



ANNEXURE D - PROJECT SPECIFICATIONS

Contract No.: RW10404061/23

**TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS
BY 15 ML/DAY AT MEYERTON**

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Status

Should any requirement or provision in the parts of the Scope of Work conflict with any requirement of any Specification(s) forming part of this contract or any drawings, the order of precedence, unless otherwise specified, is:

Drawings
Scope of Work
Specifications

Contract No: RW10404061/23

Description: TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS BY 15 ML/DAY AT MEYERTON
PROJECT SPECIFICATIONS

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1. APPLICABLE SANS 2001 STANDARDS

- SANS 2001-BE1:2008 Construction works Part BE1 : Earthworks (general)
- SANS 2001-BS1:2008 Construction works Part BS1 : Site clearance
- SANS 2001-CC1:2012 Construction works Part CC1 : Concrete works (structural)
- SANS 2001-CC2:2007 Construction works Part CC2 : Concrete works (minor works)
- SANS 2001-CS1:2017 Construction works Part CS1 : Structural Steelwork
- SANS 2001-CG1:2007 Construction works Part CG1 : Installation of glazing in window and door frames
- SANS 2001-CM1:2007 Construction works Part CM1 : Masonry walling
- SANS 2001-CS1:2005 Construction works Part CS1 : Structural steelwork
- SANS 2001-CT1:2007 Construction works Part CT1 : Structural timberwork (flooring)
- SANS 2001-CT2:2007 Construction works Part CT2 : Structural timberwork (roofing)
- SANS 2001-DP1:2011 Construction works Part DP1 : Earthworks for buried pipelines and prefabricated culverts
- SANS 2001-DP2:2010 Construction works Part DP2 : Medium pressure pipelines
- SANS 2001-DP4:2010 Construction works Part DP4 : Sewers
- SANS 2001-DP5:2010 Construction works Part DP5 : Stormwater drainage
- SANS 2001-EM1:2007 Construction works Part EM1 : Cement plaster

2. APPLICABLE NATIONAL AND INTERNATIONAL STANDARDS

- SANS 4633 Rubber Seals – Joint Rings for water supply, drainage and sewer pipelines – Specification for materials (2008).
- SANS 541 Precast concrete paving slabs
- SANS 558 Cast iron surface boxes and manhole and inspection covers and frames
- SANS 966-1 Components of pressure pipe systems Part 1: Unplasticized poly(vinyl chloride) (PVC-U) pressure pipe systems
- SANS 974-1 Rubber joint rings for use in water, sewer and drainage systems
- SANS 1083 Aggregates from Natural Sources – Aggregates for concrete
- SANS 1117 Plastic wrappings for the protection of steel pipelines
- SANS 1123 Pipe Flanges
- SANS 1601 Structural wall pipes and fittings of unplasticized poly(vinyl chloride) (PVC-U) or buried drainage and sewerage systems
- SANS 1921-1 General engineering and construction works
- SANS 1921-2 Accommodation of traffic on public roads occupied by the Contractor
- SANS 1921-3 Structural steelwork
- SANS 1921-4 Third-party management support in works contracts
- SANS 1921-5 Earthworks activities which are to be performed by hand
- SANS 1921-6 HIV/AIDS awareness
- SANS 10090 Community protection against fire
- SANS 10102 The selection of pipes for buried pipelines
- SANS 10120 Code of Practice for use with Standardised Specifications for Civil Engineering Construction and Contract Documents
- SANS 10120-2 Project Specifications (blue pages)
- SANS 10120-3 Guidelines for Design (green pages)
- SANS 10120-4 Typical Schedule of Quantities (yellow pages)
- SANS 10120-5 Contract Administration (pink pages)
- SANS 10144 Detailing of steel reinforcement for concrete
- SANS 10160 Basis of structural design and actions for buildings and industrial structures (Parts 1-8)
- SANS 10162-1 Limit-state design of hot-rolled steelwork
- SANS 10162-2 Cold-formed steel structures
- SANS 10252-1 Water Supply Installations for Buildings
- SANS 10252-2 Drainage Installations for Buildings
- SANS 10400 The application of the National Building Regulations
- SANS 10403 Formatting and compilation of construction procurement documents
- SANS 10845-1 Processes, methods and procedures
- SANS 10845-2 Formatting and compilation of procurement documentation
- SANS 10845-3 Standard conditions of tender
- SANS 10845-4 Standard conditions for the calling for expressions of interest
- SANS 10845-5 Participation of targeted enterprises in contracts
- SANS 10845-6 Participation of targeted partners in joint ventures in contracts
- SANS 10845-7 Participation of local enterprises and labour in contracts
- SANS 10845-8 Participation of targeted labour in contracts

3. APPLICABLE SANS 1200 STANDARDISED SPECIFICATIONS

The following SANS 1200 Standardised Specifications for Civil Engineering Construction are applicable:

- SANS 1200 A - 1986 General
- SANS 1200 AB - 1986 Engineer's Office
- SANS 1200 C - 1980 Site Clearance (As Amended 1982)
- SANS 1200 D - 1988 Earthworks (As Amended 1990)
- SANS 1200 DB - 1989 Earthworks (Pipe Trenches)
- SANS 1200 DM - 1981 Earthworks (Roads, Sub grade)
- SANS 1200 DK - 1996 Gabions and Pitching
- SANS 1200 G - 1982 Concrete (Structural)
- SANS 1200 H - 1990 Structural Steelwork
- SANS 1200 HA - 1990 Structural Steelwork (Sundry Items)
- SANS 1200 HC - 1988 Corrosion Protection Of Structural Steelwork
- SANS 1200 L - 1983 Medium Pressure Pipelines
- SANS 1200 LB - 1983 Bedding (Pipes)
- SANS 1200 LD - 1982 Sewers
- SANS 1200 LE - 1982 Stormwater Drainage
- SANS 1200 LF - 1983 Erf Connections (Water)
- SANS 1200 M - 1996 Roads (General)
- SANS 1200 ME - 1981 Subbase
- SANS 1200 MF - 1981 Base
- SANS 1200 MJ - 1984 Segmented Paving
- SANS 1200 MK - 1983 Kerbing and Channelling
- SANS 1200 MM - 1984 Ancillary Roadworks

4. PARTICULAR SPECIFICATIONS

The following forms part of the Particular Specifications and are presented in detail below:

- SECTION 5: Variations to SANS 1200
- SECTION 6: Mechanical: Detailed Specifications
- SECTION 7: Mechanical: Standard Specifications

Refer to the following Annexes for:

- Annexure B - Health and Safety Specifications by the Employer
- Annexure A - Construction Environmental Management Plan
- Annexure E - Structural Assessment Report
- Annexure F - Geotechnical Reports

5. ADDITIONS AND VARIATIONS TO SANS 1200

The following variations to SANS 1200 are applicable:

