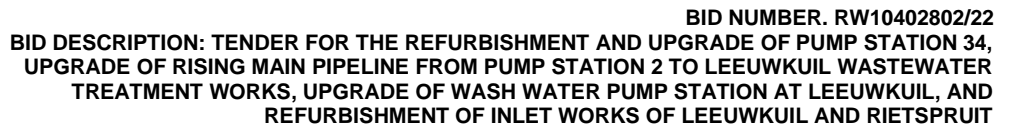


Section J Standard Mechanical Specifications

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SS 1.1 SCOPE

SS 1.2 STANDARDS

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- ### SS 1.3 RELEVANT ACTS, REGULATIONS AND STANDARDS

- a) The Occupational Health and Safety Act, 1993 (Act No 85 and amendments) and the regulations promulgated in terms of the Act
- b) The Code of Practice for the Wiring of Premises SANS 10142 and amendments, issued by the South African Bureau of Standards,
- c) The regulations and bylaws of the local supply authorities,
- d) The applicable regulations of the relevant telecommunication authority,
- e) The local Fire Department Regulations; and
- f) The relevant SANS, BS and IEC and ISO supporting specifications referred to in the standard specifications.

SS 1.6.1 Material and equipment

- a) All material and equipment shall conform in respect of quality, manufacture, tests and performance, with the relevant requirements of the South African Bureau of Standards or where no such standards exist, with the relevant current specification of the British Standards Institution and/or relevant IEC and/or ISO publications.
- b) All material and equipment shall be suitable for the conditions on site. These conditions shall include weather conditions as well as conditions under which materials are installed, stored and used. Should the materials not be suitable for use under temporary site conditions then the Contractor shall at his own cost provide suitable protection until these unfavourable site conditions cease to exist.

- c) The Contractor shall, where requested to do so, submit samples of equipment and material to the Engineer for approval prior to installation. The Engineer may retain these samples until the contract is completed after which they will be returned.

SS 1.6.2 Proprietary materials

Where proprietary materials are specified it is to indicate the quality or type of materials or articles required, and where the terms "or other approved" or "or approved equivalent" are used in connection with proprietary materials or articles, it is to be understood that the approval shall be at the sole discretion of the Engineer after the appropriate samples have been submitted to the Engineer for his evaluation.

SS 1.6.3 Voltage rating of appliances and equipment

The voltage rating of all appliances and equipment to be installed shall be in accordance with the nominal supply voltage of the supply authority except where otherwise laid down in the detail specification.

SS 1.5 APPROVAL OF DRAWINGS, MATERIAL AND EQUIPMENT

SS 1.8.1 Engineer's drawings and specifications

- a) The drawings prepared by the Engineer show general layout of all equipment and systems, complete with schematic arrangements. These, together with the specification, give sufficient information to enable the Contractor to estimate the cost and to determine how the system must be installed, tested, inspected, operated, serviced and maintained.
- b) These drawings are not dimensioned installation drawings, and shall not be used as construction/shop drawings. Location dimensions shown are only indicative of the routes and zones in which the service shall be installed.

SS 1.8.2 Contractor's drawings

Preparation of drawings

- a) Three paper print drawings of all equipment to be manufactured shall be submitted to the Engineer for approval. These drawings shall indicate all equipment, distribution systems, instrumentation positions and access requirements.
- b) The Contractor may, if he so desires, purchase software copies of the Engineer's drawings in native format for modifications and updating if required. These drawings shall be retitled in accordance with the Contractor's system and shall thereafter be submitted as Contractor drawings.
- c) No portion of the Contractor's work shall commence until the drawings have been approved by the Engineer.
- d) 'As-built' drawings shall be provided in the following formats and media:
- i) four paper print copies;
 - ii) four CDs or DVDs with software copies in .pdf (portable document format) and native format furnished on completion.
- e) 'As-built' drawings shall comprise the drawings as specified above, embodying all modifications made during construction, and further system diagrams indicating the intended functioning, capacity data and control functioning of all systems.
- f) The works shall not be certified as complete unless these drawings and the specified operating and maintenance manuals have been submitted and approved.

Submission of drawings

- a) Submission for approval will consist of the following activities executed by the Contractor and other parties involved:-
- b) The Contractor shall review, stamp, date and sign to signify his approval and submit in the manner required by the Engineer and with reasonable promptness and in orderly sequence so as to cause no delay in the work, all Contractor drawings and samples required by the contract documents or subsequently by the Engineer. Contractor drawings shall be properly identified.
- c) At the time of submission the Contractor shall inform the Engineer in writing of any deviation in the Contractor drawings or samples from the requirements of the contract documents.
- d) Three copies of the drawings shall be submitted to the Engineer for approval.
- e) By submitting drawings and samples, the Contractor signifies that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, or will do so, and that he has checked and co-ordinated each Contractor's drawing and sample with the requirements of the works and of the contract documents.
- f) The Engineer will review and approve construction drawings and samples with reasonable promptness (but within 21 days) so as to cause no delay, but only for conformance with the design concept of the works and with the information given in the contract documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.
- g) The Contractor shall make any corrections required by the Engineer and shall re-submit the required number of corrected copies of Contractor drawings or new samples until approved. When re-submitting drawings, the Contractor shall specifically direct the Engineer's attention (in writing) on revisions other than corrections required by the Engineer on previous submissions.
- h) No portion of the contract works requiring a Contractor drawing or sample submission shall be commenced until the submission has been approved.

Samples of material and equipment

- a) The Contractor shall, prior to placing orders, submit samples of all material and equipment to the Engineer for approval.
- b) For large equipment such as high voltage switchgear, transformers, standby generators, pumps, compressors and lifts, catalogues and brochures shall be submitted for approval.
- c) Equipment and material shall only be approved in writing by the Engineer and the Contractor is responsible for obtaining such approval prior to commencing with the installation.

Compliance with national and international standards

For all material and equipment that are required to conform to any national or international specification or publication, the Contractor shall submit a certificate to the Engineer, issued by an accredited testing laboratory clearly stating that the material and/or equipment complies with the required specification or publication.

SS 1.6 CONSTRUCTION PROGRAMME

- a) The Contractor shall submit his programme of work to the Engineer not later than 14 days after the Contractor has been notified of the acceptance of his tender. If necessary, the Engineer may instruct the Contractor to adjust his programme to suit other activities.
- b) The programme shall not be in the form of a bar chart only, but shall be based on a network technique and shall show clearly the anticipated quantities of work to be performed each week, together with the manner in which the listed plant is to be used, as well as the cash flow for the various sections of work.
- c) If, during the progress of the work, the quantities of work performed per week fall below those shown on the programme, or if the sequence of operations is altered, or if the programme is deviated from in any other way, the Contractor shall, within two days after being notified by the Engineer, submit a revised programme.
- d) If the programme has to be revised by reason of the Contractor falling behind his programme, he shall produce a revised programme showing how he intends to regain lost time in order to ensure completion of the works within the time for completion as defined in the General Conditions of Contract or any granted extension of time. Any proposal to increase the tempo of work must be accompanied by positive steps to increase production by providing more labour and plant on site, or by using the available labour and plant in a more efficient manner.
- e) Failure on the part of the Contractor to submit or to work according to the programme or revised programmes shall be sufficient reason for the Engineer to take steps as provided for in the General Conditions of Contract.
- f) The approval by the Engineer of any programme shall have no contractual significance other than that the Engineer will be satisfied if the work is carried out according to such programme and that the Contractor undertakes to carry out the work in accordance with the programme. It shall not limit the right of the Engineer to instruct the Contractor to vary the programme should circumstances make this necessary.

SS 1.7 SETTING OUT OF WORKS

The Contractor shall arrange for the setting out of the works by a qualified professional land surveyor.

SS 1.8 CONTRACTOR'S SITE REPRESENTATIVE

- a) In terms of the General Conditions of Contract, the Contractor shall advise the Engineer in writing of the name of the person the Contractor intends using to supervise the carrying out of the works on site.
- b) The Contractor shall furthermore submit the qualifications and details of the experience of the person the Contractor intends using on site. The Engineer reserves the right to accept or reject the employment of the proposed representative of the Contractor on site. Such representative shall have full powers to act on behalf of the Contractor.
- c) The approved representative on site shall be on site at all times while the Contractor is established on site and shall not be removed from the site and replaced by any other person without the prior approval of the Engineer. The Engineer reserves the right to stop all work on site in the event of the site representative not being on site at all times or if the approved site representative is removed from site without the Engineer's approval, until this condition is complied with.
- d) Both the Contractor and the Contractor's representative on site shall sign a declaration that they are conversant with the requirements of the contract document and that they are aware of the details of the contract. No excuses will be accepted for material or work, which does not comply with the specification.

SS 1.9 SITE MEETINGS

The Contractor or his authorised representative shall attend all meetings held on the site with representatives of the main Contractor and professional team at dates and times to be determined by the Engineer. Such meetings will be held to evaluate the progress of the contract and to discuss matters pertaining to the contract which any of the parties represented may wish to raise. It is not the intention of such meetings to discuss matters concerning the normal day-to-day running of the contract.

SS 1.10 SUB-CONTRACTORS

- a) The appointment of Sub-Contractors shall be subject to the approval of the Engineer and/or the Employer.
- b) Proposed Sub-Contractors shall first be introduced to the Employer or his duly authorised deputy before he (the Sub-Contractor) commences work.
- c) The Sub-Contractor shall have a thorough knowledge of the work to be carried out under his portion of the contract. The Employer will make payments in favour of the Contractor alone.
- d) The Contractor shall mutually arrange payments between himself and the Sub-Contractor.
- e) The responsibility for communication remains the responsibility of the main Contractor.

SS 1.11 HANDLING AND STORAGE OF EQUIPMENT

- a) Payment items have been provided for the storage of equipment either on site or at a location determined by the Engineer. These items will only be applicable if the Engineer has confirmed in writing that the equipment is ready to be installed, but that the other work on site has not advanced sufficiently to enable the equipment to be installed.
- b) Facilities for extended storage at site for plant may not always be available and the Contractor shall therefore make his own arrangements for any off-site storage which may be required for plant which become available before installation thereof can be commenced.
- c) The equipment stored on site shall be adequately protected and insured against damage resulting from weather, vandalism, theft, etc. This also applies to tools and equipment required for installation.
- d) The Engineer reserves the sole authority to determine when equipment is damaged and what remedial actions, if any, are required. If the damage is extensive, the equipment shall be rejected and removed from site. Previous payments can then be revoked until the Contractor has replaced all such equipment.
- e) The Contractor shall be responsible for the necessary maintenance of the equipment during the period of storage e.g. the maintenance of breathers, rotation of gearboxes, etc.
- f) All equipment shall, where necessary, be protected against the elements and corrosion.
- g) Payment under this item will be according to the volume of the equipment and shall be determined by measuring the largest dimensions of the width, depth and length, including the packing material, of the packed equipment.
- h) Should the Contractor claim payment of a portion of the value of some or all of the plant and equipment held in off-site stores, the items concerned must be clearly marked: 'The property of (name of the Employer)' and a certificate to this effect shall accompany his claim detailing the items and serial numbers included in his claim as well as the street address of the store where the plant is held. In addition, a certificate must also be furnished by the company with whom the plant and equipment has been insured in terms of the requirements of the general conditions of contract, in which it is certified that the plant and equipment for which the Contractor is claiming payment is fully covered by the insurance policy concerned while the plant and equipment is stored away from the site (street address of store to be stated).

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- i) The tendered rate shall include for double handling of the equipment, all packing material, insurance, maintenance, repair work where such repair work is not claimed from the insurance, storage costs, corrosion protection, administrative costs, additional transport, etc.
 - j) The volume of the equipment and the duration of storage (in months) shall be agreed on in writing by the Engineer and the Contractor before payment for storage will be made.

SS 1.12 FACTORY TESTING

Factory testing shall be executed in accordance with STD SPECIFICATION: TESTING, INSPECTION AND COMMISSIONING.

SS 1.13 INSPECTIONS

Inspections shall be in executed accordance with STD SPEC: TESTING, INSPECTION AND COMMISSIONING.

SS 1.14 SITE TESTING, COMMISSIONING AND TRIAL OPERATION

Site testing and commissioning shall be executed in accordance with STD SPEC: TESTING, INSPECTION, COMMISSIONING AND TRIAL OPERATION.

SS 1.15 HANDING OVER

- a) The handing over of completed sections of the works to the Employer and the energising/putting into operation of the completed sections of the works will only take place once the following documents and drawings have been submitted to the Engineer:
 - i) a certificate of compliance in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act or Factories, Machinery and Building Works Act, whichever is applicable;
 - ii) a certificate issued by the Contractor that the installation complies with the contract and specifications;
 - iii) a certificate of acceptance which shall be specified and signed by the Employer after the inspection, acceptance and approval of the completed sections of the works has taken place;
 - iv) "as-built" drawings;
 - v) written application to energise the completed sections of the works.
- b) The Contractor shall be responsible for timeously arranging for all tests and inspections with the Employer and Engineer, submitting the necessary documents and drawings to the Engineer and applying for the energising of the completed sections of the works.

SS 1.16 "AS-BUILT" DRAWINGS

On completion of the contract, all drawings required for the manuals shall be prepared and included in the manuals as specified.

SS 1.17 OPERATING AND MAINTENANCE MANUALS

SS 1.20.1 Submission of Manuals

- a) A complete set of provisional Operation and Maintenance manuals shall be handed over to the Engineer at least one month before any commissioning tests commence.
- b) The manuals will be checked by the Engineer and returned to the Contractor with comments. The Contractor shall make the necessary changes and amendments to the manuals to incorporate the Engineer's comments in the manuals.
- c) Portions of the information required in terms of this section may only be omitted with approval of the Engineer.
- d) After the Operation and Maintenance manuals have been approved by the Engineer, four sets of the manuals shall be provided by the Contractor for distribution by the Engineer.

SS 1.20.2 Format of the Manuals

- a) Physical appearance
 - i) Manuals shall be bound in hard cover lever-arch files with plastic coatings. The files shall be clearly labelled on the outer front cover and on the edge with the following information:
 - (1) The Contractor's name (logo optional)
 - (2) The project title
 - (3) The title "Operation and Maintenance Manuals"
 - (4) The month and year during which the manuals are finally handed over to the Employer.
 - a. Pamphlets and bound leaflets/booklets from suppliers shall be placed in plastic sachets, especially if they are of non-standard size.
 - b. Large format drawings shall be folded and placed in plastic sachets such that they can be easily removed.
 - c. The sections of the manuals described below shall be clearly partitioned.
 - d. Systems and/or functional units on the site shall be treated as units in the manuals, even if different types of equipment occur on such units. Cross-referencing may be used.
- b) Contents

The manual shall contain the following:

 - i) Title page
 - ii) Contents list.
 - iii) List of drawings and appendices.
 - iv) Plant description

This section shall give a brief but detailed overview of the complete plant covered by this manual including all systems and/or functional units.
 - v) Maintenance and lubrication schedule (summary)

This maintenance schedule shall be in a table format and shall include a summary of all the maintenance actions required of all the different systems and/or functional units covered by this manual to give a single summary of all maintenance actions required for the complete plant.

The schedule shall indicate daily, weekly, fortnightly, monthly and yearly maintenance actions. A lubrication schedule summary shall also be included under this section.

- vi) The main body of the manual shall be divided into sections, if necessary, with each section covering a system and/or functional unit. Each of these sections shall contain the following information in the sequence given below:

1) Plant Description

This section shall give a brief but detailed description of the system and/or functional unit in general.

2) Maintenance and Lubrication Schedule

This maintenance schedule shall be in a table format and shall contain all the maintenance actions required for all the mechanical equipment supplied. The schedule shall indicate daily, weekly, fortnightly, monthly and yearly maintenance actions. A fully detailed lubrication schedule shall also be included under this section.

3) Mechanical Flow Diagrams (MFDs) / Single line diagram

Mechanical flow diagrams (for mechanical systems) or single line diagrams (for electrical systems) of the system and or functional unit shall be included in the Operation and Maintenance Manuals for easy reference by the plant operators and maintenance personnel.

4) Piping and Instrumentation (P&IDs)

Where applicable, P&IDs shall be included in the Operation and Maintenance Manuals for easy reference by the plant operators.

5) Operating Instructions

The operating instructions shall be a step by step description of the "manual" start-up and shut-down procedure for every piece of equipment and/or process supplied with references to the MFDs or P&IDs.

For automatic operation the operators shall be referred to the automatic control manual (if applicable).

6) Fault Finding

A fault finding table indicating the possible causes of failure and rectification procedures for all the equipment supplied shall be included in the Operation and Maintenance Manuals.

7) Equipment Data Sheets

A data sheet shall be drawn up for every piece of equipment and/or machine supplied containing the following information:

- a) Equipment tag number
- b) Equipment description
- c) Supplier details
- d) Model/make
- e) Ordering details
- f) Details of fixed components
- g) Details of lubrication
- h) Maintenance references (refer to Supplier Technical Manuals)

8) Equipment Technical Manuals

For each piece of equipment and/or machine supplied the following shall be included in this section of the Operation and Maintenance Manuals:

- a) The suppliers Manual of Operation and Maintenance Instructions
- b) Parts lists and data sheets including all characteristic curves for machines installed indicating the operation point
- c) Calibration charts
- d) Test certificates for hydraulic pressure tests, flame proof grading, materials, non-destructive examinations, coating and lining details, etc.
- e) Prints of applicable drawings

9) "As-built" drawings

Legible, but preferably folded A3 size "as-built" drawings of the plant and/or areas thereof shall be included in the manual where applicable.

SS 1.18 SPARES

One month before commissioning and handover of a system or functional unit, the Contractor shall submit a detail priced list of recommended spares and consumables required for the system. The list shall indicate which spares are consumable spares and which are strategic spares together with an expected monthly consumption.

SS 1.19 MEASUREMENT AND PAYMENT

SS 1.22.1 Provide and maintain a quality system Lump sum

The unit of measurement shall be a lump sum.

The quoted lump sum shall include full compensation for the development and maintenance of a documented system consisting of procedures, instructions, standard forms and to ensure that the specified SANS ISO 9001 □ elements are controlled. This item shall include implementing and/or training of staff in the requirements of the system to ensure that it is entrenched and being worked to. This item shall further include the auditing of all aspects of the system by a suitably experienced quality auditor to verify the successful entrenchment of the system.

SS 1.22.2 Setting out of works Lump sum

The unit of measurement shall be a lump sum.

The lump sum tendered shall include full compensation for a qualified professional land surveyor to set out the works and to provide the Engineer with 3 paper copies of the drawings.

SS 1.22.3 Storage of equipment where storage space is provided by:

- | | | |
|-----|----------------|------------------------------|
| 0.1 | The Contractor | m³ - month |
| 0.2 | The Employer | m³ - month |

The unit of measurement shall be the cubic metre - month.

The tendered rate for sub-item 0.1 shall include full compensation for all double handling of the equipment, all packing material, insurance, maintenance, repair work where such repair work is not claimed from the insurance, storage costs, corrosion protection, administrative costs, additional transport, etc. of the equipment as specified.

The tendered rate for sub-item 0.2 shall include full compensation for all the obligations as described for sub-item 0.1 except that storage for the equipment will be supplied free of charge by the Employer.

SS 1.22.4 Test, commission and trial operate the installation Lump sum

The unit of measurement shall be a lump sum.

The lump sum tendered shall include full compensation to test and commission the complete installation as specified.

SS 1.22.5 Provide "as-built" drawings Lump sum

The unit of measurement shall be a lump sum.

The lump sum tendered shall include full compensation to provide the "as-built" drawings of the installation, in the quantities and on the media as specified.

SS 1.22.6 Provide manuals for the installation Lump sum

The unit of measurement shall be a lump sum.

The lump sum tendered shall include full compensation for the compilation of the draft manuals, submitting these to the Engineer for approval, incorporating and comments and modification requested by the Engineer or Employer until the manuals are approved by the Engineer. The tendered rate shall further include full compensation for providing 4 complete sets of approved manuals complete with complete sets of as-built drawings.

SS 1.22.7 Maintenance spares Prov sum

The unit of measurement shall be a provisional sum.

The provisional sum shall provide for the acquisition at the sole discretion of the Employer of maintenance spares. The provisional sum does not include provision for profit and handling by the Contractor, which shall be measured separately under payment item 0 below. Payment shall be effected on actual invoiced amounts.

SS 1.22.8 Charges and profit on maintenance spares %

The unit of measurement shall be the % tendered of the actual amount spent.

The tendered rate shall include for full compensation for all overhead charges, profit and handling of maintenance spares ordered under item 0 above.

SS 1.22.9 Contract administration and general requirements Lump sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the contract administration and general requirements as set out in this section of the standard specification but excluding the as-built drawings, manuals and testing and commissioning for which separate items have been scheduled.

Payment for the lump sum tendered will be made in three instalments, as follows:

- (1) The first instalment, 10 percent of the lump sum, will be paid after the Contractor has made a substantial start with construction and procurement in accordance with the approved programme.
- (2) The second instalment, 40 percent of the lump sum, will be paid when the value of work completed reaches one half of the contract price, excluding contingencies and escalation.
- (3) The third and final instalment, 50 percent of the lump sum, will be paid when the works have been completed, all "as-built" documentation and manuals have been submitted and the site has been cleared to the satisfaction of the Engineer.

SS 2 CONTRACTOR'S SITE ESTABLISHMENT

SS 2.1 SCOPE

This specification covers all work and costs involved in the establishment of the Contractor's organisation, camp and plant on the site and the removal thereof after completion of the contract. Payment for the Contractor's general obligations, liabilities and risks not covered elsewhere is also provided for in this section.

SS 2.2 GENERAL REQUIREMENTS

SS 2.2.1 Camps, personnel and plant

- a) The Contractor shall establish his construction camp, including all accommodation, maintenance and testing facilities necessary for his personnel, plant, stores, process control etc. on the site.
- b) Accommodation must comply in all respects with the requirements of the authorities who shall have free access at all times for inspection purposes.
- c) The Contractor shall move all necessary personnel and plant to the site preparatory to starting work, and from the site after completion of the work, leaving the camp clean, tidy and free from obstructions.
- d) All buildings as well as the whole camp area and fencing shall be maintained during the contract.
- e) The Contractor shall provide and maintain suitable facilities within his office complex for the holding of site meetings.
- f) The positioning of the camp on the site shall be subject to the approval of the Engineer, legal relations and responsibility to the public
- g) The Contractor shall take steps necessary to comply with the terms of the General Conditions of contract, particularly in respect of the insurance, guarantees and indemnities required, and shall comply with all regulations of statutory authorities.

SS 2.3 NOTICES, SIGNS AND ADVERTISEMENTS

- a) The Contractor shall not erect any notices, signs or advertisements on or near the site without the written approval of the Engineer.
- b) As part of his general obligations, the Contractor shall erect the official nameboard(s), the details of which are shown on the drawings.
- c) The nameboard(s) shall be erected in the position(s) indicated by the Engineer.
- d) All signboards, notices, the official nameboard(s) and advertisements shall be removed by the Contractor on completion of the works or by the end of the maintenance period, as may be directed by the Engineer.

SS 2.4 MEASUREMENT AND PAYMENT

SS 2.4.1 Contractor's establishment on site

0.1 Fixed charges	Lump sum
0.2 Time-related charges	Lump sum

Payment of the lump sums tendered under Sub-items 0.1 and 0.2 shall, for the two items together be full compensation for all the Contractor's charges in respect of the following items, collectively termed the "Contractor's establishment on site":

- (i) Setting up and maintaining his organisation, camp, accommodation, all types of equipment and plant on site, the supply of water and power, the supply and erection of temporary latrines, all other services and camp site fencing and for the removal thereof on completion of the contract.
- (ii) Effecting the insurance and providing the guarantees and indemnities required.
- (iii) All site and head office overheads, profit, finance costs, risks, legal and contractual responsibilities and other costs and obligations of a preliminary and general nature which are not specifically measured for payment under any other items of payment.

The lump sum tendered under Sub-item 0.1 above shall represent the fixed part of the Contractor's establishment on site, i.e. that part which is substantially fixed and not a function of the time required for the completion of the contract.

This sub-item shall not be subject to any variation if the actual value of the work done exceeds or falls short of the tendered amount within the limits stated in the General Conditions of Contract. Payment of the lump sum tendered under Sub-item 0.1 will be made in three instalments, as follows:

- 1) The first instalment, 50 percent of the lump sum, will be paid in the first payment certificate after the Contractor has met all his obligations under this section and has made a substantial start on construction in accordance with the approved programme.
- 2) The second instalment, 35 percent of the lump sum, will be paid when the value of the work completed reached one-half of the contract price, excluding contingencies and escalation.
- 3) The third and final instalment, 15 percent of the lump sum, will be paid when the works have been completed and the Contractor has fulfilled all the requirements of this section and the site has been cleared to the satisfaction of the Engineer.

Before any payment is made under this sub-item, the Contractor shall satisfy the Engineer that he has provided on site, a camp and plant of good quality and in value exceeding that of the first instalment.

The Contractor may also be required to furnish documentary proof that he owns the camp and plant on site.

In the event of the Contractor not being able to satisfy the Engineer as to the ownership of the camp and plant, the Engineer shall have the right to withhold part of any payments to be made under this sub-item, until the works have been completed.

Any payment made under this sub-item shall not be taken into account when determining whether the value of a certificate complies with the "minimum amount of interim certificate" as laid down in the Appendix to Tender.

The lump sum tendered under Sub-item 0.2 above shall represent that part of the Contractor's establishment on site that is substantially related to the time required for the completion of the contract.

Sub-item 2.4.1.2 will, however, be adjusted pro rata to any authorised extension to the tendered time for completion of the contract, in full settlement of any claims for varied establishment costs.

Payment for the lump sum tendered under Sub-item 0.2 will be certified monthly on the basis of the total for this sub-item on any particular certificate of payment, being calculated as follows:

$$P = \frac{A}{B} \times C \times \frac{T_e}{T_t}$$

Wherein:

- P = interim amount certified for payment under Sub-item 0.2.
- A = total amount (excluding payment for Sub-item 0.2) certified for payment on the certificate.
- B = final value, estimated if not known, of the contract Price (excluding Sub-item 0.2).
- C = amount tendered for Sub-item 0.2.

T_e = time for completion plus any extensions of time granted, or minus any reduced time for completion authorised up to the date of the certificate.

T_t = time for completion as stated in tender documents.

The final amount paid under Sub-item 0.2 in accordance with the above formula will be taken to be an agreed amount in full compensation for time-related establishment charges adjusted for varied time for completion.

SS 2.4.2

Daywork

hours

The Engineer may schedule and require unit rates for estimated numbers of hours of daywork for various classes of labour and an amount to cover materials or equipment, or both, likely to be ordered under daywork during the course of the contract. The unit rates for labour, equipment and materials shall cover overhead charges and profit, site supervision and site staff, insurances, holidays with pay and use and maintenance of tools and equipment. The rates for equipment shall cover the cost of operators, consumable stores, fuel, and maintenance. The rates or allowances shall cover travelling allowances or travelling costs (transport of men by Contractor's transport or transport hired or paid for by the Contractor), lodging allowances and any other emoluments and allowances payable to the workmen.

SS 3 GENERAL DESIGN

SS 3.1 SCOPE

This standard specification covers general design criteria and standards applicable to all sections of work. Should the requirements of this standard specification be in conflict with any other standard specification or the detail specification, the other standard specification or detail specification shall govern and the Tenderer/Contractor shall seek information of such precedence from the Engineer.

SS 3.2 STANDARDS

SS 3.2.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- | | | |
|-----|---|---|
| [1] | Republic of South Africa - Act No 85 and the Regulations promulgated in term of the Act | Occupational Health and Safety Act In areas of jurisdiction where this act is not applicable the local equivalent Act shall apply. In the absence of a local equivalent Act – the provisions and regulations promulgated in terms of this act shall apply |
| [2] | SANS 10142-1 | The wiring of premises Part 1: Low-voltage installations |
| [3] | SANS 1700-7-3 | Fasteners Part 7: External drive hexagon bolts and screws Section 3: Hexagon head bolts - Product grade C |
| [4] | SANS 1700-7-5 | Fasteners Part 7: External drive hexagon bolts and screws Section 5: Hexagon head screws - Product grade C |
| [5] | SANS 1700-14-3 | Fasteners Part 14: Hexagon nuts Section 3: Product grade C |
| [6] | SANS 1700-14-4 | Fasteners Part 14: Hexagon nuts Section 4: Hexagon thin nuts (chamfered) - Product grades A and B |
| [7] | SANS 32/ EN 10240 | Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants |
| [8] | SANS 121/ ISO 1461 | Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods |
| [9] | IEC 61000 Parts 1 to 6 | Electromagnetic compatibility (EMC). |

SS 3.2.2 Standard specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

SS : TESTING, INSPECTION, COMMISSIONING AND TRIAL OPERATION

SS 3.3 RELEVANT ACTS, REGULATIONS AND STANDARDS

- a) All electrical equipment shall be of approved manufacture and its construction, design and testing shall be in accordance with the requirements of the most recent South African National Standards, British Standards or IEC publications including all amendments issued thereto up to the date of tender.
- b) The installation and equipment shall also comply with the relevant clauses of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of the Act, and with the Code of Practice for The Wiring of Premises, SANS 10142 [2].
- c) Notwithstanding reference in this specification to South African, British Standards, IEC or ISO standards, the supplier may submit for approval material and designs conforming to other

technically equivalent national standards, provided that the supplier supplies the Engineer with a translation of the standards into English and satisfactory proof of actual compliance therewith.

SS 3.4 DESIGN

- a) The works shall be designed to facilitate easy accessibility, equipment replacement, maintenance, handling, inspection cleaning and repairs and to ensure satisfactory operation in which safety of plant, personnel and public and continuity of service is the first consideration.
- b) All plant, equipment and apparatus shall operate satisfactory under the ambient and other conditions prevailing at the site.
- c) All apparatus shall be designed to prevent the risk of accidental short circuits due to animals, birds, ants and vermin.
- d) All moving, rubbing or wearing surfaces shall be machined or ground where they bear upon each other.
- e) The plant and equipment shall be designed and constructed to keep maintenance costs and the number of persons employed for maintenance to a minimum.
- f) All the equipment shall be to the approval of the Engineer and shall, unless otherwise specified, be suitably designed for operation on normal electrical supply systems, with voltage fluctuations of plus and minus 10% and under such sudden variations of load and voltage as may be met with under working conditions.
- g) The design of equipment shall include as a major consideration the absolute safety of the general public, operating and maintenance personnel.
- h) All dimensions, units and design parameters shall be in accordance with the international metric (SI) system.

SS 3.5 QUALITY OF MATERIAL

All material shall be new and of a design and class suitable for working under the conditions specified, and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion, deterioration, or the setting up of undue stresses in any part such as to affect the efficiency and reliability of the plant and also without affecting the strength and suitability of the various parts for the duty which they have to perform.

SS 3.5.1 Generally

All materials used in the manufacture and construction of plant and equipment shall be new, unused and shall be the best of their respective kinds. The Contractor shall ensure that the materials are selected in accordance with the best engineering practice to suit the working conditions and the extremely corrosive environment.

SS 3.5.2 Steel

Structural steel shall comply with the requirements of SANS 1431 of the 300 W or 350 W series and shall be legibly marked with the maker's name or trade mark and identification marks.

SS 3.5.3 Stainless steel

The grade of stainless steel to be used shall be as specified. Unless otherwise specified, rolled material shall be supplied with a matt, annealed and pickled or otherwise de scaled surface finish. For wrought steels, the equivalent BS 970 grade may in each case be used.

A manufacturer's test certificate shall be provided for each batch of stainless steel giving details of the material analysis and any mechanical tests carried out on the material. Each stainless steel item supplied shall be clearly and permanently marked with the grade of stainless steel and cross referenced to the applicable test certificate.

Where grades EN Grade 1.4401 (316) and EN Grade 1.4301 (304) are specified, these shall be taken synonymously with the low carbon grades for welding.

SS 3.5.4 3CR12

This is the titanium stabilised, 12 % chrome steel as produced by Columbus Stainless, South Africa.

3CR12 shall always be supplied with an annealed and pickled finish. 3CR12, in cases where it is to be coated, shall be suitably abrasive blasted to ensure adherence of the prime coat.

SS 3.5.5 Plastics

Thermoplastics and fibre reinforced polymers shall be UV resistant, have adequate tensile strength and high impact strength and generally suit the application.

PVC is regarded as too brittle and shall not be used unless called for in this Specification or approved in writing by the Engineer before supply.

SS 3.5.6 CASTINGS

Castings shall comply with the relevant South African or international standard for the material used, including the following:

Grey Cast Iron	SANS 1034; BS 1452
S. G. Iron	SANS 936/7; BS 2789
Steel (General Purpose)	SANS 1465; BS 3100
Aluminium	SANS 989/992; BS 1490
Stainless Steel	DIN 17 445
Copper and Copper Alloy	SANS 200; BS 1400

Particular attention shall be paid to cleanliness, soundness and neat fettling and dressing of castings. Surfaces shall be smooth and irregularities caused by mould washaways, and the presence of porosity, inclusions and sharp edges will not be tolerated. Areas under bolt heads, nuts and washers, shall be machined or spot faced to ensure a flat and smooth pressure bearing area, and sufficient space shall be provided for the use of ring or socket spanners.

All pressure retaining castings shall be hydrostatically tested to not less than 1,5 times the maximum working pressure after machining and shall be pressure tight.

No repairs shall be undertaken to castings without the written permission of the Engineer and welding will not be permitted on cast iron castings.

Castings shall be heat treated to provide optimum corrosion resistance and toughness combined with reasonable machinability. In particular stainless steel castings shall be heat treated so as to ensure that all carbides are in solution, to ensure optimum grain size, and to provide maximum corrosion resistance.

The Contractor shall provide a test certificate for each casting or batch of castings, except for those made of grey cast iron, giving details of the material analysis, the heat treatment and any mechanical tests carried out.

SS 3.6 FABRICATION OF STEELS

SS 3.6.1 General

Steelwork shall generally be constructed, fabricated and erected in accordance with the applicable requirements of SANS 1200 H.

Welding shall comply with the General Specification "Welding".

Sharp edges, pits, inclusions, weld spatter, undercuts, indentations or other surface defects are not acceptable.

Edges shall be rounded to a radius of at least 2 mm.

Designs shall avoid inaccessible pockets and hollow spaces.

Sharp edges on items fabricated from thin sheets will not be acceptable and sharp edges shall preferably be avoided by good design.

Inspection of fabrications shall generally be done after fabrication is complete.

SS 3.6.2 Carbon Steels

Structural steelwork shall be of SANS 1431 Grade 300W steel.

All surfaces shall be accessible by blast and spray equipment. Practical requirements for providing accessibility for surface preparation and coating shall be taken into consideration. Features which would prevent access to blast material and coating application shall be removed.

Edges shall be rounded so as to be suitable for the coating system to be applied.

The requirements of the General Specification "Corrosion Protection" shall be followed if the item is to be hot dip galvanised. Designs shall provide proper access for safe and proper entry of the molten zinc into open spaces so that subsequent drilling at the galvaniser's yard is avoided.

SS 3.6.3 Austenitic Stainless Steels

Fabrication of austenitic stainless steels shall comply with the recommendations in "The Stainless Steel User Manual" issued by Columbus Stainless. Compliance with publications from equivalent authorities will be acceptable.

Stainless steel fabricators shall use permanently dedicated storage and fabrication areas and shall use machines, tools and handling equipment which are suited and permanently dedicated to this type of material.

Fabrications shall be pickled and passivated over their full surface to achieve an even colour. If grinding is required before pickling, the final grinding shall be done with a fine disc in order to remove coarse grinding marks.

SS 3.6.4 3CR12

Fabrication of 3CR12 shall comply with the requirements for austenitic stainless steels except that the recommendations in "The 3CR12 Fabrication Guide" issued by Columbus Stainless shall be used. Compliance with publications from equivalent authorities will be acceptable.

SS 3.6.5 Duplex and Highly Alloyed Stainless Steels

Fabrication of duplex, super austenitic and other highly alloyed stainless steels shall follow the metal producer's own guidelines.

Welding of duplex stainless steel pipework shall be in accordance with BS 4515 Part 2 or equivalent.

SS 3.7 INTERCHANGEABILITY

Corresponding parts throughout the works shall be made to such close tolerances that all similar components and spares shall be fully interchangeable without any further alterations or adjustments being necessary.

SS 3.8 BOLTS AND NUTS

- a) The threads of all bolts, nuts and studs shall be in accordance with SANS 1700-7-3 [3], 1700-7-5 [4], 1700-14-3 [5], 1700-14-4 [6] (in part).
- b) No brass bolt or stud shall have a diameter of less than 6 mm.
- c) All nuts and studs shall be locked in position by lock washers and where necessary, lock nuts.

- d) Each bolt shall protrude by at least one but not more than five threads through the nut with all washers in position.
- e) All bolts, nuts and washers used outdoors shall be of approved materials and treated to prevent corrosion of the threads.
- f) The Contractor shall provide special tools if any bolt, nut, screw or other fastener is used in a position, which is not accessible using conventional tools. This also applies where the size or shape of the fastener is not conventional.

SS 3.9 FIRE PRECAUTIONS

All apparatus, connections and cabling shall be designed and arranged to minimise the risk of fire and any damage, which might be caused in the event of fire.

SS 3.10 GALVANISING

- a) Where galvanising is specified, or is a requirement of the design, such galvanising shall be performed by the hot-dip process to SANS 32/ EN 10240 [7] in part and SANS 121/ ISO 1461 [8].
- b) For all parts, other than wires, the equivalent zinc coating thickness shall not be less than 455 g of zinc per square metre of surface area.
- c) The galvanising must be clean, smooth, of uniform thickness, unblemished and free from defects.
- d) The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.
- e) All drilling, welding, cutting, sawing, punching, filing and bending shall be complete and the metal shall be cleaned of any machining blemishes, mill scale, rust and lubricants, before galvanising.
- f) Galvanised areas must be kept free of lubricants. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.
- g) Electrolytic deposition of zinc is not acceptable.
- h) Where it is not practicable to coat the surface of metal by the hot-dip galvanising process, such equipment may be zinc-sprayed instead. The surface being zinc-sprayed shall be suitably prepared in accordance with the requirements of the process adopted and the rate of deposition of zinc shall not be less than 760 g per square metre of surface area. After zinc spraying the surface shall be painted with a suitable paint to render it completely impervious.

SS 3.11 WELDING

SS 3.11.1 Standards

The welding shall be executed in accordance with modern accepted practice for welding and shall be sound, full strength and free from undercut and slag inclusions. These include the following:

BS EN 1011	Arc welding carbon and carbon manganese steelwork.
BS 4677	Arc welding austenitic stainless steel pipework.
BS 2633	Class 1 Arc welding of steel pipework.
BS 2971	Class II Arc welding of steel pipework.
BS 806	Design and construction of ferrous piping in connection with land boilers (used for arc welding specification of all pipe flanges).

Intermittent welding and incomplete penetration butt-welding will not be accepted.

All fabricated items shall be stress relieved after welding.

The supplier shall well in advance of the commencement of fabrication, submit for approval details of proposed welding procedures.

Welders shall be experienced artisans approved in accordance with BS 4872 or equivalent.

SS 3.11.2 Continuous Welding and Elimination of Crevices

Welding shall be continuous on all sides of any joint.

Crevices, including those arising from welding on one side only, shall be eliminated. This requirement applies to the welding of all metals and welding procedure shall be designed to prevent unacceptable deformation.

Welds which are only accessible from one side shall be prepared so that the root run provides an acceptable profile and prevents the formation of crevices. Pipework shall be designed so that such welds can be inspected and, where applicable, pickled and passivated.

In special cases only, non-continuous welding might be approved in writing by the Engineer. The resulting crevices shall be sealed with a two part solvent free epoxy which can be applied at thicknesses of up to 600 µm and above such as Sigmeline 523 or Corrocoat Zip E or Sigmacover 1000 or equivalent.

SS 3.11.3 Weld Appearance

Welding shall be free of blowholes, projections, pinholes, splatter and undercuts and all welding flux, weld spatter and other sharp imperfections shall be removed. Weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground.

SS 3.11.4 Site Welding

Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Engineer.

SS 3.11.5 Welding of Stainless Steel and 3CR12 – Additional Requirements

Fabrication of austenitic stainless steels and 3CR12 shall comply with the recommendations in "The Stainless Steel User Manual", "The 3CR12 Fabrication Guide" and the general welding requirements in "Pocket Guide – Stainless Steels" issued by Columbus Stainless. Compliance with publications from equivalent authorities will be acceptable.

Stainless steels to be welded shall be of the low carbon grade; e.g. 1.4306 rather than 1.4301 and 1.4404 rather than 1.4401.

The welding rods used shall be the most suitable for the metal and purpose.

Only welders experienced with welding stainless materials shall be used.

Welds which are accessible from only one side shall be executed in a manner to prevent heat tint or shall be post weld treated in order to remove all traces of heat tint.

Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing. 3CR12 shall be welded as recommended in "The 3CR12 Fabrication Guide" issued by Columbus Stainless.

All possible steps shall be taken to ensure maximum corrosion resistance and strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Welds shall be passivated. Discolouration and steel contamination must be removed by pickling or electro cleaning as approved by the Engineer but should rather be avoided by taking the appropriate measures.

SS 3.11.6 Inspections

The Contractor shall arrange for all fabrications to be inspected by the Engineer prior to transport from the fabrication workshop.

SS 3.12 ELECTROMAGNETIC INTERFERENCE

- a) All equipment installed under this contract shall comply with the requirements of IEC 61000 Parts 1 to 6 [9] electromagnetic compatibility (EMC).

- b) Any equipment found producing electromagnetic emissions, in excess of the limits specified by IEC, subsequent to commissioning, shall be suppressed or replaced to the satisfaction of the Engineer without any cost to the Employer.

SS 3.13

LABELS AND NOTICES

- a) Identification labels must be attached to all equipment, motors, control gear and all panels and the equipment contained therein.
- b) Labels shall consist of either -
 - i) Engraved sandwich board ("Trifoliate", "Darvic" or equal).
 - ii) Reverse engraved acrylic material ("Perspex") with filled letters and reverse sprayed.
 - iii) For outdoor applications (where specified) labels shall be brass or aluminium (with letters filled in black), lightly sanded with fine grit paper and clear lacquered.
- c) Labels shall have a matt or satin finish to minimise reflection.
- d) Labels shall be rectangular in form with proportions appropriate to the wording, and shall have true, parallel, lightly bevelled edges and shall be neatly and squarely fixed.
- e) Engraving shall be of uniform height, character and line width.
- f) The type of material or process shall be such as to finish with black letters against a white background, except in the case of cautionary labels where the letters shall appear white on a red background.
- g) The label material used shall be selected having regard to the size and fixing methods of the label and the label shall not warp in service.
- h) Labels shall be fixed by the use of either -
 - i) Self-tapping screws
 - ii) Metal-thread screws and nuts.
 - iii) These shall be nickel plated in either case and adequate clearance shall be allowed around lettering to accommodate these. Adhesive fixing alone will not be accepted. Extruded aluminium section is preferred, provided the label is firmly held.
- i) Cables shall be labelled at both ends, at through joints and at regular intervals.
- j) Cables shall be labelled on both sides of the place where the cable passes through a permanent obstruction.
- k) All lettering shall be in uppercase letters except where standard abbreviations of units are used, e.g. kWh, kVA, etc.
- l) The wording of labels and character height shall be to the approval of the Engineer.
- m) All labels shall be in English. In addition to the English text, all Warning/Danger labels shall also be in the local language if other than English.

SS 3.14

CLEANING AND PAINTING

- a) The cleaning and painting of all exposed surfaces of all plant and accessories, unless otherwise specified or approved, shall be carried out as follows:
 - i) Surface preparation

All metal work shall be thoroughly cleaned by blast cleaning or pickling so as to be free of all mill scale, dirt, rust, welding slag and spatter, grease and all other contaminants and so as to present a dry, bright metallic finish.
 - ii) Priming

The metal work shall be primed with an approved primer which, for equipment intended for outdoor use, shall be red lead based and for indoor mounted equipment shall be phosphate based.

iii) Finishing

The primed surfaces shall be finished with a minimum of two coats of approved alkyd based enamel of which each coat shall be of a different shade.

- b) Epoxy powder coating will be considered as alternative, for indoor applications, subject to the approval of the application procedure by the Engineer.
- c) Top and bottom plates of chassis compartments assemblies and chassis runners may be protected against corrosion in an alternative approved manner (e.g. by passivated cadmium plating) due to the likelihood of damage to paint work on removal and replacement.
- d) All painting shall be spray applied using dry oil-free air.
- e) The final paint thickness shall be not less than 0,1 mm as determined by a magnetic film thickness gauge.

