding portions shall be manufactured from processed iron oxide, atomized aluminium powder, and pelletized ferro-alloys.

B4.2 SINGLE USE Crucible

B4.2.1 The 'SINGLE USE" crucible shall be manufactured from a high-grade thermal shock resistant material. The material shall be chemically and metallurgical inert and shall have no deleterious effects on the Alumino-Thermic weld.

B4.2.2 The "SINGLE USE" crucible shall tap automatically. The automatic tapping components shall also be chemically inert and have no deleterious effects on the Alumino-Thermic weld.

B4.2.3 The "SINGLE USE" crucible shall safely contain the Alumino-Thermic portion at all stages of the process prior to tapping.

B4.2.4 The minimum life expectance of the "SINGLE USE" crucible shall be one weld.

B4.2.5 The "SINGLE USE" crucible shall be designed and manufactured to ensure the correct process is automatically achieved.

B4.2.6 the "SINGLE USE" crucible shall be designed and manufactured to ensure full reaction of the Alumino-Thermic portion, the correct metallurgical mix of alloys and separation of slag, and prevent splashing of the liquid steel or slag.

B4.2.7 As a "Special" on demand by PRASA a "SINGLE USE" crucible for use inside tunnels shall be designed manufactured and supplied which will comply with this Specification and shall also contain all noxious gases produced in the Alumino-Thermic welding process. Separate rates for this "Special" shall be included in the tender.

B4.3 Preformed moulds and pouring plug

B4.3.1 The moulds and plugs shall be manufactured from a high-grade quartz sand, thoroughly mixed with a binder, gassed with carbon dioxide and hardened in an oven.

B4.3.2 Raw materials that will have a deleterious effect on the permeability of the moulds or on the Alumino-Thermic steel due to chemical interference will not be permitted.

B4.3.3 Additions shall be made to the mould and the plug raw material mix to increase the heat and moisture resistant characteristics.

B4.3.4 Moulds shall be supplied in a totally dried condition.

B4.3.5 The moulds shall be designed, manufactured to accommodate the following rail profiles; SAR 48; SAR 57; S 60, 60E1 and UIC60.

B4.3.6 Stepped moulds to accommodate worn rail profiles shall be designed and manufactured for steps of 3mm, and 6mm vertical crown wear on the above profiles.

B4.3.7 Special moulds shall be designed, manufactured and supplied for use on side –worn rails of the above rail profiles. Up to a maximum of 26 mm side wear shall be accommodated. Separate rates for these "Specials" shall be advised in the tender.

B4.3.8 Details of the mould design and rise-ring system, the expected fatigue life including "S-N" curves shall be supplied by the Manufacturer with his tender.

B4.4 Igniters

B4.4.1 Igniters shall be manufactured in the form of a pyrotechnic.

B4.5 Sealing compound

B4.5.1 Screened dry sand with bonding agents shall be used. With the addition of 5% moisture, the sealing sand must form a suitable sealing bonding mixture.

Alternative sealing methods may be proposed by the manufacturer and submitted to PRASA for approval. These proposals shall be in addition to the tenderer's prices based on the 5% water/sand sealing method.

C5 PACKAGING AND DISPATCH

C5.1 Each Alumino-Thermic portion shall be packed according to clause D3.2 in order to prevent spilling, ingress of foreign matter or contamination by water.

C5.2 Each bag of sealing sand shall be packed according to clause D3.6.3.

C5.3 Igniters shall be packed according to clause D3.5.3

C5.4 All the above items shall be packed separately into a master robust cardboard container which complies to PRASA's TRACK WELDING MANUAL with the following markings printed onto the boxes. As prescribe in Manual for Track Welding, Clause 11.1.5 and 11.1.6.

The Tenderer shall design all packaging to accommodate the stacking requirements indicated in clause 5.5.1 below. Alternatively, the Tenderer shall make recommendations in his tender as to the stacking requirements and mark his boxes accordingly.

C5.5.1 Top surface of the box: -

HANDLE WITH CARE

DO NOT STACK MORE THAN 5 HIGH

C5.5.2 Small sides of the box

KIT FOR ALUMINO THERMIC MATERIAL FOR 1 RAIL JOINT FOR

_____KG/M RAIL FOR USE WITH _____ RAIL GAP

FOR USE ONLY WITH SINGLE USE CRUCIBLE

THE CONTENTS OF THIS BOX MUST BE USED WITH A

SINGLE USE OR DISPOSABLE CRUCIBLE

C5.5.3 On the other sides:

MANUFACTURED BY _____

D5.6 GENERAL

D5.6.1 The Manufacturer shall ensure that the material is dispatched in accordance with the instruction of the Engineer.

D5.6.2 Material which does not comply with these specifications, shall not be accepted, and any material proved to be defective, due to manufacturing deficiencies, after delivery shall be returned to the Manufacturer at his own expense.

APPENDIX A:

1. TESTING METHODS AND PARAMETERS

1.1 Alumino-Thermic welding portions

1.1.1 The inspector reserves the right to select at random, and at any time, from the Manufacturer's stores or production line Alumino-Thermic Welding materials for testing purposes.

1.1.2 The following tests will be witnessed by the inspector:

1.1.2.1 Preheating and post heating process

The type of equipment used to preheat the rails as well as the procedures is to be specified by the Manufacturer.