- | | |
|--------|---|
| • PSA | GENERAL (SANS 1200 A) |
| • PSAB | ENGINEER'S OFFICE (SANS 1200 AB) |
| • PSC | SITE CLEARANCE (SANS 1200 C) |
| • PSD | EARTHWORKS (SANS 1200 D) |
| • PSDB | EARTHWORKS (PIPE TRENCHES) (SANS 1200 DB) |
| • PSDM | EARTHWORKS (ROADS, SUBGRADE) (SANS 1200 D) |
| • PSDK | GABIONS AND PITCHING |
| • PSG | CONCRETE (STRUCTURAL) (SANS 1200 G) |
| • PSH | STRUCTURAL STEELWORK (SANS 1200H) |
| • PSHA | STRUCTURAL STEELWORK (SUNDRY ITEMS) (SANS 1200 HA) |
| • PSHC | CORROSION PROTECTION OF STRUCTURAL STEELWORK (SANS 1200 HC) |
| • PSL | MEDIUM PRESSURE PIPELINES |
| • PSLB | BEDDING (PIPES) (SANS 1200 LB) |
| • PSLD | SEWERS (SANS 1200 LD) |
| • PSLE | STORMWATER DRAINAGE (SANS 1200 LE) |
| • PSLF | ERF CONNECTIONS (WATER) |
| • PSM | ROADS (GENERAL)(SANS 1200 M) |
| • PSME | SUBBASE |
| • PSMF | BASE |
| • PSMJ | SEGMENTED PAVING |
| • PSMK | KERBING AND CHANNELLING |
| • PSMM | ANCILLIARY ROADWORKS |

NOTE : Numbering in the Project Specifications correspond with the numbering of clauses in the Standard Specifications (SANS 1200). Additional clauses are preceded by an asterisk “*”.

Tenderers must make provision for all the relevant Specifications to be included when calculating the prices of the various items in the Bill of Quantities.

PSA GENERAL (SANS 1200 A)

PSA 2 INTERPRETATIONS

PSA 2.3 Definitions

a) General

Add the following Definitions:

General Conditions: The general conditions of the contract specified for use with this Contract and the special conditions of the Contract as applicable.

Specified: As specified in the standardised specifications, the drawings, or the project specifications. Specifications shall have the corresponding meaning.

c) Measurement and Payment

Replace the definitions for fixed charge, time-related charge, and value-related charge with the following:

Fixed charge: A charge that is not subject to adjustment on account of variation in the value of the Contract Price or the Time for Completion.

Time-related charge: A charge, the amount of which is varied in accordance with the Time for Completion of the work as adjusted in accordance with the provisions of the Contract.

Value-related charge: A charge, the amount of which is varied pro rata the final value of the measured work executed and valued in accordance with the provisions of the Contract."

PSA 3 MATERIALS

PSA 3.1 Quality

Add to the Sub-Clause 3.1:

"No used or recycled material may be used in the Works unless expressly authorised by the Engineer.

Materials specified supplied under this contract comply with the Standardised and Particular Specifications and all the applicable Standards Bureau and shall bear the official mark of the Bureau concerned. Proof of the required quality assurance for approval by the appropriate Standards Bureau shall be provided.

Samples of concrete aggregates and pipe bedding material are to be tested at approved South African National Accreditation System (SANAS) approved laboratory.

The Contractor shall keep systematic records of the test results and all worksheet relating thereto.

Unless otherwise specified, all proprietary material shall be used and placed in strict accordance with the published instructions of the relevant manufacturer."

PSA 3.3 Ordering of Materials

Add to Sub-Clause 3.3:

The quantities set out in the schedule of quantities have been determined from calculations based on the data available at the time and should therefore be considered to be only approximate quantities. The Contractor shall, therefore, verify the quantities before ordering materials of any kind. No liability or responsibility whatsoever shall be attached to the Employer for materials ordered by the Contractor except if they have been ordered in accordance with written confirmation issued by the Employer.

PSA 4 PLANT

PSA 4.2 Contractor's Office and Stores

Add the following to the first paragraph of Sub-Clause 4.2:

"The Contractor shall supply sufficient protection for perishable materials to the satisfaction of the Engineer, and all materials shall be used in the order in which they were delivered.

Add the following after the second paragraph of Sub-Clause 4.2:

The Contractor shall provide personal safety equipment and facilities as required by Regulation 2 of the General Safety Regulations of the Occupational Health and Safety Act No 85, 1993 (As amended).

Insert the following as the first sentence to the third paragraph of Sub-Clause 4.2:

The Contractor's camp shall be kept clean at all times and all surplus or rejected material shall be removed from site."

Add to the following additional clauses to Sub-Clause 4.2:

***PSA 4.2.1 Employees Accommodation**

"Neither housing nor shelters are available for the Contractor's employees. The Contractor shall make his own arrangements to house his employees and transport them to site.

The Employer will place an area of ground at the disposal of the Contractor at the construction site to enable him to erect his site offices, workshops, and stores. The temporary facilities and ablution facilities shall comply with the requirements of the Local Authority. The Contractor shall fence all those areas in which movement of his construction equipment and personnel will take place and he shall provide his own site security.

On completion of the Works or as soon as the Contractor's facilities are no longer required the Contractor shall remove such facilities and clear away all surface indications of their presence. The site is to be rehabilitated as described elsewhere."

***PSA 4.2.2 Condition and availability of plant**

"All plant and equipment to be supplied by the Contractor shall be in a sound working condition and of adequate capacity to complete the works well within the period or periods specified or stated in the Contract Data.

Execution of this contract is likely to require excavations of soil material, moving of earth material and demolition of concrete. The Contractor is therefore required, on the included forms, to provide satisfactory information concerning plant and labour to indicate that he is adequately equipped to execute the work involved.

To avoid delays and reduce shut-down time to a minimum it is a particular requirement of this contract that the Contractor shall have available sufficient dewatering pumps on site to ensure that excavations are kept dry at all times.

In addition, he shall have available on the site adequate standby plant to ensure that operations designed to be executed continuously are not disrupted by the breakdown of any plant provided for such operations. He shall also provide for equipment such as lighting plant and generator and adequate spares and tools to cope with emergencies that may occur at any time during the execution of the works."

PSA 5 CONSTRUCTION

PSA 5.2 Watching, Barricading, Lighting and Traffic Crossing (Sub-Clause 5.2)

Add the following to the Sub-Clause 5.2

"All open excavations shall be barricaded and closed or covered to the approval of the Engineer."

PSA 5.3 Protection of Structures

Add the following paragraph to Sub-Clause 5.3

"The Contractor, shall before commencing with works which have the potential to damage surrounding structures, services, buildings or property, arrange an inspection with the owners of such structures, services, buildings and property and representative of local or controlling authorities, as appropriate, to

determine the condition of structures, services, buildings and property that the works could affect. The Contractor shall document their current condition in sufficient detail to enable disturbances or damage (or both) which might be caused by the works to be constructed.

The Contractor shall furnish the Employer with copies of all such documentation and shall be held responsible for any disturbance and damage to such structure, services, building and property arising from the performance of the contract."