SS 3.15 WATER AND DEBRIS ACCUMULATION

All outdoor equipment must be designed so that water and debris will not readily accumulate to cause deterioration of equipment or an electrical discharge hazard. Where this cannot be avoided such places shall be easily accessible for cleaning.

SS 3.16 INSPECTION AND TESTS

- a) All equipment will be inspected and tested, both in the factory during manufacturing and on site during installation. The tests required are prescribed in the standard and detail specification. The Engineer will do all inspections accompanied by the Contractor and the Contractor shall perform all tests with the Engineer as witness.
- b) Inspections and test shall be executed in accordance with STD SPEC: TESTING, INSPECTION, COMMISSIONING AND TRIAL OPERATION

SS 4 TESTING COMMISSIONING AND TRIAL OPERATION

SS 4.1 SCOPE

This section covers the factory and on site testing and commissioning requirements for all equipment supplied and installed under this contract. The procedures described are the minimum required and additional tests/requirements are specified in the relevant standard and detail specifications.

SS 4.2 TESTING SEQUENCE

The testing to be performed includes:

- a) Factory acceptance testing at the manufacturers premises prior to packaging and transportation.
- b) Before official commissioning commences the Contractor shall test his equipment as described below to ensure that the plant has been installed correctly.
- c) After the Contractor has been satisfied that his equipment is in running order, the commissioning of the plant will commence as described below.

SS 4.3 FACTORY TESTING

- a) The Engineer reserves the right to visit and enter the manufacturer's works during the design and manufacturing stages for the purposes of interim and final inspections and for progress information acquisition. Where the Contractor makes use of third parties for the manufacturing and/or procurement of equipment, the Contractor shall ensure that this requirement is agreed with the third party.
- b) The Engineer reserves the right to be present at all or any tests (or, at the Engineer's discretion repeats of such tests) conducted on the equipment.
- c) One calendar week notice of pending tests shall be given to the Engineer in writing.
- d) Three copies of all test records are to be submitted to the Engineer for approval.

SS 4.4 INSPECTIONS

- a) The Engineer will require seven (7) days notification to avail himself for any tests or inspection. The Contractor shall arrange for the maximum number of tests and inspections to be done on the same day.
- b) In the event of the Contractor requesting the Engineer to inspect, measure, test or commission any sections of the works where the Contractor has not completed such sections of the works and is not ready for the Engineer to inspect, measure, test or commission the sections of the works or where the testing of the works fails due to the neglect of the Contractor to test such sections of the works prior to notifying the Engineer to witness the tests, the Contractor shall pay the Engineer per hour for his travelling time and time spent on site or in the factory reimburse the Engineer for all other costs incurred in travelling to and from site in accordance with the Association of Consulting Engineer's recommended time and cost tariffs.
- c) The Contractor shall furthermore be liable for the Engineer's costs as specified above for all inspections, measurements, tests and commissioning that the Engineer has to undertake after the expiry of the completion period allowed for in this contract and where no extension of time has been granted.

SS 4.5 SITE TESTING OF EQUIPMENT PRIOR TO COMMISSIONING

- a) The Contractor shall timeously inform the Engineer when he intends to perform his first tests and start-up of equipment in order to allow a representative of the Engineer to witness the tests.
- b) Before starting up any section of the mechanical plant or filling tanks and sumps with liquid, the Contractor shall clean out the tanks, pipes, fittings, equipment or structures, and, if necessary, make arrangements with other Contractors to remove their building rubble from the structures, check that all safety devices and alarms have been set and activated, all nuts have been

tightened correctly, that all the equipment is complete and ready for start-up, that the plant has been installed correctly, and that three copies of the operating manuals have been handed over to the Engineer.

- c) Each section of the equipment shall be started up by the Contractor, who shall ensure that all oil fillings, lubrication, vibration monitoring, etc. have been correctly completed. In addition, he shall be responsible for the first re-filling of all the lubricating oils as well as for adjusting the plant to operate according to specification. Before any equipment is started or energised, the Contractor shall ensure that it is safe for personnel and equipment on site to do so. Allowance for these costs shall be made in his tendered rates and sums.
- d) The Contractor shall conduct his own tests on the equipment and, only when he is satisfied that these tests meet the requirements of the specifications, shall he notify the Engineer that he is ready to conduct the official tests on completion. The Contractor shall not conduct an official test without the Engineer being present or his approval to do so. All equipment tested shall conform to the requirements specified.

SS 4.6

COMMISSIONING

- a) The Contractor shall be responsible for commissioning all sections of the works and shall perform all of the tasks set out below and as detailed in the relevant standard and detail specifications:
 - i) Prior notice of and proper arrangements for the commissioning shall be made with the Employer, Engineer, supply authority, and all electrical Contractors and suppliers of equipment, which will be affected by the commissioning operation.
 - ii) If plant and equipment, which has been supplied by others has to be commissioned, the supplier's specific permission thereto, together with any specific requirements relating to commissioning shall be obtained prior to commissioning.
 - iii) All sections of the works shall be carefully inspected by a responsible representative of the Contractor to ensure that all construction and installation work has been properly completed.
- b) Commissioning and testing on site shall be carried out by experienced personnel under the Contractor's supervision.
- c) All equipment necessary for the purpose of the tests shall be provided by the Contractor and remains the property of the Contractor.
- d) All pre-commissioning tests and checks shall be agreed with the Engineer prior to the commencement therewith.
- e) When all the tests required before commissioning, or tests before tests on completion, have been completed and accepted by the Engineer, the commissioning may proceed.
- f) At least four weeks before commissioning commences the Engineer will be requested to provide the Contractor with commissioning sheets for all the equipment installed by the Contractor. These forms shall be completed by the Contractor during the commissioning period and all items listed shall be entered. Final hand-over certificates will not be issued for equipment with incomplete commissioning reports. Information that is not available or applicable, or reasons for not performing certain tests shall be agreed with the Engineer.

SS 4.7

TRIAL OPERATION

The trial operation period shall be undertaken over a trouble-free period of at least thirty consecutive calendar days. During this period the Contractor shall instruct the operating staff in the correct procedures of operating the plant under all circumstances of operation, including emergency conditions, the correct servicing of every part, the type of oil or grease to be used, and similar instructions. This shall be done by demonstration and confirmation, in writing, and operating manuals shall be referred to for this purpose.

The thirty day trial operation period will commence with a day-one test and terminate with a day-thirty test in compliance with the commissioning report. Commissioning of the plant (which includes the

thirty days between the day-one and day-thirty tests) shall include operating under conditions which shall adequately prove that all the specifications are met. All safety devices, stand-by plant, automatic controls and protection devices shall be adequately tested for reliability and correct functioning. The Contractor may be called upon to repeat testing during the maintenance period if the performance of any equipment supplied under this contract is suspected to be substandard by the Engineer. Such tests shall be for the Contractor's account and shall comply with the requirements specified. Copies of updated commissioning reports shall be provided to the Engineer within two days after a test has been performed.

After the Contractor has provided training to the Employer and provided all other contractual requirements have been met, the latter will sign the commissioning report.

Once a commissioning report is complete, the Engineer and the Contractor will sign and date the report, whereupon the Engineer will notify the Employer that maintenance for that particular piece of equipment from then on is the Employers responsibility in compliance with the general conditions of contract.

Programs for the day-one tests, day-thirty tests and instruction/training sessions with the Employers shall be prepared by the Contractor and provided to the Engineer no less than two weeks before the commissioning period commences. Weekly updates to these schedules shall be provided by the Contractor for the duration of the commissioning period.

Note that if any equipment should fail during the 30 day commissioning period, the equipment shall be repaired or replaced by the Contractor, and testing and commissioning will commence from scratch.

During the thirty-day commissioning period, the Contractor shall be responsible for providing all labour and materials (including testing equipment) and shall carry out all the servicing and any adjustment of the plant required for ensuring that it operates as specified.

Valid calibration certificates shall be available for all testing equipment on site during the commissioning period.

The Contractor shall conduct all the tests required to satisfy the Engineer that the plant is capable of performing in accordance with the specification, and shall make allowance therefor in his tendered rates and prices. Any defects detected during the commissioning period shall be made good by the Contractor at his own expense, including all additional costs incurred by the Employer and his representatives and the Engineer. These tests shall be conducted to certify that the plant, as installed, is operating in accordance with the specified requirements. Note that all equipment will be tested as part of a system, where appropriate, and will not be passed if all protection devices, interlocking with other equipment, etc. is not fully functional.

SS 4.8

MEASUREMENT AND PAYMENT

All costs for equipment, labour and other expenses for the on-site testing and commissioning of equipment shall be included in the tendered rates for testing and commissioning as set out in the measurement and payment clauses of each piece of equipment and in the schedule of quantities. Any additional tests specified in the standard and detail specifications shall also be included in the tendered rates.

SS 5 CORROSION PROTECTION

SS 5.1 SCOPE

This section covers corrosion protection of electrical components in general and for materials or coatings for specific components. The requirements of this specification are additional to any corrosion protection that may be covered under any other section of these specifications. In the case of discrepancies between this section and the drawings, this section shall have preference.

Where alternative specifications are given to cover areas of high or low corrosivity and the environment of the component in service is not known, the specification for high corrosivity shall be used.

SS 5.2 STANDARDS

SS 5.2.1 List of Relevant National and International Codes of Practice, Standards and Test Methods

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SS 5.2.2 Codes of Practice

The following Codes of Practice shall be read in conjunction with this specification and shall be deemed to form part thereof

SANS 10044 - Welding,

Part III: The fusion welding of steel (including stainless steel) - Tests for the approval of welding procedures and production welds.

Part IV: Tests for the approval of welders working to approved procedures.

Part V: Tests for the approval of welders where weld procedure approval is not required.

Part VI: The fusion welding of aluminium and aluminium alloys; Tests for the approval of welding procedures and production welds.

Part VII: The fusion welding of aluminium and aluminium alloys; Tests for the approval of welders working to approved welding procedures.

SANS 10064 - Preparation of steel surfaces for coating.

SANS 10140 - Identification colour marking.

SANS 9000 - Quality management systems - Fundamentals and vocabulary

SANS 10214 - The design, fabrication and inspection of articles for hot-dip galvanising.

SS 5.2.3 Standard Specifications

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 630 - Decorative high gloss enamel paint for interior and exterior use.
- SANS 681 - Undercoats for paints.
- SANS 121: 2011 - Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods
- SANS 14788:2007 - Continuous hot-dip zinc-5 % aluminium alloy coated steel sheet.
- SANS 999 - Anodised coatings on aluminium (for architectural purposes).
- SANS 12944-5 - Paints and varnishes — Corrosion protection of steel structures by protective paint systems: Part 5: Protective paint systems
- SANS 1407 - Anodised aluminium (general applications).
- SANS 1274 - Coatings applied by the powder coating process.
- SANS 1319 - Zinc Phosphate Primer for steel

SS 5.2.4 Standard Test Methods

The following standard test methods shall be read in conjunction with this specification and shall be deemed to form part thereof:

- DS/EN ISO 2808 - Paints and varnishes - Determination of film thickness
- SANS 5767 - Cleanliness of blast cleaned steel surfaces for painting.
- SANS 5769 - Cleanliness of blast cleaned steel surfaces for painting (assessed by freedom from dust and debris)
- SANS 5772 - Profile of blast cleaned steel surfaces for painting (determined by micrometre profile gauge).
- SANS 5776 - Adhesion of coatings (direct pull off method).
- SANS 5159 - Adhesion of paint and varnish films (cross-cut test).
- ISO 8505-1 - Pictorial surface preparation standards for painting steel surfaces.

SS 5.2.5 British Standards

The following British Standards shall be read in conjunction with this specification and shall be deemed to form part thereof:

- BSI BS EN ISO 15607 - Specification and qualification of welding procedures for metallic materials General rules.

BS 6496 - Powder organic coatings for application and stoving to aluminium alloy extrusions etc.

SS 5.2.6 USA Specifications

The following American Standards shall be read in conjunction with this specification and shall be deemed to form part thereof:

ASME-IX 2010 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

SS 5.3 GENERAL

The Contractor shall ensure that he and his relevant sub-Contractors have available the latest edition of all the relevant Specifications and Codes of Practice, both SANS and others, as listed in the sub-clause titled "List of Relevant National and International Codes of Practice, Standards and test Methods" in this Section and the latest issues of manufacturer's data sheets for the materials to be used.

All paints in a paint system shall be purchased from one paint manufacturer. Identical paints used at one time or on one item shall be of the same batch number.

The Contractor shall proceed with purchase of the paints only upon receipt of written approval of the brand or manufacturer from the Engineer.

The materials and procedures shall comply with the appropriate SANS Specifications and Codes of Practice when relevant, and with the manufacturer's printed data sheets.

Strict attention shall be paid to fettling of surfaces by the Fabricator (refer to the clause titled "Fettling or Dressing by the Fabricator") prior to coating. Surface preparation requirements and the need for strict cleanliness and adherence to specification requirements are emphasised.

Areas, which are or potentially may be inaccessible after assembly, shall be prepared and fully coated with the specified system and to the specified requirements before assembly. The coating shall be fully hard dry before assembly.

Mating surfaces shall be coated with primer or first coat only. The coating shall be uniform in thickness and shall not interfere with the mechanical tolerances. After assembly the outside surface of the joint shall be fully coated and sealed where necessary in accordance with the relevant specification.

The painting sub-Contractor shall provide evidence of his competence to apply the specified materials in the specified manner and to apply the necessary Quality Control procedures. The Engineer, at his discretion, may demand a Quality Audit of the Contractor's facilities by a technically competent and independent organisation (refer to the clause titled "Quality Assurance Requirements").

The Contractor shall provide a Quality Plan to show the stages at which Quality Control will be carried out. Further details are given in the clause titled "Quality Assurance Requirements". The Quality Plan is subject to approval by the Engineer, who may require it to be revised if considered inadequate.

The Contractor shall furnish material suppliers with the specified descriptions of materials to be used and shall receive from them a written assurance that the materials to be supplied comply with the requirements specified in the project specifications.

If the Contractor wishes to offer an alternative to the specified system, he shall supply to the Engineer adequate technical information to enable a proper evaluation of the proposed system (see Form Q.1.). He shall not proceed with application of the system until authorised by the Engineer in writing.

SS 5.4 DESIGN

SS 5.4.1 General

All items shall be designed to minimise corrosion in outdoor environments, under immersion conditions and in interior aggressive situations such as in chlorination rooms. The following notes may be used as guidelines.

SS 5.4.2 Water retention areas

Avoid water retention areas wherever possible. For example, angle or U section steel shall be used with the toes pointing downwards and the concrete base of columns shall be sloped away from the steel. Where water retention cannot be avoided, drain holes, suitably radiused, shall be fitted at the lowest point. Joints between steel and concrete shall be sealed with a suitable sealant.

SS 5.4.3 Crevices

Accelerated corrosion results from crevices when water is present. Crevices may be avoided by using:

- 1) continuous welding, not space welding,
- 2) mastics or sealants to seal unavoidable crevices such as bolted connections,
- 3) insertion rubber or suitable plastic between mating surfaces.

5.2.4.4 Bimetallic couples

Electrical contact between dissimilar metals gives rise to a corrosion cell when an electrolyte such as water is present. Joints between dissimilar metals shall be electrically insulated, or effectively sealed to prevent water ingress.

SS 5.4.5 Accessibility

Whenever possible, the surfaces of corrodible materials such as mild steel shall be accessible for maintenance. The use of angles back to back, partially open box sections or inaccessible stiffeners shall be avoided.

SS 5.4.6 Differential aeration

Posts buried in soil are subject to accelerated corrosion due to differential aeration. Additional protection shall be given to that part which is buried and up to at least 100 mm above ground. Similarly, tanks should not stand on the ground or on a concrete bed but shall be fitted with legs to ensure that there is no contact between the tank base and its bed. Where legs cannot be used, the tank shall stand on a concrete base, the edges of which shall be sloped away from the tank. The joint between tank and base shall be sealed with a suitable mastic or sealant.

SS 5.4.7 Sharp edges, weld spatter and weld slag

The designer shall specify that all sharp edges shall be ground to a radius not less than 2 mm and that all weld spatter and weld slag shall be removed by the fabricator.

SS 5.4.8 Hot dip galvanising

The design of articles to be galvanised shall be referred to the galvaniser and shall comply with SANS Code of Practice 0214. Articles to be painted or powder coated after galvanising shall not be passivated. For galvanised articles to be powder coated, refer also to System F, detailed in the clause titled "System F - Powder Coatings".

SS 5.4.9 Vapour corrosion inhibitors

Where vapour corrosion inhibitors are specified, the form, chemical composition and quantity of VCI shall be suitable for the metals used in the cabinet and shall be adequate for at least 12 months protection in the environment in which the cabinet will be situated.

SS 5.4.10 Cathodic protection

Where cathodic protection is required, the components to be protected shall be of all-welded construction, or shall be fitted with bonding lugs to enable bonding cables to be cad-welded on site.

SS 5.5 COATING MATERIALS

No variation in materials to be used shall be permitted without the approval of the Engineer in writing.

All coating materials shall be delivered in the manufacturer's original sealed containers, clearly marked with the following:

Manufacturer's name,

- 1) Product Brand Name and Reference Number,
- 2) Batch Number, which may incorporate the date of manufacture,
- 3) Date of manufacture, unless already incorporated in the batch number,
- 4) Abbreviated instructions for storage and use of the material, which shall include mixing ratios of components of multi-component materials, the minimum temperature of application and the method of application,
- 5) The SANS mark where applicable.

Coating materials shall be kept in an approved store, which shall be dry and enclosed and in which the temperature is unlikely to exceed 40°C or drop below 0°C.

Usage of materials shall be on a first in, first out basis and no materials may be used which have exceeded the shelf life recommended by the manufacturer.

SS 5.6 FETTLING OR DRESSING BY THE FABRICATOR

Before any surface preparation or painting is carried out, dressing shall be carried out to remove projections, sharp edges, weld slag and spatter that will interfere with the corrosion protection.

All weld flux and weld spatter shall be removed before painting. Flux is best removed by washing with clean water whilst weld spatter is normally removed by grinding to a smooth surface.

Sharp edges shall be ground to a radius not less than 2 mm, except where otherwise permitted by the Engineer, e.g. cable racking.

Welds shall be continuous and shall have a smooth contour. Rough welds shall be ground where necessary to achieve the required smooth profile. Undercuts shall not be permitted. Discontinuous welds shall not be permitted except by written approval of the Engineer.

Articles for hot dip galvanising shall not have any overlapping joints. Closed sections shall be suitably vented.

SS 5.7 SURFACE PREPARATION FOR PAINTING

SS 5.7.1 Mild steel, minimum 2 mm thickness

Oil and grease contamination, when present, shall be removed by degreasing before blast cleaning.

BID DESCRIPTION: TENDER FOR THE REFURBISHMENT AND UPGRADE OF PUMP STATION 34, UPGRADE OF RISING MAIN PIPELINE FROM PUMP STATION 2 TO LEEUWKUIL WASTEWATER TREATMENT WORKS, UPGRADE OF WASH WATER PUMP STATION AT LEEUWKUIL, AND REFURBISHMENT OF INLET WORKS OF LEEUWKUIL AND RIETSPRUIT

Mild steel shall be blast cleaned in accordance with Section 4.3 of SANS 10064 Code of Practice for "The preparation of steel surfaces for coating". An additional requirement is that water soluble salts present in the steel after blast cleaning shall not exceed the appropriate values given in Table 1 below. Should these values be exceeded, the steel shall be cleaned by washing with clean potable water or by water shrouded or water injected blast cleaning until the soluble salts are within the limits specified in Table 1. The steel shall then be allowed to dry, after which it shall be flash blast cleaned to achieve the required degree of cleanliness.

The standards of blast cleaning required are given in Table 1.

TABLE 1 - STANDARDS FOR BLAST CLEANING

1	2	3	4	5
PROPERTY	ABOVE WATER SURFACES	IMMERSED SURFACES	TAPE WRAPPING	INORGANIC ZINC
Cleanliness to ISO 8501/1 (SIS 05 5900) (min)	Sa 2.5	Sa 3	Sa 2	Sa 2.5
Residual dust and debris (SABS Method 769)	0,5%	0,3%	0,5%	0,3%
Oil grease and perspiration	Nil	Nil	Nil	Nil
Surface Profile min (micrometres) max	25 50	50 100	- -	50 100
Water soluble iron salts:				
- Maximum at any point	500 mg/m ²	100 mg/m ²	500 mg/m ²	500 mg/m ²
- Average of any 250 cm ²	100 mg/m ²	10 mg/m ²	100 mg/m ²	100 mg/m ²

The time interval between blast cleaning and application of the first coat of paint shall not exceed that given in Table 2 below.

TABLE 2 - MAXIMUM TIME INTERVALS

AMBIENT RELATIVE HUMIDITY	MAXIMUM TIME (HOURS)
Below 50%	6
50 - 70%	4
70 - 85%	2
Over 85%	Coating not permitted - reblast and coat when RH below 85%

SS 5.7.2 Mild steel, less than 2 mm thickness

Mild steel less than 2 mm thickness, may distort by blast cleaning. Such steel shall be cleaned by degreasing, pickling and phosphating in accordance with SANS 10064, Section 5, or by a proprietary multistage chemical pickling and passivating process approved by the Engineer. The specified primer shall be applied immediately after completion of phosphating, rinsing and drying (see Table 2 above).

SS 5.7.3 Cast iron and cast alloys

Cast surfaces shall be blast cleaned with iron slag, copper slag, or platinum slag abrasives designed for blast cleaning. The abrasive shall not be recycled or re-used. Cast iron shall be blast cleaned until all sand particles, residual burnt on sand and casting skin have been completely removed. When castings are required to be painted, especially for immersion applications, all blowholes and omegas shall be opened up and filled with a suitable solvent free epoxy filler or putty, finished level and smooth with, or proud of the surrounding surface. Proud putty, after curing, shall be abraded to be flush with the surrounding surface.

SS 5.7.4 Galvanised steel surfaces

The Galvaniser shall be advised of components to be painted after galvanising. Such surfaces shall not be passivated. Galvanised steel surfaces shall be thoroughly degreased prior to painting, using either a water rinsable solvent degreaser, or a mild acid-detergent degreasing solution. In both cases care shall be taken to avoid entrapment of cleaning agent in recesses or other retention areas. In both cases the surfaces shall be thoroughly washed until a water break free surface is achieved. If necessary, the process shall be repeated until a water break free surface is obtained.

A water break free surface is one on which a continuous film of water is obtained when potable water is brushed thereon. The film of water shall not break up into islands or globules.

After degreasing, the surface shall be abraded to obtain a uniform matt finish by one of the following methods:

- 1) the use of abrasive paper not coarser than grade 120, or by using non-metallic abrasive pads,
- 2) By "sweep blast cleaning", using a nozzle pressure not greater than 300 kPa and a very fine abrasive. Cracking, flaking, or any form of delamination of the zinc coating due to excessive blast cleaning shall not be permitted. The thickness of zinc removed by blast cleaning shall not exceed 10 micrometres.

Finally, all dust and debris shall be removed by vacuum cleaning, or by dry brushing to attain a level of residual dust and debris not exceeding the values given in Table 1.

Alternatively, an approved multi-stage chemical treatment may be used. The instructions of the chemical supplier shall be strictly followed. The composition of the various treatment baths shall be regularly checked and adjusted where necessary. Since the rate of chemical attack on finely divided zinc is different from that on galvanising, no repair of galvanising prior to chemical treatment is permitted.

SS 5.7.5 Stainless and corrosion resisting steel

Components fabricated from stainless or corrosion resisting steel shall be supplied in the fully passivated condition. Sheared edges, welds or surfaces subjected to any form of heat treatment or contamination with iron or mild steel, shall be pickled and passivated.

Surfaces shall be thoroughly degreased with a water rinsable solvent detergent, then rinsed with potable water to obtain a water break free surface.

When it is required to paint stainless steel exceeding 1,5 mm thickness, the surface shall be blast cleaned in accordance with the parameters given in Table 1, using non-metallic abrasive such as iron slag, copper slag or platinum slag. The use of steel shot, steel grit or cast iron grit is strictly prohibited. Any contamination with iron or mild steel is prohibited. Dust and debris shall be removed before painting to achieve residual values not greater than those given in Table 1.

Where blast cleaning is impractical, the surface shall be cleaned with detergent solution and roughened manually by the use of non-metallic abrasive pads, followed by washing with clean potable water to a water break free surface. If a water break free surface is not

obtained, detergent cleaning shall be repeated until the surface is water break free. Allow the surface to dry before coating.

SS 5.7.6 Aluminium

Generally, aluminium surfaces will be anodised or powder coated and will require no further treatment. Where painting is required, the aluminium surface shall be thoroughly degreased then rinsed with clean potable water. If the surface is not water break free, repeat the degreasing process until a water break free surface is obtained. Allow to dry completely, then apply a thin coat (8 to 13 micrometres dry film thickness) of wash primer which complies with SANS 723, mixed and applied in accordance with the manufacturer's instructions.

NOTE: Wash primer is an adhesion promoter and does not replace the primer specified in the paint system.

SS 5.7.8 Painted surfaces

a) Fully painted surfaces to be repaired or overcoated

Exposed metal shall be cleaned with abrasive paper not coarser than 220 mesh to a bright metal surface. The surrounding paint, which must be intact, shall be feathered for a distance of 20 mm beyond the damaged area. Dust and debris shall be removed by the use of a clean rag dampened with water or clean solvent that will not attack the coating.

Damaged areas shall be allowed to dry, after which spot repairs shall be carried out with all the coats previously applied and shall overlap the undamaged area by 20 mm. The requirements of the spot repair shall be not less than that specified for the undamaged coating.

Where additional coats are required over the entire surface, the entire surface shall be abraded to a uniform matt finish, the dust and debris removed, and the surface allowed to dry.

All further coats shall then be applied as specified to give a uniform finish.

b) Shop applied primers to be overpainted

Primers shall be thoroughly sanded with fine abrasive paper to achieve a uniform matt surface, then scrubbed with a solution of suitable water based detergent-degreaser using a bristle brush, followed by clean water rinses to remove all grease and water soluble matter. The surface shall be allowed to dry completely before application of the specified coating system over the whole surface.

c) Plastic surfaces such as uPVC and polyester GRP

Treat as specified for painted surfaces with shop applied primers to be overpainted. The cleaned surface shall have a uniform matt finish, free from scratches and local glossy patches.

d) Concrete and plaster surfaces

Concrete and plaster surfaces to be painted shall be clean, dry and free from laitance, dust or similar friable surface layers and from mould oil or similar contaminants that will interfere with the adhesion of the coating.

Loose surface dust is one of the main causes of poor adhesion to concrete.

Mould oil shall be removed by the use of a water based detergent such as Shell Teepol Lensex (or similar), followed by high pressure water washing. When all contaminants have been removed, the surface shall be allowed to dry either to a damp condition or to a completely dry condition, depending on the coating to be applied.

For immersion or other heavy duty applications laitance shall be totally removed by water blast cleaning, with abrasive injection, or by mechanical scabbling of the surface, or by acid pickling, followed by very thorough washing with potable water.

Off shutter concrete usually shows surface blowholes or omegas. Omegas shall be drilled or chipped open to the full hole diameter. Blowholes and opened omegas shall be filled with a suitable filler such as acrylic or solvent free epoxy. The use of gypsum or cellulose based fillers is not permitted for underwater or humid conditions. Shutter kicks and similar projections shall be removed by grinding to a smooth surface.

For coatings of low water permeability, such as solvent borne epoxies, vinyls and chlorinated rubber, the moisture content of the concrete or plaster shall be not more than an indicated 5% when tested with an approved electrical conductivity meter, designed for use on concrete or plaster (such as the Delmhorst meter). The pins of the meter shall penetrate the concrete or plaster to a depth not less than 5 mm.

The first coat of the coating system may require thinning with the manufacturer's recommended solvent to assist in penetration of the substrate.

SS 5.8 THE APPLICATION OF PAINTS

SS 5.8.1 Environmental conditions

Paint shall not be applied in dusty conditions, nor when the steel surface temperature is less than 3°C above dew point, nor higher than that advised by the paint manufacturer, nor when humidity is greater than 85%, nor when the ambient temperature is less than the minimum or greater than the maximum specified by the manufacturer of the coating material.

SS 5.8.2 Mixing

All coating materials shall be very thoroughly mixed until they are completely homogeneous. In the case of two-pack materials, each component containing pigments shall be thoroughly mixed. The two components shall then be mixed together in the proportions supplied by the manufacturer until the mixture is completely homogeneous. In the case of solvent based epoxy materials, it is recommended that the mixed material be allowed to stand for an induction period of 20 to 30 minutes before use.

For two pack materials, the use of part of the contents (split packs) is strictly forbidden.

SS 5.8.3 Method of application

Application shall be by brush, roller, airless spray, or other suitable equipment as appropriate for the material, for the surfaces to be coated and in accordance with the recommendations of the manufacturer. Application equipment shall be maintained in clean condition and in good working order. The use of equipment not maintained in good clean condition may lead to rejection of the coating.

SS 5.8.4 Overcoating

Overcoating times shall be not less than the minimum nor greater than the maximum specified by the manufacturer relevant to the ambient temperature. Strict adherence to overcoating times is particularly important for coatings which are subsequently immersed. The Contractor will be held responsible for blistering of paint coatings on immersed surfaces.

All surfaces shall be clean and free from dust, oil, moisture and perspiration before overcoating. Operatives handling blast cleaned or partially painted surfaces shall wear clean gloves to avoid contamination of the surfaces.

SS 5.8.5 Permissible variations of film thickness

Minimum film thickness:	Not more than 10% of readings shall be less than the minimum specified and no reading shall be less than 90% of the specified minimum.
Maximum film thickness:	Unless otherwise agreed by the Engineer, no reading shall exceed the mean specified thickness by more than 50%.

SS 5.8.6 Handling

Coated components shall not be handled earlier than the hard dry time recommended by the manufacturer, relevant to the ambient temperature. Coated components shall be handled with broad band slings and suitable packing to minimise damage to the coating.

All damage caused in handling, transportation, and erection, shall be repaired to the satisfaction of the Engineer and at no extra cost. Storage on site shall be in suitable covered stores, where available, and on suitable soft packing to prevent damage to the coating.

SS 5.9 HOT DIP GALVANIZING

SS 5.9.1 Design and fabrication

Components for hot dip galvanising shall be designed and fabricated in accordance with the recommendations of SANS Code of Practice 10214, with the exception that the use of lead plugs is not permitted.

It is recommended that the manufacturer consults the galvaniser or the Executive Director of the South African Hot Dip Galvaniser's Association before design and fabrication to ensure that the fabrication will be suitable for galvanising.

The main requirements are as follows:

- Overlapping joints shall be avoided wherever possible. If essential, such overlap joints shall be thoroughly degreased before assembly and shall be vented by holes being drilled through one or both overlapping materials.
- Closed sections shall be suitably vented. If the inside of a closed section is not to be galvanised, a snorkel vent tube of suitable length and bore shall be attached to the vent hole.
- Gussets and internal baffles in tanks or boxes shall be cropped to allow free flow of zinc and air.
- Joints shall be continuously welded, using balanced welding techniques to avoid stresses. Welds shall be free from cavities, undercutting, weld slag and spatter.
- A symmetrical design shall be used whenever possible and the use of thin gauge steel adjacent to heavy sections shall be avoided.
- Openings and flanges of manholes and bosses shall finish flush on the inside to ensure complete drainage.
- Castings shall be designed to be of as uniform section as possible and shall be blast cleaned in accordance with the requirements of the clause titled "Surface Preparation for painting", sub-clause "Cast Iron and Cast Alloys" before they are despatched to the galvaniser.

SS 5.9.2 The hot dip galvanising process

Hot dip galvanising shall comply with the appropriate SANS specifications, such as SANS 121 for fabricated articles, SANS 14788 for pre-galvanised sheet, or SANS 935 for wire.

Mating surfaces on fabricated or cast iron components shall be wiped or centrifuged immediately after they are removed from the galvanising bath to remove blobs, runs, or excess metal that may impair the gas or liquid tightness of the joint.

Bolts, nuts and washers used for fixing shall be hot dip galvanised to SANS 121. Electroplated fasteners will not be accepted unless otherwise agreed by the Engineer in writing.

When organic coatings such as paint or powder are to be applied to galvanised articles, the galvaniser shall be so advised. Passivation after galvanising is not permitted. Special requirements may also apply for galvanised articles to be painted. Refer to specifications for painted or powder coated galvanised steel.

SS 5.9.3 Mechanical treatment of galvanised articles

Welding, flame cutting, or other heat processes shall not be carried out on galvanised articles unless permission has been granted by the Engineer. If damage has been caused then repair to the damaged galvanising shall be carried out as described below.

SS 5.9.4 Repair of galvanised articles

Repairs shall be carried out as follows:

All scale, spatter and flux shall be removed by grinding and washing with clean water. Edges shall be ground to a radius not less than 2 mm.

The repair process shall be by blast cleaning of the surface to bare steel and applying zinc by the thermal spray process in accordance with SANS 1391 Part 1, Grade Zn150. On completion of metal spraying, the surface shall be burnished by means of a mechanical wire brush to give a uniform appearance. Such burnishing shall remove not more than 10 micrometres of zinc.

Where small areas are to be repaired, the surface shall be thoroughly cleaned with fine abrasive paper, all debris removed with a damp cloth and the surface allowed to dry. An approved one pack zinc rich primer containing not less than 90% by mass of zinc in the dry film shall then be applied. A sufficient number of coats (usually 3 or 4) shall then be applied such that the repair coating thickness is not less than the average zinc thickness specified in SANS 121, SANS 14788 or SANS 935, as appropriate. The repair shall extend not less than 5 mm beyond the damaged area.

On completion of the repair and when the zinc rich primer is completely dry, one coat of alkyl resin based aluminium paint may be applied to obtain a uniform appearance.

- | | |
|------|---|
| NOTE | (i) The repair of galvanised surfaces by application of aluminium paint alone IS NOT PERMITTED. |
| | (ii) For repair of painted or powder coated galvanised articles, refer to the painting or powder coating specification. |

SS 5.9.5 The storage of galvanised components

Galvanised components shall be stored so as to avoid the formation of "white rust" or other forms of storage staining.

Components shall be separated and supported on wooden battens to ensure adequate ventilation of all surfaces and in such a manner as to avoid "ponding" by rainwater.

If storage staining does occur, repairs may not be necessary if the residual zinc thickness meets the requirements of the specification. When necessary to meet the requirements

of the specification, or when so instructed by the Engineer, repairs shall be carried out as specified in the clause titled "Repair of Galvanised Articles" above.

SS 5.10 STAINLESS STEEL FABRICATIONS

SS 5.10.1 Grades and welding techniques

The grade of stainless steel to be used shall be as specified in the appropriate section of the electrical specification or on the drawings.

Where welding is necessary, the appropriate "L" grade (low carbon content) shall be used.

Welding procedures shall be only those recommended by the manufacturer of the stainless steel or by the South African Stainless Steel Development Association. Only suitably coded welders shall be employed (Refer BS.EN ISO 15607 or ASME. IX 2010).

The fabrication of stainless steel components shall be carried out in clean workplaces where contamination by mild steel does not occur. Grinding and polishing equipment shall be dedicated for this purpose only and shall not be contaminated with iron or mild steel.

Stainless steel shall be suitably handled to avoid any scratching of the surface.

SS 5.10.2 Pickling and passivation

The cut edges, welds and heat treated surfaces of all stainless steel components shall be pickled and passivated to remove all discolouration. Proprietary pickling and passivating pastes shall be used in accordance with the manufacturer's recommendations. Care shall be taken not to exceed the maximum recommended contact time.

After passivation, surfaces shall be very thoroughly washed with clean potable water to remove all traces of acid. The surface shall be allowed to dry, then polished where necessary, using polishing compounds recommended by the manufacturer of stainless steel or the SASSDA.

NOTE: See safety precautions at the end of Paragraph "Pickling and Passivation" of "Corrosion Resistant Steel 3CR12".

SS 5.11 CORROSION RESISTANT STEEL 3CR12

SS 5.11.1 Welding techniques

Welds shall be full penetration welds, using 309 austenitic electrodes or filler wire, as recommended by the manufacturers.

Welders shall be suitably coded for welding similar thickness of austenitic stainless steel (Refer BS.EN ISO 15607 or ASME. IX 2010).

Welding procedures shall comply with the recommendations of the manufacturers of 3CR12.

Welds shall be smooth and free from blowholes, undercuts, sharp projections and similar visual defects.

SS 5.11.2 Pickling and passivating

After completion of welding, both weld and heat affected zones shall be cleaned, pickled and passivated. Heat scale on steel shall also be pickled and passivated.

The procedure shall be as follows:

- Blast clean with non-metallic grit, or grind or wire brush, using dedicated grinders or stainless steel wire brushes to achieve the required smooth profile or remove scale.
- Pickle with a thixotropic paste containing 15-20% nitric acid and 1-2% hydrofluoric acid, for a contact time of 15 to 20 minutes.

- Rinse copiously with clean water.
- Repeat the above process, if necessary to remove all discolouration.
- Passivate with 10% nitric acid solution, or a proprietary passivating paste, for a contact time of 10-15 minutes, keeping the surface wet during this period.
- Rinse copiously with clean potable water until the washings are neutral.

SS 5.11.3 Safety Precautions

Operatives shall wear protective aprons, gloves and safety glasses during pickling and passivating operations, since the solutions used are strongly acidic.

Splashes on skin shall be copiously washed with clean water immediately after contact. A weak solution of sodium bicarbonate shall be kept available for neutralisation.

Seek medical attention if in doubt.

SS 5.11.4 Effluent

Disposal of effluent shall be in accordance with the requirements of the local authority in whose area the work is being carried out.

Generally, the effluent is stored in drums containing an excess of lime (calcium carbonate) before disposal at an approved disposal site.

SS 5.12 ALUMINIUM

SS 5.12.1 Anodising

Aluminium components, specified as anodised shall be natural anodised and sealed in accordance with SANS 999 or SANS 1407, in both cases to Grade AA25 or AG25. The corrosion resistance of the coating shall be not less than 8 when tested in accordance with 3.6 of specification SANS 999. Anodising shall be carried out after completion of all welding.

When coloured anodising is specified, the aluminium components shall be anodised in accordance with SANS 999, Grade AA25.

SS 5.12.2 Powder coating

When specified by the Engineer, aluminium components may be coated with polyurethane powder. Such coating shall only be carried out by Contractors with the necessary plant, equipment and experience to pre-treat and powder coat aluminium effectively. The coating shall comply with BS.6496.

SS 5.12.3 Fixing

Fixing of aluminium components shall be carried out with Stainless Steel 304 bolts, nuts and washers. When fixed to steel components such as bridges, there shall be an effective insulation layer between aluminium and steel, such as PVC or polyethylene tape, not less than 0,25 mm thickness between aluminium base and steel. A nylon washer of adequate size shall be used between the steel main component and the nut in order to insulate aluminium from steel.

Whenever aluminium components, such as stop log frames, come into contact with concrete, the surface of the aluminium in contact with concrete shall be coated with two coats epoxy tar composition, as specified in System C2. The epoxy tar coating shall be fully cured before grouting in to the concrete.

SS 5.13 COATING SYSTEMS

SS 5.13.1 System A - Alkyd systems

General

Alkyd systems are intended for use in environments of low corrosivity, where a good decorative finish is required. Materials shall therefore be applied with due cognisance of appearance and protection. Visual defects such as runs, sags, curtaining, shrivelling or wrinkling will not be permitted.

SS 5.13.1.1 System A1 - Alkyd system on to bare steel surfaces

a) Procedure

The surface to be coated shall be prepared as specified for the surface preparation for painting of mild steel of the appropriate thickeners.

Apply one coat zinc phosphate primer complying with SANS 1319, to a dry film thickness not less than 30 micrometres. Allow to dry for a minimum of 16 hours.

Apply one coat alkyd based undercoat complying with SANS 681 Type 2, to give a dry film thickness of not less than 30 micrometres. Allow to dry for a minimum of 16 hours.

Apply one coat alkyd enamel complying with SANS 630 Type 2, in the colour specified by the Engineer, to give a dry film thickness of not less than 25 nor greater than 40 micrometres. Allow to dry for a minimum of 16 hours.

On exterior surfaces, apply a second coat of alkyd enamel, within 30 hours, to give a dry film thickness of not less than 25 nor greater than 40 micrometres in the final colour as specified by the Engineer. Allow to dry for a minimum of 16 hours.

SS 5.13.1.2 System A2 - Surfaces already cleaned and primed

a) Procedure

Clean and prepare the surface as specified for painted surfaces with shop applied primers to be overpainted.

Touch up bare areas with zinc phosphate primer complying with SANS 1319. Allow to dry for a minimum of 16 hours.

Apply one coat all over of zinc phosphate primer to SANS 1319.

Continue the system as given in System A1 (3) to (5) inclusive.

SS 5.13.1.3 System A3 - Factory finished components

a) Procedure

The Contractor shall ensure that the existing coating is compatible with the system to be applied.

Prepare the surface as specified for painted surfaces with fully painted surfaces to be repaired or overcoated.

On interior non aggressive surfaces apply one coat alkyd enamel complying with SANS 630 Type 1, in the colour specified by the Engineer, to give an applied dry film thickness of not less than 25 micrometres. Total dry film thickness to be not less than 75 micrometres.

On interior surfaces in an aggressive environment, use System B1 rather than an alkyd system.

On exterior surfaces, apply two coats alkyd enamel complying with SANS 630 Type 2, to give an applied dry film thickness not less than 50 micrometres. Total thickness shall not be less than 100 micrometres.

If the total dry film thickness is less than the appropriate value given in (3) or (5), apply a further coat of alkyd enamel.

SS 5.13.1.4 System A4 - Galvanised surfaces - above water and in non-corrosive environments

a) Procedure

Prepare the surface as specified for galvanised steel surfaces.

Apply one coat of an approved water based vinyl chloride-vinylidene chloride copolymer primer containing zinc phosphate to give a dry film thickness of not less than 30 and not greater than 60 micrometres. Allow 16 hours to cure in dry conditions before overcoating. Since this material is water based, drying time will be extended under humid conditions.

Continue the system as given in A1 (3) and (4) (one undercoat, one enamel coat).

SS 5.13.1.5 System A5 - Plastic surfaces

If required to paint for identification or decorative purposes, the following system shall be used:

- a) Prepare the surface by thorough abrasion as specified for painted surfaces with shop applied primers to be overpainted.
- b) Apply water based primer as specified in System A4 (2).
- c) Apply alkyd undercoat and finish as specified in System A1 (3) and (4).

SS 5.13.1.6 Requirements of the finished alkyd system

The finished system shall be smooth, glossy, free from excessive runs, sags, blisters, wrinkling, dirt, occlusions or other visual defects. The colour shall be a commercial match to the colour specified by the Engineer.

The total dry film thickness shall not be less than 75 micrometres in the case of interior surfaces and not less than 100 micrometres in the case of exterior surfaces.

SS 5.13.1.7 Site repair of alkyd systems

It is anticipated that alkyd systems will generally be applied on site, either on to bare steel (see System A1), or on to prepared and primed steel (see System A2), or on to fully coated components (see System A3), or on to galvanised steel (see System A4), or on to plastic surfaces for the purpose of colour coding (see System A5).

Any site repair required by the Engineer shall be carried out in accordance with surface preparation method given in the clause of the surface preparation for fully painted surfaces to be repaired or overcoated followed by all the coats required to restore the damaged area to the original system requirements.

Since patch application of the final coat rarely gives an acceptable uniform finish, the whole area in which damage has occurred shall be cleaned, abraded with fine wet or dry abrasive paper (not coarser than 200 mesh) and given one coat of enamel all over, unless otherwise accepted by the Engineer.

SS 5.13.2 System B - Two pack Epoxy / Polyurethane system for exterior surfaces, steel substrates

General

Epoxy systems have good chemical resistance and physical properties. When exposed to sunlight they degrade on the exposed surface, a defect known as "chalking". To overcome this defect, the epoxy system may be overcoated with an aliphatic polyurethane, which has very good colour and gloss retention. This combination is therefore recommended for exposed, chemically polluted environments.

Two component materials are chemically cured and, when fully cured, are difficult to recoat. It is therefore important to adhere to the overcoating times, both minimum and maximum given in the manufacturer's data sheets. Two pack epoxy - polyamide materials such as in System C1, contain solvents. It is also important to note that this solvent must be allowed to escape and the chemical reaction to complete fully before being subjected to water immersion. All solvent based epoxy resin based materials shall be allowed 28 days to cure before immersion. At temperatures below 20 °C longer periods shall be allowed, as in the case of overcoating times.