1.1.2.2 Tapping time test

The reason for the tapping test of the Exothermic steel into the moulds is to ensure that the thimble assembly is of such a nature to allow the exothermic reaction to be complete, and the 20-30 seconds time period adhered to.

The tapping time will be started on a stopwatch as soon as the igniter is placed into the Exothermic welding portion and will be stopped as soon as the weld metal is released from the crucible.

1.1.2.3 Hardness Test

The reason for the hardness test is to ensure that the weld metal is approximately 20 Brinell points higher than the parent rail steel on new rails and the spherodised zones are neither too soft nor too wide.

A Brinell test shall be carried out using a 3000 kg load and 10 mm diameter tungsten carbide ball. Three impressions shall be made on the weld centre line and one each to the left and right of the

weld, outside the heat-affected zones on the running surface of the rail. In addition, the surface of the rail crown shall be etched to reveal spherodised zones. The widths of the spherodised zones at longitudinal centre line of rail crown and the hardness in the middle of the spherodised zones shall be measured. The maximum width of spherodised zone measured on the etched test piece shall be 6 mm.

The hardness profile over the spherodised zones shall be measured with a Vickers hardness machine and the minimum hardness in the spherodised zones shall be: -

Grade 900A 220 HV 30

Grade 1100 270 HV 30

Head Hardened 280 HV 30

The required harness range of the as cast weld metal must conform to the following hardness ranges of the different rail steels.

RAIL TYPE	**HARDNESS (Weld metal)**
700 N/MM² tensile strength	**212 - 48 Brinell**
800 N/MM² tensile strength	**228 -269 Brinell**
900 N/MM² tensile strength	**255 – 293 Brinell**
1100 N/MM² tensile strength	**311 – 375 Brinell**
Head Hardened Rails	**360 - 400 Brinell**

1.1.2.4 Static Bend Test

Various masses of 0.6 m lengths of new or worn rails and different rail qualities will be supplied by PRASA to the Manufacturer, free of charge, for the sole purpose of testing the Alumino-Thermic Welding Materials. The rails are to be reused until their length is insufficient for test purposes. Rails too short for reuse as test rails are to be disposed of as instructed by the Chief Engineer.

All welds shall be performed strictly in accordance to the manufacturers “Welding Code of Practice”, except for final profile finish grinding. All details of the welding parameters employed shall be recorded and these include details of preheating.

The welds shall be allowed to cool for at least four hours before further testing.

The static bend test shall be performed on a bending press, with supports at a distance of 1 meter apart and the load applied at midspan. The test sample shall be positioned crown upwards and loaded vertical downwards. This will ensure that the crown is in compression and the flange in tension. The load shall be increased until failure occurs.

The load and deflection parameters of the static bend test shall be continuously measured and recorded on a computerized system. A load / deflection graph shall be produced for each test performed.

In addition to the computerized measuring system the test facility shall have an independent “real time” measuring and display system of load and deflection. This display shall be readily visible to the PRASA inspector.

The static bend test apparatus shall be calibrated and certified by a PRASA approved certification agency. The certification shall be immediately on award of the contract to supply Alumino-Thermic kits to PRASA and then recertified at 12 monthly intervals.

The ram and supports shall have a radius of 30 to 70 mm.

1.4.4 The minimum bend test requirement shall be as follows:

RAIL SECTON (KG/M)	**30**	**40**	**48**	**57**	**60**
MIN. LOAD AT FAILURE (kN.)	**260**	**400**	**600**	**650**	**900**

1.1.2.5 Deflection Measurement

1.5.1 The deflection of the rail at midspan after failure shall be recorded.

This is an indication of the elastic and permanent deformation.

The minimum deflection requirements shall be as follows:

RAIL SECTON (KG/M)	**30**	**40**	**48**	**57**	**60**
DEFLECTION (mm)	**12**	**12**	**10**	**10**	**6**

1.1.2.6 Visual Inspection of the fractured surface

There must be no evidence of lack of fusion, gross porosity, slag inclusions or hot tearing on the fractured surfaces.

1.1.2.7 Chemical Composition

The chemical composition of the Exothermic portions shall be compatible to Exothermic Weld the following rail steel qualities.

ELEMENT	UIC 900 GRADE A %	UIC 1200 HH
Carbon	**0.60 – 0.8**	**0.65 – 0.8**
Manganese	**0.8 -1.3**	**0.8 – 1.3**
Silicon	**0.1 – 0.5**	**0.3 – 0.9**
Chromium	**Nil**	**0.7 – 1.3**
Phosphorus	**0.05 max**	**0.03 max**
Sulphur	**0.05 max**	**0.03 max**
Nickel	**0.25 max**	**0.25 max**
Molybdenum	**0.05 max**	**0.05 max**
Copper	**0.3 max**	**0.3 max**

2. RETEST

2.1 In the event of:

2.1.1 Exothermic weld fracturing below the minimum acceptable breaking load, with a reduced deflection reading or,

2.1.2 The fracture occurs straight through the centre line of the weld or,

2.1.3 The fracture occurs as a direct result of flaws within the parent rail or,

2.1.4 The weld display inadequate riser material to enable satisfactory trimming to be carried out, then,

2.1.1 The Engineer or Inspector shall direct that two further such tests be carried out, by using two Exothermic portions taken at random from the same batch.

2.1.2 Failure on one or more of the retests to comply with specific requirements shall result in the entire batch being rejected.