PSA 5.4 Protection of Overhead and Underground Services

Add the following paragraph to Sub-Clause 5.3

"The contractor shall within 20 working days or 10% of the construction period after taking possession of the site (whichever is the lesser), satisfy himself that the dimensional accuracy, alignment, levels and setting out of existing structures or components thereof are compatible with the proposed works, and notify the Engineer of any areas of dissatisfactions.

The Contractor shall, on becoming aware of a defect on the existing works which have an impact on the performance of the contract, notify the Engineer of such defect without delay."

PSA 5.5 Dealing with Water on Works

Add the following paragraphs to the Sub-Clause 5.5

"During construction and inspections, the Contractor shall be responsible for the dewatering of excavations and the full and adequate protection of the works against damage by stormwater or water from any source whatever. He shall construct all necessary diversion works and drains to adequately deal with and bypass all water and carry out any necessary pumping of water and supply all tarpaulins or other covers which may be required to protect any section of the work during heavy rain or storm together with any other labour, work and material which, in the opinion of the Engineer is necessary to keep the work dry and safe at all times.

Full risk and cost of dealing with water during construction and inspections shall be borne by the Contractor."

PSA 5.6 Pollution

Add the following to the Sub-Clause 5.6:

"The Contractor shall maintain all access roads and the area where the offices, stores and workshops are situated to the satisfaction of the Engineer. It shall be kept damp to limit dust and inconvenience or disturbance to the residents in the neighbourhood of the works to a minimum."

PSA 5.7 Safety

Add the following paragraphs to Sub-Clause 5.7

"All work and particularly work carried out in the proximity of buildings, bridges, tanks or other structures shall be carried out in conformance with Rand Water's Health and Safety specifications.

The Contractor shall make available for the duration of the contract safety helmets, safety boots and any other necessary safety equipment for sole use by the Engineer and his representative(s)."

Add the following Clause:

PSA 5.9 Site Meetings

"The Contractor's authorised agent will be required to attend regular site meetings, which shall normally be held once a month, or more often, as may be required, on dates and times determined by the Employer and/or the Engineer. Unless otherwise indicated in the Contract or instructed by the Engineer, such meetings shall be held at the Contractor's offices on the site. At such monthly meetings, matters such as general progress on the works, quality of work, challenges, claims, payments, and safety shall be discussed, but not matters concerning the day-to-day running of the Contract."

PSA 6 TOLERANCES

PSA 6.2 Degrees of Accuracy

Add the following to the Sub-Clause 6.2:

“Generally, Degree of Accuracy II shall be applicable to the whole of the Works, unless specified otherwise.”

PSA 7 TESTING

PSA 7.1 Principles

PSA 7.1.1 Checking

Amend this Sub-Clause as follows:

“The Contractor shall carry out sufficient checks to satisfy himself that the materials used and the workmanship (i.e. the quality of construction, adherence to tolerances and, when applicable, the strength attained) comply consistently with the specified requirements and the results of those checks shall, if so ordered, be made available to the Engineer.

Every completed section of the Works shall be subject to check testing by the Contractor at the minimum frequency specified in the Contract. Once the Contractor has satisfied himself with the standard of his Works, the Engineer will be requested at least 48 hours in advance to perform inspections and/or acceptance testing for the particular section. When giving notice, the Contractor shall provide the Engineer with the results of his check testing indicating that the work complies with the Contract, or advise the Engineer in writing that, although no tests have been performed, he is confident that the requirements of the Contract have been met.

Failure by the Contractor to notify the Engineer or to provide the required information or, where specified, to perform the required test, will be grounds for the Engineer not to certify the associated work as being complete as well as all subsequent work which would be affected by the failure of the work to be tested.

The Engineer will be under no obligation to the Contractor to perform the inspections and/or acceptance tests. The Contractor shall obtain the approval of the Engineer based on the acceptance test results of any specified test before proceeding with subsequent work. If the Engineer elects not to perform a particular inspection and/or test after notification by the Contractor, he will issue the Contractor with a written instruction to proceed with the relevant Works without the inspection and/or acceptance test being performed.

Nothing contained in this Sub-Clause will relieve the Contractor of his responsibilities under the Contract or in any way limit the inspections and/or tests that the Engineer may call for or perform in terms of the Specification. The Contractor shall make due allowance for testing procedures in his construction programme.

Where applicable a Provisional Sum will be provided in Section 1 of the Bill of Quantities to allow for the cost of the Engineer's acceptance tests that meet the requirements of the Contract. The cost of all other testing shall be borne by the Contractor.

The procedure for payment of the Engineer's acceptance testing will be as follows:

- The laboratory approved by the Engineer will invoice the Contractor with all acceptance-testing costs including unsuccessful tests. If payment to the laboratory is not made within 35 days of the date of invoice the Engineer will subtract an amount equal to twice the amount payable from the subsequent payment certificates until such time as the amounts plus interest at the ruling prime lending rate plus 3% are made.
- The Contractor shall be reimbursed for all acceptance tests that meet the requirements of the Specification via the interim Payment Certificates. The Engineer requires 48 hours notice from the Contractor when each stage listed below is reached in order to perform the relevant inspection and/or acceptance test:
 - Pipe trenches

The Engineer will visually inspect excavations before placement of bedding material.
The contractor will perform density acceptance tests in pipe trenches on the bedding

layers, selected backfill and backfill at 300 mm depth intervals. The Engineer will review the test results and make a determination. The Contractor shall notify the Engineer when the pipe trench has been excavated and when each 300 mm increment of backfill has been completed.

- Pipework

The Engineer will visually inspect all anchor blocks and pipework before covering up. The Contractor shall notify the Engineer when the pipeworks are ready, before covering up. The Contractor shall perform pressure tests in the presence of the Engineer after the trench has been partially backfilled. Joints and fittings are to remain exposed. The Contractor shall retest the completed pipelines in the presence of the Engineer on completion of all the Works."

Add the following Clause:

PSA 7.5 Tests and Specialist Investigations

It shall be the Contractor's responsibility to make himself familiar with the condition of the completed or partially completed construction works, including the structural assessment report (Refer to Appendix: *Meyerton Wastewater Treatment Plant Preliminary Structural and Visual Assessment, SDM Engineering and Project Management, 30 September 2022*), and based on this, request for the necessary tests and specialist investigations to be undertaken based on industry best practices, in order to determine the extent of corrective and/or remedial work required on the completed or partially completed structures.

The Contractor shall use these tests and the subsequent corrective works to ensure that the completed or partially completed structures and buildings are constructed according to the relevant project design specifications and standards.

The Contractor will submit detailed method statements to the Engineer for all proposed tests and specialist investigations to be conducted.

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.1 Measurement

PSA 8.1.1 Method of Measurement, All Sections of the Schedule

Add the following to Sub- Clause 8.1.1

"In no case will any dimensions exceeding the dimensions required by the contract, or as ordered in writing by the Engineer, be allowed for measurement and payment."