Ambient and substrate temperatures must be measured, especially during winter months, in order to avoid dew deposition and to ensure adequate cure. Since overcoating times are frequently quoted at 20 °C or 25 °C, longer overcoating times shall be allowed at lower temperatures. As a rough guide, increase time by 50% for a 5° decrease (or by 100% for a 10° decrease) in the ambient temperature below the temperature quoted in the data sheet.

Two component epoxy materials should not be applied when the ambient temperature is below 10°C.

Polyurethanes are sensitive to moisture in the uncured state. Containers shall be kept in a dry store. Application shall be carried out in dry conditions. Air used for spray application shall be dry.

Since solvent free epoxies do not have to allow solvent to escape, the overcoating and immersion time intervals are shorter than those quoted for System B1. As a guide, the period between completion of coating and immersion in water can be as short as 7 days.

However, solvent free epoxy materials require special equipment for application. Only experienced applicators may be used.

SS 5.13.2.1 System B1 Steel substrates

a) Materials

Two pack epoxy primer for steel,

Two pack epoxy high build intermediate coat, in different colours,

Two pack aliphatic isocyanate cured polyester based polyurethane

b) Procedure

Fettle all welds and sharp edges as specified in the clause on Fetting or Dressing by the Fabricator.

Prepare the surface by a method appropriate to the fabrication. For hot rolled steel, refer to the clauses on the surface preparation for painting of mild steel. For cold rolled steel refer to the clause on the surface preparation for mild steel less than 2 mm thick. For cast iron, refer to the clause on surface preparation for painting of cast iron and cast alloys.

Apply one coat of two pack epoxy primer for steel at a dry film thickness of 30 to 45 µm.

Apply one coat of two pack high build epoxy intermediate coat at a dry film thickness of 60 to 90 µm.

Apply a second coat of two pack high build epoxy intermediate coat, in different colour from the first coat, at a dry film thickness of 60 to 90 µm.

Apply one coat of two pack aliphatic polyurethane enamel at a dry film thickness of 30 to 50 µm as top coat.

NOTE: Time interval between all coats shall be in accordance with the paint manufacturer's data sheet.

c) Repair

For repair procedure refer to the clause on surface preparation for painting of fully painted surfaces to be repaired or overcoated.

Requirements

Each coat shall be uniformly applied at the appropriate wet film thickness to give a dry film thickness within the range specified.

The completed system shall be smooth, glossy, uniform in colour, free from runs, sags, bubbles, occluded dust and other visible defects.

The colour shall be a commercial match to the colour specified by the Engineer.

The dry film thickness, tested by DS/EN ISO 2808, shall not be less than 180 nor greater than 280 μm . When tested by SANS 5159 the adhesion shall not be less than 9.

SS 5.13.2.2 System B2 - Galvanised substrates

a) Materials

Two pack epoxy primer for galvanised surfaces.

Two pack epoxy high build intermediate coat.

Two pack aliphatic isocyanate cured polyester based polyurethane.

b) Procedure

Prepare the galvanised surface as specified in the clause on surface preparation for painting of galvanised steel surfaces. Dross, ash occlusions and surface roughness are only permitted if the peak to valley profile (measured by SANS Method 5772) does not exceed 100 μm . Spikes of zinc shall be removed before coating.

Apply one coat of two pack epoxy primer for galvanised steel at a dry film thickness of 20 to 30 μm .

Apply one coat of two pack high build epoxy intermediate coat at a dry film thickness of 60 to 90 μm .

Apply one coat of two pack aliphatic polyurethane enamel at a dry film thickness of 30 to 50 μm .

NOTE: Time interval between all coats shall be in accordance with the manufacturer's data sheets.

c) Repair

For repair procedure refer to the clause on preparation for painting of fully painted surfaces to be repaired or overcoated.

d) Requirements

Each coat shall be uniformly applied at the appropriate wet film thickness to give a dry film thickness within the range given.

The completed system shall be smooth, glossy, uniform in colour, free from runs, sags, bubbles, occluded dust and other visible defects.

The colour shall be a commercial match to the colour specified by the Engineer.

The dry film thickness of the organic system, tested by DS/EN ISO 2808, shall not be less than 110 nor greater than 170 μm . The total dry film thickness shall not be less than 150 μm .

When tested by SANS Method 5159 the adhesion shall not be less than 9.

SS 5.13.3 System C - Two pack epoxy systems for use on surfaces to be submerged

General

Two pack epoxy - polyamide materials in System C, contain solvent. It is important to note that this solvent must be allowed to escape and the chemical reaction to complete fully before being subjected to water immersion.

For these reasons it is imperative that the applicator does not exceed the maximum film thickness per coat applied, nor must overcoating be carried out earlier than the minimum time specified by the manufacturer. Since overcoating times are frequently quoted at 20 °C or 25 °C, longer overcoating times shall be allowed at lower temperatures. As a rough guide, increase time by 50% for a 5° decrease (or by 100% for a 10° decrease) in the ambient temperature below the temperature quoted in the data sheet.

These materials shall not be applied when the ambient temperature is below 10 °C.

All solvent based epoxy resin based materials shall be allowed 28 days to cure before immersion. At temperatures below 20 °C longer periods shall be allowed, as in the case of overcoating times.

Since solvent free epoxies do not have to allow solvent to escape, the overcoating and immersion time intervals are shorter than those quoted for System B1. As a guide, the period between completion of coating and immersion in water can be as short as 7 days.

However, solvent free epoxy materials require special equipment for application. Only experienced applicators may be used.

SS 5.13.3.1 System C1 - On bare steel or cast iron surfaces

a) Material

Material used shall be based on epoxy-polyamide resins and shall comply with the performance requirements of SANS 1217 Type 1A - solvent borne chemically cured coating material.

b) Procedure

Prepare the surface as specified in the relevant clause.

Apply three or four coats of the epoxy polyamide material, mixed as recommended by the manufacturer and as required to give a total dry film thickness not less than 250 micrometres.

Each coat shall differ in colour from the preceding and succeeding coats in order to identify the number of coats applied.

Each coat shall be applied to a thickness not less than the minimum nor greater than the maximum recommended by the manufacturer.

The time interval between coats shall be not less than the minimum time nor greater than the maximum recommended by the manufacturer for the prevailing ambient temperature. This requirement is very important to avoid solvent entrapment. Solvent entrapment may give rise to blistering, corrosion and poor adhesion on immersion.

c) Requirements of the finished system

The coating system shall be smooth, glossy and free from orange peel effect, or bubbling or excessive runs and sags.

The total dry film thickness shall be minimum 250 micrometres, maximum 400 micrometres.

The coating shall be free from electrical insulation defects when tested with a wet sponge detector set to operate at 90 Volts, 2 Megohms. Repair of defects is permissible provided that the repaired area complies with all the requirements of this specification.

SS 5.13.3.2 System C2 - Galvanized steel surfaces

a) Procedure

Prepare the surface as specified in Sub-clause 2.4.

Apply a two pack epoxy primer specifically designed for use on galvanized steel, to a thickness of 25 - 30 micrometres.

Apply two coats of solvent borne epoxy-polyamide as specified for System C1 to give a total dry film thickness of minimum 150 micrometres and maximum 250 micrometres.

b) Requirements

All other requirements shall be as for System C1.

SS 5.13.3.3 System C3 - Solvent free epoxy on bare steel or cast iron surfaces

a) Material

Material used shall be based on solvent free epoxy resins and shall comply with the performance requirements of SANS 1217 Type 1C - solvent free chemically cured coating material.

b) Procedure

Prepare surface as specified in the relevant clause.

Apply one or two coats by means of a two component hot airless spray machine suitable for the material to be used and as recommended by the manufacturer. Alternatively, where recommended in the manufacturer's data sheet, a high ratio airless spray machine may be used. The machine shall be maintained in a clean condition and in good working order. The Contractor may be required to demonstrate to the Engineer that the machine is delivering components in the correct mixing ratio.

The Engineer may require application onto test substrates which can be subsequently tested for correct mixing ratio. Should the mixing ratio be found to be incorrect, all coated components will be rejected, after which the surfaces shall be blast cleaned and recoated.

For lining of pipes, the spray head shall be mounted on a boom of sufficient length to traverse the full pipe length and the pipe shall be constantly and uniformly rotated during application.

Requirements of the finished system

The coating system shall be smooth, glossy and free from orange peel effect, or bubbling or excessive runs and sags.

The dry film thickness shall be not less than 250 micrometres nor greater than 500 micrometres.

The coating shall be free from electrical insulation defects when tested with a wet sponge pinhole detector set to operate at 90 volts 10 Megohms. Repairs of defects is permissible provided that the procedure given below is followed and that the repaired area meets all the requirements of the specification.

c) Repair of epoxy systems

Fully cured epoxy coatings are more difficult to repair due to chemical cure of the coating. Careful attention to the following repair procedure is therefore necessary to ensure adequate adhesion of the material used for repair.

Prepare the surface by abrasion as specified in the relevant clause, wiping the surface with methyl ethyl ketone solvent, to give a contact time of approximately 30 seconds.

Wipe off any surplus solvent with a clean rag, then apply as many coats of repair material as are necessary to achieve the specified film thickness.

When using solvent borne materials, note the need for adequate time between coats as specified under System C1.

SS 5.13.3.4 System C4 - Epoxy with acrylic modified aliphatic polyurethane topcoat

a) General

All epoxy resin based materials show severe "chalking" when exposed to ultra violet light. This problem may be minimised by the application of a topcoat of aliphatic isocyanate cured polyurethane. The pure polyurethanes are difficult to recoat once they are fully cured. Acrylic modified polyurethanes, whilst slightly less water resistant than the pure polyurethanes, have the advantage of facilitating subsequent maintenance.

b) Material

The material to be used shall be an approved two component acrylic modified aliphatic isocyanate cured polyurethane.

c) Procedure

Prepare the surface and apply two pack polyamide as specified in System C1.

Within the overcoating time specified by the manufacturer, apply one or two coats of polyurethane, as required to achieve the colour specified by the Engineer. Each coat shall be applied to a dry film thickness not less than 30 micrometres nor greater than 50 micrometres.

d) Sensitivity to moisture

Polyurethanes are sensitive to moisture in the uncured state. Containers shall be kept in a dry store. Application shall be carried out in dry conditions with dry compressed air for spray application.

e) Requirements for the finished system

The coating shall be smooth, glossy and free from orange peel effect, bubbling, excessive runs or sags.

The total dry film thickness (epoxy plus polyurethane) shall be not less than 250 micrometres nor greater than 450 micrometres.

For immersion conditions, the coating shall be free from electrical insulation defects when tested with an approved wet sponge detector set to operate at 90 volts, 2 Megohms. Repair of defects is permissible provided that the repaired area complies with all the requirements of SANS 1217.

SS 5.13.4 System D - Coal-tar epoxy for use underwater

General

Coal-tar epoxy materials are two-pack chemically cured epoxy coatings containing special coal-tar. The function of the latter is to improve the water and acid-resistance of the epoxy composition and to reduce cost.

The presence of coal-tar has disadvantages in that the composition is available only in black or dark brown. It is not recommended for exposure to South African sunshine as it chalks rapidly and may show more severe actinic degradation by crocodiling.

It can be recommended as a relatively low-cost coating for underwater or underground use.

As in the case of solvent-borne two-pack epoxies, care shall be taken to strictly observe the film-thickness limitations and overcoating times specified by the manufacturer to avoid solvent retention, blistering and delamination in service.

These materials shall not be applied when the ambient temperature or that of the steel surface is below 12 °C.

Solvent-borne epoxy-tar compositions shall be allowed a minimum of 28 days to cure before immersion.

SS 5.13.4.1 System D1 - On bare steel or cast iron surfaces

a) Materials

Materials used shall comply with the requirements of SABS 801 Type 1 or Type 2, solvent-borne chemically cured epoxy tar.

b) Procedure

Prepare the surface as specified in the relevant clause, as may be appropriate.

Apply three or four coats of the epoxy-tar composition, mixed as recommended by the manufacturer, and as required to give a total dry film thickness of not less than 250 micrometres.

Each coat shall differ in colour from the preceding and succeeding coats so that the number of coats applied can be identified. The sequence of black-brown-black is acceptable.

Each coat shall be applied to a thickness of not less than the minimum or greater than the maximum recommended by the manufacturer,

The time interval between applying the coats shall be not less than the minimum time or greater than the maximum time recommended by the manufacturer in respect of the prevailing ambient temperature. This requirements is very important in order to prevent entrapment or poor adhesion.

c) Requirements of the finished system

The finished coating system shall be smooth, glossy and free from orange-peel effect, bubbling or excessive runs and sags.

The dry-film thickness shall be a minimum of 250 micrometres and a maximum of 400 micrometres.

The coating shall be free from electrical-insulation defects when tested with a wet-sponge detector set to operate at 90 volts 2 megohms. The repairing of defects is permissible provided that the repaired area complies with the requirements as set out in SABS 1217.

SS 5.13.4.2 System D2 - On galvanized steel, galvanized cast-iron or aluminium surfaces

a) Materials

Materials as specified in System D1 shall be used.

b) Procedure

Prepare the surface as specified in the relevant clause, as appropriate.

Apply System C2, except that the dry-film thickness shall be a minimum of 200 micrometres and a maximum of 300 micrometres.

c) Site repair of epoxy-tar systems

Fully cured epoxy-tar coatings are especially difficult to repair on account of the chemical curing of the coating. Careful attention to the following repair procedure is therefore necessary to ensure the adequate adhesion of the material used for repair work.

Prepare the surface by very thorough abrasion as specified in the relevant clause, followed by wiping the surface with the manufacturer's epoxy solvent, using clean rags or with a clean brush, to give a contact time of approximately 10 seconds. Wipe off any surplus solvent with a clean rag, then apply as many coats of repair material as are necessary to achieve the specified film thickness. When using solvent-borne materials, the need for adequate time between the coats as specified in System B1 shall be taken into account.

SS 5.13.5 System E - Vinyl resin based systems

General

Single component vinyl resin based paints have excellent resistance to water, chemicals, dilute acids and hypochlorites. Their resistance to heat is poor and must never be used on surfaces continually subjected to a temperature of 70°C or higher. They are not resistant to solvents and should not be used where there may be contact with oils, grease, kerosene, petrol etc.

The main advantage of vinyls is their easy maintainability. Whereas epoxies are difficult to recoat after about one month's exposure, vinyls may be recoated after any period of time, provided that the surface is cleaned by the removal of chalking, dust, grease and general grime.

Vinyls are therefore recommended for use above water and for interior and exterior use where they will be subject to chemical fumes, as in chlorination rooms.

For exterior use the topcoat may be modified with acrylic resin for improved colour retention. Such modified types usually have a semi-gloss rather than full-gloss finish.

SS 5.13.5.1 System E1 - On bare steel or cast iron surfaces

a) Material

The material used shall be based on polymerised vinyl-chloride copolymer, adequately plasticised and containing sufficient UV stabiliser for South African conditions.

The final coat may be acrylic modified to give improved colour and gloss retention when exposed to ultra violet light.

b) Procedure

Prepare surfaces as specified in the relevant system as may be appropriate.

Apply one coat of the manufacturer's recommended primer to a dry film thickness of not less than 30 micrometres and not greater than 60 micrometres. Allow at least 16 hours for curing, or longer in humid conditions.

Apply one or two coats of high build vinyl intermediate coat, in different colours, to a dry film thickness of not less than 75 micrometres and not more than 125 micrometres per coat. Do not allow less than 16 hours to lapse between coats. One coat will be used for mildly corrosive conditions, two coats for highly corrosive conditions.

Apply one coat of vinyl enamel to a dry film thickness of not less than 25 micrometres or greater than 35 micrometres.

c) Requirements of the finished system

The finished system shall be smooth, glossy or semi-glossy, free from excessive runs, sags, blisters, wrinkling or other visual defects. The total dry film thickness shall be not less than 200 micrometres nor greater than 300 micrometres in the case of the system for highly corrosive conditions, or minimum 125, maximum 225 micrometres for the milder conditions.

SS 5.13.5.2 System E2 - On painted or plastics items in chlorination rooms

a) Material

Material used as a primer/barrier coat shall be a water-based vinyl-chloride-vinylidene-chloride-copolymer primer which contains zinc phosphate.

Being water-based, the drying time is extended in humid conditions.

Care shall be taken to avoid excessive film thickness and to allow adequate drying time before overcoating.

Full drying and coalescence throughout the thickness of the film is essential.

Do not apply any coats at temperatures below 5 °C or where such temperatures are likely to be encountered before full curing has taken place. Do not apply to any wet surfaces.

b) Procedure

Prepare the surfaces as specified in the relevant clause.

Apply one coat of water-based vinyl-chloride-vinylidene-chloride-copolymer primer which contains zinc phosphate to give a dry film thickness of not less than 30 micrometres and not greater than 60 micrometres. Allow a minimum of 16 hours for curing before the overcoat is applied. Since this material is water-based, the drying time shall be longer under humid conditions.

Apply two coats of vinyl enamel. The medium shall not contain any alkyd resin or other saponifiable matter. Pigments used shall be light fast and shall not be affected by bleach solutions. The dry film thickness of each coat shall not be less than 25 micrometres or greater than 35 micrometres. The time interval between coats shall be not less than 16 hours.

NOTE: The paint manufacturer shall be consulted before specifying the colour, as the range of pigments which meet the above requirements are limited and strong colours may be costly.

SS 5.13.5.3 System E3 - On galvanized steel

a) Material

Material used as a primer shall be either an approved water-based vinyl-chloride-vinylene-chloride-copolymer which contains zinc phosphate (for above-water use only), or a two-pack epoxy-resin-based primer specifically designed for use on galvanized steel and suitable for underwater service.

b) Surface Preparation

Prepare the surfaces as specified for above-water surfaces or for underwater surfaces or highly corrosive environments as set out in the relevant clauses.

c) Application

Apply the appropriate primer, as specified above, to the clean surface at a thickness within the range specified by the paint manufacturer.

Apply one coat of vinyl high-build intermediate coat which complies with that specified in System C2 at a dry film thickness of not less than 75 micrometres or greater than 125

micrometres, followed by one coat of vinyl enamel at a dry film thickness of not less than 25 micrometres or greater than 35 micrometres.

The time interval between coats shall be not less than 16 hours.

d) Requirements of completed system

The completed system shall be smooth, uniform, glossy or semi-glossy, free from runs, sags, bubbles and other visible defects.

The dry film thickness of the vinyl system over the galvanized surfaces shall be 125 micrometres to 180 micrometres.

e) Site repair of vinyl systems

Since vinyl systems are not chemically cured, only the abrasion of exposed steel is required for preparation. Abrasion of the coating and solvent wiping are unnecessary.

Prepare the surface as specified in the relevant clause and remove all debris by brushing it with a clean dry brush.

Apply the specified primer to the bare steel, followed by the required number of coats to restore the damaged area to meet the requirements of the appropriate specification.

SS 5.13.6

System F - Two component solvent free polyurethane

General

The solvent free polyurethanes constitute a relatively new class of coating with some outstanding properties. They may be divided into two main types, each of which is subject to a wide variation in properties which depends on the particular formulation.

Elastomeric types

These are similar to rubber in that they have an elongation up to 300%, with good recovery. They have very high resistance to abrasion but need a primer with good water barrier properties when used on steel, on account of their relatively high water permeability. As the coating has a low coefficient of friction and high resilience, it is suitable for lining containers for stones, grit and similar abrasive materials.

Elastoplastic types

These are less like rubber but are still very much more flexible than epoxies, and have an elongation at break of about 25%. Their water permeability is much lower than that of the elastomeric types, and hence they are more suitable for underwater use.

The method of application of the elastomeric types is by their being cast in a mould or, in the case of pipes, by their being spin cast.

The elastoplastic types are applied by brush, trowel or by a special two component hot airless spray unit in which the two components are metered to the spray head. It is imperative that the equipment be stripped and thoroughly cleaned periodically during use. Frequent checks shall be carried out to ensure that the correct mix ratio is maintained.

Both types must be applied to dry surfaces under dry conditions.

SS 5.13.6.1

System F1 - Elastoplastic polyurethane on mild steel, underwater, mildly abrasive

a) Materials

Primer for steel

The primer shall be a suitable primer for steel supplied by the manufacturer of the coating material and shall be applied at the manufacturer's specified thickness and shall be overcoated within the specified overcoating time.

Coating material

The coating material shall be a solvent-free two component polyurethane hybrid based on polyether type polyol and aromatic isocyanate. The cured coating shall comply with the following requirements:

- Tensile strength at a 3mm thickness (ASTM D 638) - not less than 15 MPa.
- Adhesion to correctly primed steel - not less than 10 MPa.
- Impact resistance direct - (ASTM G 14) - not less than 8 joules.
- Dielectric strength - not less than 10 kV/mm.
- Elongation at break - not less than 25%.
- Compressibility - not less than 25 MPa.
- Surface hardness of 5 mm thick sample - not less than 60 or greater than 80 Shore 'D'.
- Water vapour permeability - not greater than 0,5g/24h/m²/mm.
- Cathodic disbanding - when tested in accordance with ASTM G8 Method A, for 60 days, the disbanded area shall not exceed 500 mm².

b) Procedure

Prepare surface as specified in the relevant clause.

Prime the surface with the coating manufacturer's primer for steel.

Within the minimum and maximum overcoating time interval specified for the primer by the manufacturer apply one coat or two coats by means of an airless spray machine fitted with metering pumps that dispenses the correct mix ratio at the spray head. The machine shall be maintained in a clean condition and in good working order. The Contractor may be required to demonstrate to the Engineer that the machine is delivering components in the correct mixing ratio. Test panels shall be coated during the application to enable test to be carried out for adhesion and for Shore Hardness. Adhesion test panels shall be coated at the specified thickness but for Shore Hardness, the coating shall be not less than 5mm in thickness.

c) Requirements of the finished system

The coating shall be smooth, glossy, free from excessive orange peel effect, bubbling, or excessive runs or sags.

The dry film thickness shall be not less than 1,0 mm.

The coating shall be free from electrical insulation defects when it is tested with a high voltage Holiday detector set at 5 kV.

SS 5.13.6.2

System F2 - On mild steel in underwater highly abrasive conditions

As for System F1, except that the coating thickness shall not be less than 2 mm. No electrical insulation defects shall be detected when it is tested with a high voltage Holiday detector set at 10 kV.

SS 5.13.6.3 System F3 - On mild steel in underwater very abrasive or cavitation conditions

As for System F1, except that the coating or lining thickness shall be not less than 3mm. No electrical insulation defects shall be detected when it is tested with a High Voltage Holiday Detector set at 15 kV.

SS 5.13.6.4 Repair procedure for polyurethane systems

Since polyurethane systems are chemically cured, very thorough abrasion of damaged or defective coating is required to ensure an adequate physical bond.

If repair is carried out within 16 hours of application of the last coat of polyurethane, the surface shall be abraded with abrasive paper. Wipe it free from dust and debris, then apply the brush grade polyurethane thoroughly mixed in the correct proportions, in as many coats as are required to achieve the specified thickness and freedom from holidays.

If repair is carried out later than 16 hours after application of the last coat, the surface shall be abraded as given above, the debris removed, then the manufacturer's adhesive, thoroughly mixed in the correct proportions applied to the abraded surface only NOT to any area which has not been abraded. Allow not less than 30 minutes nor more than 4 hours before the brushing grade polyurethane, thoroughly mixed in the correct proportions, is applied to achieve the total thickness and freedom from holidays as required by the specification.

SS 5.13.7 System G - Powder coatings

General

Powder coatings comprise a wide range of polymeric materials, which are supplied in powder form and are converted to a coating by appropriate heating.

The materials may be divided into thermoplastic, which can be repeatedly melted and revert to solid on cooling, or thermoset which are resins that chemically cure when heated to the appropriate temperature for the appropriate time. After curing, they no longer become liquid on reheating.

Since thermoset materials have excellent adhesion to correctly prepared surfaces, this type is preferred at the present time.

Curing of thermoset materials requires heating up to 220°C. It is therefore important that the substrate be free from blowholes, cracks, crevices, surface roughness and similar sources of air entrapment. All blowholes and omegas in castings shall be filled flush with the surrounding surface (refer to the clause on surface preparation for painting of cast iron and cost alloys). Rough surfaces shall be suitably prepared and primed with a liquid two pack epoxy primer, suitable for the substrate, prior to the application of powder. Blisters, pinholes and fish eyes in the final coating will not be accepted.

Correct heating schedule is essential to ensure full cure of the powder. The mass of the article being coated affects the rate of heating, hence due allowance must be made for heavy components such as those made from cast iron.

a) Surface preparation of articles fabricated from steel plate

Fettling and dressing by the fabricator shall be in accordance with the requirements of the clause on Fettling or Dressing by the Fabricator.

Surface preparation required is as referred to in the clause on surface preparation for painting of mild steel less than 2 mm thickeners and it shall be carried out as follows:

A recognised chemical pre-treatment shall be carried out on the steel just prior to priming. (See SANS 10064 Section 5.).

The chemical pre-treatment shall consist typically of a seven stage zinc phosphate process.

The process shall result in the complete removal of all foreign matter, e.g. scale, grease, cutting oil, soil, weld flux, rust etc. The pre-treatment shall impart a uniform texture to the surface so as to render it suitable for the coating, which is to be applied.

A fine grained crystalline zinc phosphate is recommended at a coating weight of 1,5 - 2,5 g/m².

Great care shall be taken with water rinsing so as not to contaminate the next cleaning process. The last rinse shall be sufficiently thorough to remove all water soluble material and any residual smuts.

After phosphating the articles shall be primed as soon as possible after drying. In any event this time shall not be longer than 16 hours if the phosphated items are kept under dry cover. Clean cotton gloves shall be used for any manual handling prior to coating.

b) Surface preparation of galvanised articles

Galvanising

The Fabricator shall observe the recommendations of SANS 10214. Galvanising shall be carried out after fabrication by the hot dip process in accordance with SABS 763, except that:

- Dross and other inclusions that give a surface roughness exceeding 100 µm maximum peak to valley height shall not be permitted (SABS Method 772).
- Runs, drips and spikes shall be removed by filing before coating. Such filing shall produce a smooth surface with a residual zinc coating not less than the specified minimum thickness.
- Repairs by zinc metal spray or by zinc rich primer are not permitted. Repairs by special solder are acceptable only if the solder does not interfere with the pickling and passivating process.

c) Surface Preparation of the galvanised surface

The galvanised surface shall be degreased, etched and phosphated by a recognised 7-stage dip or spray process for chemical treatment of galvanised steel to give a surface suitable for painting. The process shall remove all foreign matter such as grease, oil, soil and white rust. It shall impart a uniform texture to the surface, free from loose particles, smuts, water soluble salts and other contaminants that will impair performance of the coating system.

d) Priming

The specified primer shall be applied in accordance with the manufacturer's instructions to give a dry film thickness of 20 to 30 micrometres.

e) Curing time for primer

The primer shall be left for the period recommended by the manufacturer, relevant to ambient temperature and humidity.

It is essential that all solvent shall have evaporated before the application of powder.

Low temperature baking is permissible if recommended by the manufacturer.

SS 5.13.7.1 Application of powder coating

a) General

All dust shall be removed.

The primer shall be cured as set out above.

The powder coating shall be applied by the electrostatic spray application method to a dry film thickness of 75 to 100 micrometres.

b) Stoving

The powder coated items shall be exposed to the stoving schedule recommended by the powder manufacturer. The oven conveyor speeds or oven temperatures shall be adjusted to accommodate various metal thicknesses to ensure that every part is ultimately exposed to the minimum stoving schedule. Preference will be given to Contractors using travelling oven recorders.

c) Test Plate

To avoid or minimise the use of destructive tests on the finished article, the Contractor may run a test plate, of identical steel and approximately 150 x 100 mm in area. The test plate shall be attached to the article such that it is subjected to all the processes of cleaning, phosphating, priming, powder coating and stoving identical to the processes applied to the article. A second test plate of powder only, without primer shall also be prepared for powder cure tests.

To check the curing of the stoved coatings, sample chips of the coating shall, if necessary, be subjected to a differential scanning calorimetry (DSC) test, when delta-Tg shall be not greater than 3°C.

d) Requirements of the finished system

(i) Appearance

The coating shall be smooth, glossy and free from excessive orange peel, bubbling, runs or sags, and shall comply with the requirements of SANS 1274 of the appropriate type.

(ii) Coating Thickness

The dry film thickness shall not be less than the minimum specified, when tested non-destructively on the article(s) coated, using SANS Method 10141.

(iii) Adhesion

Adhesion shall not be less than 9 when tested on the test plate by SANS Method 10159. In case of doubt, the test shall be repeated on the article or representative samples. Test areas shall be repaired to the satisfaction of the Engineer.

e) Repair of powder coating

Any chipped or damaged areas of the coating shall be repaired as follows:

- The area shall be abraded to white metal or to a uniform matt finish of the powder by using a 350 - 220 grit waterproof paper and water as a lubricant.
- Dry the area with a clean cloth.
- Apply by brush or spray the epoxy-polyamide primer recommended by the manufacturer of the powder to a dry film thickness of minimum of 30, maximum 50 micrometres to the bare metal.
- After the recommended minimum and before the recommended maximum overcoating time, apply a top coat of polyurethane acrylic, as recommended by the powder manufacturer and tinted to the same colour as the powder coating. Care shall be taken not to overlap the abraded area by more than 10 mm.
- When cured, the repair may be burnished.

The aesthetic appearance of the patch shall be subject to approval by the Engineer. If not approved, the whole item shall be returned to the manufacturer for stripping and recoating.

f) Handling of powder coated items

Powder coated items shall be packed and handled so as to prevent damage up to the point of completion of installation.

SS 5.13.7.2 System G1 - Polyurethane powder coating on primed mild steel for exterior exposure

a) General

The primer used shall be a solvent-based polyamide cured epoxy material containing strontium chromate as an anti-corrosive pigment. It shall be a material designed for use as a primer for polyurethane powder coating, and which will withstand the maximum stoving cycle associated with the powder coating process.

The powder coating shall be a thermosetting polyurethane based material suitable for constant exterior exposure. The product shall comply with the requirements of SANS 1274 Type 6. The powder coating shall be suitable for application over the primer specified above.

b) Surface Preparation prior to powder coating

Refer to the sub-clause on surface preparation of articles fabricated from steel plate for system G - Powder Coating.

c) Primer

Apply the primer described above in accordance with the sub-clause on Priming for System G - Powder Coating.

d) Powder

Apply the powder described above in accordance with the sub-clause on the application of Powder Coating for System G - Powder Coating to a dry film thickness of 75 to 100 µm.

e) Requirements of the Coating System

The system shall comply with the requirements of the sub-clause on the requirements of the finished system for System G - Powder Coating and with the requirements of SANS 1274 Type 6. The total dry film thickness shall not be less than 95 µm.

SS 5.13.7.3 System G2 - Corrosion resistant powder coatings for interior and exterior use

a) Materials

The powder to be used shall comply with the requirements of SANS 1274, Type 5, Thermosetting.

b) Surface Preparation

Refer to the sub-clause on surface preparation of articles fabricated from steel plate for System G - Powder Coating.

c) Primer

No primer is required for this system.

d) Application of Powder Coating

Refer to the sub-clause on the application of powder coating for System G - Powder Coating.

e) Requirements

The system shall comply with the requirements of the sub-clause on the requirements of the finished system for system G - Powder Coating with a minimum dry film thickness of 75 µm, and with the requirements of SANS 1274 Type 5.

SS 5.13.7.4 System G3 - Powder coating on aluminium for interior or exterior exposure

a) Material

The powder to be used shall comply with the requirements of Section 2 of BS.6496.

b) Pre-treatment

An approved chemical pre-treatment dedicated only to the pre-treatment of aluminium shall be carried out just prior to powder coating.

The pre-treatment shall comply with the requirements of BS. 6496, Section 3, Clause 8.

This is the only type of pre-treatment acceptable prior to powder coating on to aluminium components.

NOTE: The conductivity of the demineralised water draining off the rinsed work pieces shall not exceed 10 mS/m at 20µC. The metal surface after the pre-treatment and prior to coating shall be free from dust and powdery deposits.

After pre-treatment the articles shall be powder coated as soon as possible after drying. In any event this time shall not be longer than 2 hours if the items are kept under cover.

c) Application of Powder Coating

The powder coating shall be applied to the clean pre-treated aluminium so as to result in a dry film thickness of minimum 50 micrometres. The thickness on any significant surface that requires a limited thickness of finish as indicated on suitably marked drawings, shall not exceed 120 micrometres.

The stoving temperatures shall be such that the heat history of the final product is in accordance with the manufacturer's recommendations, and takes into account the effect of varying metal thicknesses.

d) Requirements of the Finished System

The coating shall be smooth, glossy and free from excessive orange peel or bubbling runs or sags. The coating shall comply with the requirements of Section Three of BS. 6496.

The dry film thickness shall be not less than 50 micrometres and where necessary, shall not be greater than 120 micrometres.

Tests for full cure of thermosetting materials shall be carried out. If full cure is not achieved, the articles shall be reheated or may be totally rejected, as determined by the Engineer.

e) Touch up and repair of damaged areas

Polyurethane and epoxy powders, when fully cured, are hard and impervious and difficult to overcoat without risk of delamination. The procedure given in the sub-clause on the repair of powder coating System G - Powder Coating shall be strictly adhered to.

SS 5.13.7.5 System G4 - Polyurethane powder on galvanised mild steel for exterior exposure

a) Materials

Primer shall be a two pack epoxy primer containing strontium chromate, designed for application to properly prepared galvanised steel.

Powder coating shall be a Polyurethane Powder complying with all the requirements of SANS 1274 Type 6, Thermosetting.

b) Surface Preparation

Refer to the sub-clause on surface preparation of galvanised articles for System G-Powder Coating.

c) Priming

Apply the primer specified above in accordance with the requirements of the sub-clause on primary for System G - Powder Coating.

d) Powder Coating

Apply the powder coating specified above in accordance with the sub-clause on the application of powder coating for System G - Powder Coating.

e) Requirements of the System

The system shall comply with the requirements of the sub-clause on the requirements of the finished system for System G - Powder Coating and SANS 1274 Type 6. The minimum thickness of organic coating shall be 95 µm and the total coating thickness (galvanising plus organic coating) shall be minimum 135 µm.

SS 5.13.7.6 System G5 - Polyester powder coating on galvanised steel

The system shall be the same as specified for SYSTEM G4, except that SANS 1274 Type 6 shall be replaced by SANS 1274 Type 4.

SS 5.13.8 System H - Heat resistant systems

General

Systems given in this section are for application to surfaces which may become hotter than 100°C in service and which may remain at a high temperature or which may fluctuate between ambient and high operating temperature.

Corrosion only becomes a problem if the time at ambient temperature is long relative to the heated time. Since allowance must be made for thermal expansion and contraction, thin coats are preferred even though thick coats give the best corrosion protection. All heat resisting systems are therefore a compromise between flexibility and corrosion protection.

Since most organic media and most pigments discolour when heated, the most popular and practical finish is an aluminium paint, the medium of which may vary according to the maximum service temperature.

Blast cleaning is essential to ensure optimum adhesion to the substrate and so avoid peeling and flaking in service.

SS 5.13.8.1 System H1 - Phenolic aluminium for resistance up to 400 °C maximum

a) General

This system utilises the excellent corrosion and heat resistance of inorganic zinc silicate primer combined with the attractive appearance, relatively low cost and heat resistance of phenolic aluminium.

b) Materials

The primer shall be a two component zinc silicate based on self-curing ethyl silicate medium.

The aluminium top coat shall be a specially formulated phenolic aluminium guaranteed by the manufacturer to be suitable for temperatures up to 400 °C.

c) Surface Preparation

The surface shall be prepared as specified in the relevant clause as appropriate, to the standards required for immersed surfaces given in Table 1.

d) Primer

The primer shall be mixed and applied strictly in accordance with the manufacturer's instructions. Particular note shall be made of the following factors that can profoundly affect performance.

The whole of the zinc dust shall be mixed with the whole of the liquid component by slowly sifting the powder into the constantly agitated medium.

The mixed material shall be sieved to remove any unsettled lumps, which should be minimal in quantity.

The mixed material shall be constantly agitated during application.

The application of the primer to the prepared surface shall take place within the maximum times specified in Table 1.2.

The primer shall be applied uniformly by an applicator skilled and experienced in the application of the zinc silicate. The dry film thickness shall be not less than the minimum nor greater than the maximum given in the manufacturer's data sheet. In the absence of this information, the dry film thickness shall be not less than 50 micrometres nor greater than 100 micrometres. During application, the film shall appear wet. Dry spray is not permitted.

When relative humidity is below 60%, cure may be prolonged. In this case, allow not less than 4 hours after application, then spray the surface of the primer with a gentle mist of water.

overcoating of the zinc silicate shall not take place until the primer is cured sufficiently to resist 30 double runs with a pad soaked in methyl ethyl ketone (MEK test) and shall not show any fracture when scraped with the edge of a coin under pressure (coin test).

Care shall be taken to avoid damage to the primer during transportation and erection of the primed components.

e) Top coat

Except where the component can be heat cured at the point of application, the top coat of heat resistant aluminium shall be applied on site after erection, since the top coat does not fully harden until subjected to heat. It is therefore not suitable for transportation and erection in the partially cured or uncured state.

The primer shall be cleaned as specified in the relevant clause, except that abrasion is not necessary. However, it is imperative that the primer is completely dry before overcoating.

To clean, dry primer surface, apply the Heat Resistant Aluminium Paint strictly in accordance with the manufacturer's instructions.

f) Requirements of the finished system

The finished system shall be smooth and uniform, with a metallic lustre, free from excessive runs, sags, blisters, bubbles, wrinkling or other visible defects.

The total dry film thickness shall be not less than 70 micrometres nor greater than 120 micrometres. Since the coating will not be fully cured until it is put into service, the dry film thickness shall be measured by the use of a plastic shim of known thickness placed between the painted surface and the probe of the electromagnetic thickness gauge, the thickness of the shim then to be deducted from the total thickness readings obtained.

SS 5.14 QUALITY ASSURANCE REQUIREMENTS

SS 5.14.1 Contractor qualification

The Engineer may, at his discretion, require a Quality Audit of the painting sub-Contractor to ensure that he has the management, facilities and skilled staff, to meet all the requirements of the specification. He must also have the facilities and staff to carry out quality control during application of coatings to ensure compliance with the specification.

The 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 or his representative.

SS 5.14.2 Data sheets, specifications and codes of practice

The Contractor shall have available the latest issues of manufacturer's data sheets for materials to be used, National Specifications and Codes of Practice relevant to the work to be carried out, as well as a copy of this specification, all of which shall be available to the Contractor's Quality Control Manager, who shall read the relevant documents and follow the relevant instructions.

SS 5.14.3 Quality control

The Contractor shall have the necessary equipment and staff knowledgeable in test procedures to carry out all the quality control required to ensure compliance with the specification. The Contractor will be required to produce a quality plan and a program for carrying out the work. The Contractor shall maintain quality control records of all stages of the work, batch numbers of materials used, environmental conditions, as required by the specification. Quality control shall be inclusive in the Contractor's tender price.

NOTE: The SANS ISO 9000 series should be used to develop the required quality control procedures.

SS 5.14.4 Quality control records

Proper and adequate quality control records shall be maintained by the Contractor for all stages of the work. These records shall be available for inspection by the Engineer or his representative at the time of Quality Surveillance. Incomplete, inaccurate or inadequate records shall be regarded as non-conformance with the specification.

SS 5.14.5 Alternative systems

Products or specifications considered to be equivalent to those specified may be submitted for approval by the Engineer. This approval will only be considered if the manufacturer of the products provides adequate written evidence of equivalence. Form Q.1. Shall be completed in duplicate and submitted to the Engineer with supporting evidence. Use of the system may not commence until approval in writing is given by the Engineer.

SS 5.14.6 Quality surveillance

Independent surveillance - The Engineer may employ an independent technically qualified organisation to carry out quality surveillance of the work.

Program - The Contractor shall advise the Engineer timeously, in writing, when and where the following processes will be carried out: -

- a) Completion of fettling or dressing prior to leaving the Fabricator's works.
- b) Blast cleaning and application of the primer coat.
- c) Completion of factory painting.

SS 5.14.7 Commencement of site painting.

Failure of the Contractor to advise the Engineer of his program may result in rejection of the work.

SS 5.14.8 Access for surveillance

For the purpose of carrying out quality surveillance, the Engineer or his representative shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time. The 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.

SS 5.14.9 Samples

The Engineer or his representatives may remove any reasonable samples of materials to be used in the coating application. Rejection of the sample will place a hold on the use of materials 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.

SS 5.14.10 Destructive testing

The Engineer or his representative may carry out reasonable destructive tests to ascertain compliance with the specification. Areas thus damaged shall be repaired by the Contractor to the satisfaction of the Engineer at no additional cost.

SS 5.14.11 Cost of quality surveillance

Cost of Quality Surveillance shall be borne by the Employer, except when surveillance results in rejection of the lot for non-conformance with specification or when notice by the Contractor results in a fruitless trip, in which cases the cost of the Surveillance shall be debited against the Contractor's account.

SS 5.15 SPECIFIC APPLICATIONS

SS 5.15.1 Enclosures

Outdoor applications - For large cabinets in non-corrosive environments, use SYSTEM A1. In corrosive environments, use SYSTEM B.

For enclosures small enough to be powder coated, in non-corrosive environments, use SYSTEM G1.

In corrosive environments, use SYSTEM G4.

Indoor applications, use SYSTEM A1 (Interior) for non-corrosive conditions, or SYSTEM B for corrosive environments.

Where powder coating is practical, use SYSTEM G2 for non-corrosive conditions, or SYSTEM G4 for corrosive environments.

For all corrosive conditions, add VCI emitter after completion of installation.

After completion of installation, install VAPOUR CORROSION INHIBITORS in the form of EMITTERS. The size, number and chemical composition of the emitters shall be adequate for at least 12 months protection of all the metals inside the cabinet. Replacement of VCI emitters shall be included as part of the maintenance manual for the equipment.

SS 5.15.2 Cable trays and ladders

Due to many edges, cable trays and ladders must always be hot dip galvanised. In corrosive environments, or when so specified by the Engineer, they shall also be coated. Note the special requirements for galvanising to be coated, in addition to the requirements of SANS 121.

GALVANISING or SYSTEM G5 is required for interior conditions.

GALVANISING or SYSTEM G4 is required for exterior conditions.

SS 5.15.3 Supports for cable racks

Use the same system for CABLE TRAYS and LADDERS or, if an air drying system is required, use System A1 for non-corrosive conditions or System G5 for corrosive conditions.

SS 5.15.4 Switch gear

Refer to the systems prescribed for enclosures.

In corrosive conditions, indoor or outdoor, add VCI emitters after installation. Reference to replacement of VCI emitters must be made in the maintenance manual.

SS 5.15.5 Transformers

These are normally coated with specialist materials designed for Flood Coating. The system used shall be designed for 25 years maintenance free life and shall have a coating thickness not less than 100 micrometres, except in the case of hot dip galvanising, when the requirements of SANS 121 will be acceptable.

SS 5.16 MEASUREMENT AND PAYMENT

Full compensation for the Contractor's obligations regarding all corrosion protection as described in this section shall be included in payment, at the tendered rates, for the relevant items of equipment as specified in other sections of this specification.

TABLE 1: SUMMARY OF COATING SYSTEMS

SYSTEM A - ALKYD SYSTEMS

SCOPE: For application to surfaces in non-corrosive environments for attractive appearance or colour coding. **NOT** to be used for immersion, splash-zone protection or in very humid environments.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
A1	Bare steel	Degrease Blast clean Degrease, pickle and passivate	Cleanliness Sa 2.5. Dust & debris 0,5%. No oil or grease. Profile 25-50 µm.	Zinc phosphate SANS 1319	GP undercoat SANS 681 Type 2	Enamel SANS 630 Type 2 (ext.) Type 1 (int) 1 coat (int) 2 coats (ext.)	Smooth, glossy finish, free from visible defects. DFT minimum 75 µm - interior 100 µm - exterior	Light fast pigments for exterior use. Colour as specified by the Engineer.
A2	Factory cleaned and primed steel surfaces	Abrade the surface, degrease, wash and dry.	Dust & debris 0,5%. No oil & grease. Water-break-free surface. Dry.	Zinc phosphate SANS 1319. Touch up, plus 1 coat all over.	GP undercoat SANS 681 Type 2	As A1	As A1	As A1
A3	Factory finished surfaces	Sand surface. Touch up damaged areas. Sand the entire surface.	As above.	Touch up only.	Touch up only.	Enamel SANS 630 Type 1 (int) 1 coat (int) 2 coats (ext.)	As A1 but total DFT not less than 50µm - interior. Type 2 (ext.) 75µm - exterior.	Do not use in chlorination rooms - see specification E2.
A4	Galvanized steel	Degrease, abrade or sweep-blast. Remove debris.	Zinc removal not more than 10 µm. Water-break-free surface. Allow to dry.	Special primer - see specification	GP undercoat. One coat SANS 681 Type 2	As A1	As A1	Thorough degreasing necessary and complete drying of primer before applying undercoating.
SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
A5	Plastic surfaces.	Abrade the surface, degrease, wash and dry.	Matt clean surface.	As A4	None.	Two coats SANS 630 Type 1 or Type 2	As A1. Alkyd enamel.	DO NOT USE SOLVENT DEGREASER - only water-based detergent type. Primer must be completely dry before applying enamel.