Add the following new Sub-Clauses

***PSA 8.1.2.4 Payments to Service Authorities**

Insert the following new Sub-Clause 8.1.2.4:

"Where applicable, the Contractor shall make necessary payments to the relevant Services Authorities before commencing work on such services, or for work to be carried out by such Service Authorities."

PSA 8.2 Payment

PSA 8.2.1 Fixed charge and value-related items

Replace the contents of this sub-clause with the following:

"Payment of fixed charges in respect of item 8.3.1 will be made as follows:
Eighty percent (80%) of the sum tendered will be paid once the facilities have been provided and approved. The remaining twenty percent (20%) will be paid once the work has been completed, the facilities removed, and the campsite cleared and cleaned.

Payment for the sum tendered under item 8.3.2 will be made in three separate instalments as follows:

- a) The first instalment (which is 40% of the sum), will be paid when the Contractor has met all his obligations to date under his specification, the general conditions of Contract and the special conditions of Contract, and where the value of work certified for payment, excluding materials on site and payments under preliminary and general items is equal to not less than 5% of the total value of the work listed in the schedule of quantities.
- b) The second instalment (which is 40% of the sum) will be made when the amount certified for payment, including retention monies but excluding the second instalment referred to herein, exceeds 50% of the tendered sum.
- c) The final payment (which is 20% of the sum) will be made when the works have been certified as completed and the Contractor has fulfilled all his obligations to date under this specification, the general conditions of Contract and the special conditions of Contract.

PSA 8.2.2 Time-related Items

Replace the contents of this sub-clause with the following:

“Subject to the provisions of 8.2.3 and 8.2.4, payment under item 8.4.1 (time-related item) will be made monthly in equal amounts, calculated by dividing the sum tendered for the item by the tendered contract period in months, provided always that the total monthly amounts so paid for the item is not more than in proportion to the progress of the work as a whole.

Should the Engineer grant an extension of Time for Completion of the works, the Contractor will be entitled to an increase in the sum tendered for the relevant time-related item, which increase shall be in the same proportion to the original tendered sum as the extension of time is to the original Time for Completion of the works.

Payment for such increased amounts will be taken to be in full compensation for all additional time-related preliminary and general costs that result from the circumstances pertaining to the extension of time granted.”

PSA 8.5 Sums Stated Provisionally by Engineer

A complete As-Built survey including all structures, pipework, etc. by a registered land surveyor on completion of works

Mechanical installation for Meyerton WWTW (Nominated Sub-Contractor)

Overheads, charges and profit on item A1.4.4

Electrical installation for Meyerton WWTW (Nominated Sub-Contractor)

Overheads, charges and profit on item A1.4.6

Provisional Sums for the provision of access and safety equipment required to gain access to structures for initial inspections and testing by the Structural Engineer / Specialists, including all scaffolding, platforms, safety gear and certification and any other equipment required to safely access all areas of the following structures:

- Raw Water Pump Station
- Biological Reactor
- Secondary Sedimentation Tank
- Buildings, as required
- Other structures not listed above, as required

PSA 8.8 Temporary Works

PSA 8.8.4 Existing Services

Replace Sub-Clause 8.8.4 with the following:

Accommodation of Traffic

Unit: Sum

"The tendered rate shall cover all the costs for the supply of road signs, cones, flag men, 200l drums or other barricading as required to accommodate traffic safely at road crossings where underground services are to be installed. The unit of payment will be the number of road crossings and the rate shall include all the costs for the duration of the work at each road crossing.

(b) Temporary protection of:

(i) Existing underground pipe **Unit: Sum**

The rates shall cover the cost of excavating by means of hand tools within authorized dimensions, for all precautionary measures to protect the services from damage during excavation and backfilling, and for subsequent backfilling and compacting. Compaction material in all areas except in roadways shall be to 90% of the modified AASHTO density.

(ii) Existing concrete structures **Unit: Sum**

The rates shall cover the cost of excavating by means of hand tools within authorized dimensions, for all precautionary measures to protect the services from damage during excavation and backfilling, and for subsequent backfilling and compacting. Compaction material in all areas except in roadways shall be to 90% of the modified AASHTO density.

(c) Detection of Underground Services **Unit: Hour**

The tendered rate shall include all the costs for the supply and use of specialised equipment by the Contractor or a sub-contractor for the detection of underground electrical/communication cables and water and sewer pipelines. Payment unit will be a full day of 8 hours during which the equipment was continually used for the detection of underground services.

(d) Hand Excavation for location and exposing of existing services in all materials:

(ii) in all other areas **Unit: m³**

The rates shall cover the cost of excavating by means of hand tools within authorized dimensions, for all precautionary measures to protect the services from damage during excavation and backfilling, and for subsequent backfilling and compacting. Compaction material in all areas except in roadways shall be to 90% of the modified AASHTO density.

The rate for excavation in roadways shall include compensation for compacting excavated or selected backfill material to 93% of modified AASHTO density. Reinstating layerworks and surfacing shall be measured and paid under SANS 1200 DB.

The tendered rates shall also include for keeping the excavations safe, for dealing surface and sub-surface water, for removing surplus excavated material from Site, for transporting all material within free-haul distance, and for supplying adequate supervision during both excavation and backfilling operations. Free haul is applicable in this contract. The boundary will be taken as the existing site fenced area."

Add the following new Sub Clause 8.8.7:

PSA 8.8.7 Clear entire site **Unit: ha**

The rate shall cover the cost per hectare to clear the entire site, prior to commencement of construction, including outside and inside of all structures and buildings, of amongst others, all weeds, builders rubble, dewatering of structures and grass cutting on establishment on site by the Contractor. Further clearing may be required as instructed by the Engineer.

The Contractor is to take note and prioritise immediately upon site establishment the requirement to clear the site as listed in the sequence of the works outlined in the Scope of Works.

Add the following new Sub Clauses 8.9 and 8.10:

***PSA 8.9 Signage**

"The tendered sum(s) shall cover the cost of providing and attaching all signs to the new proposed structures, Namely: "MEYERTON WWTW", "MEYERTON WWTW Connection Box" and "Inlet Division Box". Labels to be painted on 0.8mm Steel plate and adequately bolted to the structure. All paints to have gloss finish and comply with SAND 1519-2. Colour of paint to conform to BS 2000 No.0/013. All lettering to be done according to the provision of the latest edition of the South African Development Community Road Traffic Signs Manual. All lettering to be 50mm DIN 1451 Part 2 Style unless otherwise indicated."

***PSA 8.10 Acceptance Testing**

"Payment procedure in accordance with PSA 7."

***PSA 8.12 Mechanical and Electrical**

PSA 8.12.1 Contractor's designs related documentation and drawings Unit: Sum

The tendered Sum shall include for all requirements of the Mechanical Specifications and the Electrical Specifications (also refer to Clause C3.2.2) for the preparation and provision of design related documentation and drawings. Payment shall be made on a pro rata basis in terms of Clause 8.2.2 of SANS 1200 A. Failure to provide any item or comply with any instruction of the Responsible Person could be cause for non-payment of the whole lump sum.