BID NUMBER. RW10402802/22
BID DESCRIPTION: TENDER FOR THE REFURBISHMENT AND UPGRADE OF PUMP STATION 34, UPGRADE OF RISING MAIN PIPELINE FROM PUMP STATION 2 TO LEEUWKUIL WASTEWATER TREATMENT WORKS, UPGRADE OF WASH WATER PUMP STATION AT LEEUWKUIL, AND REFURBISHMENT OF INLET WORKS OF LEEUWKUIL AND RIETSPRUIT

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 2: SUMMARY OF COATING SYSTEMS (continued)

SYSTEM C - TWO-PACK EPOXY SYSTEMS

SCOPE: For application to surfaces to be submerged, in splash zone or in corrosive environments.

Surfaces exposed to sunlight shall be protected from UV light by applying acrylic modified polyurethane - see C4.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENT	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
C1	Bare steel	Blast clean	Sa 3	Three or four coats of solvent-borne Epoxy-Polyamide SANS 1217 Type 1A. Each coat to differ in colour from the previous coat. Each coat to be applied within the thickness and time limits specified by the manufacturer.			Smooth, glossy, free from visible defects. DFT min 250 max 400µm Underwater surfaces free from EID at 90 volts 2 megohms.	Precautions required on overcoat times to avoid solvent retention. Repairs permissible if correct procedure is followed. Note overcoat times.
	Cast iron	Blast clean (non re-used abrasive). Fill all blowholes.	Sa 3					
C2	Galvanized steel or cast iron	Degrease, abrade, remove debris.	Water-break free. Not more than 10µm of zinc removed.	Special two pack epoxy primer followed by 2 coats epoxy polyamide as used in C1.			As B1, except that DFT shall be min 150 max 250µm.	As for C1.
C3	Mild steel	Blast clean	Sa 3	One or two coats (wet on wet) of solvent free epoxy SANS 1217 Type 1C. Mix ratio of components is critical - machine must be frequently stripped to maintain cleanliness internally.			Smooth, glossy, free from visible defects. DFT min 250 max 500µm Free from EIDs at 90 volts 10 megohms.	Special spray equipment required. Contractor may be required to demonstrate that machine delivers the correct ratio of components
	Cast iron	Blast clean (non re-used abrasive)	Sa 3					
C4	Mild steel	Blast clean	Sa 3	System B1 plus - Topcoat - Acrylic modified Polyester Aliphatic Polyurethane enamel.			Smooth, glossy, free from visible defects. DFT min 250 max 450µm	Precautions required on overcoat times to avoid solvent retention.
	Cast iron	Blast clean (non re-used abrasive)	Sa 3					



BID NUMBER. RW10402802/22

BID DESCRIPTION: TENDER FOR THE REFURBISHMENT AND UPGRADE OF PUMP STATION 34, UPGRADE OF RISING MAIN PIPELINE FROM PUMP STATION 2 TO LEEUWKUIL WASTEWATER TREATMENT WORKS, UPGRADE OF WASH WATER PUMP STATION AT LEEUWKUIL, AND REFURBISHMENT OF INLET WORKS OF LEEUWKUIL AND RIETSPRUIT

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 2: SUMMARY OF COATING SYSTEMS (continued)

SYSTEM D - TWO-PACK EPOXY-TAR SYSTEMS

SCOPE: For application only to surfaces to be submerged and not exposed to UV light.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
D1	Mild Steel	Blast clean	Sa 3	Three or four coats of Epoxy-tar composition SANS 801 Type 1 or Type 2. Alternative colours for each coat.				Smooth, glossy, free from visible defects. DFT - minimum 250 µm maximum 400 µm Free from EIDs at 90 volts 2 megohms
	Cast Iron	Blast clean (non re-used abrasive)	Sa 3					
D2	Galvanized steel or aluminium surfaces	Degrease, abrade, remove debris.	Water-break free. Not more than 10µm of zinc removed.	Two or three coats of Epoxy-tar composition - SANS 801 Type 1 or Type 2. Alternative colours each coat.				Smooth, glossy, free from visible defects. DFT - minimum 150 µm maximum 300 µm

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 2: SUMMARY OF COATING SYSTEMS (continued)

SYSTEM E - VINYL SYSTEMS

SCOPE: For application to surfaces exposed to chemical pollution by chlorine, ferric-chloride solutions or similar corrosive environments.

For immersed service, use epoxy systems, such as C1 or C4.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
E1	Mild Steel	Blast clean	Sa 2 .5	Vinyl	Two coats of high-build vinyl	Vinyl enamel	Smooth, glossy or semi-glossy, no visual defects. DFT 200 - 300 µm or 125 - 225 µm	Note definition of vinyl. Saponifiable matter not permitted.
	Cast iron	Blast clean (non re-used abrasive)	Sa 2 .5	Vinyl				
E2	Painted or plastic items in chlorination rooms	Degrease, abrade, remove debris.	Uniform matt grease-free surface.	Water-based vinyl.	None.	Two coats of vinyl enamel.	Smooth, glossy or semi-glossy, no visual defects.	Pigments shall be unaffected by chlorine or bleach solution.
E3	Galvanized steel	Degrease, abrade or sweep blast clean	Uniform matt grease free surface	Water-based vinyl high-build vinyl	One coat of high-build vinyl	One coat of vinyl enamel	Smooth, glossy or semi-glossy no visual defects DFT - 125 - 180 µm	See E1.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 2: SUMMARY OF COATING SYSTEMS (continued)

SYSTEM F - TWO COMPONENT SOLVENT FREE POLYURETHANE

SCOPE: For abrasive and acidic underwater conditions.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM				NOTES
		METHOD	REQUIREMENTS	PRIMER	UNDERCOAT	FINISH	REQUIREMENTS	
F1	Mild Steel	Blast clean	Sa 3	Special primer	One or two coats of solvent free polyurethane applied by special two-component hot spray machine.		Smooth, glossy, no visual defects. DFT - minimum 1 mm. Free from EIDs at 5 kV.	Surface and ambient conditions must be DRY. For MILD abrasive conditions.
F2	Mild Steel	Blast clean	Sa 3	Special primer	One or two coats of solvent free polyurethane applied by special two-component hot spray machine		Smooth, glossy, no visual defects. DFT - minimum 2mm. Free from EID's at 10 Kv	Surface and ambient conditions must be DRY. For HEAVY abrasive conditions.
F3	Mild Steel	Blast clean	Sa 3	Special primer	Multicoats of solvent free polyurethane applied by special two-component hot spray machine.		Smooth, glossy, no visual defects. DFT - minimum 3 mm. Free from EID's at 15 kV.	Surface and ambient conditions must be DRY. For VERY HEAVY abrasive conditions.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 2: SUMMARY OF COATING SYSTEMS (continued)

SYSTEM G - POWDER COATINGS

SCOPE: Powder coating of cable racks, handrails, control boxes etc.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM			NOTES
		METHOD	REQUIREMENTS	PRIMER	POWDER	REQUIREMENTS	
G1	Mild Steel	Chemical phosphating.	Fine grain zinc or iron phosphate.	Special epoxy polyamide.	Polyurethane SANS 1274, Type 6.	Smooth, glossy. DFT 80 - 140 µm. See also SABS 1274, Type 6, Table 7.	For exterior use.
G2	Mild Steel	Chemical Phosphating.	As G1.	Nil	Thermoset or Thermoplastic	Thermoset - DFT min 75 µm. Thermoplastic - DFT min 300 µm. See also SABS 1274, Type 5.	Interior and exterior use.
G3	Aluminium	Chemical BS 6496, Section 3, Clause 8.	See BS 6496.	Nil	Special powder. See BS 6496, Section 2.	DFT min 50 max 120 µm. Full cure BS 6496, Section 10	For aluminium door and window frames, handrails and similar hardware.

NOTE: For Fusion Bonded Epoxy Powder Coating of pipes, valves and pumps, see Civil Specification S0105.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 2: SUMMARY OF COATING SYSTEMS (Continued)

SYSTEM H - HEAT RESISTANT SYSTEMS

SCOPE: Compressor heads, incinerators, mufflers and stacks

Resistance up to 400 °C maximum.

SYSTEM NO	SUBSTRATE	SURFACE PREPARATION		COATING SYSTEM			NOTES
		METHOD	REQUIREMENTS	PRIMER	TOP COAT	REQUIREMENTS	
H1	Mild Steel or Cast Iron	Blast Cleaning	Sa3 Profile 50 - 70µm	Two pack Zinc Silicate	Heat resistant Phenolic Aluminium	Smooth, metallic lustre DFT 70 - 120µm	Primer to be applied at works. Top coat may only be applied on site unless facilities are available for heat curing.

NOTE: These summary Tables are for convenient reference. Their use does not absolve the Contractor from compliance with all the requirements of the specification.

TABLE 3 - SUMMARY OF RECOMMENDED ELECTRICAL APPLICATIONS

ARTICLE	INDOOR		OUTDOOR	
	Non-Corrosive	Corrosive	Non-Corrosive	Corrosive
Enclosures – large	SYSTEM A1 (Interior)	SYSTEM G5 plus VCI after installation	SYSTEM A1 (exterior)	SYSTEM G5 plus VCI after installation
Enclosures – small	SYSTEM G2	SYSTEM G5 plus VCI after installation	SYSTEM G1	SYSTEM G4 plus VCI after installation
CABLE TRAYS AND LADDERS	GALVANIZED or SYSTEM G5	SYSTEM G5	GALVANIZED or SYSTEM G4	SYSTEM G4
PEDESTALS	SYSTEM A1 (interior) or SYSTEM F2	SYSTEM C4 or SYSTEM G5	SYSTEM A1 (exterior) or SYSTEM G1	SYSTEM C4 or SYSTEM G4
	TAKE NOTE OF THE CLAUSES ON WATER RETENTION AREAS AND SERVICES IN THE GENERAL SPECIFICATION			
SUPPORTS FOR CABLE RACKS	SYSTEM A1 (interior) or SYSTEM F5	SYSTEM C4 or SYSTEM B5	SYSTEM A1 (exterior) or SYSTEM G4	SYSTEM C4 OR SYSTEM G4
SWITCH GEAR	SYSTEM A1 (interior) or SYSTEM G2	SYSTEM C4 or SYSTEM G5 plus VCI after installation	SYSTEM A1 (exterior) or SYSTEM G1	SYSTEM C4 or SYSTEM G4 plus VCI after installation

NOTE: Table 3 is for convenient reference only. Its use does not absolve the Contractor from compliance with all clauses of the detailed specification.

TABLE 4 - SUMMARY OF COATING SYSTEMS

SYSTEM	GENERIC TYPE	SURFACE PREPARATION	TOTAL No OF COATS	BROAD ENVIRONMENT
A1	Alkyd	Blast clean or chemical	3 4	Interior non-corrosive Exterior non-corrosive
A2	Alkyd	Already primed	3 4	Interior non-corrosive Exterior non-corrosive
A3	Alkyd	Factory finished	As required	Interior non-corrosive Exterior non-corrosive
A4	Alkyd over vinyl primer	Galvanised	3	Interior and exterior non-corrosive
C1 - C4	Two-pack epoxy	Blast clean	Varies	Undercoater applications not required for this specification
D Systems	Epoxy Tar	Blast clean	Varies	Underwater applications only
E Systems	Vinyl	Blast clean	Varies	Chemical environments - not required for this specification
F Systems	Solvent-free polyurethane	Blast clean	Varies	Special applications only - not required for this specification
G1	.. Polyurethane powder on primed steel	Chemical	2	Exterior use ; non or mildly corrosive
G2	Epoxy polyester powder	Chemical	1	Interior and exterior - non- corrosive
G3	Special powder	Special chemical	1	For aluminium surfaces only
G4	Polyurethane powder on galvanised steel	Chemical	2	Exterior use - corrosive
G5	Polyester powder on galvanised steel	Chemical	2	Interior use - corrosive

NOTE: Table 4 is for convenient reference only. Its use does not absolve the Contractor from compliance with all clauses of the detailed specification.

FORM Q.1. - QUESTIONNAIRE TO BE COMPLETED BY CONTRACTORS

OFFERING ALTERNATIVE CORROSION PROTECTION

Name of Supplier:

Contract No.:

Equipment to be Supplied: Materials of Construction, e.g.: mild steel, cast iron, cast aluminium, bronze etc. Give grade of material e.g.: 316 L stainless steel.

.....

.....

CORROSION PROTECTION TO BE APPLIED

Galvanise or metal spray	
Surface Preparation	
Primer	
Top Coats (1)	
(2)	
(3)	
Are all coats from same supplier	
* Generic type of coating	
Primer thickness (micrometres)	
Top Coats (1)	
(2)	
(3)	
Total dry film thickness - min (µm)	
Total dry film thickness - max (µm)	
QUALITY ASSURANCE - - Were QC documents completed? - Were the components subject to Third Party Inspection? - If so, please supply documentation	

* Specify alkyd, chlorinated rubber, phenolic, epoxy etc.

COMPANY STAMP

SS 6. ELECTRIC MOTORS

SS 6.1 SCOPE

This specification covers all electric motors that may be incorporated in any of the items of equipment to be supplied under the contract.

SS 6.2 STANDARDS

SS 6.2.1.1 National and International Standards

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- | | | |
|---------------|---|--|
| SANS 60034 | - | Three-Phase Induction Motors (all parts) |
| SANS 60529 | - | Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides) |
| SANS 60034 | | Rotating Electrical Machines |
| DIN 3404 | - | Lubricating nipples; button head |
| SANS 1701-2-8 | - | Rolling bearings Section 8: dynamic load ratings and rating life |

SS 6.2.2 Standard specifications included in this contract document

The following Standard Specifications bound in this document shall be read in conjunction with this specification:

Standard Specification: Testing and Commissioning

Standard Specification: General Corrosion Protection

SS 6.3 GENERAL REQUIREMENTS

Electric motors shall comply with the requirements of SANS IEC 60034 and shall at minimum be of efficiency rating IE3.

The motor shall be selected so that it shall reach full operating speed within 5 seconds for the method of starting and drive arrangement used.

All motors shall be standard catalogue models and shall be readily available.

All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to prevent stocking a variety of special spares.

SS 6.4 WORKING VOLTAGE AND SUPPLY SYSTEMS

The motors shall be capable of operating within $\pm 10\%$ of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified 3-phase voltage system under actual service conditions, including the $\pm 10\%$ voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.

At +10% voltage, the magnetic circuit shall be over fluxed and continuous operation at +10% V shall not result in deleterious heating.

All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between plus and minus 5 per cent of the nominal supply voltage.

The slip-in speed of any motor at 80 per cent of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

SS 6.5 TEMPERATURE RISE

The temperature rise, as determined by resistance, of all motors, shall not exceed the following derated values:

Insulation class	E	B	F	H
Temperature rise (K)	50	60	80	100

SS 6.6 EFFICIENCY AND POWER FACTOR

The efficiency of all motors shall be guaranteed by the Contractor and shall comply with the requirements of 60034 part 30 and shall comply with efficiency class IE3. Deviations from the guaranteed efficiency shall be within the limits specified in SANS 60034-30.

The guaranteed efficiency of each size and rating of motor shall be as determined in accordance with SANS 60034-2-1 and shall be of the high confidence class. A basic test certificate of efficiency will be accepted for a motor of identical size and rating or a basic test of efficiency shall be conducted if no certificate is available.

The power factor of motors with a capacity of 20 kW or more shall not be less than 0,85 under all operating conditions.

SS 6.7 VIBRATION

Motors shall be statically and dynamically balanced.

All motors shall be checked for vibration without load, and at full rated voltage at the manufacturer's works, and the vibration amplitude as measured shall be in accordance with SANS 60034: Part 14, quality grade 'Special'.

The ratio of axial to radial vibration shall not exceed 0,5.

SS 6.8 NOISE LEVEL

Unless otherwise specified motors shall be of 'normal sound power', in compliance with SANS 60034-9 Rotating electrical machines part 9: Noise limits.

SS 6.9 ENCLOSURE AND FRAME

Each motor shall be protected to the degree required by its application, and its enclosure shall be designed for the system of cooling associated therewith.

Notwithstanding the requirements above, the minimum degree of protection shall be IP55 to SANS 60529 and, unless otherwise required, motors shall preferably be of the totally enclosed fan-cooled (TEFC) type.

All motors of the vertical-spindle type and exposed to the weather, shall be provided with a robust canopy of approved design.

Medium-length motors are preferred but short-length motors may be accepted where space is limited and written permission has been granted by the Engineer. Motor frame sizes shall be in accordance with SANS 60072-1 and 60072-2

SS 6.10 MOTOR TYPE

Motors shall be of the squirrel-cage induction motor type. Slip-ring induction motors or other approved types will be considered if the Contractor is of the opinion that better results could be

obtained by using such motors. Full electrical and mechanical details of each alternative shall be submitted with the tender documents.

SS 6.11 RATING AND STARTING REQUIREMENTS

Motors shall be adequately rated for the service for which they are intended, and due allowance shall be made for the temperature, altitude, climatic conditions and variations in the supply voltage. Motors shall, however, not exceed 120% of the required capacity without prior approval having been obtained from the Engineer.

Not only shall motors be based on the full load requirements, but the motor capacity and starting characteristics shall be compatible with the requirements of the driven equipment.

Where motors are required to drive high inertia loads, the starting torque of the motor and the torque curve of the driven load shall be submitted to the Engineer for approval prior to manufacture. Such motors shall be capable of three starts per hour, with two consecutive starts from normal operating temperature, or more frequently if required by the Engineer.

Motors shall be of the continuously running duty class S1 unless otherwise specified in the detailed specification or if a more onerous duty is dictated by the drive requirement.

All squirrel-cage induction motors shall be suitable for direct-on-line starting at full voltage. Single-speed motors shall conform to SANS 60034-12, Design B characteristics unless otherwise approved by or dictated by the drive requirements.

All motors shall be capable of starting its associated load with a minimum accelerating torque of not less than 5 percent of full-load torque when the voltage at the motor terminals during starting is reduced to 80 percent of the nominal value.

Unless otherwise approved, the -15 percent tolerance on locked-rotor torque permitted by SANS 60034-1 will not be accepted and shall be limited to -10 percent.

Documentation shall include performance curves to suit the expected working conditions.

SS 6.12 BEARINGS

All motors shall, wherever possible, be provided with pre-lubricated sealed bearings.

Regreasable bearings shall require only one lubrication per year. Grease lubrication of ball or roller bearings, where approved, shall be by means of hexagonal button-type grease nipples to DIN 3404.

Grease-lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed, which holes shall be positioned so that the excess grease can be easily removed. Cups shall be fitted to contain excess grease.

Bearings shall be protected against eddy currents and shall be capable of withstanding vibrations caused by unbalanced loads.

All bearings shall be designed for a minimum L_{10h} , basic life rating of 50 000 hours at the rated load and speed for the application in accordance with SANS 1701-2-8.

SS 6.13 EARTHING

All motors shall be provided with a machined or spot-faced boss tapped to receive a bolt of not less than 10 mm in diameter for earthing purposes, which is located on one side between the mounting feet.

SS 6.14 HEATERS AND DRAINAGE

Non-submersible motors which will be located out of doors or in a damp location such as in a drainage sump, shall be provided with suitable means of drainage to prevent the accumulation of water due to condensation. They shall also be fitted with anti-condensation heaters suitable for a 230V AC supply if considered advisable by the manufacturer.

Where specified in the detail specifications, motors shall be supplied with anti-condensation heaters to keep the motor temperature at 23°C when the motor is not operational to prevent moisture from condensing in the motor.

Heater terminal boxes shall be fitted on the motor frame and shall be of robust design, liberally sized and complete with suitable terminal block and mechanical cable gland or conduit entry.

SS 6.15**TERMINAL ARRANGEMENTS**

The line connections of each motor shall be brought out to a terminal box located in an approved position. In the case of two-speed motors, separate terminal boxes shall be provided for each speed.

Terminal boxes shall be of the totally enclosed type designed to exclude the ingress of dust and moisture and sealed from the internal circuit of the motor, and shall be manufactured from sand-cast metal. The terminal boxes be as specified in SANS 1804-2. The terminal box shall be so designed that the cable entry may be made in any one of four positions placed at right angles to one another.

Terminal boxes shall be of ample size to allow the cable to be terminated in the box. Under no circumstances will the cable be allowed to be in contact with the inside of the box or lid.

Terminals shall be of a substantial design and shall be suited to receive cable lugs. Pinch-screw connections will not be accepted.

The terminal arrangement shall permit the motor to be disconnected from its supply cable without damaging the cable tails and shall allow the supply cable and motor windings to be tested separately.

The electrical clearance and creepage distances, with the correct cable terminations in position, shall comply with the requirements of SANS 60034.

Terminal markings shall be clear and permanent and shall comply with SANS 60034. Irrespective of the direction of rotation required on the site, the connections shall be such that, when the supply leads L1-L2-L3 are connected to the motor terminals U-V-W respectively, the motor shall rotate in a clockwise direction when viewed from the driving end.

Motors suited for only one-directional rotation, shall be clearly marked as such by an arrow fixed to the motor frame at the driving end.

Before the Contractor orders terminal boxes for electrical equipment he shall supply details of the proposed boxes to the Engineer for approval. These precautions are necessary to ensure that the size of the connecting blocks installed is sufficient to accommodate the cables supplied and connected by another Contractor, and that sufficient space exists within the box to route cables conveniently.

SS 6.16**MOTOR/LOAD COUPLING**

Motors shall be coupled direct to the equipment to be driven by means of approved couplings and/or gearboxes. Refer to the relevant sections for general specifications on transmission couplings and gearboxes. Vee-belt and chain drives will be considered only if direct coupling of the motor to the equipment is impossible or impractical. Motors driving vee-belt or chain drives shall be fitted with heavy-duty bearings suited to the full side thrust at 120% of full load torque and short-term overloads of up to 250% of the full load torques during starting. The stiffness of the rotor shaft shall be checked to ensure that resonance and fatigue do not occur.

Where applicable, the flanges of the motors and equipment shall be identical.

The precision tolerance class shall apply to all flange-mounted motors with regard to concentricity, perpendicularity and shaft run-out.

SS 6.17**ADDITIONAL SPECIFICATIONS FOR TWO-SPEED MOTORS**

The following additional specifications apply to all two-speed motors:

- a) Terminal markings shall be as per SANS 60034-7.
- b) The starting current shall not exceed six times the full load current of the high-speed rating.

SS 6.18**SUBMERSIBLE MOTORS**

The following additional requirements apply specifically to all submersible motors:

All submersible motors shall be suited for submersion up to a depth of 1,5 times the depth of submersion shown on the drawings for each application, or as specified in the detail specifications.

All submersible motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.

All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.

All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the motors.

An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1,0 m above the maximum water level by means of a purpose-made, weatherproof, outdoor junction box. The submerged cable shall be supported to minimize any movement of the cable which result from turbulence caused by the operation of the equipment or the flow of the water.

Thermistor protection or Klixon type temperature switches shall be provided for submersible motors.

Seal monitors shall be provided for submersible motors, together with the required seal monitor relays. The cost for the seal monitor relays shall be deemed to be included in the rates tendered for the equipment.

SS 6.19 ADDITIONAL REQUIREMENTS

The rotation speed of motors shall not exceed 1 500 r/m unless approved otherwise by the Engineer.

Thermistor protection shall be provided for each winding of each motor.

The preferred class of insulation is Class F, de-rated in accordance with the relevant clause above.

SS 6.20 TESTING

Tests on completion (commissioning tests) shall be performed as described in the specifications covering testing and commissioning.

SS 6.21 MEASUREMENT AND PAYMENT

No separate payment will be made for electric motors for equipment.

SS 7. FLOW CONTROL VALVES AND SLUICE GATES

SS 7.1 SCOPE

This section covers the supply, delivery, installation, testing and commissioning of manually and electrically actuated control valves, sluice gates and ball float valves.

The Contractor shall take note that valves associated with certain plant, equipment or installations as specified in the detailed specification will be measured together with the applicable equipment.

SS 7.2 INSTALLATION AND HANDWHEELS

Valves shall be installed in positions as shown on the relevant drawings process flow diagrams and as specified in the detail specifications.

Where applicable, the spindles or wheels of valves shall clearly indicate the direction of closure, which shall be clockwise when viewing the valve from and along the valve spindle axis.

SS 7.3 STANDARDS

These specifications shall be read in conjunction with the following documents:

SANS 1123	-	Steel pipe flanges
SANS 664	-	Cast iron gate valves for water works

SS 7.4 MECHANICALLY PINCHED RUBBER-SLEEVE VALVES

Each mechanically pinched rubber-sleeve valve shall comply with the following specifications:

- 1) The valve shall be of the full metal-body mechanical-pinch type with flanged joint buds on both the body and the rubber sleeve.
- 2) Flanges shall be drilled in accordance with SANS 1123.
- 3) Port areas shall be 100% of the full pipe area throughout the entire length.
- 4) All internal valve metal parts shall be completely protected by a flexible elastomer pinch tube. The elastomer pinch tube shall be of single-piece construction with integral flanges drilled to the same flange drilling as the rest of the pipeline. Should the flanges be drilled to another standard which is incompatible with the specified SANS standard, suitable adaptors shall be included with the valve to ensure its satisfactory operation.
- 5) All materials shall be resistant to the corrosive environment in which it has to operate.
- 6) The pinch tube shall be nylon reinforced with an exterior wrapping of 3 mm thick neoprene.
- 7) The closing mechanism shall be double-acting and shall pinch the sleeve equally from two opposing sides.
- 8) The stem shall be non-rising and mounted to the driving mechanism through the stem by direct coupling.
- 9) No cast parts shall occur in the operating mechanisms of the valve.

SS 7.5 GATE VALVES

Gate valves shall have non-rising spindles.

Each gate valve shall comply with the following specifications:

- 1) Each valve shall be a resilient seal gate valve in accordance with SANS 664.
- 2) Each valve shall be designed to facilitate maintenance without the body of the valve having to be removed from the line.
- 3) Each valve shall be double flanged, with the flange drilling being in accordance with SANS 1123.
- 4) Each valve shall be resistant to the corrosive environment in which it has to operate.
- 5) The following materials shall be used in the manufacture of each valve in pipelines for the conveyance of water and sewage with diameters in excess of 100 mm:

<u>Component</u>	<u>Material</u>
Body	Cast iron
Bonnet	Cast iron
Gate	Cast iron
Bridge	Carbon steel
Gland	Carbon steel
Spindle	Stainless steel 304
Gate seals	Neoprene
Gate studs	Stainless steel 304
Gate nuts	Stainless steel 304
Gland packing	Polytetrafluoroethylene (PTFE)
Gaskets	Rubber

SS 7.6 BUTTERFLY VALVES

Butterfly valves shall comply with the requirements of SANS 1849 (BS EN 593) and shall be of the double-flanged, lugged or wafer types, as may be specified. They shall be designed to fit between flanges drilled in accordance with SANS 1123.

Butterfly valves may be controlled by weather-proof actuators fitted with hand wheels as specified in the detail specifications. Safety devices such as shear pins shall be built into the actuators to prevent damage from being done to the valve should excessive force be applied to the hand wheel in the fully open or closed positions. If so specified, valves with a 200 mm diameter and smaller shall be controlled by direct-mounted ratchet handles.

Closure of valves shall be by the clockwise movement of the hand wheel or ratchet handle, and the fully open and fully closed positions shall be indicated by a positive stop. Handwheels shall be clearly marked to show opening and closing directions.

Valve discs shall be of a single casting, have a stream-lined shape and shall also have smooth surfaces. Where resilient seats are specified, they shall be moulded to the shape of the valve body but shall not be bonded to the body so that they can be easily replaced.

Butterfly valves of class 16 and higher, or with a 350 mm diameter and larger, shall be fitted with self-lubricating two-way adjustable thrust bearings to permit precise disc-to-seat positioning at all times.

Valve shafts shall preferably be continuous, but if stub shafts are provided, they shall each extend into the disc hub for a distance of at least 1,5 times the shaft diameter.

SS 7.7

SLUICE GATES

The frames, spindles, spindle braces and gates of all sluice gates shall be manufactured from stainless steel 304, unless otherwise specified.

All gates shall be guided by rigid guide rails. The gates shall be held uniformly against the side facings of the frames by the action of adjustable wedges and shall provide drop-tight closure under the specified conditions.

All channel sluice gates shall be of the level invert type fitted with renewable seals of a non-biodegradable material on the invert.

All hand-operated and shall be supplied with clockwise closing handwheels. If rising spindles are to be used, the rising spindles shall be protected by suitable sleeves which provide convenient visual inspection and greasing facilities.

Handwheels shall be of cast iron with diameters to suit operating either directly on the head frame or on a stainless steel (grade 304) tubular pedestal to suit the installation depth. Where necessitated by the mass of the gate and/or the pressure against the gate, suitable gearing shall be provided so as to facilitate the operation.

All parts shall be designed with a minimum factor of safety against structural failure of not less than 3,0, based on the working stresses of the material. In the design due consideration shall be given to the thickness of materials with regard to corrosion and operating conditions.

The sluice gates shall be designed with suitable stiffeners to prevent the gates from deforming or buckling on account of unbalanced pressures acting on the sluice gates.

All channel sluice gates shall be designed for an unbalanced water pressure caused by a water column of twice the height of the gate. The maximum force required at a handwheel or crank to raise a gate or open a valve shall not exceed 100 N.

The Contractor shall supply the Engineer with all information regarding cavities to be left in the channel floors and walls and all the details concerning holding-down bolts or any other information relating to details of installation in civil structures to be constructed.

The Contractor shall be responsible for all handling, installation and grouting of the sluice gates and shall carry out all necessary adjustments to ensure proper and smooth operation.

SS 7.8

BALL FLOAT VALVES

Ball float valves shall be used where storage tanks, make-up tanks and/or other containers will have their liquid level automatically maintained at the full level (as set by the ball float mechanism).

The Contractor shall take special care with regard to corrosion protection as ball float valves are frequently used in chemical dosing plants (make-up tanks).

Unless otherwise specified the ball float valve shall effectively and completely seal off against a pressure of 8 bar. It shall be possible to adjust the height at which the valve closes completely by means of a convenient mechanism.

SS 7.9

ELECTRICALLY DRIVEN ACTUATORS

Each electrically driven actuator shall be supplied by a reputable supplier as standard equipment and shall comply with the following specifications:

- 1) The actuators shall be compatible with the relevant valves or sluice gates on which they have to operate.
- 2) The actuators shall operate from a 380/220 V 50 Hz power supply.

- 3) Standards for the various components on the actuator shall be equal or exceed that set by actuators from Rotor or approved equivalents.
- 4) The actuators shall be adequately sealed and insulated to guarantee satisfactory operation under a submergence of 10,0 m of water.
- 5) The various actuators shall either be equipped with a mechanism by which either an analogue 4 -20 mA signal is generated in proportion to the status of the valve or sluice gate setting to facilitate proportional control, or the actuators shall be actuated by a digital signal which causes them to open fully or close fully. Distinction between these will be made in the detail specifications.

The two types of electric actuator shall have the following control/signal facilities (type A = open/close, type B = modulating):

A OPEN/CLOSED VALVE

Open coil - 220 VAC - Facilities to open the valve by means of a potential free contact.

Close coil - 220 VAC - Facilities to close the valve by means of a potential free contact.

Potential free contact to signal that the valve is open.

Potential free contact to signal that the valve is closed.

Potential free change over contact to signal local "Local/Remote" selection.

B MODULATING VALVE

Position signal: 4 - 20 mA.

Position feedback: 4 - 20 mA.

Potential free changeover contact to signal local "Local/Remote" selection.

Each actuator shall be designed for modulating operation (S4). The equipment shall be designed to tolerate 10 changes in the setting of a valve or sluice gate per hour on a continuous basis.

The ambient temperature at which the actuators shall operate is expected to be between -5 °C and 45 °C.

Each actuator shall be provided with a local/remote-control selection switch as well as a handwheel by which the setting of the valve or sluice gate can be manually adjusted when the local/remote-control selection switch is in the local-control position. The directions for closing and opening shall be indicated on the wheels. The local/remote-control selection switch shall be designed with a locking device to inhibit unauthorized adjustments being made to the valve settings.

Each actuator shall be designed to facilitate maintenance. The coupling between the actuator and the valve or sluice gate shall be easily accessible. It shall be possible to do maintenance work on the actuator whilst the valve or sluice gate is in operation under local control.

The design requirements for electrical actuators are summarized as follows:

- Double sealed housings are preferred.
- Only direct, gear-driven units will be accepted.
- Open/close limits on the valve or sluice shall have adjustable set points.
- The valve or sluice position on modulating units shall be infinitely variable, so that any position can be selected.
- Control of valves shall be by means of non-rising spindles unless otherwise specified.
- The gear case shall be isolated from valve or sluice thrust.
- The actuator shall be capable of operating effectively at any angle.
- No plastic or nylon gears will be accepted.
- Oil-bath lubrication is preferred for the gearbox.
- Permanently sealed bearings are preferred.

- The actuator shall be protected by means of a torque switch, an instantaneous reversal protection circuit and a jammed valve motor protection circuit.
- For high speed applications, torque limiting brakes shall be supplied to prevent excessive valve seat loading.
- Indications for response times (fully closed to fully open) are given in the detail specifications.

SS 7.10 CORROSION PROTECTION

Corrosion protection shall be in accordance with the section dealing with corrosion protection and the Contractor shall ensure that the unit is fit for operation in the relevant environment.

SS 7.11 MEASUREMENT AND PAYMENT

SS 7.11.1 Supply and delivery of manually or electrically actuated flow-control

valves and sluice gates **No.**

The unit of measurement shall be the number of manually or electrically actuated valves or sluice gates supplied.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage or on the site, etc., as well as all royalties, patent rights, etc., for the flow-control valves or sluice gates complete with electric motor, gearbox, motor control, headstock, seals, guide rails, frame, etc., as specified.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

SS 7.11.2 Installation, testing and commissioning of manually or electrically

actuated flow-control valves or sluice gates **No.**

The unit of measurement shall be the number of manually or electrically actuated flow-control valves or sluice gates installed.

The tendered rates shall include full compensation for the installation, making good all the damaged corrosion-protection areas, testing, calibration, commissioning and maintenance of the flow-control valves or sluice gates and for all other costs and actions that are necessary for obtaining a complete and efficiently working system.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the relevant equipment unless the required operation and maintenance manuals have been supplied and have been accepted by the Engineer.

SS 8. INSTALLATION, ERECTION AND FIXING OF EQUIPMENT TO CONCRETE STRUCTURES

SS 8.1 SCOPE

This section covers the installation, erection and fixing of equipment to concrete structures.

SS 8.2 INSTALLATION AND ERECTION

The Contractor shall be responsible for ensuring that any work carried out by his own staff or any Sub-Contractor working for him is carried out to his satisfaction and that the equipment meets all the requirements of the specification as well as all statutory regulations applicable to the works.

All connectors such as anchor bolts (cast in situ or grouted), expansion bolts, base plates, etc., shall be designed or selected by the Contractor to suit the equipment supplied by him and to ensure compliance with these specifications.

All mechanical equipment supplied and delivered under this contract shall be placed and firmly fixed in position by the Contractor on holding-down bolts supplied by him to ensure that it will operate efficiently to the satisfaction of the Engineer. Affixing shall mean the supply and installation of all nuts, bolts, plates, grout, etc., and shall include all labour and other activities such as sawing, scabbling, cutting, filing, grinding, drilling, welding, the repair of corrosion protection, grouting, etc., required for the fixing of the equipment. If the Contractor does not have the qualified personnel at his disposal, he shall appoint the necessary specialists at his own cost. Specialist shall be approved by the Engineer prior to the commencement of such work.

If the Employer has entered into civil-engineering contracts the duration of which overlaps with and of which the works interfaces with this contract, those Contractors will be required to leave openings in any concrete structures constructed by them in accordance with the requirements of the Contractor and as authorised by the Engineer. The Contractor shall then erect, install and affix all relevant equipment to the concrete, ready for commissioning.

The Contractor shall, within three weeks of the contract having been awarded, submit details of pockets, sleeves, holding-down bolt holes, etc., for incorporation in the civil design, failing which, the cost of cutting or drilling pockets, installing sleeves, etc., will be for the Contractor's account.

The sealing of holes made by others through concrete or left by them, intended for the installation of equipment supplied under this contract, shall be undertaken by the Contractor.

The Contractor shall be responsible for providing all bolts, nuts and washers, steel supports, brackets, etc. for fixing mechanical equipment in position. The cost of fixing and providing supports shall be included in the tendered rates and sums.

All holding-down bolts cast into the concrete, and all bolts, nuts and washers which will be permanently or occasionally below water level, shall be of 316L stainless steel unless otherwise specifically approved by the Engineer. All other bolts, nuts and washers shall be galvanised in accordance with the section dealing with corrosion protection.

Before erection, the Contractor shall check all levels, dimensions of holes, supports, fixtures, pipes, and all other relevant work done under other contracts to ensure that the plant will fit correctly into the structures provided.

All dimensions of all equipment shall be checked by the Contractor after manufacture and on delivery.

Grouting shall be carried out as specified in the section dealing with civil engineering work and shall be included in the tendered rates for the installation of equipment.

It is the Contractor's responsibility to verify that the concrete or civil structure will sustain the loads imposed by the fasteners and the installed equipment, before such equipment is installed.

Equipment shall be mounted and affixed in such a manner as to ensure:

- a) that it complies with the manufacturers specifications,
- b) that it is plumb and aligned with all structural elements,
- c) that vibration is contained, and
- d) that the installation is safe.

SS 8.3 FASTENERS

The Contractor shall refer to the detail specifications for the preferences in fastener types for this project. Notwithstanding the preferences indicated, it is the Contractor's responsibility to ensure that the load limits specified below are not exceeded.

The Contractor shall make alternative offers in a covering letter if the preferences indicated in the detail specifications should cause any application to be outside the limits as set out below.

All fasteners shall be standard equipment (for example Upat, Hilti, etc.) and only high quality equipment will be accepted.

SS 8.4 Light duty expansion fasteners

A light duty fastener is defined as a nail or screw which, when driven or screwed into a nylon or light metal sleeve inserted in a drilled hole, forces the sleeve to expand. Typically, these fasteners are referred to as "Standard Fixings". For examples refer to a supplier catalogue.

These fasteners shall only be used for light duty applications such as the surface mounting of small diameter pipes and ducts, wall mounting of signs and boards, etc.

The maximum allowable working loads in shear and tension shall not exceed 800 N in the application of these fasteners.

Only standard equipment as supplied by reputable suppliers shall be utilised.

The Contractor shall ensure that the working load limits for fasteners, as specified by the supplier, are not exceeded.

Only drilled holes will be allowed, and the depth, diameter, spacing and distance from edges shall be in accordance with the supplier specifications.

The Contractor shall ensure that the correct tools, as specified by the supplier, are used in the installation of fasteners.

All fasteners shall comply with the corrosion protection requirements as set out in the section dealing with corrosion protection of these specifications. Suitably protected nails, screws, washers and sleeves shall be used. Plastic or nylon sleeves shall be supplied by reputable suppliers.

SS 8.5 Heavy duty expansion fasteners

A heavy duty expansion fastener is defined as a stud with a nut, or a bolt, pulling an expansion cone(s) through a metal sleeve, usually split, causing the sleeve to expand. Typically, these fasteners are referred to as "Heavy Duty Fixings". For examples, refer to a supplier catalogue.

These fasteners may be used for medium to heavy duty applications such as the fixing of mechanical equipment (pumps, compressors, etc.), fixing of structures and brackets, etc. to civil structures including fixing to suitably reinforced floors, plinths, walls and ceilings.

The working loads in shear and tension for the application of these fasteners shall fall in the range 0,8 kN to 30 kN.

Only standard equipment supplied by reputable suppliers shall be utilised.

The Contractor shall ensure that the working load limits for the fasteners, as specified by the suppliers, are not exceeded.

Only drilled holes will be allowed, and the depth, diameter, spacing and distance from edges shall be in accordance with the supplier specifications.

The Contractor shall ensure that the correct tools, as specified by the supplier, are used in the installation of fasteners.

All fasteners shall comply with the corrosion protection requirements as set out in the section dealing with corrosion protection of these specifications. Suitably protected studs, bolts, nuts, washers and sleeve parts shall be used. Locking mechanisms or devices shall be utilised where high vibration levels are present. Studs and bolts shall be hot dipped galvanised, cadmium plated zinc coated or stainless steel, suitably selected according to the loads imposed and the corrosion environment of the application.

SS 8.6**Chemical anchors**

Chemical anchors are used for heavy duty applications and are defined as studs driven through a capsule filled with a suitable chemical substance. After a specified curing time the studs are set tight in their holes and ready for use. Typically, these fasteners are referred to as 'Chemical Anchors'. For examples refer to a supplier catalogue.

These fasteners may be used for medium to very heavy duty applications such as the fixing of large mechanical equipment (pumps, compressors, etc.), fixing of large, heavy structures, etc. to civil structures. This includes fixing to suitably reinforced floors, plinths, walls and ceilings.

The permissible working loads in shear and tension shall fall in the ranges 15 - 60 kN and 20 - 70 kN respectively for the application of these fasteners.

Only standard equipment supplied by reputable suppliers shall be utilised.

The Contractor shall ensure that the working load limits for the fasteners, as specified by the suppliers, are not exceeded.

Only drilled holes or pockets will be allowed, and the depth, diameter, spacing and distance from edges shall be in accordance with the supplier specifications.

The Contractor shall ensure that the correct tools, as specified by the supplier, are used in the installation of fasteners.

All fasteners shall comply with the corrosion protection requirements as set out in series 1 of these specifications. Suitably protected studs, bolts, nuts, washers and sleeve parts shall be used. Locking mechanisms or devices shall be utilised where high vibration levels are present. Studs and bolts shall be hot dipped galvanised, cadmium plated zinc coated or stainless steel, suitably selected according to the loads imposed and the corrosion environment of the application.

SS 8.7**MEASUREMENT AND PAYMENT**

All equipment and labour required for the installation, erection and fixing of equipment to structures shall be included in the tendered rates for installation for the relevant equipment, as measured in the relevant section.

SS 9. DRY-WELL PUMPING EQUIPMENT

SS 9.1 SCOPE

This specification covers the supply, delivery, installation, testing, commissioning and payment item descriptions for dry-well pumping equipment. Dry-well pumping equipment shall mean pumping equipment of which the motors may or may not be submersible, but which operate in a non-submersible mode.

SS 9.2 STANDARDS

SS 9.2.1 National and international standards

The latest edition, unless a specific edition is cited, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

[10] BS 5316, Part 1	Acceptance tests for centrifugal, mixed flow and axial pumps
[11] ISO 281/1	Rolling bearings – Dynamic load ratings and rating life
[12] BS EN ISO 9906	Rotodynamic pumps. Hydraulic performance acceptance tests.
[13] BS 5315	Hose clamps (worm drive type) for general purpose use (metric series)

SS 9.2.2 Standard specifications included in this contract document

The following standard specifications shall be read in conjunction with this specification and shall be deemed to form part thereof:

Standard Specification	Electric motors
Standard Specification	Power transmission couplings
Standard Specification	Corrosion protection
Standard Specification	Testing, commissioning and trial operation

SS 9.3 TECHNICAL REQUIREMENTS APPLICABLE TO ALL PUMP TYPES

SS 9.3.1 Pump layout

Together with their tenders, tenderers shall provide full details and drawings of the proposed pump layout, including all pipework to facilitate coupling with existing pipes which shall be subject to the approval of the Engineer before acceptance of the tender. The design of all pipework, if required by the detail specification, and layout shall be included in the tendered rates. The tenderer shall submit details with regard to the required plinth sizes and civil requirements in order to install the equipment.

SS 9.3.2 Material

The Contractor shall take cognisance of the operating environment and the properties of the pumped liquid when selecting the materials of manufacture for the pump components. Full specifications in this respect shall accompany the tender and the tenderer's advice will be considered.

SS 9.3.3 Condition monitoring

Pumps fitted with motors rated in excess of 110 kW shall be designed to accept transducers for the monitoring of:

- 1) the vibration levels in three mutually perpendicular directions, and
- 2) the lubricant temperature of the bearings.