PSA 8.12.2 Provision of operation and maintenance manuals Unit: Sum

The tendered Sum shall include for all requirements involved in the preparation and submission of Operation and Maintenance (O&M) Manuals. Payment shall only be made upon handing over of the final manuals to the Employer.

Three (3)-off draft copies of the O&M Manuals shall be submitted for approval (2 weeks prior to commissioning) and five (5)-off final copies of the O&M Manuals, hard copies and electronic copies, shall be provided.

The manuals shall be all inclusive of the requirements of the Mechanical Specifications and Electrical Specifications and the following minimum information shall be provided:

- Contact information for all parties involved
- Description of Works
- Equipment List
- Drawings
- Electrical Cable Schedule
- Electrical Certificates
- Pipe and Valve Test Records
- Process and Control System Description and Operating Manual
- Maintenance Schedule of Mechanical Equipment
- Specification Sheets and Part Lists for all Mechanical Equipment
- Specification Sheets and Part Lists for all Electrical Equipment
- Specification Sheets and Part Lists for all Electronic Equipment

The Contractors attention is drawn to the fact that the above list is not exhaustive and serves merely as a guideline to assist the Contractor.

PSA 8.12.3 Record drawings Unit: Sum

The sum tendered shall include for all requirements involved in the preparation and submission of Record Drawings / As-built Drawings as specified.

PSA 8.12.4 Training of the employer's operating staff Unit: Sum

The tendered Sum shall include for all requirements of the Mechanical Specifications and the Electrical Specifications related to the training of the Employer's operating staff during the commissioning period.

Training shall take place for the duration of the commissioning period and the Contractor shall submit a comprehensive training schedule to the Engineer for approval. The schedule shall indicate the time and date of the training, type of training, the target group for the training, the duration of the training, training materials provided, name of person presenting the training etc.

Where the Employer's staff works on a shift basis the Contractor shall allow for the fact that certain training sessions may have to be presented more than once in order to allow all relevant staff members to attend.

The 28 day Operational Acceptance Period shall commence once the works are commissioned to the satisfaction of the Engineer. The tendered rate Sum be held to include all necessary items during the trial period (e.g. servicing of equipment, adjustments to plant, monitoring and recording of performance, supervision, etc.) for all Mechanical Electrical Works (also refer to Clause C3.5.4.5).

Fixed portion	Unit: Sum
Time-related portion	Unit: weeks

An optional item to cover the cost of double handling into and again out of storage may be included and payment shall be made on the basis of 95% on loading from store and 5% on completion of the maintenance period.

The time-related portion will be paid on a monthly basis and covers the cost of storage, insurance, etc. measured from the time of entry into the store to the date of removal from the store.

PSAB ENGINEER'S OFFICE (SANS 1200 AB)

PSAB 2 INTERPRETATIONS

PSAB 2.1(b) Supporting Specifications

Delete the Sub-Clause and substitute the following:

"(b) SABS 1200 A"

PSAB 2.3 Definition

Delete the first two lines and substitute the following:

"For the purposes of this specification the definitions given in SABS 1200 A shall apply:"

PSAB 3 MATERIALS

PSAB 3.1 Nameboards

Replace the first sentence of Sub-Clause 3.1 the following:

"The Contractor shall supply and erect at locations approved by the Engineer, two contract nameboards specified in Appendix 1: Scope of Works which, unless otherwise specified in the Contract, shall comply with the recommendations for the standard board of the South African Association of Consulting Engineers with regard to size, painting, decorating and detail, and the requirements described hereunder."

PSAB 3.2 Office Building(s)

Delete the first sentence and substitute the following:

"The Contractor shall supply and furnish two air-conditioned "Kwikjack" (6 m x 3 m) offices, (One for use of the Engineer and his/her staff and one for the Employers' inspectors) and an air-conditioned "Kwikjack" (9 m x 3.4 m each) conference facility for conducting meetings. Minimum size of each air conditioner shall be 12000 BTU."

and replace subclause 3.2(j) of SABS 1200 AB with the following:

"(j) a heater and fan or air-conditioning unit capable of both heating in summer and cooling in winter."

Add the following to the Sub-clause:

"In addition to the furnishings listed under sub-items (a) to (i), the following shall be provided and properly maintained:

- (j) electrical installation to include a light and two 15A plug points, two pin plugs plus adequately sized air conditioning units (for heating and cooling) for each unit
- (k) one refrigerator of at least 100 litre capacity
- (l) one kettle of at least 2 litre capacity
- (m) one tea set comprising ten cups and saucers, ten teaspoons, one teapot, one sugar bowl and one milk jug
- (n) covered parking for ten vehicles
- (o) un-covered parking space for two vehicles
- (p) two "Barhold" or similar wall mounted racks each with 6 clamps suitable for hanging A0 sized drawings
- (q) two large meeting tables (For meeting room only)
- (r) ten additional chairs (For meeting room only)"

Add the following new Sub- Clause

***PSAB 3.3 CARPORT**

"The Contractor shall construct the number of carports specified in Appendix 1: Scope of Works for the sole use of the Engineer and his staff. Each carport shall be constructed so that the vehicle parked under it is always protected against the direct rays of the sun. The carport area shall be at

least 125 m² and the floor shall be covered with a layer of crushed stone to alleviate dusty and muddy conditions. The carport(s) shall be positioned so as to provide easy and convenient access to the Engineer's office."

PSAB 4 PLANT

PSAB 4.1 Telephone

Delete the Sub-Clause and substitute the following:

"The Contractor shall provide a cellular phone (s) and minimum of R500.00 airtime (per month) for the sole use of the Engineer and/or his Representative (s)" WiFi to be supplied, minimum 4Mbit Uncapped."

Add the following new Sub-Clauses

***PSAB 4.2 SURVEY EQUIPMENT**

"The Contractor shall provide the following survey equipment on the Site from the commencement to the completion of the Works:

- One tacheometer capable of reading to twenty seconds of arc plus tripod
- One automatic reading Engineer's level plus tripod
- One levelling staff (5 m long, 1 cm graduations)
- One staff angle bubble
- One metal change-point for levelling
- One separate plumb-bob
- One spirit level (one metre long)
- One hammer (2 kg) with steel or wooden pegs as necessary
- One 50 m steel or glass fibre tape
- One 5,0 m (or longer) retractable steel tape

The equipment may be shared by arrangement between the Contractor and the Engineer or his representative on Site. The Contractor shall keep the equipment continuously insured against any loss, damage, or breakage and he shall indemnify the Engineer and the Employer against any claims in this regard. Upon completion of the Works the survey equipment as listed above shall revert to the Contractor.

The Contractor shall maintain the equipment in good working order and keep it clean until the completion of the Works."