Adequate access around the bearing housing shall be available for the positioning of transducers.

The system analyzer to be used to interface with the transducers will be detailed in the detail specifications and the Contractor shall ensure that his fittings on the pumps are compatible with suitable transducers. Accelerometer type transducers are preferred for vibration monitoring.

SS 9.3.4 Pump casings

Pump casings shall be manufactured from high-grade cast steel or grey iron No 30, rigidly secured to a bed plate or base, and shall be finished off smoothly before a high-quality corrosion protection system is applied. The casing shall be selected for a minimum of 1 000 kPa or 1,5 times the actual discharge pressure, whichever is the greater. The removing of parts may in no way interfere with the pipework.

SS 9.3.5 Pump shaft

The shaft shall be manufactured of high-tensile steel. Where the shaft passes through stuffing boxes it shall be fitted with renewable sleeves of high-quality, wear-resistant alloy.

The shaft shall be so designed that the running speed is well below the first critical speed, and the complete rotor shall be accurately balanced after assembly.

SS 9.3.6 Pump impeller

The impeller shall be bored and keyed. All parts inaccessible to machining shall have a smooth finish. The impeller shall be hydraulically, statically and dynamically balanced.

SS 9.3.7 Bearings

Only ball or roller bearings shall be installed and bearings shall have a minimum L10h basic life rating of 25 000 hours at the rated load and speed for the application unless specified to the contrary in the detail specification.

Special bearings shall be provided to absorb any axial thrust that may be caused by the characteristic of the impeller or by the type of coupling selected between the pump and the motor.

Pump shaft bearings shall be carried outside of the main casing and glands on extensions to the main casing. Bearings shall be positively sealed against water penetration.

Bearing numbers shall be given for all bearings in the pumps to facilitate replacement.

SS 9.3.8 Wearing rings

Wearing rings shall be easily replaceable.

SS 9.3.9 Shaft seals

SS 9.3.9.1 Clean-water pumps

Pumps shall be fitted with stuffing boxes and shall have packings of adequate depths unless otherwise specified in the detail specification. A lantern or water seal shall be housed between the inner and outer packing rings and shall be connected by copper tubing to the discharge volute.

The packing shall be designed to permit high speed rotation without the possibility of seizing and charring the packing material or shaft. An automatic water seal shall be provided to prevent the entry of air into the pump.

Drains from the pump seals shall be provided. These shall discharge visibly into funnel-shaped receivers before discharging to a suitable drainage point. Drainage pipework shall be included in the tendered rates for the pump.

SS 9.3.9.2 Sewage pumps

The pumps shall be fitted with stuffing boxes as above but a separate clean water supply shall be provided to the glands. This will either be done by means of pumps supplied by the Contractor or as specified in the detail specification. A mechanical seal arrangement as described below for sludge pumps may also be offered as an alternative to glands.

SS 9.3.9.3 Sludge pumps

All pumps utilized for the pumping of biological sludges shall be fitted with double, flushed mechanical seals, which shall be included in the cost of the pumps.

Pump shafts shall be hardened and accurately ground where the seal bears on the shaft.

The mechanical seals shall be supplied by a reputable supplier and shall be of the axial direction, face-type shaft seals. The rotating seal face shall be mounted on a flexible member, the latter also sealing on the shaft. The flexible member shall be manufactured from rubber, PTFE or equivalent material suitable for the operating environment.

SS 9.3.10 Coupling between pump and motor

The pump and motor shall either be separately mounted on a common base frame or the motor shall be flange mounted to the pump. The former method is preferred for centrifugal pumps and the latter for positive displacement pumps.

No V-belt couplings will be accepted, unless required in the detail specifications or approved by the Engineer. In this case, the bearings shall be suitable for such operation.

The pumps and motors shall be directly coupled with a suitable type of coupling which will satisfactorily take up minor misalignment or off-setting of the motor and pump shaft.

Refer to the standard specification on power transmission couplings for additional specifications.

SS 9.3.11 Pump motor

Unless otherwise specified, each pump shall be supplied complete with an electrical motor which shall comply with the requirements as specified in the standard specification on electric motors.

SS 9.3.12 Base plate/frame

The pump and electric motor shall be mounted and levelled on a common base plate of fabricated steel construction or cast iron. Machined facings shall be provided to receive the pump and motor.

The base plate shall be bolted down onto a concrete base. The concrete base will be constructed by others. Before fabrication is commenced with, detailed drawings of the base including its exact position in the building shall be submitted to the Engineer for approval.

The Contractor shall supply the required holding down or mounting bolts manufactured from galvanized or plated high tensile steel to be grouted into the plinth pockets by others. The Contractor shall be responsible for the grouting of the base plates/frames.

The pump shall be accurately aligned with the motor and at least two dowel pins shall be installed in the base plate.

SS 9.3.13 Accessories

The pump shall be fitted with air cocks, drain cocks, lifting eyes if the mass of the pump is more than 25 kg and all guards required in terms of the Occupational Health & Safety Act, (Act 85 of 1993).

All pumps supplied shall be fitted with glycerine filled pressure gauges on the suction and delivery sides. The pressure gauges supplied shall have a face diameter of at least 100 mm. The pressure gauge scale shall be sized such that the normal operating pressure shall be at approximately 60% of full scale, but not higher than 80% of full scale. The gauge shall be protected against the deleterious effects of surge over pressures up to the pressure rating of the pipe system. Chemical seal gauge protectors shall be installed on all gauge installations with the exception of gauge installations for potable water. Each gauge installation shall be fitted with a 3-way gauge cock to isolate the pressure gauge when not required.

The pressure gauge installation shall be such as to minimize vibration on the pressure gauge. Pressure gauges installed on separate pedestals are preferred above gauges installed on the pump or pipework.

The location of the pressure gauge fitting shall be as per BS 5315 [13] and shall also be such that the pressure gauge is easily accessible and can be clearly seen from the emergency stop station for the pump.

SS 9.3.14 Priming of pumps

Where the pump is connected to a flooded suction manifold, a master gate valve shall be fitted in the manifold as close as practicable to the water retaining wall as a safety precaution against flooding.

Where the pump is so installed that it is dependent on a foot valve or reflux valve to maintain priming at start-up it shall be provided with additional priming arrangements such as piping and valves not less than 50 mm in diameter supplied from a head tank well above the pump. An electrically operated priming pump or a hand-operated diaphragm pump will also be considered. Where an adequate volume of water is available in the discharge line at a low head, priming may be carried out by means of a bypass around the discharge reflux valve.

SS 9.3.15 Lubrication details

The pump housing shall be fitted with a sight glass or a dipstick facility to monitor oil levels where applicable.

Suitable lubrication arrangements such as accessible grease nipples shall be provided.

Full details on lubrication intervals, oil and/or grease specifications and acceptable substitutes shall be specified in the operations and maintenance manuals.

SS 9.3.16 Pump technical details and installation

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.

The head at zero delivery of the curve for the impeller selected shall be at least 1,2 times the maximum head in the pump's operational range.

The possible percentage variation of data measured on site by the supplied and/or installed instrumentation when compared with the catalogued performance data must be submitted.

All calculations for static and dynamic heads are to be based on an atmospheric pressure above sea level as specified in the detail specifications.

The Engineer or his representative reserves the right to call for -

Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or site inspection, customer reports/references and user's interviews, and/or full engineering, design and component selection details in order to check the correctness of the service life claimed.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in an "as new" condition until taken over by the Employer.

The required unobstructed space left around the installation for maintenance and servicing of the equipment shall be in accordance with the manufacturer's instructions, local authority by-laws and with the Occupational Health & Safety Act, Act 85 of 1993.

Pumps shall be statically, dynamically and hydraulically balanced, at the manufacturer's works, to within the design operating range.

If the Contractor is required to be responsible for the pipework by the detail specification, he shall ensure that overhauling and removal of the pumps is possible without extensive dismantling or any cutting of pipework.

A metal lubrication instruction plate shall be attached to the pump where it is clearly visible. The plate shall indicate the recommended lubricant, points of lubrication and the recommended frequency of lubrication.

Detailed pressure drop and net positive suction head calculations for the system shall be included in the operations and maintenance manuals.

SS 9.4

CENTRIFUGAL PUMPS

Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:

Preference will be given to pumps of the self-regulating type and where the power consumption characteristic is such that with an increase in delivery to beyond a certain limit, the power consumption decreases, thereby ensuring that the motor is not overloaded in the event of a large reduction in pumping head.

The casing for centrifugal pumps shall be horizontally or vertically split to allow removal of parts.

The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.

SS 9.5

PROGRESSING CAVITY PUMPS

Progressing cavity pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following requirements:

The pump shall be of the progressing cavity type with a stator and a rotor, similar to Mono, Orbit or approved equivalent pumps.

The stators of the pumps shall be manufactured from a suitable wear-resistant rubber and shall be formed by moulded-to-metal construction. The rubber shall be resistant to wear and heat caused by the occasional dry running of the pumps and the maximum permissible time span during which the pumps can run dry without any damage caused to the pumps, shall be indicated in the covering letter at tender stage.

The rotors shall be manufactured from stainless steel 316.

Shaft sealing shall be by packed glands with a flush-fitting lantern ring. The gland surface areas shall be hard chrome plated.

The efficiency of the pumps shall not be less than 75%. The normal operational efficiency of the pumps shall not be less than 3% below the peak efficiency of the pumps.

Each pump shall have a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange. This valve shall be included in the tendered rates.

SS 9.6 DIAPHRAGM PUMPS

Diaphragm pumps shall comply with the relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:

The Contractor shall take special care to ensure that the materials of construction, in particular the diaphragm material, are resistant to the corrosive actions of the liquid being pumped. The relevant liquids are frequently highly corrosive chemicals such as ferric chloride.

The pump mechanism for diaphragm pumps shall incorporate a positive return of the plunger. Pumps with spring-returns on the plungers are not acceptable. The pumps shall be single units and shall be of a modular, standard design.

Flow dampers shall be installed if required to protect the reflux valve seats incorporated in the pump head.

Each pump shall have a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange. This valve shall be included in the tendered rates.

SS 9.7 PERISTALTIC PUMPS

Peristaltic pumps shall only be supplied if specified in the detail specification.

The pump shall consist of a pump casing with rotor and pumping tube, the rotor being driven through a gearbox by a flange mounted electric motor. The motor and gearbox shall comply with the standard specification on electric motors and the standards specification on gearboxes.

The pumping tube or hose shall be manufactured from a compliant, tough material resistant to cracking and special care shall be taken to ensure that it is resistant to chemical attack from the pumped liquid. The tenderer shall indicate at tender stage which material he intends to use for the specified application.

The pumping hose shall have an outer diameter to inner diameter ratio of not less than 1,75.

The pumping hose shall be easy to replace and each pump shall be supplied with a spare replacement hose.

The rotor shall have at least two rollers mounted on roller bearings, and the rotor shaft shall also be supported in roller bearings. All bearings shall be permanently sealed.

It shall be possible to rotate the pump in the reverse direction for cleaning/maintenance purposes.

SS 9.8 SCREW PUMPS

SS 9.8.1 Trough Design Requirements

The pump trough shall consist of a benched cement trough with a fabricated stainless steel deflector. The civil Contractor shall be responsible for benching the pump trough but, the mechanical Contractor shall submit his proposed method statement to the Engineer for his approval and as instruction to the civil Contractor prior to commencing with the work

SS 9.8.2 Screw Design Requirements

- a) The tip speed of the screw flight shall not exceed 2,2 m/s.
- b) The central tube, end plates, shafts and fixing arrangements shall be designed to prevent distortion and fatigue in accordance with accepted standards of design. The design and the assessment of design life shall be in accordance with BS 5400, as applicable or equivalent standard. Stress calculations shall not include an allowance for

BID DESCRIPTION: TENDER FOR THE REFURBISHMENT AND UPGRADE OF PUMP STATION 34, UPGRADE OF RISING MAIN PIPELINE FROM PUMP STATION 2 TO LEEUWKUIL WASTEWATER TREATMENT WORKS, UPGRADE OF WASH WATER PUMP STATION AT LEEUWKUIL, AND REFURBISHMENT OF INLET WORKS OF LEEUWKUIL AND RIETSPRUIT

the attachment of the flights to the centre tube or for buoyancy when the screw is lifting liquid and the maximum stress in the central tube shall not exceed 20 MPa while the maximum deflection shall not exceed tube length/2500.

- c) The outer edges of each flight shall consist of a strip of EN Grade 1.4401 (316) stainless steel. The strip shall have a width of at least 75 mm and this shall be welded to the main part of the screw blade. The strip shall be at least as thick as the flight itself and shall be fully welded on both sides. The leading edges of each flight shall also be provided with a stainless steel strip to the same specification.
- d) A screed strip shall be provided on the outer edge of the flight. This shall be welded in place and shall be of the same material as the stainless steel strip. This shall be carefully removed after the concrete benching has been approved.
- e) Screw flights shall be evenly spaced and accurately fabricated to a cylindrical shape. Stub shafts shall be well radiused at any change of section and shall be readily removable for replacement. The fixing arrangements for stub shafts and end covers shall be air and water tight. All other joints, spigots, threads and crevices of any nature shall also be sealed during assembly using flexible sealants to prevent the ingress of water, moisture or air.
- f) The screw shall be provided with at least two suitably positioned lifting lugs.
- g) Fabrication shall comply with the General Specifications "Fabrication of Steels" and "Welding".

SS 9.8.3 Upper Bearing Design Requirements

The upper bearing shall be designed to take the axial thrust. It shall be possible to easily dismantle and replace this bearing assembly without removing the stub shaft. Means for supporting and holding the screw pump while this is done shall be provided. The bearing arrangement shall be grease lubricated and fitted with seals on both ends. Care shall be taken to ensure that the greasing point is readily accessible.

The bearings shall be designed for an L10 life in excess of 100 000 hours

SS 9.8.4 Lower Bearing Design Requirements

The bottom bearing shall be a sleeve bearing of the grease-lubricated, heavy-duty type mounted in a cast-iron housing. The bearing shall be sealed against the ingress of liquids. The design shall be such that rags and similar material cannot accumulate around the shaft at the bearing.

The bottom bearing shall be continuously lubricated by a grease pump while the screw pump is in operation. One grease pump shall be provided per screw pump and the grease pump output shall be adjustable. The grease container shall have a capacity of more than 1 kg and the grease level shall be indicated. The container shall be easy to refill without stopping or affecting the operation of the pump. The pump shall incorporate a device to release air trapped in the grease during filling. A device, such as a clear length of glass pipe in a protection sleeve, shall be provided which will allow the Operator to visually confirm the grease flow in the pipeline.

The grease shall be piped to the bottom bearing via EN Grade 1.4401 (316) stainless steel pipe with stainless steel fittings. The pipe shall be visible wherever this is feasible.

Alternative designs of bottom bearings and their lubrication will be considered acceptable if a written report including the Employer's confirmation of successful operation over a five year period is provided.

The bearings shall be designed for an L10 life in excess of 100 000 hours.

SS 9.8.5 Drive train Design Requirements

The motor and gearbox shall be mounted within a closed room. The drive shall be provided by a shaft which passes from the room into the screw channel area.

The upper bearing shall be mounted on a rigid support frame designed to transfer the thrust load to the concrete structure. The upper bearing housing shall preferably be foot mounted but may be flange mounted. The shaft shall, in either case, be provided with a seal between the screw and the gearbox/motor room. Arrangements which incorporate a single baseplate for both motor and gearbox are preferred.

A flexible coupling of the elastomeric type shall be provided between the gearbox and the screw shaft. A means of aligning the motor and the gearbox shall be provided. Gearboxes shall have environmental protection to IP 55 or higher and shall comply with the Standard Specification "Gearboxes" and "Power Transmission Couplings". The service factor used shall not be less than 2.

A backstop shall be provided in order to prevent reverse rotation. The complete unit shall have environmental protection which is suitable for washing by hose.

SS 9.8.6

General Requirements

The motor rating shall be sized to be at least 10 % greater than the required shaft power for the pump in this application.

Motors shall have ingress protection to at least IP 55 and shall comply with the electrical specifications. Motors shall be provided with a tropical rated corrosion protection system.

Motors shall comply with the General Specification "Electric Motors"

Fabrication shall comply with the General Specifications "Fabrication of Steels" and "Welding". The complete screw, with the exception of the flight tips, shall be of a suitable grade of structural carbon steel. Flight tips shall be of EN Grade 1.4401 or better.

Fasteners shall be of EN Grade 1.4401 stainless steel.

Components sealed inside the building may be of hot-dip galvanized and painted carbon steel, but all exposed metal shall be EN Grade 1.4401 (316) stainless steel

Installation work shall comply with the General Specification "Installation"

Grease pipework shall be supported with stainless steel pipe supports at distances not exceeding 500 mm. Pipework shall comply with the General Specification "Pipework"

The screw drum and blades shall be protected against corrosion by applying a suitable two part epoxy suitable for immersion. The steel surface shall be abrasive blasted to ISO-Sa3 in accordance with ISO 8501. This shall be followed by three coats of epoxy coatings, each with a dry film thickness of 140 µm. The total dft provided shall be 420 µm. The coating shall cover the stainless steel strip used on the screw blade outer edges and the leading edges. Each coat shall be of a different colour.

Corrosion Protection shall comply with the General Specification "Corrosion Protection".

Fasteners shall be of EN Grade 1.4401 (316) and shall comply with the General Specification "Fasteners"

Gearbox oil temperature shall be measured and displayed.

An hour meter which cannot be reset shall be provided

The Contractor shall satisfy himself that no operational difficulties will occur with the equipment proposed. If the Contractor deems that sunscreens will be necessary for the equipment to be supplied, the sunscreens shall be provided in the form of fibre glass or aluminium panels mounted on a stainless steel or GRP framework. A number of panels shall be hinged to give an evenly distributed 50% open area along the length of the screw. The sunscreen structure and panelling shall be able to accommodate a point load of 150kg at any point of the structure or an evenly distributed line load of 150kg/m over the centre of the screw shaft (both loads shall be able to be accommodated). All fasteners shall be in at least EN Grade 1.4401 (316) stainless steel.

The Contractor shall make provision in his tender price to provide the following spares:

- a) A complete stub shaft, spare bottom bearing and a set of all seals shall be provided for each unit; i.e. one complete shaft, bearing and seals sets. Spare bearing housings and pedestals must also be provided if these are required to achieve replacement of the bearing surfaces.
- b) One complete spare top bearing and a set of all seals shall be provided (a spare bearing housing and flange, or equivalent, is not required).
- c) Thirty refills shall be provided for the grease pump container

One emergency stop shall be provided near the motor/gearbox assembly and another shall be located alongside the screw at a suitable point

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect the screw fabrication in the workshop prior to corrosion protection and prior to dispatch to Site. If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the fully assembled equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

SS 9.9

SPECIAL REQUIREMENTS IN RESPECT OF CHEMICAL DOSING PUMPS

The Contractor shall refer to the standard specification on chemical dosing plant with regard to special requirements for chemical dosing plant and chemical dosing pumps shall also conform to the following:

- (a) Chemical dosing pumps shall either be progressing cavity, diaphragm or peristaltic type pumps unless otherwise specified in the detail specification.
- (b) The Contractor shall select suitable materials of manufacture for all components in order to render the pump resistant to chemical attack from the pumped liquid whilst retaining effective performance from the pump.
- (c) The flow rate of diaphragm pumps shall be variable between certain values given in the detail specifications. A fine-adjustment facility shall be incorporated with positively distinguishable increments as given in the detail specifications. The stroke length shall be manually adjustable and shall be calibrated as a percentage of the full stroke.
- (d) Variable speed drives may be required on all types of pump as specified in the detail specification. The Contractor shall ensure that the electric motor has sufficient cooling facilities while the motor runs for extended periods at the minimum speed setting, as prescribed by the Contractor. The minimum speed setting shall never be less than 40% of the maximum running speed.
- (e) The Contractor shall include in the maintenance manuals of the pump, graphs which show the flow of the liquid chemical (in m³/h) vs the stroking speed (in strokes per minute) for various stroke lengths, varying from 10% to 100% of the full stroke, in steps of 10% of the full stroke.
- (f) Gearboxes may be fitted to dosing pumps in accordance with the standard specification on gearboxes, and the AGMA service factor, based on installed power, shall not be less than 1,75. Details on the service factor calculations are supplied in the standard specification on gearboxes.

SS 9.10 TESTING AND COMMISSIONING

SS 9.10.1 Test to be performed

All pumping equipment shall be subject to the commissioning tests as described in the standard specification on testing and commissioning.

At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow rate or volumetric flow testing facilities will be supplied by others unless otherwise specified in the detail specification.

The operating point of each pump shall be determined.

Efficiency tests will only be performed when specified in the detail specification.

NPSH tests will only be performed when specified in the detail specification.

SS 9.10.2 Pump operating point

During the day-01 commissioning tests the pump operating point shall be determined by observing the following:

- a) pump delivery and suction pressures, and
- b) electric motor power consumption.

If no efficiency tests are required in the detail specification then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

SS 9.10.3 Flow rate (delivery), efficiency and NPSH tests

Testing will be done in accordance with BS EN ISO 9906 [12].

Power consumption of electric motors shall be as determined by the three Wattmeter method where efficiency tests are required in the detail specification.

SS 9.10.4 Test conditions

All tests will be performed in situ.

The pumped medium or liquid specified as the process liquid in the detail specifications shall be utilized during the tests. The Contractor shall obtain from the pump manufacturer, the test point for clean water corresponding to the specified duty point for the pumped liquid, in order to relate the measured performance to the pump supplier's curves which are based on water.

SS 9.10.5 Additional tests

Additional tests may be specified in the detail specification.

SS 9.11 CORROSION PROTECTION

All corrosion protection shall be in accordance with the standard specification on corrosion protection.

SS 9.12 MEASUREMENT AND PAYMENT

SS 9.12.1 Supply and delivery of dry-well pumping equipment

No.

The unit of measurement shall be the number of dry-well pumping installations supplied and delivered.

The tendered rate shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site

and off-loading including all handling of the complete dry-well pump unit which shall include the following:

- i) the pump unit,
- ii) the required prime mover (electric motor unless otherwise specified in the detail specification),
- iii) power transmission coupling,
- iv) all safety guards,
- v) pressure ports and all required bleeding screws and priming valves,
- vi) suction and delivery side pressure gauges,
- vii) pressure relief valves, where required,
- viii) base frame, onto which the above shall be mounted,
- ix) all required fasteners holding down bolts and auxiliary materials to render a complete and operational pump unit, and
- x) drainage pipework.

Separate items will be scheduled in the schedule of quantities for different types and sizes of dry-well pumping equipment.

SS 9.12.2	Installation of dry-well pumping equipment	No.
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The unit of measurement shall be the number of dry-well pumping installations installed.

The tendered rate shall include full compensation for the site handling and positioning of the dry-well pumping equipment including the fastening of the equipment in its designated position, including full compensation for the following:

- i) Alignment of prime mover and pump unit, if the unit was shop assembled the correct alignment shall never the less be proved on site.
- ii) Piping of all gland drains to a suitable building drain.
- iii) Coupling of all required pipe flanges (suction delivery and if required seal water pipes) including all required gaskets, nuts, bolts and washers.
- iv) All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be scheduled in the schedule of quantities for different types and sizes of dry-well pumping equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the pumping equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the Engineer.

SS 9.12.3	Testing and commissioning of dry-well pumping equipment	No.
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The unit of measurement shall be the number of dry-well pumping installations tested and commissioned.

The tendered rates shall include full compensation for all preliminary tests, delivery, NPSH and efficiency tests if required by the detail specification and commissioning tests. The commissioning tests shall include the day-01 and day-30 test sessions as well as the 30-day monitoring period as described in the standard specification on testing and commissioning.

Separate items will be scheduled in the schedule of quantities for different types and sizes of dry-well pumping equipment.

SS 10. HOISTING EQUIPMENT

SS 10.1 SCOPE

This section covers the manufacture, transportation, installation, testing and commissioning of hoisting frames and manual or electrically driven chain hoists and crawls.

SS 10.2 STANDARDS

SS 10.2.1 National and International Standards

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications, and codes of practice shall be read in conjunction with this specification and shall be deemed to be part thereof:

SANS 2408	: Steel wire ropes for general purposes - Characteristics
ISO 1328-1	: Cylindrical Gears - ISO System of Accuracy - Part 1
SANS 1592	: Short-link steel chain (close-tolerance) for lifting appliances
BS EN 13001-1	: Cranes — General design — Part 1: General principles and requirements.
BS 2853	: 1957 Specification for the design and testing of steel overhead runway beams
BS 3037	: Part 1 : 1958 : Double flanged parallel-tread tyres
BS 4235	: Specifications for metric keys and keyways
BS EN 1011-1	: Welding — Recommendations for welding of metallic materials Part 1: General guidance for arc welding
BSI BS 7121-1 to 3	: Code of practice for safe use of cranes
SANS 10044	: Welding
SANS 10094	: The use of high-strength friction-grip bolts
SANS 10142-1	: The wiring of premises
SANS 1411-1	: Materials of insulated electric cables and flexible cords Part 1: Conductors
SANS 1411-2	: Materials of insulated electric cables and flexible cords Part 2: Polyvinyl chloride (PVC)
SANS 1804-2	: Induction motors Part 2: Low-voltage three-phase standard motors
SANS 1222	: Enclosures for electrical equipment

SS 10.2.2 Proprietary Branded Items

Where an item is a standard proprietary brand item, the Contractor shall ensure that the latest edition, including all amendments up to date of tender, of the manufacturer's written specifications, operating and maintenance documentation, written guarantees, and all applicable national and international standards, publications and codes of practice applicable to the item, shall be read in conjunction with this specification, and shall be deemed to form part thereof. Such specification, operating and maintenance documentation and a written guarantee of the manufacturer shall form part of the operating and maintenance manuals to be supplied by the Contractor. Prior to ordering a standard proprietary brand item, the Contractor shall obtain the approval of the Engineer. The use of a proprietary brand item for which no written manufacturer specifications, no operating and maintenance documentation and no written guarantee exists, shall not be permitted without the approval of the Engineer.

SS 10.2.3 Standard Specifications Included in this Contract Document

The following standard specifications bound in this document, shall be read in conjunction with this specification:

Std Spec	:	General, corrosion protection
Std Spec	:	General design
Std Spec	:	Installation, erection and fixing of equipment to concrete structures
Std Spec	:	Power transmission couplings
Std Spec	:	Gearboxes
Std Spec	:	Electric motors

SS 10.3 GENERAL REQUIREMENTS FOR ALL HOISTING EQUIPMENT

SS 10.3.1 Introduction

Apart from the general requirements for all hoisting equipment specified in this sub-clause, hoisting equipment shall also comply with the additional requirements as specified under other sub-clauses in this section, depending on the type of hoisting equipment.

SS 10.3.2 Structural Steelwork

All structural steelwork and profiles shall be of the highest quality and shall conform to BS 436 Part 2.

All bolted connections shall comply with the requirements of SANS 10094, and all welded joints shall comply with the requirements of SANS 10044.

Welding shall only be permitted in workshops or on flat surfaces on the site. All *in situ* joints and connections of structural steel profiles to be done on the site, shall be bolted. All site welding shall be approved by the Engineer. If welding is done to any steel member or plate cast into concrete, care shall be taken to prevent damage to the concrete by the heat of the welding operation.

SS 10.3.3 Welding

All welding shall be carried out under the supervision of a qualified person, who shall lay down the welding procedure and the order in which the welding shall be done.

All welding shall conform to the Code of Practice for Welding: SANS10044 Parts I to VII.

All welds shall be thoroughly cleaned.

SS 10.3.4 Fixing of Structural Steel to a Concrete Wall

Structural steel, or any part of the hoisting equipment, to be fixed to the building, shall only be fixed to a structural concrete member of the building specifically designed for such fixtures.

Suitable anchorages shall be cast into the concrete by the Civil Contractor for the fixing of any structural steel members to the building. Details of such fixings shall be supplied by

the Mechanical Contractor before the concrete is cast. Should any other fixing be required for which no anchorage has been cast into the concrete, the method of fixing such structural steel to the concrete shall be in accordance with the standard specification on installation, erection and fixing of equipment to concrete structures and subject to approval by the Engineer.

No structural steel member shall be fixed to brick walls.

The corrosion protection of structural steel work shall comply with the standard specification on corrosion protection and shall be suitable for the operating environment.

SS 10.3.5 Lifting Cable/Rope

Cable/rope used for lifting purposes shall comply with SANS 2408 and shall be manufactured from materials suitable for the operating conditions of the lifting equipment.

The cable shall be of sufficient length to reach any one of the lifting or hoisting eyes, lugs or handles of the equipment with the hoisting device in its intended working position.

The cable shall be sized for the specified safe working load plus a factor of safety of not less than four.

The cable drums, pulleys and sheaves shall be dimensioned to ensure long rope life and to minimise rope wear.

Cables used shall be non-spin cables where only one lifting cable is used.

SS 10.3.6 Chains

Lifting chains shall comply with SANS 1592 and shall be manufactured from suitable materials and shall be corrosion protected to suite the operating environment of the hoist. The chain shall be selected for the specified safe working load and shall include a factor of safety of not less than four.

The design of the chain wheels and pulleys shall minimise wear and stresses on the chain.

SS 10.3.7 Safety Hook

A safety hook shall be supplied on the free end of each cable. The hook shall have a safety factor of 6, and shall be supplied complete with a spring-loaded safety clip or hinged plate closing the opening of the hook and preventing the unhooking of slings when slack. The hook shall furthermore be provided with a device allowing free rotation.

SS 10.3.8 Design Calculations

The design calculations of the hoisting equipment shall be made available for perusal by the Engineer on request of the Engineer.

SS 10.3.9 Bearing Requirements

All bearings shall be ball or roller bearings and shall be of the medium or heavy-duty type. The bearings shall be designed for a minimum L_{10h} , basic life rating of 20 000 hours of operation. The bearings shall be precision aligned to ensure vibration-free operation of the shafts. Permanently lubricated bearings shall be used wherever such application is feasible. All other bearings shall be lubricated by means of a standard lubrication system by which adequate lubrication is provided during the operation of the bearings.

SS 10.4 HOISTING FRAMES

Apart from complying with the general requirements on hoisting equipment as specified above all hoisting frames shall comply with the additional requirements specified in this sub-clause and in the standard specification on structural metalwork and corrosion protection.

The hoisting frame shall not restrict access to the equipment to be serviced and shall not clash with or damage the equipment. All hoisting frames shall be visibly marked with a SWL sign and shall be supplied with a test certificate.

SS 10.4.1 A-Frames

The A-frame shall have a horizontal lifting I-beam on which a manual or electric crawl hoist shall operate. The lifting beam shall have a span equal to the maximum distance between

**BID DESCRIPTION: TENDER FOR THE REFURBISHMENT AND UPGRADE OF PUMP STATION 34,
UPGRADE OF RISING MAIN PIPELINE FROM PUMP STATION 2 TO LEEUWKUIL WASTEWATER
TREATMENT WORKS, UPGRADE OF WASH WATER PUMP STATION AT LEEUWKUIL, AND
REFURBISHMENT OF INLET WORKS OF LEEUWKUIL AND RIETSPRUIT**

the service point and an accessible point where the load can be safely off-loaded. This distance shall be specified in the detail specification or be detailed on the drawings. The lifting beam shall be fitted with end stops at both ends of which at least one shall be removable.

A-frames shall have not less than two A-shaped support legs with additional support legs installed should the total length of the lifting beam necessitates mid-span supports.

The A-frame shall be either a mobile or fixed installation as specified in the detail specification.

A mobile hoisting frame shall have at least four retractable wheel assemblies, one on each corner. Each wheel assembly shall be of the castor-action type and all wheels shall be at least 200mm in diameter to facilitate easy travelling across all standard types of open-grid flooring. Each of the wheel assemblies shall consist of a twin set of polyurethane tyres, each of 76 mm tread width, bonded to cast-iron hubs or an approved equivalent type. The load capacity of each wheel shall be double the distributed wheel load of a fully loaded hoist including the weight of the frame and hoist. The wheels shall be in a retracted position during hoisting operations. Retraction and extension of the wheels shall be effected by jack-screwing the vertical castor shaft by hand with a suitable removable handle.

The wheels shall be non-retractable should the specified safe working load be low enough not to overload the wheels under maximum wheel load conditions and all the wheels shall be fitted with foot brakes.

The Contractor shall submit detailed drawings of the A-frame for approval by the Engineer.

A-frames shall be supplied with a hoist and carriage that shall operate on the lifting beam of the frame.

The hoist used on the lifting beam shall be manually or electrically driven and shall be fixed on a manually or electrically driven crawl. Details of the hoist and carriage shall be supplied in the detail specification and shall comply with the section in this document regarding manual and electric crawls and hoists.

Permanent A-frames shall be fixed to concrete structures with stainless steel anchors in accordance with the standard specification on the installation and fixing of equipment to concrete structures.

All hoisting frames shall be supplied with a test certificate in accordance with the section regarding testing and commissioning of hoisting equipment.

SS 10.4.2 Lifting Davits and Jib Cranes

SS 10.4.2.1 Lifting Davits

Apart from compliance with the general requirements for all hoisting equipment, all lifting davits shall comply with the additional requirements specified in this sub-clause.

Unless otherwise specified or shown on the drawings, lifting davit shall be portable and shall operate on a rotating davit-principle. The davit shall be inserted in a socket cast into concrete or fixed otherwise. The vertical mast of the davit shall rotate by means of a horizontal handle.

A cable winch shall be fixed to the mast. The cable shall be rigged from a winch through a pulley at the tip of a horizontal beam fixed to the top of the mast, unless otherwise shown on the drawings.

The winch shall be designed to allow one person to operate it unaided to lift or lower the load specified in the detail specification. The winch shall have a factor of safety of not less than 6 and shall be of a worm gear construction that will not allow the winch to rotate freely under maximum load conditions without additional work input on the handle by the operator. The Contractor may submit details of alternative winch systems for approval.

The Contractor shall submit a detailed drawing of the proposed lifting davit for approval by the Engineer.

SS 10.4.2.2 Jib Cranes

Wall mounted jib-cranes shall comply with the standard requirements for all hoisting equipment specified in this section and with the additional requirements specified in this sub-clause.

The jib crane shall have a lifting hook onto which a manual or electric chain hoist can be fitted. The jib crane shall rotate out of the working area when not in use and shall be stored against the wall. The Contractor shall submit detailed drawings of the jib crane to the Engineer for approval.

Wall mounted jib cranes shall be fixed to concrete structures in accordance with the standard specification on installation and fixing of equipment to concrete structures. The position and method of fixing of the jib crane shall be subject to the Engineer's approval.

SS 10.5 MANUAL CRAWL AND CHAIN HOISTS

Apart from compliance with the general requirements for hoisting equipment specified in this section, manual crawl and hoist units shall comply with the additional requirements specified in this sub-clause.

Manual crawls shall be installed on single lifting I-beams and shall be chain driven unless stated otherwise in the Detail Specification. The I-beam shall be supplied by others unless stated otherwise in the detail specification.

The crawl carriage shall be fitted with not less than four steel wheels that shall be sized for the safe working load of the specified lifting beam.

Two of the carriage wheels shall be chain driven through a gear ratio that shall ensure that the operator does not have to exceed more than 20 kg of downward force on the drive chain during operation. The carriage shall have a minimum displacement along beam of 200 mm for every downward chain stroke of 500 mm.

The crawl carriage shall have an attachment point onto which the hoist shall hook.

The hoist shall use crane chain to lift the load unless steel wire rope is specified in the detail specification.

The maximum downward force required at the lifting chain shall not exceed 40 kg when the maximum load is hoisted.

The hoist shall be a standard catalogued, proprietary brand product with spare parts readily available in the country of installation.

Hoist and crawl drive chains shall be long enough to enable the operation of the hoist and crawl from the lowest operator working level. Details of the maximum lift, lowest operator level and safe working load shall be specified in the detail specification or indicated on the drawings.

Full technical details of the proposed equipment shall be submitted with the tender.

SS 10.6 ELECTRICALLY DRIVEN CRAWLS AND HOISTS

Apart from compliance with the general requirements for hoisting equipment and manual crawl and hoists specified in this section, electrically driven crawls and hoisting units shall comply with the additional requirements specified in this sub-clause.

SS 10.6.1 Electric Motors

SS 10.6.1.1 AC motors

AC electric motors shall be of standard design and shall comply with the requirements of the standard specification on electric motors. All motors shall comply with the following minimum requirements:

- | | | | |
|----|----------------|---|--|
| a) | Enclosure | : | SANS 1222: Class IP55 |
| b) | Insulation | : | Class F rated for Class B temperature rise |
| c) | Power supply | : | 380/220 V; 50Hz |
| d) | Service factor | : | S3 |

SS 10.6.1.2 DC motors

Direct current (DC) motors shall, if used, comply with the following general specifications:

- a) Enclosure : SANS 1222: Class IP55
- b) DC motors with thyristor control shall be specifically designed for such a control system.
- c) The total magnetic circuit of the motors shall be of the laminated steel plate type.
- d) Time delayed reaction to sudden changes in the load shall be limited to the absolute minimum.
- e) Communication shall not be influenced by harmonic currents.
- f) The insulation of the motors shall be class F according to SANS 1804-2.
- g) The motors shall be equipped with constant-pressure springs at the brushes.

SS 10.6.2 Electrical Supply Cables and Conductors

All wiring shall comply with the latest edition of the Code of Practice for the wiring of premises, SANS 10142.

All cables and conductors shall comply with the requirements of SANS 1411-1 and the insulation of such conductors shall comply with the requirements of SANS 1411-2.

All connections to control boards, consoles and motors shall be by means of terminal boxes specially provided for this purpose and the cores of the cables shall be fitted with suitable cable lugs.

All cables shall be suitable for the purpose for which they are intended to be used. The rating of cables with a supply voltage of between 50 volts and 600 volts shall be 600/1000 volt.

Flexible cables shall be insulated with neoprene or rubber and the cores of such cables shall be insulated in a similar fashion as the cable. The copper strands of the individual wires shall have a diameter of $\pm 0,2\text{mm}$.

All power supply to the crawl and hoist shall be by means of flexible cables. Should the Contractor wish to propose, as an alternative, a system by which the power supply to the crane is done by means of a busbar system, he shall give full details of such a system to the Engineer for approval.

All flexible cables shall be supported by means of a standard support system, which shall ensure that the cables are not stretched, twisted or damaged due to excessive tension created by the movement of the crawl or hoist.

BID DESCRIPTION: TENDER FOR THE REFURBISHMENT AND UPGRADE OF PUMP STATION 34, UPGRADE OF RISING MAIN PIPELINE FROM PUMP STATION 2 TO LEEUWKUIL WASTEWATER TREATMENT WORKS, UPGRADE OF WASH WATER PUMP STATION AT LEEUWKUIL, AND REFURBISHMENT OF INLET WORKS OF LEEUWKUIL AND RIETSPRUIT

Where both the crawl and hoist are electrically driven the power supply to both units shall be by means of a single multi-core electric cable. Both the crawl and hoisting unit shall also be controlled from a single control console.

The electric motor supply cable for both the hoist and crawl motors shall be supported on a cable festoon system that shall ensure the smooth operation of the hoist and that the cables are not stretched or damaged during operation.

The supply, delivery, installation, testing and commissioning of the electrical equipment and cable festoon system from the supply point to the hoisting equipment shall fall under the scope of the hoist supplier and shall form part of this contract. A local isolator shall be supplied by others and the hoist supplier shall be responsible for the termination at the local isolator.

The payment for the electrical equipment, supply cables, cable festoon system and terminations shall be deemed included in the rates for the supply, delivery, installation, testing and commissioning of the hoisting equipment unless a separate item is scheduled in the Schedule of Quantities or it's specifically excluded in the detail specification.

The hoist and crawl motors shall both be single speed drives unless otherwise specified in the detail specification.

The hoist and crawl motors shall be pendant controlled with the pendant suspended from the hoist on two stainless steel cables.

The crawl shall be installed on a monorail crawl beam and shall have not less than four wheels of which two shall be electrically driven through a suitable gearbox.

The hoist shall be bolted onto the electric trolley with a locked connection.

The hoist shall be complete with a chain storage bag fitted to the hoisting unit suitably sized for the chain length.

SS 10.7 CORROSION PROTECTION

Corrosion protection of hoisting equipment shall be in accordance with the Standard Specification on corrosion protection and shall take into consideration the operating environment of the equipment.

Special requirements regarding corrosion protection shall be detailed in the Detail Specification. If the manufacturers' standard corrosion protection is offered, the details of this corrosion protection shall be submitted to the Engineer for approval.

SS 10.8 OPERATING AND MAINTENANCE MANUALS

Operating and Maintenance manuals shall be supplied in accordance with the requirements for Operating and Maintenance manuals as specified in Section 1 of the Standard Specifications.

SS 10.9 TESTING AND COMMISSIONING

SS 10.9.1 Factory Testing

The hoist shall be supplied with factory test certificate where the hoist was tested with a test weight of 1.25 times of the specified safe working load.

The tests shall be carried out according to test procedures specified in BS 466 and the calibration certificates of the test equipment shall be attached to the test certificate.

SS 10.9.2 Testing on Site

After the hoist has been installed on site but before the equipment is taken over by the Engineer, the Contractor shall perform an additional operating test on the hoist that shall be to the approval of and shall be witnessed by the Engineer.

The hoist shall be required to lift a load of 1.1 times its maximum lifting capacity as part of the commissioning tests. The hoist shall be required to perform all hoisting, and long travel actions under this load condition and the operation of the hoist shall be to the approval of the Engineer.

The Contractor shall supply all test loads required for this test and the costs involved for the supply of the test loads shall be included in the tendered rates for testing and

commissioning. The Electrical power requirements of the hoist shall be measured during this test by the Contractor and the results shall be to the approval of the Engineer.

SS 10.9.3 Testing of Hoisting Frames

Steel hoisting frames shall be tested on site in accordance with BS EN 13001-1 and deflections shall be measured while under a load of 1.1 times the safe working load.

The hoisting frame shall be supplied with a test certificate and the test results shall be to the approval of the Engineer.

The Contractor shall supply the test weights for this deflection test and shall supply the calibrated measuring equipment.

SS 10.10 MEASUREMENT AND PAYMENT

SS 10.10.1 Supply and delivery of hoisting frame No.

The unit of measurement shall be the number of hoisting frames supplied and delivered as specified.

The tendered rates shall include full compensation for preparing workshop details where they have not been provided in the drawings, the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading, all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and temporary bracing, transportation and loading and off-loading to render a complete and operating system.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

SS 10.10.2 Supply and delivery of chain hoist with crawl No.

The unit of measurement shall be the number of chain hoists supplied and delivered as specified.

The tendered rates shall include full compensation for preparing workshop details where they have not been provided in the drawings, the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading, all nuts, bolts, rivets, washers, holding-down bolts where specified, for cutting, waste and temporary bracing, transportation and loading and off-loading to render a complete and operating system.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

SS 10.10.3 Installation, testing and commissioning of hoisting frame No.

The unit of measurement shall be the number of hoisting frames installed, tested and commissioned as specified.

The tendered rate shall include full compensation for the installation, the making good of all damaged corrosion protection areas, testing, commissioning and maintenance of the hoisting equipment, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal shall be included on the tendered rates if required for installation.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

SS 10.10.4 Installation, testing and commissioning of chain hoists with crawl No.

The unit of measurement shall be the number of chain hoists with crawl installed, tested and commissioned as specified.

The tendered rate shall include full compensation for the installation, the making good of all damaged corrosion protection areas, testing, commissioning and maintenance of the hoisting equipment, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal shall be included on the tendered rates if required for installation.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of equipment.

SS 11. POWER TRANSMISSION COUPLINGS

SS 11.1 SCOPE

This specification covers the minimum requirements with regard to the selection, supply, installation, testing, commissioning and the payment item descriptions for of power transmission couplings.

SS 11.2 STANDARDS

SS 11.2.1 National and International standards

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS 46 Part 1

BS 4235 Part 1 & 2

BS 436

SS 11.2.2 Standard specifications included in this contract document

The following standard specifications bound in this document, shall be read in conjunction with this specification:

STD SPEC: DRY-WELL PUMPING EQUIPMENT

SS 11.3 DIRECT DRIVES / COUPLINGS

To reduce noise and vibration levels, all direct drives shall be of the flexible type which allow for misalignment unless otherwise specified.

The coupling shall be selected such that it can safely transfer 150% of the design starting torque and can safely operate up to a rotational speed of 150% of the nominal duty speed.

The motor/engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60% of the safe allowable limits specified by the supplier of the driving and/or driven equipment.