Add the following new sub-clauses PSAB 4.3, PSAB 4.3.1 and PSAB 4.3.2:

***PSAB 4.3 Computer Equipment**

"The Contractor shall provide laptops (and an Internet Dongle) on site for the exclusive use of the Engineer and his staff, such computer hardware and software shall comply with the specifications set out in sub-clauses PSAB 4.3.1 and PSAB 4.3.2 hereunder."

***PSAB 4.3.1 Laptop hardware**

(a) "Laptops

Laptops shall comply with the following minimum specifications:

- (i) Processor: Core i5 2.5GHz
- (ii) Operation System: Windows 7 Pro 64-bit
- (iii) RAM: 4 GB
- (iv) HDD: 500GB
- (v) Wireless Mouse with a Mouse Pad

(b) Printers

Printers shall, be HP DeskJet IA 3835 4-in1 printers.

All computer hardware shall be provided complete with the requisite connecting cables and all interfacing devices and software necessary for its efficient operation as an integral system.

Compatible Ink Cartridges:
HP 652 Black Ink Cartridges
HP 652 Tri-colour Ink Cartridge"

***PSAB 4.3.2 Computer software**

"The following software shall be properly installed on the computer, and the original licence agreements and disks shall be provided to the Engineer for safekeeping:

- (a) Microsoft Windows (latest edition)
- (b) MS-Office (latest edition).
- (c) Microsoft Project (2013 edition or later)"

PSAB 5 CONSTRUCTION

PSAB 5.2 Engineer's Office

Add the following to the Sub-Clause:

"The two toilet facilities (Female and Male) provided for the sole use of the Engineer or his representative(s), the Employer's inspectors, Community Liaison Officer (CLO) and Project Steering Committee (PSC) shall be maintained in a hygienic and sanitary condition and shall be removed on completion of the Works. The facilities provided shall conform to the local health authority's requirements as applicable and the Contractor shall pay all sanitary fees and charges."

PSAB 5.4 TELEPHONE

Replace the contents of Sub-Clause 5.4 with the following:

"PSAB 5.4.1 Cellphones

The Contractor shall advise the cellular service provider of any faults which develop in the cellphone service and/or the cellphone handsets and shall, in such circumstances, arrange for the earliest possible restoration of the said service.

The costs of any necessary repairs and/or the replacement of components to the handsets of the cellphones shall be for the Contractor's account.

The Contractor shall ensure that all accounts for cellphone calls and the respective service contracts are promptly paid. The Contractor shall, on production of an itemised statement, be reimbursed only for the cost of the Engineer's cellular telephone calls."

PSAB 5.5 Survey Assistants

Delete the first sentence and substitute the following:

"The Contractor shall make available to the Engineer two suitably educated labourers for use on and about the site on survey and other work directed by the Engineer at all reasonable times."

Add the following new sub-clauses PSAB 5.6 and PSAB 5.7:

***PSAB 5.6 Computer Equipment**

"All computer equipment provided shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff."

***PSAB 5.7 Survey Equipment**

"All survey equipment provided by the Contractor shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff."

Where required by the Engineer, the Contractor shall, at his own cost, promptly arrange for the recalibration of survey equipment provided."

PSAB 8 MEASUREMENT AND PAYMENT

PSAB 8.1 Scheduled Items

Delete the 1st sentence and substitute the following:

“Items will be scheduled in terms of Sub-Clauses 8.3.2 and 8.4.2 of SABS1200 A.”

PSAB 8.2.1 Fixed and Time-related Charges

Delete the 1st sentence and substitute the following:

“The terms of Sub-Clause 8.2 of SABS 1200 A, and amended herein, shall apply.”

PSAB 8.2.2 Offices and Facilities

“The Contractor must supply furnished offices and facilities in accordance with PSAB 3.2 and PSAB 5.2.”

PSC SITE CLEARANCE (SANS 1200 C)

PSC 3 MATERIALS

PSC 3.1 Disposal of Material

Add to the following to the Sub-clause:

“Material obtained from clearing shall be disposed of offsite by the Contractor at his expense. Disposal of combustible material by burning will not be permitted. The Contractor will be held responsible for observing the by-laws and regulations of the local authority.”

PSC 5 CONSTRUCTION

PSC 5.2.3.2 Individual Trees

Delete the second sentence of the Sub-Clause and substitute the following:

“The amount of the penalty payable by the Contractor for the removal or damage by him of a tree designated for preservation shall be determined by the penalty table in the bid document.

PSC 5.3 Clearing

Add the following new Sub-Clauses 5.3.1, 5.3.2, 5.3.3 and 5.3.4:

***PSC 5.3.1 Restoration of Fences onto Servitude Boundary**

“Where existing fencing is encroaching on the water treatment works servitude, such fencing shall be removed prior to construction and re-erected to a condition no worse than that pertaining prior to the removal, on the formal cadastral boundary all as indicated on the respective land plans. For the period that the fence or wall is dismantled and not yet re-erected, the Contractor shall erect, at the end of each day’s operations, a temporary fence to close the gap in the existing fence or wall and shall maintain security adequate to prevent use of the temporary fence as a point of access by unauthorised persons.”

***PSC 5.3.2 Temporary Fencing Closures**

“Where the treated water pipeline route crosses an existing fence or wall, a section of fencing or wall not exceeding 10,0 m in length may be removed temporarily during construction and thereafter reinstated to a condition no worse than the original condition as soon as the pipeline has been installed and backfilled in the immediate vicinity of the crossing. For the period while the existing fence or wall is dismantled, the Contractor shall erect, at the end of each day’s operations, a temporary fence to close the gap in the existing fence or wall and shall maintain security adequate to prevent use of the temporary fence as a point of access by unauthorised persons.”

***PSC 5.3.3 Demarcation Fencing**

“The Contractor shall supply, install and maintain temporary fencing on around the working area (servitude) and around the perimeter of all agreed additional working areas during construction for prevention of unauthorised access and shall remove the fencing on completion of the works. The fencing shall comprise 2m high Bonnox 4 x 4 Mesh fencing, Bonnox pattern 1972/4, with straining posts and straining wires as required and according to supplier’s directions and with mesh spacing not exceeding 100mm in both the vertical and horizontal directions. Chevron tape shall be interwoven in a zig zag pattern from the top to the bottom of the fence thereby clearly marking off the working area.

Gates shall be provided by the Contractor at all points as required for construction access purposes. The Contractor shall be held responsible for the control of access at these gates at all times as well as to the worksite during removal and re-erection of fencing. No other opening in the fence shall be permitted and the Contractor shall be responsible for monitoring the fencing on a daily basis and repairing any such opening within the same day that it is detected. Notices in two official languages (English and Sotho) shall be attached to the fence where appropriate to indicate that the site is for personnel employed on the Contract only and that unauthorised entry is forbidden.”

***PSC 5.3.4 Childproof Barrier**

‘In proximity to residential areas, and wherever ordered, the Contractor shall provide and fix to the demarcation fencing described in PSC 5.3.3 above, approved and substantial plastic square mesh to act as an additional childproof barrier and shall remove same on the completion of the Works.”

PSC 5.6 Conservation of Topsoil

Add the following to the Sub-Clause:

“All topsoil shall be conserved for later use by stockpiling clear of the working area.”

PSC 5.8 Demolition of Structures

Add the following new Sub-Clauses 5.8.1 and 5.8.2:

***PSC 5.8.1 Removal and Re-Erection of Structures**

“Where the Contractor is directed to dismantle structures to facilitate construction and thereafter to re-erect the same structures, the structures shall be erected at the same locations, or such other locations as may be required by the owner within the same property, using the same or similar materials as those set aside when removing the structure. The acceptance of the work by the Engineer and certification for payment shall be subject to the Contractor submitting to the Engineer documentary evidence of the owner’s satisfaction with the re-erected structure the over-riding consideration being that it shall be in a condition no worse than that pertaining prior to its removal.

The tendered rates shall include for the provision of a detailed photographic and written record of the structures before dismantling commences and following re-erection.”

***PSC 5.8.2 Demolition of Building Structures**

“Where the Contractor is directed to demolish structures, the Contractor shall provide a Method Statement for the approval of the Engineer. Entering upon the premises for the purpose of the demolition shall not commence before the Contractor has received a release form, duly authorised by representatives of the Employer and the Engineer, in which any special conditions applicable to the demolition are documented.”

PSC 8 MEASUREMENT AND PAYMENT

PSC 8.2 Scheduled Items

PSC 8.2.10 Conservation of Topsoil

Add the following to the Sub-Clause:

“All topsoil shall be conserved for later use by stockpiling clear of the working area.”

Add the following new Sub-Clauses 8.2.12, 8.2.13, 8.2.14, 8.2.15 and 8.2.16:

***PSC 8.2.12 Temporary Fencing Closures**

“Separate payment will be made for dealing with fences in the manner specified in PSC 5.3.2 above including re-instatement as scheduled.”

***PSC 8.2.13 Removal and Re-Erection of Structures**

“Separate payment will be made for removing and re-erecting structures in the manner specified in PSC 5.8.1 above as scheduled and including for the costs of photographic and written records.”

***PSC 8.2.14 Demolition of Building Structures**

“Separate payment will be made for demolishing structures in the manner specified in PSC 5.8.2 above as scheduled and including for the cost of removal of rubble to an approved spoil site, backfilling any excavations and compacting to 90% mod AASHTO and shaping the ground level in line with the natural terrain.”

***PSC 8.2.15 Demarcation Fencing**

“Payment will be made per linear metre of temporary fencing installed in the manner specified in PSC 5.3.3 above, and the rate shall include for maintaining such fencing in good condition, including daily surveillance and repair, throughout the duration of construction and removal on completion of the works.”

***PSC 8.2.16 Childproof Barrier**

“Separate payment will be made as an extra-over for the installation of plastic mesh on the demarcation fencing to provide a childproof barrier in the manner specified in PSC 5.3.4 above and the rate shall include for maintaining such barrier in good condition throughout the duration of construction so as to serve its intended purpose and removal on completion of the works.”

PSD EARTHWORKS (SANS 1200 D)**PSD 3 MATERIALS****PSD 3.1 Classification for Excavation Purposes****PSD 3.1.2 Classes of excavation**

"Notwithstanding the provisions of Sub-Clause 3.1.2, the materials excavated, other than hard rock, will not be classified for the purposes of measurement and payment. The unit rate for excavation shall cover the cost of excavation in all materials with the only extra-over items payable being those for excavation in hard rock."

PSD 4 PLANT

Add the following new Sub-Clauses 4.5 and 4.6:

***PSD 4.5 Restriction on use of Plant**

"Where the Contractor finds it impractical to use mechanical plant for excavation or to complete portions of the work due to restrictions caused by difficult access or the presence of existing structures, pipelines or services shown on tender drawings, the Contractor will be deemed to have satisfied himself as to the alternative requirements when entering rates against the appropriate items in the Bill of Quantities as no claim for extra payment based on the inability to use plant in such circumstances will be considered."

***PSD 4.6 Vibration loadings from use of Plant**

"The onus will be on the Contractor, when proposing to use heavy plant or equipment to complete work in close proximity to existing structures, pipelines or services, to determine the effect of the vibration loading from the plant or equipment on the supporting ground or foundation and the structure, pipeline or service and take all necessary steps to ensure that the stability or integrity of the element concerned is not compromised by the particular selection and use of plant or equipment."

Any damages caused to existing elements directly or indirectly arising out of the use of plant and equipment in close proximity shall be made good, to the satisfaction of the Engineer by the Contractor at his own expense."

PSD 5 CONSTRUCTION**PSD 5.1 Precaution****PSD 5.1.1 Safety****PSD 5.1.1.1 Barricading and Lighting**

Delete the Sub-Clause and substitute with the following:

"Without limiting any obligation which the Contractor may have in terms of any Act, Ordinance or other legislation, the Contractor shall ensure that all excavations which are accessible to the public or which are adjacent to a public road or thoroughfare, or by which the safety of persons may be endangered are protected as set out in Clause 13 of the General Safety Regulations of the Occupational Health and Safety Act, 1993 and that watchmen are employed to ensure that barricades, barriers and lights are effective at all times."

No danger tape is allowed to be used for excavation demarcation. Excavations shall be protected using rigid fencing and / or snow netting or plastic mesh as necessary. The supports shall consist of poles or iron standards securely planted in solid ground at not more than 10 m centres so as to enclose the spoil and the excavations

Bridges for vehicles and/or pedestrians shall be provided along the route of the work as and where may be considered necessary by the Engineer. They shall consist of a number of suitably sized steel plates laid across open excavated trenches. They shall be protected on each side by a stout two rail timber safety barrier, at least 1m high, consisting of 150 x 75 mm timber verticals set firmly into the ground and, 75 mm x 50 mm rails securely fastened to them. At least 4 lamps or reflective markers shall be provided at each crossing.

Where construction is in, or across, public roads the barricades or barriers and temporary road signs that are erected shall comply with the requirement of the relevant authority. All such signs and positioning thereof shall comply with the requirements set out in Road Note 13 read in conjunction with the SA Road Traffic Signs Manual."

PSD 5.1.1.2 Safeguarding of Excavations

Replace Clause 5.1.1.2 (b) with the following:

"The Contractor must note that the excavations for some manholes are deep and the concrete walls to be constructed are vertical. The deep vertical faces of excavations could collapse during construction causing injury or death and the Contractor must either:-

- a) provide a shoring system, designed by the Contractor and signed by a suitably qualified Professional Engineer,
- OR
- b) reduce the slope of excavations to the safe angle as determined by a suitably qualified Professional geotechnical engineer employed by the Contractor."