The driven equipment and electric motor shall be aligned to within 0,05 mm for equipment rated in excess of 100 kW, and to within 0,25 mm for equipment rated below 100 kW, both radially and axially, to avoid vibration.

Care shall be taken to ensure that the axial clearance between coupling flanges is well within the range specified by the supplier. The clearance shall lie not closer than 25% of the allowable range from either the lower or higher limits. No thrust shall be transferred from the motor to the driven equipment or vice versa.

All couplings shall be covered with a sturdy guard that covers but does not touch moving parts. The guard shall be bolted in position and shall be easily removable.

Direct, flexible couplings shall be maintenance-free.

Rigid couplings shall only be used if specified in the detail specifications or if prior approval is obtained from the Engineer.

SS 11.4 BELT DRIVES

Belt drives shall only be used with the permission of the Engineer or as specified in the detail specifications. The use of belt drives shall be fully motivated in a covering letter if the Contractor has specific reasons for using them.

This clause only deals with V-belts, but full details of alternatives may be submitted to the Engineer for approval.

The Contractor shall install at least two belts per coupling if belt drives are approved.

The coupling (the belts, pulleys, shafts and keys) shall be selected such that it can safely transfer 200% of the design starting torque and can supply operate up to a rotational speed of 150% of the nominal duty speed.

The motor/engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60% of the safe allowable limits specified by the supplier of the driving and/or driven equipment. Radial runout on pulleys shall not be more than 1% of the pulley diameter.

Keys and keyways for load transfer to and from shafts shall comply with BS 46 Part 1 and BS 4235 Part 1 and Part 2.

Suitable and accessible methods for adjusting the tension of the belts shall be provided.

The driving and driven pulleys and belts shall be enclosed in a single sturdy guard which allows visual inspection of the belt condition with the guard fitted. The guard shall be easily removable for belt maintenance.

Pulley sizes and ratios shall be selected such that operational belt speeds never exceed 25 m/s and are never less than 10 m/s.

The arc of contact on the small pulley shall be more than 120°. The pulley ratio shall not be less than 1,25:1, unless prior approval is obtained from the Engineer.

Belts shall be easily removed and installed for maintenance purposes and shall be to the approval of the Engineer.

SS 11.5

CHAIN DRIVES

Roller chain drives shall only be used when approved by the Engineer or as specified in the detail specifications. The use of chain drives shall be fully motivated in a covering letter if the Contractor has specific reasons for using them.

The coupling (the chain, sprockets, shafts and keys) shall be capable of safely transferring 200% of the design starting torque and can safely operate up to a rotational speed of 150% of the nominal duty speed.

The motor/engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60% of the safe allowable limits specified by the supplier of the driving and/or driven equipment.

Sprockets shall be precision machined with hardened teeth in accordance with BS 436.

Keys and keyways for load transfer to and from shafts shall be in accordance with BS 46 part 1 and BS 4235 part 1 and part 2.

Suitable and accessible methods for adjusting the tension of the chain(s) shall be provided.

The driving and driven sprockets and chain(s) shall be enclosed in a sturdy guard which allows visual inspection of the chain condition with the guard in place. The guard shall be easily removable for chain and sprocket maintenance.

For low speed applications sprockets shall not have less than 11 teeth and for moderate to high speed applications, not less than 17 teeth.

Drip feed or shallow bath lubrication is preferred. The application of heavy oils or greases shall only be considered for very low speed applications for which the prior approval of the Engineer shall be obtained. In the case of grease lubrication pre-lubricated chains with O – ring seals are preferred.

Chains shall be easily removed and installed for maintenance purposes.

SS 11.6

TESTING AND COMMISSIONING

Testing and commissioning of all power transmission couplings shall be included in the tests of the relevant motors/engines and driven equipment.

SS 11.7

MEASUREMENT AND PAYMENT

Measurement and payment for all power transmission couplings shall be deemed to be included in the rates tendered for motors/engines and driven equipment.

SS 12. GEARBOXES

SS 12.1 SCOPE

This section covers gearboxes that may be incorporated in any of the items of equipment to be supplied under the contract.

SS 12.2 GENERAL

Only well proven gearboxes of high quality will be accepted such as Hansen's or an approved equivalent in all respects.

SS 12.3 DESIGN AND MANUFACTURE

The gearbox shall be a unit specially selected for the specified application and shall employ standardised components. The helical and spur gears shall be manufactured from alloy steel and shall be thoroughly hardened prior to grinding. No worm gears will be accepted. Gears that are cut from special alloys shall not cause galvanic or chemical reactions between the gears and the gearbox shafts.

The housings shall be made of grey cast iron and shall be equipped with a breather, drain and oil refilling plugs which shall be accessible above the mounting frame. Oil level indication shall be provided either by means of a window or a dipstick.

The gearbox shall have lifting lugs for lifting purposes if its mass is more than 25 kg.

The bearings shall have a minimum L_{10h} , basic life rating of 60 000 hours at full torque rating unless specified to the contrary in the detail specification. Bearing ratings shall be to AGMA standards as specified in the clause on ratings and calculations of this specification.

The design of shafts and bearings shall be carefully calculated to allow for the adequate stiffness, life and the required overhung load capability for the unit. The shaft seatings for bearings, gear wheels and oil seals shall all be ground. The shaft shall preferably run at well below the first critical speed.

Special care shall be taken to account for large bending moments, thrusts and other forces due to large overhangs where applicable.

Gearbox housings shall be of suitable rigid construction but with provision for ease of maintenance.

The Contractor shall ensure that bore and keyway sizes and tolerances for high speed and low speed shaft coupling halves are compatible with the gearbox shaft extensions.

Proof of experience in the particular application shall be given by way of a reference list. If no adequate reference list exists a 5 year guarantee shall be required.

Manufacturing quality

Gear teeth shall be manufactured to the following standards:

Class 12 to AGMA 390.02

or

Class 7 to ISO 1328

Shafts, housings, etc., shall be design so that anticipated deflections under load together with tolerance on manufacture do not exceed the allowable deviations in helix angle provided for in the above standards.

Proof from the SABS that the tenderers systems conform to SABS ISO 9000 will be favoured.

SS 12.4 RATINGS AND CALCULATIONS

For purposes of selection, the power transmission rating of the gearbox shall be calculated in accordance with the method laid down by the American Gear Manufacturers Association for indefinite operation with a reliability of 99%. Strength and durability calculations may be required from the successful tenderer in accordance with AGMA 2001. Gear calculations shall indicate the reference specification used and all factors used in the calculation.

The service factor, chosen in accordance with AGMA 6010-E88 and based on the installed motor power, shall not be less than the factor specified for each application in these specifications (refer to the relevant sections). However, if no service factor is specified for particular equipment, the lower limit for this factor shall be taken as 2,0. The service factor calculation shall be based on a maximum motor torque of twice full load running torque. The tenderer shall, on request, submit to the Engineer the full service factor calculation in accordance with AGMA 6010-E88, complete with full substantiation of all factors used. The Contractor shall ensure that the service life and lubrication of all bearings are not adversely affected due to the specified service factor. Where required, additional precautions shall be taken to ensure adequate operation and lubrication of all bearings. The Contractor shall submit fully detailed calculations on request to substantiate his compliance with these requirements. A copy of the bearing life calculations shall be submitted and the a_{23} or similar factor used must be shown clearly.

SS 12.5 TEMPERATURE AND LUBRICANTS

The normal maximum operating temperature of the gearbox under full load shall not exceed 90 °C in a maximum ambient temperature of 40 °C.

Unless the gearbox is totally full of oil, the space above oil level shall be protected from corrosion by a vapour corrosion inhibitor added as a 10 % addition thoroughly mixed into the manufacturer's recommended oil. VCI 329 from Cortec (Pty) Ltd or other approved inhibitor may be used.

The corrosion inhibitors added by the oil manufacturer do not protect the surfaces above the oil level.

Mineral oils with extreme pressure additive shall be used and a list of suitable lubricants shall be supplied by the Contractor in his Operations and Maintenance Manuals.

The Contractor shall ensure that no joints, seals, gaskets and external oil fittings (where applicable) leak oil, and shall tighten all pipe fittings and unions after installation.

SS 12.6 PAINTING/COATING/CORROSION PROTECTION

All housings shall be abrasive blast cleaned with new, non-recycled iron, copper or platinum slag abrasives designed for blast cleaning. The abrasive used for cast iron shall not be recycled. Cast iron shall be blast cleaned until all sand particles, burnt on sand and casting skin have been removed. The cleanliness shall not be less than SA 2,5 of ISO 8501-1 (formally SIS 05 5900). Omegas shall be opened up to their full diameter and filled, together with blowholes, with a solvent free epoxy filler or putty, finished level and smooth with the surrounding surface. After curing, the surface shall be blast cleaned, dust and debris removed by vacuum cleaner (preferred) or by clean dry brush to achieve a residual dust and debris level not greater than 0,5 % (SABS Method 769). Within 4 hours of blast cleaning (or less if relative humidity exceeds 70 %) apply a suitable primer which shall be suitable for overcoating with two pack epoxy material on external surfaces. If the primer is a two-pack material, each pigmented component shall be thoroughly mixed, after which the two components shall be mixed together for not less than 5 minutes. The whole of the two packs shall be mixed and the use of split packs without ACCURATE measurement is not permitted.

Priming shall be allowed to cure for a minimum of 24 hours before machining.

The exterior paint finishing system shall be subject to approval by the Engineer. In severe corrosive conditions, special protection may be specified.

Paint finishing shall be done after final shop test running. The tenderer shall submit on request his standard finish paint specification for approval.

Also refer to the clause on temperature and lubricants above with regard to corrosion inhibitors added to oil.

SS 12.7 PROTECTION DEVICES

Gearboxes rated at more than 75 kW installed power shall have oil pressure indicators and oil low pressure limit switches fitted for protection purposes.

SS 12.8 SHOP TESTING

Each gearbox shall after assembly be test run for approximately 24 hours but no less than 12 hours under no load at the speed and in position it will operate in service. It shall be checked for oil tightness, proper lubrication of bearing and gears, meshing of gears and correct clearances of bearings. Access must be allowed to inspectors to witness the testing procedure.

Housings and covers will show no visible leaks. During testing the indication of the operating oil level shall be checked and in case of a dipstick which can be removed, the serial number shall be stamped on the dipstick.

A test certificate shall be supplied by the Contractor to the Engineer.

SS 12.9 SHAFT COUPLINGS AND ALIGNMENT

The motor shall be mounted to the gearbox via an accurately located lantern housing unless otherwise specified. A precision high speed flexible coupling, incorporating rubber buffers, shall transmit power from the motor to the gearbox.

All couplings of shafts on the gearbox output side shall be flexible flanged couplings, except where fixed or rigid couplings have been specified. Fixed or rigid couplings shall not be utilized unless specifically authorized by the Engineer.

Flexible couplings shall make provision for minor misalignment of shafts only and shall tolerate minor relative axial movement between shafts. Flexible couplings shall dampen the effect of shock loadings and cyclic fluctuating loads. Energy dissipation in the flexible elements of the flexible couplings shall contribute to the dampening of torsion vibrations.

Flexible couplings shall be installed and adjusted strictly according to the supplier's instructions. Clearances between coupling flanges shall be carefully set to in all planes/axes.

Where rigid output couplings have specifically been indicated either solid or hollow shaft gearboxes shall be implemented as specified in the detail specification.

The Contractor shall refer to the section dealing with power transmission couplings for additional specifications.

SS 12.10 MARKING AND RECORDS

Each gearbox will be fitted with a nameplate showing at least the following information:

- a) Gearbox type or model number
- b) Serial number
- c) AGMA rating
- d) Nominal ration
- e) Approximate oil quantity required
- f) The successful tenderer shall keep suitable records accessible from the serial number which will contain at least:
- g) Date of manufacture
- h) Details of test runs
- i) List of part number used in the assembly.

SS 12.11 TESTING AND COMMISSIONING

Gearboxes shall be tested together with the driving motors and driven equipment as required in the standard specification on testing and commissioning.

SS 12.12 MEASUREMENT AND PAYMENT

A gearbox shall be supplied and installed as a complete integrated unit with its driving and driven equipment, and shall therefore be included in the tendered rates for the driven equipment as specified in the relevant section.

SS 13. BAFFLES, WEIRS AND OTHER SPECIALLY FABRICATED DEVICES

SS 13.1 SCOPE

This section covers the manufacture, transportation and installation of baffles, weirs and other specially fabricated devices that are usually fabricated from various corrosion-resistant metals.

SS 13.2 STANDARDS

SS 13.2.1 National and International Standards

The applicable national and international standards, publications and codes of practice listed under the various sections of the Standard Specifications included in this contract document shall apply.

SS 13.2.2 Standard Specifications Included in this Contract Document

The following Standard Specifications bound in this document, shall be read in conjunction with this specification:

STD SPEC: INSTALLATION, ERECTION AND FIXING OF EQUIPMENT TO
CONCRETE STRUCTURES

STD SPEC: GENERAL CORROSION PROTECTION

STD SPEC: GENERAL DESIGN

SS 13.3 BAFFLES

Each baffle shall be supplied complete with holding-down bolts, fixing brackets, spacers, bracing, supports, sealant materials and all other items required to render a complete and fully operational system.

All metal components shall be manufactured from 3CR12 corrosion-resistant steel.

For all adjustable-overflow weirs and otherwise submerged items, the holding-down bolts, nuts, washers, etc., shall be of stainless steel.

The baffle shall be suitably designed by the Contractor to prevent buckling under all operational conditions.

Where applicable, each baffle shall be supplied with a suitable seal to ensure 100 % drop tightness along all applicable edges under all normal operational conditions.

SS 13.4 WEIRS

SS 13.4.1 General

Each weir shall be manufactured from 3CR12 corrosion-resistant steel.

SS 13.4.2 Fixed Weir

Unless otherwise specified in the Detail Specification, a V-notch weir shall be installed.

The V-notch weir shall be installed along the entire length of the overflow, against the upstream side of the supporting structure.

The V-notch weir shall be at least 300 mm high with 100 mm deep notches. The V-notch weir shall allow for 50 mm vertical adjustment for levelling purposes and shall be installed perfectly level with the inverts of all V-notches horizontal at the same level, not less than 10 mm above the top of the overflow wall of supporting structure.

The weir plate fasteners shall be of an approved material and shall be spaced not more than 500 mm apart, measured centre to centre. The thickness of the weir plate shall be 4,5 mm. Non-continuous weir plates shall be sealed watertight at joints. All holes for fixing shall be sealed after installation. Sealants resistant to biological and ultraviolet decay shall be used, subject to the approval of the Engineer.

A sealing strip resistant to biological and ultraviolet decay shall be used between the weir and the wall. The material of construction shall be in accordance with the Detail Specifications.

SS 13.4.3 Adjustable Weir

The length and vertical adjustability shall comply with the requirements specified in the Detail Specification for each adjustable weir.

Unless otherwise specified in the Detail Specifications, each adjustable weir shall be supplied with a scum baffle.

Each adjustable weir shall be supplied with a stainless-steel indicator showing the height position of the weir in mm on a stainless steel faceplate. Increments of the travel in cm shall be punched on the dial or faceplate and the words "FULLY LOWERED/TEN VOLLE NEERGELAAT" and "FULLY RAISED/TEN VOLLE OPGELIG" shall be punched onto the faceplate indicating the minimum and maximum position respectively.

Each weir shall be installed such that if lines are projected parallel to the still water level through the lowest and highest points of the top edge of the weir for any weir position, the maximum vertical distance between these lines shall not exceed 1 mm.

Each weir shall be watertight along its hinged bottom and along its sides.

Adjustment to the height shall be done with a lockable hand wheel on a headstock. The hand wheel, locking device, indicator and rising spindle supported by a headstock shall be included for each weir.

SS 13.5 SPECIALLY FABRICATED DEVICES

Each specially fabricated device shall be in accordance with the Detail Specification.

SS 13.6 CORROSION PROTECTION

Corrosion protection of all materials, fasteners and consumables shall comply with the requirements of the Standard Specifications on general corrosion protection. Where no corrosion protection is stipulated, the following shall apply *mutatis mutandis* as specified:

- Pickling and passivating on corrosion-resistant and stainless steels
- Two-pack chemically used or solvent-free epoxy on cast iron
- Galvanising, vinyl, two-pack chemically cured or solvent-free epoxy or epoxy with aliphatic or elastomeric polyurethane topcoat on mild steel.

SS 13.7 TESTING

Testing as specified for structural metalwork shall apply. In addition, the Contractor shall formally arrange with the Engineer for *in situ* testing of all equipment and recording of results on a checklist where simple operation of equipment is required.

SS 13.8 TOLERANCES

Fabrication and assembly tolerances as specified for structural metalwork shall apply.

SS 13.9 MEASUREMENT AND PAYMENT

Note:

Each rate tendered for supply and delivery shall include full compensation for preparing workshop details where they have not been provided in the drawings, the supply of all the required materials, fabrication, corrosion protection, process control, loading, transporting, storage and off-loading, and patent rights, royalties, etc. if applicable. They shall also include full compensation for all nuts, bolts, rivets, washers, holding-down bolts and seals.

The rates tendered for installation, testing and commissioning shall include full compensation for the installation, the making good of all damaged corrosion-protection areas, testing, commissioning and maintenance of the structural metal items, and for all other costs and actions that are necessary for obtaining complete and efficient functional systems. The erection of scaffolding and its subsequent removal, if required for installation, shall be included in the tendered rates.

SS 13.9.1 Supply and delivery of baffle No.

Individual baffles will be listed in the Schedule of Quantities. Scum baffles and Stanford baffles for settling tanks will not be listed, and will be deemed to be included in the tendered rates for settling tank equipment.

The unit of measurement shall be the number of baffles supplied and delivered as specified.

The tendered rate shall include full compensation for the baffle, seal, brackets, spacers, fixing devices and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete baffle.

SS 13.9.2 Supply and delivery of fixed weir No.

Individual fixed weirs will be listed in the Schedule of Quantities. Fixed weirs for settling tanks will not be listed, and will be deemed to be included in the tendered rates for settling tank equipment.

The unit of measurement shall be the number of fixed weirs supplied and delivered as specified.

The tendered rate shall include full compensation for the weir, seal, fixing devices and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete fixed weir.

SS 13.9.3 Supply and delivery of adjustable device No.

Individual adjustable weirs will be listed in the Schedule of Quantities.

The unit of measurement shall be the number of adjustable weirs supplied and delivered as specified.

The tendered rate shall include full compensation for the adjustable weir, spindle, hand wheel, hinges, seal, fixing devices and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete adjustable weir.

SS 13.9.4 Supply and delivery of specially fabricated device No.

Individual specially fabricated devices will be listed in the Schedule of Quantities.

	<p>The unit of measurement shall be the number of specially fabricated devices supplied and delivered as specified.</p> <p>The tendered rate shall include full compensation for the specially fabricated device, frame, brackets, seals and all appurtenant items including all labour, plant, materials and all other requirements as specified above for the supply and delivery of a complete device.</p>	
SS 13.9.5	<p>Installation, testing and commissioning of baffle</p> <p>Individual baffles will be listed in the Schedule of Quantities. Scum baffles and Stanford baffles for settling tanks will not be listed, and will be deemed to be included in the tendered rates for settling tank equipment.</p> <p>The unit of measurement shall be the number of baffles installed, tested and commissioned.</p> <p>The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.</p>	No.
SS 13.9.6	<p>Installation, testing and commissioning of fixed weir</p> <p>Individual fixed weirs will be listed in the Schedule of Quantities.</p> <p>The unit of measurement shall be the number of fixed weirs installed, tested and commissioned.</p> <p>The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.</p>	No.
SS 13.9.7	<p>Installation, testing and commissioning of adjustable weir</p> <p>Individual adjustable weirs will be listed in the Schedule of Quantities.</p> <p>The unit of measurement shall be the number of adjustable weirs installed, tested and commissioned.</p> <p>The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.</p>	No.
SS 13.9.8	<p>Installation, testing and commissioning of specially fabricated device</p> <p>Individual specially fabricated devices will be listed in the Schedule of Quantities.</p> <p>The unit of measurement shall be the number of specially fabricated devices installed, tested and commissioned.</p> <p>The tendered rate shall include full compensation for all requirements for installation, testing and commissioning as specified above.</p>	No.

SS 14. PIPEWORK

SS 14.1 SCOPE

This specification covers the requirements for the manufacturing, supply, delivery, installation, erection, testing, commissioning, handing over and the payment item descriptions for the construction of fluid, gas or air pipelines and reticulation systems as well as service connections operating under pressure

SS 14.2 STANDARDS

SS 14.2.1 National and international standards

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 1223	: Fibre cement pressure pipes and couplings
SANS 455	: Covered electrodes for the manual ore welding of carbon and carbon manganese steels
SANS 546	: Cast iron fittings for asbestos-cement pressure pipes
SANS 533-1	: Black polyethylene pipes for the conveyance of liquids
SANS 558	: Cast iron surface boxes and manhole and inspection covers and frames
SANS 227	: Burnt clay masonry units
SANS 801	: Epoxy-tar paints
SANS 966-1	: Components of unplasticized polyvinyl chloride (uPVC) pressure pipe systems
SANS 62	: Steel pipes
SANS 14	: Malleable cast iron fittings threaded to ISO 7-1 (ISO 7 is withdrawn, use DS/EN 10226-1&2 instead)
SANS 719	: Electric welded low carbon steel pipes for aqueous fluids (ordinary duties)
SANS 2001-DP2	: Construction works Part DP2: Medium pressure pipelines
SANS 10044 - Part IV	: The fusion welding of steel (including stainless steel): Tests for the approval of welders working to approved welding procedures
SANS 1123	: Steel pipe flanges
SANS 1700	: Fasteners Part 1 Section 1
BSI BS EN 512	: Fibre-Cement Products - Pressure Pipes and Joints
BS EN 13101	: Steps for manhole entry chambers

API 1104	: Welding of pipelines and related facilities
BS EN 10226-1 to 3	: Pipe thread where pressure tight joints are made on the thread
BS 1710	: Specification for identification of pipelines and services
SANS 10044 - Part III	: The fusion welding of steel (including stainless steel): Tests for the approval of welding procedures and production welds

SS 14.2.2 Standard specifications included in this contract document

The following standard specifications bound in this document, shall be read in conjunction with this specification:

STD SPEC: GENERAL CORROSION PROTECTION

SS 14.3 DEFINITIONS

For the purposes of this standard specification, the following definitions shall apply:

a) Fittings

Standard accessories available ex stock, such as bends, crosses, tees, plugs, flanges, sockets, adaptors, reducers, couplings, elbows, saddles, reflux valves, air valves, etc.

b) Specials

Any of the accessories mentioned in (a) above which are purpose-made for a specific project or for use in conjunction with pipes.

SS 14.4 ABBREVIATIONS

For the purposes of this specification, the following abbreviations shall apply:

CI	:	Cast iron
CID	:	Constant inner diameter
COD	:	Constant outer diameter
FRC	:	Fibre-reinforced cement
GMS	:	Galvanized mild steel
HDPE	:	High-density polyethylene
uPVC	:	Unplasticized polyvinylchloride
SS	:	Stainless steel
PTFE	:	Polytetrafluoro-ethylene

SS 14.5 PIPES, FITTINGS AND SPECIALS

SS 14.5.1 General

All pipes and fittings shall be marked with the manufacturer's name, its grade, type or class, the SANS standardization mark where applicable, and any other markings that may be required in terms of this specification. Pipework shall be colour coded in accordance with the process application as per BS 1710.

Pipes shall be supplied in standard lengths unless otherwise specified in the schedule of quantities. Each standard length shall be deemed to include one pipe coupling for coupling to another standard length. For flanged pipes this includes the flange at either end of the pipe and the required nuts, bolts, washers, a gasket and any other items

required for the correct coupling of one end of the pipe. Nuts and bolts shall conform to the metric system, and unless stated otherwise, lock clockwise.

Specials shall be fabricated to the details shown on the drawings, using, where applicable, the same materials, welding procedures and protective linings and coatings as are specified for the corresponding straight pipes.

Fittings and specials shall be hydraulically tested to the pressures specified for the corresponding straight pipes.

Satisfactory temporary end covers shall be provided for the protection of threads, flanges and the prepared ends of pipes, fittings and specials, and for the prevention of damage to linings and coatings during transportation and during storage and handling on the site.

SS 14.5.2 FRC pipes and fittings

FRC pipes shall be of the class specified and shall comply with the requirements of SANS 1223.

FRC pipes shall be joined by means of FRC three-ring sleeve-type couplings which comply with the relevant requirements of BS EN 512 or with approved CI short-collar couplings where pipe ends have been cut. When jointing FRC pipes to plain-ended steel pipes, FRC triplex adaptors shall be used. FRC bends shall not be used.

CI fittings for use with FRC pipes shall comply with the requirements of SANS 546.

SS 14.5.3 HDPE pipes and fittings

HDPE pipes shall comply with the relevant requirements of SANS 533 type IV for a working pressure of 1 200 kPa. Pipe fittings and couplings for HDPE pipes shall be Plasson or approved equivalent compression fittings and shall be manufactured and tested for a working pressure of 1 600 kPa.

SS 14.5.4 uPVC pipes and fittings

uPVC pipes shall comply with the requirements of SANS 966 for class 12 pressure pipes and shall be fitted with spigot-and-socket Z-joints with rubber sealing rings. Except for bends, which shall be of uPVC with a factory-applied Z-joint at one end, all fittings for use with uPVC pipes shall be of cast iron, with wall thicknesses in accordance with SANS 546 and socket dimensions in accordance with SANS 966.

All uPVC pipes and fittings shall, prior to delivery, be factory tested to 4,2 times the specified working pressure, and a certificate to this effect shall accompany all deliveries. uPVC products shall be stored away from sunlight and shall be backfilled as soon as practicable after having been installed where installation is in ground trenches, or shall be painted in accordance with the requirement of the standard specification on general corrosion protection for pipework installed above ground level, in buildings and non-ground backfilled pipe trenches or service ducts.

SS 14.5.5 GMS pipes and fittings with 150 mm or smaller nominal diameter

GMS pipes shall be solid-drawn, seamless, medium-duty, screwed-and-socketed pipes which comply with the requirements of SANS 62. Welding will not be permitted on GMS piping.

Screw threads shall be tapered in accordance with BS EN 10226-1 to 3.

Pipe fittings shall be of malleable cast iron and shall comply with the requirements of SANS 14.

Unless otherwise specified in the detail specifications, pipes and fittings shall be galvanized inside and outside in accordance with the requirements of the standard specification on general corrosion protection.

SS 14.5.6 Steel pipes, fittings and specials of the nominal diameter range
from 165 mm to 2 230 mm

SS 14.5.6.1 General

All steel pipes with a diameter exceeding 150 mm shall conform to the requirements of SANS 719 and specials shall be manufactured from straight pipes in accordance with the relevant requirements of BS EN 10311. All welding in pipes and specials shall be electric fusion welding.

The grade of the steel plate or strip to be used in the manufacturing process, the wall thickness, corrosion protection and diameter of the pipes, and whether flanges, welding or couplings will be used for jointing the pipes and specials shall be as specified in the detail specifications or as shown on the drawings. Pipelines with a diameter of less than 600 mm shall not be joined by welding in the field.

The Contractor shall furnish the Engineer with the manufacturer's certificates which cover the chemical analysis and physical properties of the steel used in the manufacture of pipes and specials, and shall provide written confirmation that welding has been carried out by coded welders.

All production welding of pipes and specials shall be done by welders who are competent in terms of the procedure-approval tests set out in SANS 10044 Part IV or an acceptable equivalent standard, and all welding, whether by hand or otherwise, shall be so carried out that the height of inner-weld reinforcement and of upset metal on the inner surface shall not exceed 1 mm. Field welding for pipes with a diameter of more than 600 mm shall comply with the relevant requirements of API 1104.

The ends of pipes and specials shall be bevelled for the field welding of butt-welded joints and shall be plain-ended for use with slip-on couplings, all in accordance with the relevant requirements of BS EN 10311.

SS 14.5.6.2 Flexible couplings

All flexible couplings for plain-ended steel pipes and fittings shall be of the slip-on type without centre register, such as Viking Johnson or an approved equal and similar coupling, and shall comply with the relevant requirements of BS EN 10311. Flexible couplings shall be thoroughly cleaned and painted as specified in the detail specifications.

Flexible couplings installed on pump discharge lines, long gravity pipelines and pipelines exposed to water hammer shall be constrained by means of anchor bolts.

SS 14.5.6.3 Pipe record

The Contractor shall maintain a record, in an approved form, showing the pipe serial and delivery numbers, the steel cast number for the plate used in each pipe section, the date of fabrication and hydrostatic testing, together with the actual test pressure and details of defects and subsequent repairs. Each record shall be signed by the Contractor, and copies shall be handed over to the Engineer before the commencement of the maintenance period.

SS 14.5.7 Electrical-continuity bonds

Steel pipes of similar materials other than those with welded joints shall be double bonded by two separate copper connecting wires of 16 mm² copper-strand green PVC-covered wire being installed across all flanged joints and flexible couplings to provide electrical continuity over the entire pipeline.

Connections on the pipe on either side of the coupling and on the coupling barrel shall be made by Thermite welds and shall be done only when the pipeline is full of water (i.e. during pressure tests, etc.), to prevent possible damage to the internal lining of the pipe.

The costs of repairing the external coating at the welds shall be included in the price of the pipes.

SS 14.6 CORROSION PROTECTION

The requirements for corrosion protection of all pipelines shall be as specified in the standard specification on general corrosion protection.

Fully insulated flanges shall be installed where dissimilar metals are flanged together as described below.

SS 14.7 ACCESSORIES AND APPURTENANT MATERIALS

SS 14.7.1 Flanges

Unless otherwise specified, the flanges of flanged pipes and fittings shall be drilled in accordance with SANS 1123, table 16, for pipes and fittings with a diameter of 150 mm and smaller, and in accordance with table 10 for diameters exceeding 150 mm, of flanges for air-valves and matching tees, where the drilling shall conform to the drilling of the valve supplied.

Loose flanges for galvanized steel pipes shall be threaded to fit the threaded pipe, and loose flanges for welding onto steel pipes shall be manufactured from the same steel as is specified for the pipes and shall be either flat-faced or raised in accordance with SANS 1123.

Any item that is found to have flanges that are incorrectly drilled will be rejected, and the reaming of bolt holes to oversize dimensions to make a particular piece fit will not be permitted.

All flanged items shall be supplied with one set of bolts and nuts and one suitable gasket with the appropriate diameter and shall be made from a material that is suitable for the maximum test pressure.

Refer to the relevant clause in the section dealing with installation and testing of pipework for requirements with regard to insulated flanges for the flanged connection of dissimilar steel pipework.

SS 14.7.2 Bolts and nuts

Bolts and nuts shall be of mild steel unless otherwise specified in the detail specifications or shown on the drawings and shall comply with the relevant requirements of SANS 1700. High tension bolts shall be used for high pressure applications.

The bolt thread protrusion through the nut shall be a minimum of 1,5 threads but not more than 5 threads.

A flat washer shall be installed under each nut unless a spring washer is used as a locking device.

All bolts shall point in the direction of flow for horizontal pipelines and shall point downwards for vertical pipelines unless the construction of the joint prevents the use of this convention.

SS 14.7.3 Step irons

Step irons shall be of malleable cast iron and shall comply with the appropriate requirements of BS 1247, figure 1, or shall be of the type shown on the drawings or specified in the detail specifications. The length of step irons shall be suitable for being fixed in brick or in situ concrete.

SS 14.7.4 Surface boxes and valve-chamber covers and frames

All surface boxes and the covers and frames of valve chambers shall be of CI and shall comply with the requirements of SANS 558. All covers shall be embossed with letter groups as specified in the detail specifications.

All surfaces which will not be in contact with concrete shall be painted with two coats of epoxy-tar paint prior to installation.

The types of boxes, covers and frames shall be as follows:

a) Surface boxes for valves shall be in accordance with the details shown on the drawings.

The surface box mentioned shall be installed with the longer side parallel to the water main served by the valve.

b) Valve chambers

In roadways : Type 2A - SANS 558

On sidewalks : Type 9D - SANS 558

c) Air-valve chambers :

Type 9D - SANS 558, with ventilation openings.

The Contractor shall be at liberty to precast the surface box into its concrete surround by using a mould made of 2 mm steel plate. The concrete shall be class 1:2:4/19, and light reinforcing shall be used as shown on the drawings.

SS 14.7.5 Reflux valves, air valves and pressure relief valves

The Contractor shall ensure that the necessary reflux (non-return or one-way) valves and air valves are fitted in order to attain an efficient and trouble free pipework system with the minimum maintenance requirements. Reflux valves shall be installed where required to protect pumps or compressors or to ensure correct process flow.

All compressors, blowers and positive displacement pumps shall have pressure relief valves installed on their delivery pipework, as close as possible to the delivery flange. The valves shall preferably be calibrated to between 1.3 x the operational pressure and 0,8 x the maximum safe operating pressure of the compressing / pumping equipment. Two copies of the calibration certificates shall be submitted to the Engineer.

Reflux, air and pressure relief valves shall be included in the tendered rates for pipework unless special requirements are specified, in which case separate pay items will be scheduled.

SS 14.7.6 Appurtenant materials

SS 14.7.6.1 Bricks

Bricks shall be obtained from an approved manufacturer and shall be either general-purpose (special) or engineering-grade bricks which comply with the appropriate requirements of SANS 227. The Contractor shall furnish the Engineer with samples of the bricks which he intends to use, for approval.

SS 14.7.6.2 Mortar

Mortar for brickwork shall consist of 1 part of cement and 4 parts of building sand. All mortar shall be prepared using ordinary Portland cement, unless otherwise specified.

SS 14.7.6.3 Concrete

Concrete shall conform to the requirements of the detail specification.

SS 14.7.6.4 Marker blocks and markers

Marker blocks and markers indicating the position of house connections shall be constructed and positioned in accordance with the detail specification.

SS 14.7.6.5 Epoxy-tar paint

Epoxy-tar paint used for protecting metal surfaces where specified, shall conform to the requirements of SANS 801 type III and shall be applied in two coats with a dry-film thickness of 0,230 mm each.

SS 14.7.6.6 Welding electrodes

Welding electrodes shall comply with SANS 455, and the type of electrode shall be compatible with the welding operation to be performed. Also refer to the standard specification dealing with corrosion protection and structural metalwork in this regard.

SS 14.8 HANDLING AND STORAGE

The method of handling pipes and other items will depend on the material from which the item has been made or with which the item has been coated. Light-sensitive items as well as items prone to weathering shall be stored under cover. The manufacturer's instructions regarding the handling and storage of his products shall, where applicable, be strictly adhered to and copies of such instructions shall be supplied to the Engineer before any such item is despatched to the site. Concrete pipes however shall, irrespective of the manufacturer, be handled and stored as set out in the latest issue of the Concrete Pipe Handbook issued by the Concrete Society of Southern Africa, unless otherwise directed by the Engineer. The Contractor shall obtain his own copy.

Should the Engineer consider that any pipes or components are being handled, stacked, stored or transported in such a way that damage, deterioration or contamination may occur, he may instruct the Contractor to adapt the method used, or to take specific precautions without the Contractor being entitled to any additional payment. Unless otherwise specified, no separate payment shall be made for taking delivery of, or for handling, storing, stacking, transporting, protecting, etc., pipes and components or materials, and allowance must be made (in the rates tendered for pipe-laying) for all labour, plant and equipment required for such work during the validity of the contract.

SS 14.9 EXCAVATION

The excavation of trenches, the preparation of trench bottoms, and the additional excavation for valve chambers and joint holes shall be carried out if required by the detail specifications and shall be approved by the Engineer before any pipe bedding and pipe laying may be carried out.

The minimum trench widths shall be as specified in the detail specifications or as determined by the Engineer on the site.

Variations in the authorized widths may be effected only with the written approval of the Engineer.

The Engineer reserves to himself the right to limit the length of excavation preceding the pipe-laying activities.

Excavations for valve chambers and other brickwork structures shall be 200 mm wider than the outer dimensions of the structures, i.e. 100 mm measured from each outer face.

Excavations for reinforced-concrete chambers which require the use of formwork shall be such that a working space of 600 mm will be available around the outer perimeter of the structure.

SS 14.10 PIPE BEDDING

Where founding conditions are unsuitable, the trench bottom shall be excavated deeper than instructed by the Engineer and backfilled to the original level as specified in the detail specification.

Only material placed alongside the pipes and to a height of 300 mm above the top of the pipe barrels will be regarded as the pipe bedding, payment for which shall be made under this section.

Bedding material shall be free from stones exceeding 10 mm and from organic matter and lumps of clay, and shall contain sufficient fine material to ensure a densely graded, well-compacted bedding. Bedding material shall be compacted in layers not exceeding 100 mm of compacted thickness.

SS 14.11 DESIGN OF PIPELINES

All piping shall be routed and configured by the Contractor using suitable diameters, wall thicknesses, corrosion protection and materials as required in the detail specification. The design of pipework reticulation systems shall be submitted to the Engineer for approval. The Contractor shall make allowance for all costs involved in the design of the pipework. No additional payments shall be made for the design. The design shall include adequate scour and drainage valves for the complete emptying of each pipeline as well as air valves removing entrapped air.

Pipelines shall be designed such that adequate compensation is made for the thermal expansion and contraction of the pipe system. Equipment such as pumps and compressors shall have negligible thermally-induced loads from the pipe system imposed on them. No excessive loads shall be present at thrust blocks due to thermal expansion or contraction.

Pipes, fittings, joints, support brackets, etc. shall be selected such that all parts are either electrolytically compatible or are effectively insulated from each other.

The Contractor shall ensure that all pipe systems are effectively earthed in conjunction with the required electrical continuity bonds across flanges, etc.

All pipelines shall be designed and constructed such that all air valves, water traps, flame arresters and other similar fittings can be isolated by means of valves, and that these components can be removed without damage to the pipeline. Pipelines utilized for the conveyance of gasses shall be routed at suitable gradients to allow condensate removal. Refer to the standard specification dealing with the compressing plant.

All air and scour valves shall be located at the highest and lowest points respectively in the pipelines in locations accessible for maintenance.

SS 14.12 LAYING OF PIPES

SS 14.12.1 General

Pipework shall be installed along routes as shown on the drawings and in conformance with building and structure conditions. No deviations from the drawings may be made without the written approval of the Engineer having been obtained. Exposed piping shall be parallel, or at right angles to the walls of structures. Provision shall be made so that expansion and contraction will not cause undue stress in the piping systems. Pipework shall be supported adjacent to valves to the satisfaction of the Engineer.

All pipes, fittings, specials and valves shall be thoroughly cleaned and carefully examined for damage and defects before they are laid. The onus of detecting damage and defects before installation shall be on the Contractor. Should any damaged or defective pipe, fitting, special or valve be found after laying or installation, it shall be removed and replaced at the Contractor's expense.

Each pipe shall be laid with the identification marks visible on the crown of the pipe. Where markings are no longer visible once the pipes have been laid, the Contractor shall at his expense, remark the pipes in a manner approved by the Engineer. Control of laying shall be by means of boning rods and sight rails or by other approved methods.

Precautions shall be taken to prevent the entry of foreign matter and unwanted water into the pipes, and, if laid in trenches, to prevent the flotation of the pipes caused by water and mud. At the close of each day's work, or at any time when work is suspended for a significant period,

the last laid section of each pipe shall be plugged, capped or otherwise tightly closed until laying is recommenced.

An approved cleaning device such as a badger shall be drawn through all pipes smaller than 600 mm in diameter as they are being laid and jointed. Pipes with a 600 mm diameter and larger shall be kept clean internally by the pipes being carefully swept by hand as laying progresses.

SS 14.12.2 Underground pipelines

Pipes shall be laid in the centre of the trench and, except where it is specified that they should be supported on precast pedestals, they shall be laid in such a manner that the full lengths of their barrels will bear uniformly on the prepared trench bottom except at joint holes. Valves shall be placed with spindles in the upright position unless otherwise specified or shown on the drawings. All valves, specials and fittings shall be set, supported and placed in their correct positions as the work proceeds, which positions shall not be governed by the standard lengths of pipe.

SS 14.12.3 Above-ground pipelines

uPVC, galvanized mild steel or stainless-steel piping is generally preferred on account of their resistance to corrosion. If exposed to sunlight, steel piping is generally preferred due to UV-decay (ultraviolet-decay) of uPVC piping. If uPVC pipework is required in outdoor applications, the pipework shall be adequately coated with a UV resistant paint as approved by the Engineer.

Pipe supports for vertical and horizontal uPVC pipes shall be provided at the following minimum centres (in metres):

<u>Nominal size of pipe</u>	<u>Classes 6 and 9</u>	<u>Classes 12 and 16</u>
16 mm	-	0,70
20 mm	-	0,90
25 mm	-	1,00
32 mm	-	1,00
40 mm	-	1,20
50 mm	-	1,20
63 mm	1,00	1,40
75 mm	1,20	1,50
90 mm	1,40	1,60
110 mm	1,50	1,80
125 mm	1,70	2,00
160 mm	2,00	2,20
200 mm	2,40	2,70

Supports for uPVC pipes shall be prefabricated and shall be specifically designed for the relevant pipes.

Stainless-steel pipes of less than 50 mm in diameter shall be fixed to walls with galvanized malleable cast-iron School-board-pattern brackets. Pipes of more than 50 mm in diameter shall be fixed with stainless steel hinged holderbats and fastened with stainless-steel pins or bolts. The brackets or holderbats shall be fixed to walls or floors with cement mortar. Pipes fixed to timbers shall be secured with approved stainless-steel pipe clips screwed to the woodwork.

Supports for steel pipes shall be provided at the following minimum distances:

<u>Pipe size</u>	<u>Horizontal</u>	<u>Vertical</u>
15 mm to 20 mm	1 200 mm	1 800 mm
25 mm to 40 mm	1 800 mm	2 500 mm
50 mm to 100 mm	2 500 mm	3 050 mm
More than 100 mm	4 600 mm	4 600 mm

Before any one of the supports listed above is installed, samples thereof shall be supplied to the Engineer, whose written approval shall first be obtained. Where items are too large for samples to be submitted, full documentary descriptions of the item shall be supplied to the Engineer for approval.

SS 14.13 THE JOINTING OF PIPES

Subject to approval of the methods to be used and the observance of the necessary precautions, only steel pipelines with welded joints and HDPE pipes may be jointed outside their trenches prior to being laid. In all other cases pipes shall be jointed in their final positions.

SS 14.13.1 FRC pipes

FRC pipes and their fittings shall be jointed in accordance with the manufacturer's instructions.

After cutting an FRC pipe to suit the position of a valve or fitting, the Contractor shall use an approved field-turning apparatus to turn the cut ends to suit the coupling sleeve, as filling of the ends of an FRC pipe will not be permitted.

Where CI detachable couplings are used, a gap of 10 mm, central to the coupling, shall be left between the pipe ends to allow for expansion when the pipes are filled and have absorbed moisture.

SS 14.13.2 HDPE pipes

HDPE pipes and their fittings shall be jointed in accordance with the manufacturer's instructions, and special care shall be taken not to over-tighten the couplings.

SS 14.13.3 uPVC pipes

uPVC pipes and their fittings shall be jointed strictly in accordance with the manufacturer's instructions and, except for the joint, shall be backfilled as soon as possible after laying.

SS 14.13.4 GMS pipes

Before connections are made, all external and internal threads of GMS pipes and fittings shall be thoroughly cleaned, and external threads shall be covered with a small quantity of yarn and a thin layer of approved jointing compound. The external threads of pipes and fittings

smaller than 25 mm may be wrapped with an approved PTFE tape in lieu of the yarn and compound.

Care shall be taken to avoid tool damage to the surfaces of pipes and fittings during installation. All joints shall be screwed up tightly.

SS 14.13.5 Steel pipes

a) Flanged joints

In the jointing of steel pipes with flanges, special care shall be taken to align and level the pipes, specials, fittings and valves to avoid straining of the flanges. To facilitate the alignment process, all flanged pipes and the larger fittings, specials and valves shall be supported on precast, pre-positioned concrete pedestals, all in accordance with the drawings.

The mating face of each flange shall be thoroughly cleaned immediately before jointing. Gaskets shall be placed so that no portion of the gasket will project inside the bore of the pipe.

Nuts shall be tightened up evenly in opposite pairs to ensure a uniform bearing on the gasket but shall not be fully tightened until all bolts have been inserted and the flanges accurately aligned relative to each other.

The Contractor shall repair all damage to corrosion protection layers due to the installation activities at his own cost. All repair work shall be to the satisfaction of the Engineer. Wherever loose flanges are welded onto pipes, the Contractor shall make sure that the linings and coatings are repaired and are soundly jointed to existing linings and coatings.

b) Fully insulated joints

To prevent galvanic corrosion at joints between pipes of dissimilar metals, (e.g. stainless/mild steel) fully insulated flanged joints shall be used. Fully insulated flanged joints shall comply with the following minimum requirements:

The flange bolt shanks shall be insulated from flanges by means of GRP sleeves with a thickness of 1 mm. The flange bolts and nuts shall be suitably downsized for the application. The Contractor shall ensure that performance/strength requirements and specifications are met in this regard. Bolt heads and nuts shall bear on the standard required steel washers for the downsized bolts.

The steel washers shall be insulated from the flanges by means of insulating washers with a diameter 10 mm larger than the specified diameter of the steel washers.

An insulating gasket shall be installed between the flanges. The central 3 mm thick fabric reinforced phenolic full face resin gasket shall be installed with one full face neoprene gasket.

Lightning/surge protection shall be provided across insulated flanges which shall consist of a suitable spark gap across the insulating flange and bolted directly to the steel flange face on either side. The spark gap shall be subject to the approval of the Engineer.

Insulating flanges not continuity bonded shall be identified as follows:

The entire insulating flange shall be wrapped circumferentially with a white plastic backed polymer modified bituminous tape with a red strip in the centre. A metal tag shall be attached through a pre-drilled 2 mm hole in the most overt insulating flange stud via 1 mm stainless steel locking wire. On the metal tag shall be stamped the words: -

"OPERATING INSULATING FLANGE NO ATTACHMENTS TO PIPEWORK PERMITTED
CHAMBER TO BE KEPT DRY"

c) Slip-on type couplings

Slip-on type of couplings shall be installed strictly in accordance with the manufacturer's recommendations, and the angular deflection allowed by the couplings shall not be exceeded. Before commencing with the installation of slip on type couplings, the allowable deflection / misalignment specified by the coupling manufacturer, shall be submitted to the Engineer.

d) Welded joints

All field welding of butt-welded joints shall be carried out by welders who are competent in terms of the procedure-approval tests of SANS 10044 part III.

While welding is done inside pipes, these pipes shall be ventilated to the approval of the Engineer.

SS 14.14

ENCASING OF PIPES

Where specified or ordered by the Engineer, pipes shall be fully encased in accordance with the drawings. During concreting, pipes shall be supported near their ends on suitable pedestals and shall be suitably anchored where necessary to prevent uplift. All spaces under and around the pipes shall be properly filled with concrete.

No part of the concrete casing shall be closer than 150 mm to any flexible joint, and concreting between joints shall be carried out in one continuous operation. The concrete shall be raised equally on both sides of the pipe.

Where shown on the drawings or ordered by the Engineer, soilcrete shall be used to encase the pipes fully and shall be placed in the same manner as concrete casing. Care shall be taken to prevent concrete or soilcrete from entering flexible joints.

Encasing the pipes shall only be carried out after the pipeline has been tested and passed and while the pipeline is still full of water. Formwork shall be used where necessary to ensure that flexible joints remain uncased, and payment for such formwork shall be deemed to be included in the rates tendered for the encasing of the pipe.

Where puddle pipes are encased in civil structures the Contractor shall ensure that sufficient precautions have been taken for corrosion protection. Unless otherwise specified in the detail specification, all puddle pipes with a diameter less than 200 mm that terminate inside a liquid containing sump/container shall be manufactured from 304 L stainless steel, with the necessary insulated flanges installed where required. Other puddles shall be suitably coated and/or wrapped in accordance with the standard specification on general corrosion protection and/or the detail specification.

SS 14.15

THRUST BLOCKS

Thrust blocks shall be constructed in accordance with the drawings and/or the Contractor's pipeline design at tees, bends, terminal valves and end caps and where otherwise directed by the Engineer. All flexible couplings shall be supported in the thrust directions by means of thrust blocks.

The sides and bottoms of excavations against which thrust blocks are cast shall be sound and undisturbed, and all loose material shall be removed. Excess excavations shall be filled with concrete simultaneously with the concreting of the thrust block and shall not be paid for unless the excess excavations have been authorized.

Care shall be taken to leave all pipe joints accessible, and no pipeline shall be tested unless the concrete has attained its full strength. Formwork shall be used to ensure the accessibility of joints.

Unless otherwise directed, no thrust blocks shall be constructed where steel pipes with flanged or welded joints are used.

SS 14.16

VALVE CHAMBERS

After a section of pipeline or reticulation has been completed and successfully tested as specified below, valve chambers shall be constructed where required by the detail specification to details as shown on the drawings.

Brickwork for chambers shall be supported on a concrete foundation, on compacted backfill material, or on a concrete slab, as shown on the drawings. The top of the chamber cover or surface box shall be at the level of the sidewalk or street or at a height of 40 mm above ground level in the case of unsurfaced areas.

Chambers for flanged gate valves with a nominal bore not exceeding 200 mm and for air valves shall be constructed after the backfilling has been thoroughly compacted around the valve and above the pipe to serve as a firm base for the brickwork. Chambers for flanged gate valves with a nominal bore exceeding 200 mm shall be constructed on a class 15/19 concrete slab.

Where pipes with diameters exceeding 200 mm pass through the brick walls of chambers, relieving arches shall be built neatly over the upper halves of the pipes. In all other cases the bricks shall be carefully cut to fit not closer than 10 mm from the pipes to allow for possible differential settlement.

If required, step irons shall be built into one wall of the chamber at 300 mm intervals staggered left and right in vertical rows.

CI valve chamber covers and frames, surface boxes and surface boxes precast into their surroundings shall be fitted on top of the chambers as shown on the drawings.

SS 14.17

BACKFILLING

No backfilling shall be carried out prior to authorization by the Engineer to do so.

Before pipelines are hydraulically tested, the bedding shall be completed, also at joints, valves, specials and fittings to a height of 300 mm above the top of the pipe barrels, with the use of the materials in the manner required by this section and with great care being taken not to damage protective materials with which pipes, specials, etc., may be coated. All joint holes shall be carefully backfilled with the same material as that on which the pipe has been laid.

Should suitable material for bedding not be available from the excavation of the trench which is backfilled, the Contractor shall obtain suitable material from other authorized excavations on the site. In the event of suitable material not being available on the site, the Contractor shall screen the excavated material using a sieve with 10 mm clear openings but, if the latter method is impracticable, the Engineer may order the Contractor to import suitable material.

After the beddings have been completed and approved, the balance of the trench shall be backfilled as described in the section dealing with civil engineering work, except above the bedding at joints, valves, specials and fittings.

The pipeline shall now be tested as specified in this standard specification.

When the tests have been successfully completed and the pipeline approved, the balance of the trench shall be backfilled at joints and at all other positions where no chambers have to be constructed.

At valves the bedding shall be completed to a level as shown on the drawings, or, as may be applicable, a concrete slab shall be constructed followed by the construction of the valve chambers. Backfilling around valve chambers shall be carried out with the use of selected material compacted by hand in 100 mm layers or with soilcrete where insufficient space is available; and the cost of backfilling shall be included in the rates tendered for valve chambers.

SS 14.18

ROUTE MARKERS

For underground pipelines, marker blocks shall be installed if required by the detail specification after the trimming of the surrounding area has been completed so as to mark the pipe routes.

The marker blocks will be detailed in the detail specifications.

SS 14.19

CONNECTION TO EXISTING NETWORK OR PIPELINE

Wherever a new reticulation system or pipeline joins up with an existing network or pipeline, the Contractor shall notify the Engineer in good time as to when the connection will be required. The work will be carried out by the Contractor who shall supply all nuts, bolts, gaskets and labour to perform the coupling.

SS 14.20 FLUSHING AND STERILIZATION OF PIPELINES FOR POTABLE WATER

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter has been removed.

The pipeline shall then be filled with water containing 0,015 grams per litre of chloride of lime. The solution shall be allowed to flow slowly into the pipeline until it fills it completely, and shall be left there for at least 24 hours. The pipeline shall then be thoroughly and repeatedly flushed with clean water until the water, which is flushed from the pipeline, complies with the requirements of the Employer.

SS 14.21 FLUSHING OF PIPELINES OTHER THAN THOSE FOR POTABLE WATER

SS 14.21.1 Pipelines for the dosing of liquid chemicals

After each pipeline has been tested, it shall be thoroughly flushed out until all sediment and other foreign matter has been removed. Water shall be used for flushing-out purposes, provided that the water is suitable as a dilutant for the chemical which the pipeline is ultimately intended to convey. If water is not suitable as a dilutant, the undiluted chemical shall be used for flushing purposes. If it is practicable to dilute the chemical with a dilutant which is non-detrimental to the materials of the pipeline, the Contractor may do so. However, the dilution percentage shall be subject to approval by the Engineer.

During flushing, the pipeline shall not be subject to pressures exceeding 1,5 times the maximum design working pressure of the pipeline. Upon completion of the flushing operation, the Contractor shall empty the flushing liquid from the pipeline and shall then clean it and leave it ready for the Employer to feed the correctly diluted chemical into the pipeline for commissioning.

The Contractor shall ensure that no spillages whatsoever occur during flushing and cleaning and he shall clean up any such spillages in a manner approved by the Engineer. The Contractor will be held responsible for all damages caused by spillages and he shall enforce all safety precautions in the handling of hazardous chemicals. Commissioning shall commence only after the Contractor has received written notice from the Engineer that the chemical solution has been delivered and that commissioning can proceed.

SS 14.21.2 Pipelines for liquids containing raw or treated sewage

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter have been removed.

SS 14.21.3 Pipelines for gaseous media

Pipelines for the conveyance of gaseous media such as air-blower pipelines, methane-gas pipelines, chlorine-gas pipelines, etc., shall be blown clean with compressed air, or flushed with water, or a non-reactive chemical solution, after having been successfully tested. Clearing of the pipelines shall be as follows:

a) Pipelines up to 150 mm in diameter

These pipelines shall be directly connected to a contaminant-free compressed-air supply, capable of maintaining a linear air-flow velocity of not less than 5ms^{-1} through the pipeline section with the largest nominal bore. All fittings which reduce the nominal bore, such as restrictions, orifices, nozzles, etc., or form recesses in the pipe invert like check valves, etc., shall be removed. These shall immediately be reinstalled after the air-flushing operation and after they have been blown clean with compressed air.

During the air-flushing operation, all in-line valves on the particular section being flushed shall be fully open. The air flow shall be maintained until all foreign objects or particles trapped inside the pipeline has been blown out at the open end. If drainage or scour valves are installed on the particular section being flushed, these valves shall be opened and closed in succession to promote the removal of dirt and foreign material as quickly as possible.

b) Pipelines larger than 150 mm and up to 600 mm in diameter

These pipelines shall be treated as pipelines for liquids containing raw or treated sewage as specified above, and shall afterwards be ventilated with compressed air until the entire pipeline is internally dry.

c) Pipelines larger than 600 mm in diameter

These pipelines shall be manually cleaned by brushing and the use of compressed air. Adequate ventilation shall be provided by using compressed air to ensure the removal of suspended dust particles and to ensure compliance with safety requirements. Cleaning operations shall progress in the same direction as the flow of the ventilation currents.

SS 14.22 TOLERANCES

Where pipework or pipework reticulation systems have been detailed in drawings the permissible tolerance limits for the positioning of the pipework shall be as follows:

SS 14.22.1 Valves, fittings and specials

a) Lateral deviation:

100 mm, except where pipelines are to be laid at a designated distance from a fence, kerb or boundary, in which case the permissible deviation shall be ± 25 mm.

b) Vertical deviation:

100 mm.

SS 14.22.2 Pipelines

Permissible horizontal deviation from a straight line joining valves, fittings and specials shall be ± 100 mm with a permissible deviation per pipe length of ± 20 mm. The permissible vertical deviation from a straight line joining valves, fittings and specials shall be ± 50 mm.

SS 14.22.3 Valve chambers

a) Lateral deviation:

As for valves, provided that access to bolts, nuts, etc., is maintained.

b) Vertical deviation:

To suit the valve.

SS 14.23 PIPEWORK TESTING

SS 14.23.1 General

All tests shall be conducted in the presence of the Engineer or his representative. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

SS 14.23.2 Testing of welds

a) Shop welds

In order to prove the procedures, radiographic examination shall be made on 100% of the welded seams of the first pipe of each type. If unsatisfactory results are obtained, the successive pipes shall be radiographically examined until the procedures are found to be acceptable. Thereafter one pipe from each lot of 50 pipes shall be radiographically examined.

Irrespective of the above, each and every coil-joining butt weld for helically formed pipes, a 400 mm length from each end of every longitudinal weld seam of every pipe, and all welded seams of all specials shall be tested radiographically.

b) Field welds

The Contractor shall supply all equipment and materials on the site and also personnel to conduct the radiographic examination in accordance with the requirements of API 1104 in respect of the full length of 10% of the circumferential welds made by hand welding and 2.5% of the circumferential welds made in accordance with to an approved automatic process during the installation of pipes and specials.

c) Defects

Cracks, a lack of complete penetration or a lack of complete fusion shall be considered as being injurious defects, and defective field welds shall be repaired in accordance with API 1104. The full length of all repairs shall be radiographically tested.

SS 14.23.3 Testing of linings and coatings

a) Epoxy linings and coatings

In accordance with requirements of the standard specification on general corrosion protection, a low-voltage pinhole detector with a wet-sponge probe, which is operated at a voltage between 80V and 100V, shall be used for the detection of pinholes in linings and coatings with a thickness of less than 0,50 mm. A high-voltage holiday detector operated at a voltage between 12 kV and 15 kV shall be used to detect pinholes and holidays in linings and coatings exceeding 0,50 mm in thickness.

b) Repairs

Repairs to and the making good of damaged areas and areas that have failed shall be carried out strictly in accordance with the manufacturer's instructions and the section dealing with corrosion protection in these specifications.

If an area exceeding 0,5% of the coated or lined area needs repairing, the entire coating or lining shall be removed and the pipe recoated.

Where linings and coatings have been cut back to facilitate the jointing of pipes, the uncoated section shall, where applicable, be reinstated in an approved manner to a standard and quality not inferior to the original protection. Protective linings and coatings shall be reinstated strictly in accordance with the manufacturer's instructions.

c) Other tests

Any other tests, as may be considered by the Engineer to be necessary, to be conducted on pipe linings and coatings, shall be as set out in the detail specifications.

SS 14.23.4 Hydrostatic testing of steel pipes

Prior to the application of protective coatings and linings, each pipe shall be subjected to an approved hydrostatic test at a test pressure determined as follows:

$$P = \frac{2000.t.f}{D}$$

Where:

P is the test pressure in kPa

f is 85% of the guaranteed minimum yield strength in MPa for the steel plate

D is the outer diameter of the pipe in mm and

t is the wall thickness in mm.

Hydrostatic testing shall not be done until all aspects of fabrication have been completed.

The pressure shall be applied steadily by an approved method and shall be maintained, without variation, for a period of time as agreed by the Engineer to allow proofing and inspection.

Should water sweat or ooze from any part, or any defect of any other nature be discovered, the pipe shall be emptied and the defect made good. The pipe shall then be retested. Should a pipe, after repair, fail to pass the second hydraulic test, the Engineer may order its rejection.

SS 14.23.5 Hydraulic or pneumatic field-testing of pressure pipes

a) General

Hydraulic or pneumatic testing shall commence only after the permanent thrust blocks have attained their specified strength. The Contractor shall provide all the necessary testing equipment, including pressure-testing domes, blank flanges, the pump or compressor, meters, temporary valves, etc., for the conducting of the tests on the various pipes. Water for testing purposes will be provided free of charge by the Employer.

After the trench has been partly backfilled, and before the trench is filled in at the pipe joints and the fittings, the pipelines shall be tested in sections between isolating valves, end caps, blank flanges or other isolating devices at a pressure of 1,5 times the design maximum working pressure.

In the case of fibre-cement pipelines, each section shall be filled with water 24 hours before the pressure is applied.

In the case of water pipes care shall be taken to ensure that all the air is expelled from the line to be tested after it has been filled and before the test commences.

b) Visible or audible leaks

The test pressure shall be maintained for a period of at least 3 hours (or such longer period as may be necessary for the inspection of the pipeline) by means of a suitable pump or compressor, during which period all pipes, specials, joints and fittings shall be carefully inspected for leaks. All visible or audible leaks shall be made good and any pipe, special or fitting found to be defective shall be removed and replaced at the expense of the Contractor, and such replacement material shall be tested at the expense of the Contractor after having been installed.

In the case of pipes with a nominal diameter of less than 400 mm, the test period may be reduced proportionally to the nominal diameter of the pipe, provided that the test period shall not be less than 1 hour.

c) Permissible leakage rates

The test pressure shall be maintained for a further period of 1 hour after the completion of the test period, during which time the volume of water required to be pumped into the pipeline for maintaining the pressure shall be measured. No additional water shall be required in the case of continuously welded steel pipes, and in other cases the volume shall not exceed the value, in litres, calculated from the appropriate formula below:

$$V = F \times d \times l \times \sqrt{P}$$

with:

V : maximum volume in litres that may be added to maintain pressure

F : multiplication factor:

= 0,075 for fibre cement pipes

= 0,01 for jointed pipes in steel, uPVC and HDPE

= 0 for all other pipes

d : diameter of pipe in millimetres

l : length of test section in kilometres

P : test pressure in MPa

SS 14.23.6 Field-testing of electrical continuity bonds, earthing and insulated flanges

Electrical continuity and earthing of pipework and insulated flanges shall be tested, if required, as specified in the detail specification.

SS 14.24 COMMISSIONING OF PIPEWORK

Complete pipework or reticulation systems forming one process unit shall be commissioned together with the pumping and/or compressing equipment. The costs involved shall be deemed to be included in the tendered rates for commissioning for the relevant pumping and/or compressing equipment.

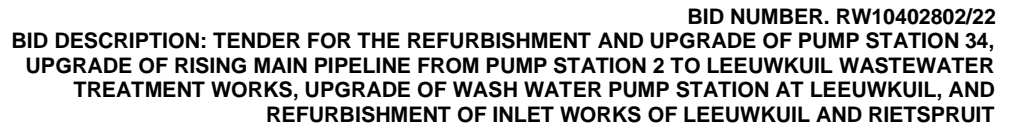
SS 14.25 MEASUREMENT AND PAYMENT

SS 14.25.1 Supply and delivery of pipework, fittings and specials Lump sum

The unit of measurement shall be the lump sum for the pipework or pipework reticulation between two or more points as specified in the detail specifications.

The tendered lump sum shall include full compensation for the design, manufacture, procurement, corrosion protection, patent rights, pre-delivery tests, storage, transport for delivery to site and off-loading including all handling of the complete section of pipework or pipework reticulation specified, which shall include the pipes, fittings, fixing equipment, reflux valves, drainage valves, manual isolation valves, pressure reducers, flanges and appurtenances to ensure a complete operational system.

Separate items will be scheduled in the schedule of quantities for different types, sizes and locations of pipework.



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The tendered sum or rate shall include full compensation for all field testing, including re-testing where required and the Contractor shall provide all instrumentation, tools, equipment and labour at no extra cost to perform the following:

Separate items will be scheduled in the schedule of quantities for different types, sizes or locations of pipework.

The tendered rate shall include full compensation for the installation and flushing of the pipework to provide a complete working system detailed in the standard and detail specifications. The cost for handling of equipment, fixing of pipework, coupling of flanges and all installation materials and labour shall be included in the tendered rates.

The tendered sum or rate shall include full compensation for all field testing, including re-testing where required and the Contractor shall provide all instrumentation, tools, equipment and labour at no extra cost to perform the following:

- testing of welds
- testing of linings and coatings
- hydraulic or pneumatic field-testing
- field testing of electrical continuity bonds, earthing and insulated flanges, where required by the detail specifications.

The pipework system shall be tested as a whole together with the appurtenant pumps, compressors, blowers, boilers, etc.

Separate items will be scheduled in the schedule of quantities for different types, sizes or locations of pipework.

**SS 14.25.6 Installation, field testing and commissioning of pipework,
fittings and specials**

No.

The unit of measurement shall be the number of described units installed and tested.

The tendered rate shall include full compensation for the installation and flushing of the pipework to provide a complete working system as detailed in the standard and detail specifications. The cost for handling of equipment, fixing of pipework, coupling of flanges and all installation materials and labour shall be included in the tendered rates.

The tendered sum or rate shall include full compensation for all field testing, including re-testing where required and the Contractor shall provide all instrumentation, tools, equipment and labour at no extra cost to perform the following:

- testing of welds
- testing of linings and coatings
- hydraulic or pneumatic field-testing
- field testing of electrical continuity bonds, earthing and insulated flanges, where required by the detail specifications.

The pipework system shall be tested as a whole together with the appurtenant pumps, compressors, blowers, boilers, etc.

Separate items will be scheduled in the schedule of quantities for different types, sizes or locations of fittings and specials.

Separate items will be scheduled in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the relevant equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the Engineer.

SS 15. SUBMERSIBLE PUMPING EQUIPMENT

SS 15.1 SCOPE

This section covers the supply, delivery, installation, testing and commissioning of submersible pumping equipment.

SS 15.2 STANDARDS

SS 15.2.1 National and international standards

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS EN ISO 9906 - Rotodynamic pumps - Hydraulic performance acceptance tests – Grades 1 and 2

SS 15.2.2 Standard specifications included in this document

The following standard specifications bound in this document shall be read in conjunction with this specification:

STD SPEC	:	ELECTRIC MOTORS	
STD SPEC	:	GENERAL	CORROSION
PROTECTION			
STD SPEC	:	TESTING AND COMMISSIONING	
STD SPEC	:	HOISTING EQUIPMENT	
STD SPEC	:	STRUCTURAL STEEL WORK	

SS 15.3 PUMP DESIGN AND REQUIREMENTS

Submersible pumps shall be designed to be suitable for submersion in water up to a depth of 10 m.

The pump shaft shall be manufactured from stainless steel and shall be sealed where it enters the casing with double mechanical face seals.

The impeller shall be manufactured from stainless steel or in the case of other materials, it shall be coated with an approved material resistant to abrasion and corrosion due to the environment specified. Full details shall be submitted at tender stage. For pumps rated below 2 kW non-metallic impellers may be utilised.

The impeller shall be statically, dynamically and hydraulically balanced. No holes may be drilled in the impeller to balance it with regard to mass distribution.

Only permanently sealed ball or roller bearings shall be installed.

Bearings shall have a minimum L_{10h} , basic life rating of 25 000 hours at rated load and speed unless specified to the contrary in the detail specification.

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.

The head at zero delivery of the curve for the impeller selected shall be at least 1,2 times the maximum head in the pump's operational range.

Each submersible pump and mixer shall be clearly labelled. The label shall be a 0,5 mm thick stainless steel plate of dimensions 100 mm x 50 mm. The label shall be affixed to the pump exterior with an approved adhesive or other method over its full back surface after the completion of corrosion protection on the pump. It may follow the shape of the pump exterior over areas suited for the bending of flat surfaces excluding sharp folds. Under no circumstances shall the label plate influence, damage or otherwise have other detrimental effects on the corrosion protection system.

Prior to being fixed onto the pump, the following information shall be punched on the label:

- Employer name: (e.g. CITY COUNCIL OF JOHANNESBURG).
- Treatment works name (e.g. OLIFANTSVLEI SEWAGE
PURIFICATION
WORKS).
- Contract No: (THE NUMBER OF THIS CONTRACT).
- Employer serial No: (TO BE PROVIDED BY THE EMPLOYER).

All submersible pumps shall be supplied together with a length of power cable to suit the installation shown in the drawings, but shall not be less than 10 m in length. The unterminated end of the cable shall be properly sealed prior to installation and final termination to prevent the ingress of water into the cable and electric motor.

Electric motors shall comply with the section dealing with electric motors.

SS 15.4 CIVIL AND PIPEWORK REQUIREMENTS

The Contractor shall refer to the relevant drawings for the required installation and shall detail any special requirements with regard to openings in civil structures in order to fit the submersible pump.

If the installation so requires, the Contractor shall supply and install the necessary seating frames, duckfoot bends, guide rails and hoisting facilities as detailed below, the costs thereof being included in the tendered rates. Requirements in this regard will be indicated in the drawings and/or the detail specification.

SS 15.5 HOISTING FACILITIES

All submersible pumps shall have a lifting lug situated such that it hangs upright while being lifted by means of a cable. This applies equally to configurations fitted with outlets for duckfoot bends.

Hoisting facilities shall be supplied and installed in accordance with the standard specification on hoisting equipment where required by the detail specifications. The hoisting facilities shall be included in the tendered rates and shall consist of the following:

All stainless steel holding down bolts, to be grouted into position by others.

Guide rails from stainless steel or galvanised mild steel where specified in the detail specification.

A fixed or mobile hoist frame manufactured from galvanised mild steel.

The hoisting cable or chain.

A hand operated winch whereby the pump is lifted from the relevant sump, or a chain hoist fitted to a bogey, as specified in the detail specification.

The Tenderer shall refer to the drawings for details on hoist frame and guide rail dimensions.

The guide rails shall be included in the tendered rates for the submersible pumping equipment, together with its fastening devices.

The hoisting frame shall either be a fixed, single point hoisting facility or shall have a crawl beam installed with a hoist bogey to serve more than one pump. Details will be supplied in the drawings and the detail specifications. The frame shall comply with the section dealing with structural steelwork.

SS 15.6 PROTECTION AND CONTROL DEVICES

Float switches for the purposes of control and low liquid level protection of the pump will be provided by others, except for drainage pumps rated lower than 0,75 kW which shall have float switches or equivalent switches attached to switch the pump on and off.

All pumps with installed power of more than 2 kW shall be equipped with di-electrodes for monitoring seal condition. The di-electrodes shall cause the pump to trip when the seal condition has deteriorated to an unacceptable level. Seal monitor relays shall be supplied by the Contractor and the cost shall be included in the tendered rates.

SS 15.7 CORROSION PROTECTION

The Tenderer shall take note of the environment the pumps will operate in and the liquid to be pumped. In the case of raw sewage special care shall be taken to ensure that components of the pump is resistant to the corrosive action of the pumped medium. Corrosion protection shall be in accordance with the standard specification dealing with general corrosion protection.

SS 15.8 TESTING AND COMMISSIONING

SS 15.8.1 Test to be performed

All pumping equipment shall be subject to the commissioning tests as described in the relevant section.

At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow rate or volumetric flow testing facilities will be supplied by others unless otherwise specified in the detail specification.

Efficiency tests will only be performed when specified in the detail specification.

NPSH tests will only be performed when specified in the detail specification.

Flow rate (delivery), efficiency and NPSH tests

Testing will be done in accordance with BS EN ISO 9906, where required by the detail specification.

Power consumption of electric motors shall be as determined by the three Watt meter method.

SS 15.8.2 Test conditions

All tests will be performed in situ.

Tests will be performed with clean water unless otherwise specified. The Contractor shall obtain from the pump manufacturer, the test point for clean water corresponding to the specified duty point for the pumped liquid.

SS 15.8.3 Additional tests

Additional tests will be specified in the detail specification.

SS 15.9 MEASUREMENT AND PAYMENT

SS 15.9.1 Supply and delivery of submersible pumping equipment No.

The unit of measurement shall be the number of submersible pumps supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading including all handling of the equipment. The equipment shall include the following:

- The pump and motor as integrated unit.
- Electrical power cable.
- Duckfoot bend, seating frame, guide rails, guide rail spacers and related fixing devices if required by the drawings or the detail specification.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

SS 15.9.2 Installation of submersible pumping equipment No.

The unit of measurement shall be the number of submersible pumps installed.

The tendered rates shall include full compensation for the site handling and positioning of the submersible pumping equipment including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- Installation of the guide rails and sealing frame.
- Coupling of all required pipe flanges, including all required gaskets, nuts, bolts and washers.
- Routing and fastening of the power cable up to the isolator box.
- All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

No taking-over certificate (or partial taking-over certificate) will be issued for the relevant equipment unless the required operating and maintenance manuals have been supplied and have been accepted by the Engineer.

SS 15.9.3 Testing and commissioning of submersible pumping equipment No.

The unit of measurement shall be the number of submersible pumping installations tested and commissioned.

The tendered rates shall include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

SS 16. FLUID / FLOW MEASUREMENT EQUIPMENT

SS 16.1 SCOPE

This specification covers requirements for various equipment and instruments used to determine the properties of fluids or the flow as present in the process during operation of the relevant plant.

SS 16.2 STANDARDS

SS 16.2.1 National and international standards

The latest edition, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS EN 10226-1 to 3 Pipe threads pressure-tight joints are made on the threads.

BS EN 10255 Non-alloy steel tubes suitable for welding and threading.

BS EN ISO 9906 Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1 and 2

BS EN 837-1 Pressure Gauges Part 1: Bourdon Tube Pressure Gauges - Dimensions, Metrology, Requirements and Testing.

SS 16.3 MECHANICAL PRESSURE GAUGES

Analogue mechanical or bourdon tube pressure gauges shall be of the bottom entry type and shall have a face of at least 60 mm in diameter with clear, readable markings and indicators. The screw-in fitting shall be compatible with the pipe fitting, which shall be the metric equivalent of a 2 inch BSP internal thread unless otherwise specified in the detail specifications. Threads shall be in accordance with BS EN 10226-1 to 3 for jointing threads or BS EN 10255 for long screw threads. Details in this regard shall be supplied by the Contractor in the operation and maintenance manuals.

The indicated range on the gauge shall span 120% of the operational pressure range specified for the relevant equipment. Accuracy shall be within 3% of the full scale deflection value. An adjustable indicator shall be set to indicate the maximum operational system pressure clearly.

It shall be possible to isolate the pressure gauge from the pipe pressure by means of a valve or a gauge cock, which shall be supplied and installed by the Contractor and shall be included in the tendered rate for the equipment.

A gauge protector shall be fitted where a gauge has to indicate pressures in corrosive media or liquids that could easily clog the pressure ports. It is a requirement that gauge protectors be fitted where sludge is the working medium.

Pressure gauges fitted to hydraulic pipe lines shall be glycerine-filled for damping purposes, and gauges fitted to pneumatic or gas pipelines shall be vacuum damped. The circumferential positioning of pressure gauges on water and sewage pipes shall be in accordance with BS EN ISO 9906, and the static head tapings shall also comply with these standards.

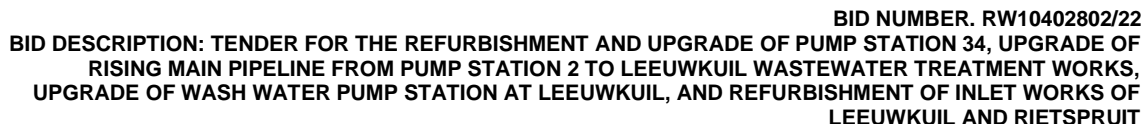
Bourdon type pressure gauges shall comply with BS EN 837-1.

SS 16.4 TESTING AND COMMISSIONING

The equipment shall be tested and commissioned together with the relevant pipework and other equipment such as pumps or compressors.

SS 16.5 MEASUREMENT AND PAYMENT

Pressure gauges will be deemed to be included in the tendered rates for the relevant equipment to which they are fitted.



SS17.1 Scope

SS17.2 General Requirements

SS17.3 Materials of Construction

SS17.4 Corrosion protection

Mild Steel System - Fusion Bonded Epoxy 250 microns minimum.

Colour Golden Yellow (B49)

SS17.5 Testing and Commissioning

Checks on all equipment will be conducted for correct operation and functioning during the defects liability period at 1 month, 6 months and 12 months after final plant take-over.

SS17.6 Measurement and Payment

SS 17.6.1 Design and supply

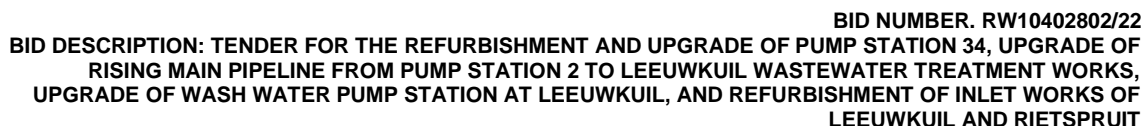
Unit : No.

The tendered rates shall include for full compensation for design, manufacture, factory testing, supply, delivery and storage on site of the unit.

SS17.6.2 Installation and commissioning

Unit : No.

The tendered rates shall include for full compensation for the installation, fixing of corrosion protection where needed and commissioning of the unit supplied, and for all other costs and actions that are necessary for obtaining an efficient and complete working system.



SS 18. WASTE SKIP TRAILER

This specification covers the supply, delivery, offloading, transport, double handling (if required), storage, erection, installation, commissioning, testing, adjustment, handing over in complete working order and upholding during the Defects Liability Period of a waste skip trailer.

6m³ waste skips will be required to be moved around the site with an appropriate waste skip trailer which is to be attached to and towed by a tractor or other suitable vehicle to be specified elsewhere.

The trailer is to be able to hydraulically lift the skip off the ground and for it to be transported with the trailer behind the tractor. If the tractor does not have a hydraulic drive, a hydraulic drive is to be supplied and installed onto the gearbox shaft of the tractor.

The waste skip trailer is to be constructed from SANS 1431 350WA mild steel and conform to ISO 16880 for lifting equipment.

The hydraulics are to be sufficiently selected for the duty load and to be in accordance to ISO 17165.

The wheels and tyres must be designed for the purpose and terrain, it will be driven on. A spare wheel complete is to be attached to the unit.

The coupler to the trailer shall be of the bolted type and the trailer shall be wired with tail lights and indicators and be road worthy and must comply with the Road Ordinance regulations.

Corrosion protection shall be carried out in accordance with the requirements of the General Corrosion Protection Specification: -

Mild Steel System - Fusion Bonded Epoxy 250 microns minimum.

Colour Golden Yellow (B49)

The waste skip trailer is to be able to load and off load the 6 m³ waste skip efficiently, effectively and safely and with out any spillage of the contents inside the skip.

Checks on all equipment will be conducted for correct operation and functioning during the defects liability period at 1 month, 6 months and 12 months after final plant take-over.

SS 18.6.1 Design and supply

Unit : No.

The unit of measurement shall be for the unit supplied including all ancillary equipment

and accessories as specified.

The tendered rates shall include for full compensation for design, manufacture, factory testing, supply, delivery and storage on site of the unit.

SS 18.6.2 Installation and commissioning

Unit : No.

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The tendered rates shall include for full compensation for the installation, fixing of corrosion protection where needed and commissioning of the unit supplied, and for all other costs and actions that are necessary for obtaining an efficient and complete working system.

Payment will only be transferred once the engineer has received full Operation and Maintenance Manuals along with the relevant plant drawings.

SS 19. PIPEWORKS, VALVES AND FITTINGS**SS 19.1 Scope**

This specification covers the manufacture, supply, delivery, installation, testing and commissioning of pipework, valves and fittings associated with mechanical equipment.

SS 19.2 Pipes And Fittings

All pipe systems shall be arranged, installed, supported and provided with all necessary means of venting, draining and expansion, all to the approval of the Engineer.

The pipework layout shall be designed so that items of equipment and sections of pipework can be removed from the pipeline without major disturbance to the adjacent pipework. Particular care shall be taken to ensure that pipework thrusts are not transmitted to machinery or associated apparatus. The Contractor shall indicate on his detailed drawings the thrust blocks required to anchor his pipework.

The Contractor shall provide flexibility in the pipework at joints in the main structures and shall submit proposals for the approval of the Engineer. Flexible joints or collars and cut pipes shall be allowed on all pipework where necessary to allow for some margin of error in the building work. Wherever possible flexible joints shall be provided with tie bolts or other means to transfer longitudinal thrust as a whole so that external anchorages may be kept to a minimum. Flexible joints shall also be provided for ease of erection and future dismantling.

All necessary supports, saddles, slings, fixings bolts and foundation bolts shall be supplied to support the pipework and its associated equipment in an approved manner. Valves, meters, strainers and other devices mounted in the pipework shall be supported independently of the pipes to which they connect.

Dead legs shall be avoided but where this is not possible provision shall be made for flushing the pipework. Changes in pipe bore sizes shall be by the use of proprietary fittings or fabricated sections to avoid sudden changes.

Where relevant, formed bends and offsets shall be used and be cold formed in a standard pipe bending machine. They shall have an inside radius of not less than 4 times the outside diameter of the pipe.

Flushing and drain connections on pipework below 150 mm shall be made using proprietary welded fittings with G series internal parallel threads to BS EN ISO 228-1: 2003 which shall be immediately sealed with hexagon headed shouldered plugs and seals. Holes thus made in the pipe shall have burrs removed and be finally pulled through to remove loose particles.

Template or closure pipes shall be provided where necessary to facilitate erection. The design and construction of the template pipes shall be to the approval of the Engineer, and the Contractor will be responsible for establishing the dimensions of the template pipes such that there will be no strain placed on the connected items after installation.

All nuts, bolts, washers, flanges, gaskets, flanged tied adapters, drain valves, special connection pieces, together with all terminal point connection materials shall be supplied under the Contract.

Viking-Johnson or approved equivalent flange adapters shall be fitted where necessary to facilitate the removal of valves and fittings. Adequate provision shall be made for anchoring pipes at these joints.

Hydraulic pipework shall be sized to maintain fluid velocities below those specified and provide a safety factor of 4:1 on the design pressure, which shall be taken as 120 % of the working pressure.

Compressed air pipework shall be sized such that the air flow velocity does not exceed 8 m/s. To provide adequate condensate drainage, the pipework system shall be run with a horizontal fall of not less than 1 in 50 in the direction of airflow and incorporate drainage points at distances of not less than 30 m. Drainage points shall be formed by use of equal tees with a down-pointing leg fitted preferably where changes of direction of flow occur.

Any branch take-off shall be from the top of the main and the bottom of any falling pipe shall be drained.

Pipework materials, sizes, pressure ratings, fittings, coupling arrangements and medium carried shall be as detailed in the Detail Specification, pipework being in metric sizes where possible.

SS 19.2.1

Steel Pipe

General purpose steel pipework with screwed fittings shall be of galvanised mild steel to BS 1387 heavy grade with fittings of galvanised malleable iron to BS 143/1256, having tapered internal and external threads to BS 21.

Steel pipe and fittings over 80 mm diameter, shall be carbon steel in accordance with BS 3601 with pipe sizes to BS 3600. Joints shall be flanged. Pipes shall be fabricated in accordance with BS 534 with welding in accordance with BS 2633 or BS 2971 and BS 4515.

After fabrication and machining of flanges all pipework and fittings shall be tested to a test pressure equal to 150% of the maximum working pressure (pump closed valve head).

Where pipes are to be joined with sleeves or couplings, a sufficient length of pipe shall be left bare of coating to accommodate the sleeve or coupling.

Plain ended pipes shall be supplied rounded at both ends. An adequate number of pipes shall be supplied rounded throughout their length so that they may be cut and such pipes shall be clearly marked.

Couplings for use with steel pipes shall comply with BS 534 except where other types of couplings are shown on the Contract Drawings or specified in other sections of this Specification.

Components of flexible joints from different manufacturers shall not be used together.

Tests on pipes shall be made in accordance with the relevant British Standard in the manufacturer's works when required by the Engineer and in the presence of the Engineer. Two copies of the results of all such tests shall be submitted to the Engineer.

Flanges on steel pipes shall be welded in accordance with BS 2633 or BS 2971 and shall have raised or flat faces.

Steel pipes which are to be welded shall have the ends prepared by the manufacturer to suit the type of welded joint shown on the Contract Drawings. The pipes shall be free of external and internal coating for a distance of 75 mm from each weld line.

After fabrication all welding scale and beads as well as hardened fluxes shall be removed and joints shall be free of pores and as smooth as possible. Where specified all pipes and specials shall then be degreased and grit blasted prior to coating with Scotchkote Epoxy 206N fusion bonded epoxy coating (or similar approved).

The coating shall be tested to ensure the correct thickness and the absence of pores using spark testing equipment.

Bends, branches and other fittings for use with steel pipe shall comply with the British Standard or other approved standard. Calculations for the design of all special fittings shall be submitted to the Engineer before manufacture commences.

Pipes shall be stacked on a firm base using two timber packers only under the barrel of pipes.

Fittings and specials of any type shall be stored in a single layer only.

Pipes and fittings shall at all times be adequately protected from damage during transport, storage and handling.

Pipes shall be fitted in the factory with end caps and reinforcement adequate to prevent distortion during transport, storage and handling.

Rubber rings and other pipe jointing material shall be stored under cover away from direct sunshine.

SS 19.2.2 Galvanised Mild Steel Pipe

Galvanised mild steel pipes shall comply with SABS 62 and shall be seamless screwed and socketed pipes rated for medium duty. Pipes and fittings shall be galvanised both on the inside and the outside, unless otherwise specified in the Detail Specification.

SS 19.2.3 PVC-U Pipe

Unplasticised PVC (PVC-U) pipes shall comply with BS 3505 and BS 3506. Fittings shall comply with BS 4346, Parts 1 or 2 as appropriate.

Joints shall be either made with rubber sealing rings or shall be solvent welded as specified. Solvents shall comply with BS 4346 Part 3.

Ferrules, straps and other metal fittings shall be gunmetal.

SS 19.2.4 HDPE Pipe

High-density polyethylene (HDPE) pipes shall comply with SANS 4427 / SABS ISO 4427: 1996 Type IV. Pipe fittings used with HDPE pipes shall be of the compression fitting type rated for pressures of up to 1 600 kPa.

SS 19.2.5 Ductile Iron Pipe

Where used, Ductile Iron pipework shall be in accordance with BS EN 545:1995, BS EN 598:1995 and BS EN 969:1996 with flanged joints and fittings unless otherwise specified.

All pipes and fittings shall be protected against corrosion with an internal lining of cement mortar and an external coating of zinc and bitumen in accordance with BS 4772. The bitumen solution shall be in accordance with BS 3416 for use with potable water supplies.

SS 19.2.6 Small-bore Pipework

Small bore pipework up to 15 mm OD shall be manufactured from stainless steel tubing with suitable compression type fittings. All small bore pipework and capillary tubes shall be adequately and securely clipped or clamped. Compression fitting bends shall be kept to a minimum as pulled bends of generous radii are preferred. Compression couplings shall be heavy series to BS 4368 Part 1.

Any gauges, transducers or switches, fed via small bore pipework shall have an individual isolating cock adjacent to each component with adequate space being allowed for component removal for servicing.

SS 19.2.7 Gaps For Equipment

Where gaps have to be left in pipelines for the later installation of equipment such as valves and other items, the ends of the pipes shall be accurately aligned one with the other across the gap paying strict attention to bolt positions if relevant. The length of the gap shall be accurately determined with the aid of dimensional sketches which shall be submitted to the Engineer before the work is carried out.

All gaps left for valves or other equipment shall include space for a dismantling joint.

SS 19.2.8 Flexible Couplings

Flexible couplings shall be of the slip-on type without a center register unless otherwise specified in the Detail Specification. Flexible couplings shall comply with BS 534.

Where appropriate, such as on rising mains, long gravity mains and under conditions where water hammer may occur, flexible couplings shall be restrained by means of anchor bolts and restraining flanges.

SS 19.2.9 Welded Joints

Line-up clamps shall be designed to prevent tears, scars, or indentations of the pipe walls and keep misalignment of pipes at a minimum. Interior line-up clamps are required for the mm diameter pipe.

All welding shall be carried out in accordance with specific procedures prepared by the Contractor and approved by the Engineer.

Cleaning of pipe ends shall be done by power wire brushing and/or grinding. Pipe ends damaged such that they no longer meet joint specifications shall be re-beveled by a suitable machine.

Align pipe ends with line-up clamps such that the longitudinal weld seams of the adjacent pipes are staggered by at least 20 degrees.

Stringer bead on the transmission pipeline shall be applied by at least two welders welding in opposite quadrants.

Completed welds shall have a substantially uniform cross-section around the entire circumference of the pipe. At no point shall the crown surface be below the outside surface of the pipe nor be raised above the parent metal by more than 1.5 mm.

All joints on which welding has started shall be completed before the end of each day's work. At night or when work is not in progress, pipe ends of the pipeline shall be securely capped with

a suitable cover to prevent the entrance of dirt, small animals, water, and foreign matter into the pipeline.

Tie-ins shall be carefully aligned to limit residual and/or reaction stresses after completion of the weld and shall be made within a temperature range of 10°C to 30°C.

The Contractor shall maintain records of all welding and repairs of whatever nature to pipe and pipeline describing and locating such repairs.

Welding pipes together which have been cut shall be done with one weld if it is practical to pull the line into position, otherwise, two welds shall be made by setting in a piece of pipe at least 2 m in length.

SS 19.2.10 Flanged Joints

All flanged connections of pumps, pipework, valves and other relevant equipment shall have flanges in accordance with BS 4504 Table 16, unless otherwise specified in the Particular Specification Sections.

Gaskets for use in flanged joints shall consist of rubber complying with BS 2494 for type 1 rings or rubber reinforced with cotton and complying with BS 5292 or as instructed by the Engineer.

All flanged joints shall be made with 3 mm thick full face canvas reinforced rubber insertion gaskets to BS 4865 Part 1.

On flat face flanges the gaskets shall extend over the full flange area and on raised face flanges they shall cover the raised face only. No asbestos shall be used on any flange of pipework or fitting carrying potable water.

During Installation all pipes shall be hung on their respective supports and lined up so that their joint faces are parallel before flanges are bolted together.

In making joints, no springing of pipes into position shall be allowed.

Joints on flanges that exist or have been installed under other contracts shall be made with the same material and suitable for the flange faces.

Flanged joints shall be made with rubber gaskets and shall be fitted without twist or distortion. Pipes and fittings shall be fully supported so that the flange faces are parallel and concentric. The flanges shall be drawn together uniformly by tightening opposite pairs of bolts in succession and no bolts shall be omitted. The size and number of bolts in flanged joints shall be in accordance with BS 4504 and BS 4772 for the pressure rating of the pipeline given on the Drawings. Bolt threads shall be coated with an approved paste such as Lactate before use unless otherwise instructed by the Engineer.

SS 19.2.11 Puddle Flanges

Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the Contract Drawings and the resultant thrust clearly indicated. Puddle flanges shall only be fitted with the Engineer's prior approval.

After the pipework is installed, the Contractor shall seal the ends of all ducts, pipes, or trenches leading into buildings.

The seals shall be approved water, gas and fire sealing transit units with appropriate fillers. Insert blocks shall be fitted to duct and trench entries. All steelwork on such transit assemblies

and frames shall be hot dip galvanised. Where detailed in the Specification or shown on the Contract Drawings, transit frames will be incorporated in the construction by the Civil Works Contractor.

SS 19.2.12 Integral Flexible Joints

Flexible joints between pipes having integral sockets shall be formed by a shaped rubber gasket fitted within the socket or by a rubber ring of circular cross section (O-ring) placed on the pipe spigot. The type of flexible joint to be used shall be subject to the approval of the Engineer.

Before any joint is made all parts of the joint shall be clean and free from mud, oil, grease or other deleterious matter.

Fixed gaskets shall be lubricated strictly in accordance with the manufacturer's recommendations. O-ring gaskets shall not be lubricated. Components of flexible joints from different manufacturers shall not be used together.

After jointing, the position of O-rings shall be tested with a feeler to ensure that they are correctly positioned. If any ring shows a significant departure from a line following a pipe circumference, the joint shall be broken and remade using a new ring.

After completing the joint any damage to the protective coating shall be made good.

SS 19.2.13 Bonding

All flexible, flanged and similar discontinuous joints shall be bonded across the joint to provide electrical continuity throughout each buried pipeline.

SS 19.2.14 Deviation At Joints

Where a pipeline is laid to a curve by changing direction at joints the maximum deflection at each joint shall not exceed the following:

- a) for any type of flexible joint, three quarters of the maximum permissible deflection stated by the manufacturer;
- b) for welded joints in steel pipelines, the deflection shown on the Contract Drawings. The ends of the pipes shall be cut to suit.

No deviations shall be made at flanged or solvent welded joints.

SS 19.2.15 Cutting Pipes

The cutting of pipes for making up lengths shall be carried out by a method that leaves a clean square end.

Steel pipes used for cutting shall have been rounded throughout their length and shall be clearly marked as such. Cutting shall be carried out by cutting disc or by oxy-acetylene and the cut end shall subsequently be ground to the correct profile for the method of jointing in use.

SS 19.2.16 Accuracy Of Work

The fabrication, machining and finish of all pipe lengths shall be such that when assembled either in the shop or on the site, the appropriate tolerances are obtained. Clearance at joints shall be sufficiently small to avoid turbulence, and thus avoid vibration and all moving parts shall operate freely without risk of undue wear or jamming. Finished faces shall be free of any wind or twist.

Pipeline lengths shall conform to the following tolerances:-

- a) Roundness, $\pm 0.2\%$ on a gauge length of pipe diameter/4
- b) Ovalness, $\pm 0.2\%$ diameter
- c) Step between adjacent strakes, 2.0 mm maximum.
- d) Straightness, ± 20 minutes of arc
- e) Line and level, each section shall be set within 10 mm of the true line and level.

SS 19.2.17 Protection Of Pipework

Immediately after the completion of fabrication at the works or on site and during transport and storage, pipe ends shall be protected from external damage and sealed against ingress of dirt by suitable caps, plugs or other similar means. After cleaning and inspection, machined surfaces of all steel and ironwork shall be covered with preserving fluids of approved types or otherwise protected and all flanges shall be fitted with blank discs bolted to each face.

External and internal protection to pipes shall be made good after completion of joints as directed by the Engineer. Protective tape of a type acceptable to the Engineer shall be applied in two separate layers. Each layer shall be wound with an overlap equal to half the tape width and shall extend at least 150 mm beyond the area requiring protection.

SS 19.2.18 Reference Marking

Prior to dispatch from the manufacturer's works each pipe section shall be marked with an appropriate reference number for future identification.

SS 19.2.19 Branch Pipes And Bosses

Whenever any small bore pipework makes a connection into the pipeline system, a boss or branch pipe shall be provided which shall be at least twice the diameter in width and one diameter in thickness of the tapped hole which it contains.

Bosses shall be located at the main pipe horizontal centerline and those provided for water sample cocks shall be tapped 38 mm (1.5") BSP and have reasonable access for sampling. Bosses provided for instrumentation equipment shall be tapped 25 mm (1") BSP with a reducer fitted to suit the small bore pipework and isolating cock. Unused bosses shall be fitted with blank plugs having a central squared projection for tightening or removal.

Bosses shall be provided for pump performance monitoring. These shall be installed on all pump suction and delivery pipes at least 2 pipe diameters from the pump flange unless otherwise specified in the Detail Specification. Each tapping shall be provided with a 13 mm ($\frac{1}{2}$ inch) isolating cock.

The inside of bosses and branches and the junction between them and the interior of the pipe shall be adequately protected against corrosion.

SS 19.2.20 Connection To Existing Pipelines

No interruption in the operation of existing pipelines for reasons of connecting new pipework to such existing pipelines shall be effected without the permission of the Engineer.

The Contractor shall inform the Engineer at least one week in advance of his intention to connect to an existing pipeline.

SS 19.3 Excavation

Excavation required for the laying of pipework associated with mechanical equipment as indicated on the drawings shall form part of the responsibilities of the Contractor.

Trench width shall be such as to allow a minimum of 300 mm space on each side of the pipe to be laid, unless a lesser allowance is approved by the Engineer. All excavated pipe trenches shall be inspected and approved by the Engineer prior to the placement of bedding and the laying of pipes.

Excavation for pipelines shall include additional excavation required for the construction of valve chambers along the route of the pipeline. Brick manholes and valve chambers require excavation such that at least 150 mm space is provided between the outer wall of the structure and the edge of the excavation.

SS 19.4 Bedding

Bedding shall consist of fine, densely graded and compactible material. Bedding shall be defined as being a layer with thickness equal to the pipe diameter, a 100 mm thick cradle under the pipe and a 300 mm thick blanket layer over the pipe, ie the pipe diameter + 400 mm.

SS 19.5 Pipe Laying

Pipes shall be layed in the centre of pipe trenches or, where pipes are fixed to the outside of walls or structures, shall be installed in the positions as indicated on the drawings. No deviations from the route indicated shall be allowed without the permission of the Engineer.

Pipework fixed to the outside of buildings or structures shall be fixed parallel or at right angles to the structures or walls and to other pipes to create a neat installation.

All pipes and fittings shall be thoroughly cleaned prior to laying and again before trenches are backfilled.

SS 19.6 Backfilling

Backfilling shall be done in layers of 100 mm and each layer shall be compacted before another layer is added. Joints shall be left exposed until the pipeline has been successfully tested for leaks, whereafter the backfilling may be completed.

SS 19.7 Route Indication

If specified in the Detail Specification the route of the pipeline shall be marked with pipeline route indicators. Detail of such route indicators will be included in the Detail Specification.

SS 19.8 Concrete Encasing

Where concrete encasing of pipes is required this shall be done in accordance with the requirements as specified in the Detail Specification.

SS 19.9 Thrust Blocks

Thrust blocks shall be constructed in accordance with the dimensions stated on the drawings.

Where thrust blocks have not been indicated on the drawings but are deemed necessary the Contractor shall submit his thrust block design to the Engineer for approval prior to construction.

SS 19.10 Valves And Other Flow Control Devices

This specification covers valves required to be used on the more common applications. Where special valves are necessary for specific applications, the Tenderer must select suitable valves and provide details with his tender submittals for approval by the Engineer.

Valves shall be designed and constructed to ensure reliable operation after long periods of non-operation.

Valves shall be provided as specified on the drawings and in the Detail Specification, and shall be specifically designed for use with raw and treated water and with chemical solutions used in water treatment.

Unless otherwise specified valves shall be double flanged and flanges shall be as per specifications.

All valves and penstocks shall be of the sizes shown on the Drawings or stated in the Documents and shall be obtained from manufacturers approved by the Engineer. Where specified valves shall be fitted with easing screws and a clean-out box in the base.

All valve bodies shall give the following information:-

- a) Manufacturer's name
- b) Hydraulic test pressure
- c) Size of valve
- d) Direction of flow arrow

Unless otherwise specified all valves over 450 mm diameter and which are subject to a maximum differential pressure in excess of 40 m shall be fitted with flanged bypasses with integral valves.

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified service value, with a maximum applied torque of 150 Nm for valves with nominal diameter in excess of 450 mm, and 100 Nm for valves smaller than 450 mm nominal diameter. Any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 30 kg.

SS 19.10.1 Materials

Valve bodies, discs and wedges shall be of good quality grey cast iron, with facing rings, seating rings, wedge nuts and other trim of corrosion resistant bronze, all as specified.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

Valve bodies and other components of plastic or other non-metallic materials shall be compatible with the medium and of robust industrial design.

SS 19.10.2 Gate Valves

Unless otherwise specified, all gate valves shall be double-flanged wedge gate valves, shall be of the non-rising spindle type and shall be in accordance with the relevant clauses of BS 5163 or BS 5150.

High tensile brass or stainless steel spindles, gun-metal nuts, wedge gates with gun-metal faces and seats, bronze gland bushes and bonnets fitted with soft packing glands are required.

Valves greater than 400 mm diameter shall have detachable bolted covers for inspection, cleaning and flushing purposes.

Valves shall be provided with renewable seats and it shall be possible to remove the gates without removing the valve body from the pipework.

The gate face rings shall be screwed into the gate or alternatively securely pegged over the full circumference.

Unless otherwise detailed on the Contract Drawings, gate valves in chambers, and other similar locations shall be provided with handwheels. Valves that are to be buried in the ground shall be provided with extension spindles, protection tubes, spindle caps, spindle supports and surface boxes.

Valves larger than 400 mm diameter and accessible for maintenance shall be fitted with a studded cast iron cover at the bottom of the valve body for inspection, cleaning and flushing purposes.

Valves of 450 mm diameter and above shall be provided with a geared headstock for manual operation.

Each valve shall be tested in accordance with the requirements of BS 5150 or BS 5163, open-ended in each direction.

Where specified resilient seal type valves shall be provided. The valve shall have a resilient nitrile rubber seal bonded to a cast iron gate. Resilient seal gate valves shall not be used as scour valves or in applications where pressures exceed 1 MPa, and shall be used only for diameters not exceeding 400 mm.

SS 19.10.3 Cast iron gate valves with resilient seals

Resilient seal gate valves may be used on raw sewage, raw water, effluent and general duties where some solids may be present but must not be used on high solid applications such as sludge and grit duties.

The valves shall comply with SANS 664 or SANS 665, Class 10 or higher as required.

The valves shall be double flanged. Valves shall have rising spindles unless otherwise specified or necessary because of space restrictions. Non-rising spindle valves shall be fitted with indicators showing the valve opening position.

Valve bodies, handwheels and bonnets shall be manufactured from spheroidal graphite iron, free from blow holes and carefully fettled after casting to remove surface imperfections. Spindles shall be manufactured from or stainless steel or EN57 or equal approved material according to the duty requirements. At least two spindle seals of the nitrile rubber "O" sealing rings in a corrosion resistant housing shall be provided, along with one nitrile rubber wiper ring to prevent the ingress of dirt. Replacement of the seals shall be possible with the valve under pressure.

Handwheels shall be of cast-iron.

Fixing lugs for end of travel limit switches shall be provided

Handwheel size and construction shall permit easy opening of the gate when subjected to a differential pressure equal to the maximum operating pressure anticipated. Suitable gearboxes shall be fitted to provide easy opening when necessary. These gearboxes shall be grease filled.

Valves larger than DN 150 shall be provided with bypass arrangements.

SS 19.10.4 Knife gate Valves

Knife-gate valves must be used on water sludges as well as on primary, waste activated and digested sludge duties. They shall also be used on other high solids application and may be used for duties specified under Clause "Cast Iron Gate Valves with Resilient Seals".

Valves shall be Insamcor HDH CI STD, or equivalent, with cast iron bodies, stainless steel blades, cast handwheels, and no carbon steel parts.

Valves for water sludges shall be anti-clockwise closing. Valves for primary, waste activated and digested sludges shall be clockwise closing.

Valves shall have chamfered blade edges and resilient body seals, and may have either rising or non-rising spindles. Gate position indication shall be provided if the overall design does not make this apparent. The blade shall be loaded through its central plane during opening and closing and this shall be achieved by the use of a clevis link or similar.

Blade scrapers shall be incorporated to protect the body seal and valve chest. As the valve is opened, the scrapers shall clean the blade surfaces before these contact the body seal. The scrapers shall be of a non-elastomeric, non-metallic material and shall be designed to cause minimal damage to the blade.

Valves shall be droptight in either flow direction. Suitable sealing shall be provided to prevent leakage from the valve and it shall be possible to adjust these seals while the valve is in line under pressure.

Internal and external surfaces of the valve body shall be protected with a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating in accordance with System - Fusion Bonded Epoxy.

Valves shall be double-flanged and shall suit the standard flange rating but may incorporate drilled and tapped fastener holes (the type of valve which is clamped between two flanges will be considered for acceptance only in positions where it is very likely that the pipe or flanged item on either side will never have to be removed or if isolation will not be necessary if it is removed). Fasteners may be studs or setscrews manufactured to suit the tapping depth.

SS 19.10.5 Telescopic Bell-mouth Valve

Each telescopic bell-mouth shall be fitted with manual operated hand-wheels. The vertical travel shall be such that a distance from the top of the bell-mouth to 200mm below top water level (TWL) and 100mm above TWL can be accommodated in the arrangement.

The inflow pipe diameter of the telescopic bell-mouth shall match that of the nominal bore specified on the drawings. The inner tube diameter will be designed by the Contractor to suit the hydraulic design within the vertical travel limits.

Each valve shall be fitted with adjustable travel limits and the torque on the hand-wheel shall be sufficient to function without overloading.

Each valve must also be fitted with a calibration device to identify the appropriate withdrawal settings.

All piping shall be manufactured in 316L s/s, and the spindle shall be of a non-corrodible material suitable for the duty, with square thread spindle nuts manufactured in bronze or gun

metal. The spindle shall be fitted with a clear polycarbonate weatherproof cover to visually see the degree of opening. Hand wheels shall be mounted at an operating height of 950mm from standing floor level such that the bell-mouths can be easily controlled by the hand wheel mounted on the headstock manufactured from either cast iron or aluminium. All mounting brackets and holding down bolts for the hand wheel shall be manufactured from 316 stainless steel. Proposed details for the hand wheel control mechanism and manner of operation are to be submitted with the tender.

The bell-mouth essentially consists of a pipe within a pipe. No metal-to-metal contact shall occur and the seal arrangement on the sliding section shall be suitable for long life in sewage sludge conditions. Should it be required to change the seal, it shall be accomplished without having to remove the complete bell-mouth.

SS 19.10.6

Butterfly Valves

Rubber seated butterfly valves shall be airtight when shut-off. Valves shall be suitable for the application/pressures and for mounting in any position and shall comply with BS 5155, for double flanged valves, except where otherwise specified. All bolts, nuts and other fixings that will be in contact with the contents of the pipelines or, in the case of buried valves within the ground, shall be stainless steel.

Butterfly valves shall be suitable for frequent operation as well as for operation after long periods of idleness in either the open or closed position.

Unless otherwise specified valves shall be hand operated with handwheels driving through 90° gearboxes.

The valve body shall be cast grey iron, the flanges and hubs for the shaft bearing housing being integrally cast with the valve body.

The disc shall be ductile iron having edges machined with rounded corners and polished to a smooth finish. The valve disc shall rotate through an angle of 90 degrees from the valve opened to the fully closed position where the seating shall be at an angle normal to the axis of the pipe. Adjustable mechanical stops shall be provided to prevent over-travel of the valve disc in both the open and closed positions.

Particular attention shall be given to the pipework both upstream and downstream of all butterfly valves to ensure that the disc cannot foul the adjacent pipe.

The shaft shall be fabricated of stainless steel. The shaft, disc and mechanical stops shall be capable of absorbing the full operating torque with a minimum design safety factor of five. Shaft seals, when used, shall be rubber O-ring type. Packing shall be either rubber O-ring or self-adjusting chevron type.

The valve seat shall be replaceable and formed of nitrile rubber 70/75 IRHD. The rubber sealing ring shall be mounted on the disc, securely held by stainless steel retainers, and fasteners which shall seal against a stainless steel seating ring attached to the valve body. This seal should ideally be replaceable. Alternatively, where a nitrile rubber lining to the body of the valve is provided, this shall incorporate the rubber seat for the disc. The disc shall have a stainless steel sealing ring securely fixed in place with stainless steel fixings. All fastenings shall be set flush so as to offer the least resistance possible to the flow through the valve.

Valve seats which extend over the face of the flanges to secure the seat in place, or which require surface grinding and/or hand fitting of the disc, or designs which require the adjoining pipe flange to retain the seat in place and resist line pressure, are not acceptable.

Each valve shall be tested in accordance with the requirements of BS 5155 for body, seat and disc strength tests. Seat and disc strength tests shall be carried out in each direction and the valve shall be drop-tight.

Metal faced butterfly valves shall generally be as above except:

- a) The valves shall have metal to metal seating.
- b) The valves shall be designed for operation in the partly closed, throttled position for long periods.
- c) The valves shall not be of the tight shut-off type and the leakage rate shall not be greater than the following figures:
 - for valves up to 300 mm: 0.075 l/s
 - for valves 300 - 500 mm: 0.150 l/s
 - for valves 500 - 1200 mm: 0.225 l/s.

SS 19.10.7 Non-Return Valves

Non-return valves shall be installed as required, suitable for the operating condition and where applicable conform to BS EN 12334: 2001. Long pattern valves shall generally be used.

Check valves shall possess high speed closing characteristics by use of heavy flaps with external weights where specified but designed for minimum slam condition when closing.

Flaps shall be fitted with renewable bronze or gun-metal sealing faces, which shall mate accurately with renewable bronze or gun-metal seating rings in the valve body. All seating/seals shall be positively located.

Covers shall be provided to allow ample access for inspection, cleaning and servicing and shall be supplied complete with tapped boss fitted with an air release cock.

Valves greater than 500 mm diameter shall be provided with lifting eyes, feet and jacking screws.

Valve body design shall be such that there is adequate clearance around and at the back of the flap to minimise jamming by rags, solid matter.

Valves installed on delivery lines at boreholes shall be of the single door swing type and fitted with heavy-duty external lever suitable for back flushing.

Check valves for potable water shall be free acting type single flap or multiflap with external by-pass and hand operated control valve as necessary. Flaps shall be of design and weight to suit the prevailing hydraulic conditions and shafts shall turn in close fitted low friction bearings. Valves shall be fast-acting with short travel and designed to minimise slamming.

Hinge pins/shafts and internal fixing devices shall be stainless steel. Hinge pins/shaft shall preferably be square in section to ensure positive location of flaps and provide for secure fixings.

For valves with external levers and adjustable balance weight the hinge pins/shafts shall extend through a renewable sealing gland on the side of the body.

Each valve shall be tested in accordance with BS EN 12334:2001 or if outside the size of this standard to the form as set out in BS EN 12334:2001 and to the nominal pressure designation/test pressure relationship set out therein or 700 kN/sq. m for 30 minutes whichever is the greater.

For potable water applications where space is at a premium wafer type double flap non-return valves with spring assisted closing may be specified. These valves shall have cast iron bodies and flaps with resilient seats and be fitted with stainless steel hinge pins and springs.

SS 19.10.8 Air Release Valves

Air release and vacuum break valves shall be double orifice with anti-shock orifice mechanism, of type "Vent-O-Mat Series RBX" or similar approved with flanged inlets and rated for a minimum working pressure as specified.

Air valves shall normally be installed at high points in pipework and as shown on the drawings. The valves shall be capable of exhausting air from pipework automatically when being filled, the air being released at a sufficiently high rate to prevent the restriction of the inflow. The valves shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high velocity air discharge or the subsequent rejoining of separated water columns. The limitation of pressure rise must be achieved by deceleration of approaching water prior to valve closure.

The valves shall also automatically release air accumulating in pipework during normal working conditions. Air valves shall be designed to prevent premature closure prior to all air having been discharged from the line.

Similarly the valves shall be capable of ventilating pipework automatically when being emptied, the air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines.

The intake/discharge orifice area shall be equal to the nominal size of the valve.

The inlet shall be fitted with an isolating valve with vertical spindle, key operated from above.

Air valves shall be able to withstand twice the maximum rated pressure and shall provide a positive drop-tight closure from a minimum pressure of 50 kPa up to the maximum rated pressure.

The material of the body and cover shall be grey cast iron.

The orifice shall be positively sealed in the closed position but the float (ball) shall only be raised by the water and not by a mixture of air and water spray.

The valve seats shall be designed to prevent the float sticking after extended periods in the closed position.

SS 19.10.9**Control Valves**

Pressure and flow control valves shall be installed as shown on the Contract Drawings and be suitable for the operating conditions specified.

The basic valves shall be either of the pressure compensating globe valve design with externally arranged spring and diaphragm assembly or of the streamline two chamber concentric plunger and pilot valve regulating assembly enclosed within the valve body as required for the particular applications.

Valve bodies shall be of a suitable grade of close-grained cast iron to BS EN 1561:1997.

Valves shall be sized such that the fully open capacity is more than adequate to accept the specified maximum flow at the minimum differential pressure.

The globe valve design shall have the main seat in the stream flow and an upper cylinder for the valve element control piston type and shall have the required number of bosses drilled and tapped to receive strainer unit, relay valves and pressure gauges. The cover plate shall include an air vent and lifting eyes. The main seat shall have a renewable element and the upper portion shall be in the form of a piston and the lower portion shall have a face ring and ported guide.

Valves shall be fitted with an external control relay system which shall be capable of controlling the required parameter of flow or pressure within + or -5 per cent of the set value. The relay system shall include connecting piping couplings and isolating valves to permit maintenance or replacement without interrupting supply.

The rate of response of opening and closing of the main valve shall be adjustable and means for external indication of the main valve element position shall be fitted.

The particular control system for the different duties shall be as specified below.

a) Altitude Valves

The main valve shall be controlled by a slave ball cock mounted in the controlled tank at top water level and connected to the valve operating mechanism by small-bore pipework. The level of the ball shall be adjustable in service so that the main valve is fully drop-tight closed when the water level in the tank reaches top water level.

b) Flow Control Valves

Flow control valves shall be designed to prevent the flow downstream rising above that specified in the Particular Specification or shown on the Drawings for the particular application, regardless of the operating pressures in the system upstream or downstream of the valve. The relay system valve shall be operated by the pressure differential measured across the main flow orifice which shall be fitted at the upstream end of the flow control valve.

c) Pressure Reducing Valves

Pressure reducing valves (PRV) shall be able to limit the maximum downstream pressure to a set value under all flow conditions. They shall have upstream and downstream pressure gauges and an adjustable pressure regulating setting. Pilot feed lines shall be equipped with adequate grit strainers of sufficient size to allow at least

one month's proper operation without requiring cleaning. Strainers shall be equipped with flush valves.

d) **Pressure Sustaining Valves**

Pressure sustaining valves shall be able to sense upstream pressure and hydraulically control the flow through the valve in order to maintain a set upstream pressure, irrespective of the flow and pressure conditions downstream of the valve. They shall have upstream and downstream pressure gauges and an adjustable pressure regulating setting. Pilot feed lines shall be equipped with adequate grit strainers of sufficient size to allow at least one month's proper operation without requiring cleaning. Strainers shall be equipped with flush valves.

e) **Pressure Relief Valves**

Pressure relief valves shall be designed to prevent the pressure in the pipeline immediately upstream of the valve rising above a preset value. The valve shall remain closed at lower pressures.

Adjustment of the pressure at which the valve opens to relieve pressure shall be made by a screw on the relay valve or by changing weights as appropriate. A pressure gauge indicating upstream pressure shall be incorporated.

SS 19.10.10 Diaphragm Valves

Diaphragm valves shall be of the straight-through design with minimal flow resistance and glandless construction conforming to the requirements of BS 5156.

The valves shall be made up of two durable body parts and the diaphragm, all interchangeable with replacements parts for easy maintenance. Diaphragm valves shall be completely leak tight and suitable for pressures up to 10 bar.

The diaphragm shall be moulded in a reinforced, flexible material of a grade to suit the specified duty and liquid content of the system. In the open state the diaphragm shall lift clear and not obstruct the flow of liquid. The internal surfaces of the valve body shall also be lined with material compatible with diaphragm duty.

The valves shall be operated by hand wheels unless otherwise specified on the Contract Drawings. Hand wheels shall have adequate leverage to give the closure effort required and a facility to lock in any position.

Where indicated on the Drawings diaphragm valves shall be supplied with extended spindles or extensions for pedestals.

SS 19.10.11 Ball Float Valves

Ball float valves shall be designed for installation on the inlet pipe to a storage tank and shall automatically shut off when the water reaches a predetermined level. They shall be of the piston type with direct float and lever operation type.

Valves shall be designed for a working pressure of 1000 kN/m². Valves shall be drop-tight when they are held shut by the floating ball. Valves shall be tested for leakage at 1000 kN/m² when they shall be drop-tight, and shall be tested for body and valve element strength with the valve closed and a test pressure of 1500 kN/m² applied to the inlet end.

Valves shall be constructed of a suitable grade of close-grained cast iron to BS EN 1561: 1997 with gun-metal trim to BS 1400 Grade LG2. The valves shall incorporate rubber faces. The ball float shall be made in tinned copper and the float lever shall be mild steel.

SS 19.10.12 Pinch Valves

Pinch valves shall have a single piece elastomer pinch tube which shall be suitably reinforced to ensure a long life. All internal metal parts of the valve shall be protected by this tube, however, all internal and external metal parts shall be suitably protected against the possible corrosive properties of the environment in which it is to operate.

The pinching mechanism shall be such that the pinch tube is pinched from both above and below.

SS 19.10.13 Isolating Cocks

For isolation of small bore pipework, tappings for instrumentation equipment, and for individual component isolation, the cocks shall be stainless steel, 0.25 turn ball or plug valves with the operating handle arranged to indicate the open and closed positions. Where specified, means shall be provided for securing the valve body to a front panel or rear surface.

Where corporation cocks are specified, these shall be similar to the above isolating cocks but shall have a detachable key handle for fitting onto a squared operating shaft, the shaft end being marked to indicate the open and closed valve positions.

SS 19.10.14 Penstocks

Penstocks shall comply with the requirements of the standard specification on sluice gates, hand stops, stop logs and weirs, contained elsewhere in this document.

SS 19.10.15 Hand wheels

All hand wheels shall be arranged to turn in a clockwise direction to close the valve or penstock and the direction of rotation for opening and closing shall be permanently indicated on the hand wheels.

Unless otherwise specified the hand wheels shall be manufactured from cast iron or mild steel, adequately protected against corrosion and shall incorporate facilities for padlocking in both the open and closed positions.

Headstocks and valves of 50 mm, or greater, nominal bore shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. 0.25, 0.50, 0.75, 1.

SS 19.10.16 Extended Spindles And Pedestals

Extension spindles shall be adequately sized to prevent buckling and shall be attached to the valve/penstock stem by a suitable adapter incorporating two muff couplings, scarf lap jointed and pinned with at least two coupling joints included. Universal joints and waterproof sleeves shall be provided where specified. Extension spindles shall be manufactured from 080M40 (EN 8) steel.

Intermediate bearing support or guide brackets of cast iron, with slotted holes for site adjustment, shall be fitted to long shafts where necessary. Bearings shall be of PTFE or similar approved type.

Penstock and valve pedestals shall be of cast iron or heavy duty, welded, mild steel construction, with a substantial base and fixing provision. The base and top of the pedestals shall be machined normal to the axis of the drive shaft. Where necessary, support guide bushes shall be fitted at the base of the pedestal. The pedestal height shall be such that the handwheel is 900 mm above the operator's floor level.

Covers of an approved type shall be provided for all rising spindles to totally enclose them when in the fully raised position.

SS 19.10.17 Valve Chambers And Access To Valves

All valves, hand wheels, spindles and headstocks shall be positioned to give good access for operational personnel.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements.

Valves buried or installed in underground chambers where access to a hand wheel would be impractical shall be provided with a cap-top for key operation. A valve key shall be supplied as part of each valve with a cap-top.

It shall be possible either to remove and replace or to recondition seats, gates or gland packing which shall be accessible without removal of the valve from the pipework.

SS 19.11 Actuators

Where actuators are required for the operation of valves these shall comply with the specifications given in the Standard Specification on Valve Actuators and in the Detail Specification.

Where actuated valves are specified the cost of the relevant actuator shall be deemed included in the rate for the supply and delivery of the valves concerned.

SS 19.12 Corrosion Protection

All pipework, valves and fittings shall be adequately protected against corrosion in accordance with the provisions of the standard specification on corrosion protection.

SS 19.13 Testing And Commissioning

a) General Requirements

The testing of pressure pipelines shall be carried out in lengths to be proposed by the Contractor, and agreed to by the Engineer. Lengths not exceeding 1000 metres shall be tested as soon as possible after completion of the length concerned.

Before testing commences, the Contractor shall ensure that all anchor and thrust blocks are complete, and that temporary supports have been installed where required. Thrust from temporary pipe ends or branch pipes shall be adequately strutted, and the section under test shall be closed off with stop ends, blank flanges or other closure fittings.

The Contractor shall supply all equipment and materials necessary for carrying out the requirements of this Clause.

Pressure gauges used for testing pipelines shall have 300 mm dials calibrated in metres head or equivalent. Each gauge shall have been calibrated by a testing station and the

Contractor shall produce a calibration chart and dated test certificate for the Engineer's inspection.

All pipelines shall be cleaned before testing by flushing, or by passing through them a swab or pig as appropriate and as agreed by the Engineer.

All tests shall be carried out in the presence of the Engineer and for this purpose the Contractor shall give the Engineer 24 hours notice in writing of any pressure tests which he intends to carry out. Tests shall be conducted in accordance with the appropriate Sub-Clauses below.

Within 24 hours of the completion of any test the Contractor shall submit two copies of a full record of the test to the Engineer. The record shall be in a form acceptable to the Engineer.

b) Normal Water Test

The length of pipeline to be tested shall be filled with clean water, making sure that all air is expelled, and then kept under nominal working pressure for 24 hours. At the end of this period the pressure shall be raised to the specified test pressure using a hand operated force pump which is fed from a calibrated tank. The test pressure will depend upon the particular circumstances and will be specified by the Engineer but for general guidance only will be about 1.5 times the maximum sustained operating pressure.

The test pressure shall be held for the period instructed by the Engineer, pumping in water as required from the calibrated tank, and the amount of water used per hour shall be noted. If the loss exceeds the equivalent of 0.003 litres per millimetre of nominal bore of pipe per kilometre for every metre head of test pressure measured at the highest point of the pipe run in a period of 24 hours, the pipe shall be deemed unsatisfactory and the Contractor shall search for and repair the leaks and then repeat the test.

c) Testing Steel Pipelines with Butt-Welded Joints

Where instructed by the Engineer welded pipelines shall be subjected to a preliminary air pressure test in short sections. An air pressure of between 0.6 and 0.7 N/mm² shall be applied to the section under test and a solution of detergent in water applied by brush to the joints. The location of any leaks shall be clearly marked and the joint in these places shall be gouged out and re-welded.

On completion of a section of pipeline not exceeding 1000 metres the line shall be filled with water and tested as stated in the Normal Water test above, except that the pressure shall be held for 24 hours and there shall be no loss of water. The test pressure will be as instructed by the Engineer.

SS 19.14

Cleaning And Disinfection

Unless otherwise specified in the Detail Specification, pipelines for the conveyance of potable water shall be cleaned and disinfected as follows:

- a) The line shall be swabbed and flushed with clean water.
- b) The line shall be filled with water containing a minimum of 20 mg/ℓ available chlorine and allowed to soak for a minimum of 24 hours.
- c) The line shall be flushed to remove excess chlorine.

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- d) The line shall be filled with clean potable water and allowed to soak for an additional 24 hours.
 - e) The water shall be tested by an approved laboratory for compliance with the water quality standards as specified in the Detail Specification.

Laboratory testing shall include testing for pH, turbidity, residual chlorine, total coliforms, faecal coliforms and standard plate count. Tests shall be performed on the water used to soak the line after disinfection, on samples taken before and after the second soaking period. The cost of water quality testing shall be included in the amount tendered for testing and commissioning the pipework concerned.

If the water quality testing indicates unsatisfactory results after the second soaking period, the disinfection procedure shall be repeated at the Contractor's cost. If the line passes the water quality tests, it shall be connected to the existing system within 7 days. Should the Contractor fail to connect to the existing line within the stipulated time period, then the line shall be re-tested.

SS 19.15

Payment Items

Unless otherwise specified in the Detail Specification or separately scheduled in the Bill Of Quantities, the cost of the supply, delivery, installation, testing and commissioning of pipework, valves and fittings shall be deemed included in the tendered rates for the equipment to which they are connected, and no separate payment items shall apply.

Where "DESIGN" is added to the description of this payment item in the Bills of Quantities, the rate shall include the cost of design services as specified for this contract (refer to Clause 2.1). The detail of the pipework that is given on the drawings is deemed to be adequate for tendering and planning purposes. Any changes deemed necessary by the Contractor to provide a fully reliable and functional system in accordance with the specifications shall be included in the tendered rates. No variations in payment will be entertained during the construction stage.

Where additional supports or brackets are schematically shown on the drawings or deemed necessary by the Contractor, the rate shall include the design, manufacture and construction of required for the supports.

When an "extra-over" item is specified the installation, testing and commissioning shall be measured separately in the Bills of Quantities.

SS 20. LIFTING EQUIPMENT**SS 20.1 Scope**

This section covers the supply, delivery, installation, testing and commissioning of electric overhead cranes for use in pump stations, generator buildings, chemicals stores, chlorination installations, etc.

SS 20.2 General

Electric overhead cranes shall be designed in accordance with BS 2573 and shall comply with the requirements of BS 466 Class 2 Medium Duty Operation.

The term crane shall be deemed to include gantry rails, platform with hand rails for maintenance purposes, down shop conductors, end stops, holding down bolts and all other items required for complete installation.

The Contractor shall be responsible for the provision of detail information for the successful and complete installation of his equipment, and for carrying out the installation, testing and commissioning.

SS 20.3 Electric Motors

Electric motors shall comply with the provisions of the standard specification on electric motors, contained elsewhere in this document.

All motors shall be of the quick reversing type with electric mechanical brakes suitable for the duties specified. All movements shall be electrically powered suitable for operating with the hook loaded. Facilities shall be provided for the accurate location of the hook by means of 'inching' the cross travel and down shop travel motions.

A 3 phase monitoring relay shall be fitted to prevent operation of the crane when the 3 phase supply is reversed or when all 3 phases are not present.

Motors and switchgear shall be provided with anti-condensation heaters which shall be energised when the crane is at rest and suitable warning-labels shall be provided.

The hoist and travel motors shall be based on the sliding rotor principle, shall be totally enclosed, and designed for instant reversing and crane duty.

The electric motors for the main hoist, long travel and cross travel shall be of squirrel cage construction.

All shafts shall be supported on high-precision ground roller and ball bearings.

All motors shall be designed specifically for crane duty, and travel motors shall have soft starting characteristics to reduce load swing.

SS 20.4 Gearboxes

Gearboxes for crane duty shall be of the totally enclosed free-floating planetary type, life-lubricated with oil.

SS 20.5 Couplings

The motor to gearbox connection shall be through a flexible roller coupling in both radial and axial directions. This coupling shall be able to transmit the motor output to the gearbox without vibrations, and shall ensure quiet running.

SS 20.6 Components

The overhead crane as specified shall be supplied and delivered with all components required to provide a fully functional unit suitable to the application as described. More detail regarding the minimum requirements for various components is given below. The components listed do not necessarily constitute the components for the crane required and certain components may be added or deleted as dictated by the particular application. All components shall conform to the relevant local or international standard specification or code of practice.

SS 20.6.1 Crane Bridge

The bridge shall consist of a single universal beam, supported on rails by purpose-made end carriages on each side.

End carriages shall be of welded construction, jig bored to guarantee perfect wheel alignment. End carriages shall be fitted with buffers of cellular structure.

High strength friction grip bolts shall be used for connecting the bridge girder to the end carriages.

Four double-flanged long-travel wheels, with flame hardened treads and flanges accurately machined to size shall be provided. The flanges shall be tapered and corners shall be rounded.

Each long travel drive wheel shall be driven by one squirrel cage pole changing electric travel motor. These motors shall be flange-mounted totally enclosed axle-mounted oil-bath lubricated reduction gearboxes.

SS 20.6.2 Monorail Hoist

The hoist shall be an electric wire rope hoist of the manufacturer's standard and current design, and shall be suspended from a four-wheel electrically driven carriage having machined steel slides for track width adjustment.

Four single flanged wheels, ball bearing mounted, shall be provided. Two wheels shall have machine-cut gear-rims totally enclosed, grease lubricated and meshing with the drive pinions from the gearbox.

Cross-travel drive shall be effected by means of a flange-mounted motor driving through a totally enclosed gearbox.

The hoist arrangement shall have an in-line drive and shall comprise a brake motor, multi-stage

planetary gearbox, rope drum and integral electrical panel, resulting in speed, safety and efficiency of operation.

SS 20.6.3 Rope And Rope Drum

The rope shall be specially manufactured for use in crane applications using steel of minimum 1770 MPa tensile strength. In all cases the rope shall be rated for the duty for which the crane is specified.

The rope drum shall be manufactured of fabricated steel (ST 52.3) with deep grooves machined to suit the size of rope used and shall be supported at each end on precision-ground ball races.

Three extra safety windings shall be provided.

All drums shall be provided with a recess to accommodate an emergency rope drum brake, which shall be provided as part of the crane assembly.

SS 20.6.4 Bottom Block, Hook And Sheaves

Crane hooks shall be forged steel 'C' type hooks and shall be fitted with safety catches. The bottom block shall incorporate fully guarded rope sheaves.

The bottom block shall ensure safe handling through convenient rope entry and standard black and yellow warning colours.

The sheaves shall be completely shrouded-in by an ergonomically designed guard and a safety device fitted to prevent the sling leaving the hook. The sheaves shall be manufactured of cast iron, shall be self-lubricating for long life, and shall be accurately machined to suit the lifting ropes. Sheaves shall run on precision ball or roller bearing.

SS 20.6.5 Brakes

Each motor shall be equipped with an instantly acting electro-mechanical brake, spring-applied and electrically released, actuated by the axial displacement of the conical rotor.

The brake shall be capable of holding the load in any position or stopping the motion of the crane in case of electrical power failure.

Brake linings shall be asbestos-free and shall be easily accessible for adjustment. Adjustment shall be simple and worn linings shall be easily replaced without the need for riveting.

SS 20.6.6 Down-Shop Conductors

Down-shop conductors shall be of the fully insulated shrouded busbar type. The current collectors shall have renewable contact pieces. Festoon cables may be used for the cross travel. A crane isolator lockable in the off position and incorporating a warning lamp, illuminated when the electrical supply is live, shall be provided at the bottom of the access ladder. A second isolator shall be provided at a control cubicle located on the crane platform.

SS 20.6.7 Rigging Equipment

Sufficient slings, ropes, shackles, lifting beams, and other rigging equipment shall be supplied

to handle all items of plant covered by the crane. They shall be labelled or marked with the Safe Working Load (SWL) and the purpose for which they are intended.

SS 20.7**Controls**

Operation shall be from ground floor level by bridge-mounted pendant push-button controls. Controls shall be mechanically and electrically interlocked to prevent inadvertent operation of opposing motions. Maximum pendant control voltage shall not exceed 115 V AC. The pendant shall be supported independently of the electric cable.

The Contractor shall include with the cranes all control cubicles and protection equipment necessary to operate the crane and provide adequate electrical protection against overload, phase and earth fault and fail-safe protection in the event of an interruption in the power supply. All access ladders and platforms required to carry out maintenance and repairs shall be provided and installed by the Contractor.

SS 20.8**Hoist And Travel Speed**

The following hoist and travel speeds shall not be exceeded:

- a) Hoist (low speed): 0.4 m/minute
- b) Hoist (high speed): 4 m/minute
- c) Cross travel: 10 m/minute
- d) Down shop travel: 15 m/minute

SS 20.9**Electrical Requirements**

The electrical equipment shall be suitable for operation from a 4000 Volt, 3 phase, 50 Hz power supply with an allowable $\pm 6\%$ variation of supply voltage. The equipment shall be suitable for operation at an altitude of up to 1500 m, in an ambient temperature ranging between -5 and 55 degrees Centigrade, and shall conform to BS 466, with contactors rated to IEC Class II Category AC4 for squirrel cage motors.

The main motions of the crane shall be driven directly from the 400 Vac, 3 phase, 50 Hz supply, while all control circuits shall be operated from control circuit transformer supply, the secondary not exceeding 115 Vac.

All motors shall be fitted with overload relays of the bimetal thermal type. The motors shall be direct on line, direction-controlled by electrical and mechanical interlocked reversing contactors.

SS 20.9.1**Control Housing**

The electrical control housing shall be of the enclosed type in dust-proof steel housings fitted with hinged doors, having positive closing non-lockable operating handles. The housing shall be baked enamel finished to SABS 1091, colour B26 orange. The housing shall be either wall- or floor-mounted. The crab housing shall be an integral part of the hoist unit.

SS 20.9.2	Contactors Contactors shall be supplied by a recognised supplier approved by the Engineer. All contactors shall be rated in accordance with IEC Class II Category AC 4 for squirrel cage motors.
SS 20.9.3	Isolators The main isolator shall be rated as a motor start circuit breaker with thermal and magnetic short-circuit protection.
SS 20.9.4	Panel Wiring All wiring shall be carried out in minimum 660 V grade PVC multi-strand panel wire, insulated, lugged and ferrules numbered in accordance with the wiring diagram and wired down to a suitably mounted terminal rail. The terminal rail shall be angled upward for ease of access to external connections.
SS 20.9.5	Labels All isolating switches, contactors, relays etc. shall be labelled according to the wiring diagram.
SS 20.9.6	Pendant Controllers The pendant controller shall be of moulded non-ferrous construction and of a completely insulated design, enclosure rating IP65, for safety purposes and ease of handling. On all pendant-controlled cranes provision shall be made for de-activating the pendant controller to prevent inadvertent operation from the floor while maintenance work is being carried out on the crane. All push buttons shall automatically return to the 'OFF' position once they are released. The control station shall include a device for opening and closing the main contactor.
SS 20.9.7	Festoon Systems The power/control supply to the crab and mobile pendant system shall be by means of highly flexible PVC trailing cables suspended from ball-bearing-mounted swivel hangers running in a "C" profile rigid track along the crane bridge.
SS 20.9.8	Cables General wiring of the crane shall be by means of PVC-insulated minimum 660 Volt rated cable. The cables shall be run in cable trunking for protection and aesthetic reasons. Suitable compression glands shall be used for termination of cables.
SS 20.9.9	Hoist Limit Switches The crane shall be fitted with positively acting limit switches to prevent excess travel, over-hoisting and over-lowering of the crane hook. The limit switches shall cut off the controls and apply the brakes when the hook has risen or dropped to a predetermined level. These switches shall be of the self-resetting type.
SS 20.10	Safety Signs Two name plates, showing the safe working load of the crane, will be mounted on the bridge structure as well as an identification "Crane Serial Number".
SS 20.11	Corrosion Protection The equipment provided shall be manufactured from corrosion-resistant materials. Where