PSD 5.1.1.3 Explosives

Add the following to the Sub-Clauses:

"The Engineer shall be notified at least 48 hours beforehand of the Contractor's intention to use explosives on site

It shall be the Contractor's responsibility to make himself aware of the restrictions to blasting imposed by electric transmission or telephonic lines and other similar services. Where the presence and location of electric transmission or telephonic lines etc, are known or are shown on the Engineer's drawing at tender stage the Contractor shall make allowance in his rates and programmes for restrictions and delays which may result from restrictions imposed by the authorities."

Add the following new Sub-Clauses 5.1.1.3a, 5.1.1.3b and 5.1.1.3c

***PSD 5.1.1.3a) Use of Explosives**

"Generally, the Contractor will be permitted to use explosives for breaking up rock and hard material during excavations, for demolishing existing structures and for such other purposes where it may normally be required, subject to the following conditions:

- a) The Engineer or Inspector of Explosives shall have the power to prohibit the use of explosives in cases where in his opinion, the risk of injury or damage to persons, property or adjoining structures is too high. Such action by the Engineer shall not entitle the Contractor to any additional payment for having to resort to other less economical methods of construction unless otherwise provided in the Contract Data or Bill of Quantities.
- b) Should blasting be necessary, the Contractor shall take every precaution to protect the Works and persons, animals and property in the vicinity of the site. The Contractor will be held responsible for any injury or damage caused by any blasting operations and shall make good such damage at his own expense.
- c) The requirements of the Explosives Regulations Act (Act 26 of 1956) and the requirements of the Inspector of Explosives shall be complied with. In addition, where applicable, the requirements of Chapter 9 of the Regulations published in terms of the Mines and Works Act (Act 27 of 1956) and the requirements of the Government Mining Engineer shall be complied with.
- d) A copy of each blasting permit issued to workmen, and of each permit issued to the Contractor to cover the purchase, storage and transport of explosives, shall be handed to the Engineer. The Contractor shall grant the Engineer access to all records maintained for the Inspector of Explosives or the Government Mining Engineer, as the case may be.
- e) Before any blasting is undertaken, the Contractor, together with the Engineer shall examine and measure up any buildings, houses or structures in the vicinity of the

proposed blasting and establish and record together with the owners thereof the extent of cracking or damage that may exist before commencement of blasting operations. It is advised that a photographic record will be required of neighbouring structures before blasting commences. These structures will be pointed out by the Engineer. It shall be the responsibility of the Contractor to make good at his own expense any further damage to such houses, buildings or structures which is a result of the blasting.

- f) Where there is reasonable danger of damage to power and telephone lines or any other property, the Contractor shall suitably adapt his methods of blasting and the size of the charges and use adequate protective measures such as cover blasting in order to limit the risk of damage as far as possible.
- g) When blasting to specified profiles, the Contractor shall so arrange the holes and charges such that the resulting exposed surfaces are as sound as the nature of the material permits. The Contractor shall make good at his own expense any additional excavation necessitated by the shattering of rock in excess of any over break allowance specified in the Specification Data or in any other specification or given on a drawing."

***PSD 5.1.1.3b) Limitations for Blasting**

- a) "Approval of methods and keeping of records

No blasting work may be carried out prior to the Engineer's approval being given in writing

Prior to starting any drilling for the first section of blasting, the Contractor shall submit for approval to the Engineer, details of the proposed overall methods of blasting that will be used on site, including spacing, depth and pattern of holes, charging levels (kg/m³), spacing and positioning of relays, method of blast initiation, precautions to prevent 'fly rock', maximum charge per relay, traffic arrangements during blasting, and any other details he may consider relevant. These details shall be submitted in writing and supported with sketches at least 7 days before the commencement of drilling and blasting.

The Engineer will evaluate these details in relation to the given limitations and prior to giving his approval, will indicated to the Contractor any changes that may possibly be needed to comply with the limitations.

For all subsequent blasts, the Contractor shall, at least 24 hours beforehand, notify the Engineer of the intention to blast and at the same time shall note if any changes will be made relative to the approved method.

The Engineer reserves the right to order the Contractor to modify his method of drilling and blasting, or to employ reduced blasting, without thereby invalidating the Contract. The Contractor shall have no claim for extra payment, over and above his tendered rates, due to his being ordered to use such a different method of drilling or blasting or reduced charges, regardless of any prior approval by the Engineer of any previous method.

After every blast, the Contractor shall, within 24 hours, submit to the Engineer details of the actual total mass of explosives used, the approximate volume of material loosened and the maximum simultaneous mass of explosives detonated (maximum charge per relay).

Notwithstanding any approval given by the Engineer, the Contractor shall at all times be responsible for the safety of the Works, persons, animals and property in the vicinity of the Site during blasting operations.

- b) Vibrations

Blasting vibrations are caused by the transmission of the shock wave from the explosion charge through the material being blasted. This shock wave could cause damage to structures in the vicinity of the blasting if the vibrations are not limited to acceptable levels. Damage to structures is closely associated with peak particle velocity of the ground vibrations in the vicinity of the structure. Advisable maximum levels for peak particle velocity are given in Table 2.

Table 2 - Maximum Particle Velocities (Vibration)

Maximum particle velocity (mm/s)	Effect on people and buildings
0,5	Threshold of human perception unlikely to cause damage of any type
5	Limit for blasting adjacent to historical monuments
25	Limit for blasting near private dwellings in order to reduce disturbance to residents to a minimum
50	Limit for blasting adjacent to residential structures on good foundations
84	Limit for property owned by concern doing the blasting (ie. minor plaster cracks acceptable)
120	Recommended maximum level for blasting adjacent to sturdy reinforced concrete structures

The peak particle velocity V is related to the distance D from the blast and the maximum mass of explosive E instantaneously detonated (maximum charge per relay) by the general equation:

$$V = \left(\frac{k}{D} \right)^m x E^n$$

where k , m and n are constants for a particular set of circumstances. V is in mm/s, D is in metres and E is in kilograms. Experimentation has shown that $n = 0,5$ but k and m have to be determined for each site by means of vibration measurements. However blasting can be safely conducted without vibration measurements or expert advice if the following relationship is used:

$$V = \left(\frac{1150}{D} \right) x E^{0.5}$$

Which gives the maximum charge levels for $V = 50$ mm/s listed in Table 3.

Table 3 - Maximum Charge Levels

Minimum distance from nearest blast hole structure (m)	Maximum charge mass per relay (kg)
10	0,19
20	0,76
30	1,7
40	3,0
50	4,7
60	6,8
70	9,3
80	12,1
90	15,3
100	18,9

Only detonating relays of at least 20 milliseconds delay interval shall be used.

The above relationship can be used to calculate charge mass for other velocity limits. However, if higher charge levels have to be used for practical reasons, expert advice and possibly vibration measurements will be required.

Notwithstanding the above blasting limits, the Contractor shall at all times be responsible for the safety of the Works, person, animals and property in the vicinity of the Site during blasting operations."

"The Contractor shall be liable for all damages to services caused as a result of the Contractor's negligence."

PSD 5.1.2 Existing Services

PSD 5.1.2.2 Detection, location and exposure

Add the following paragraphs to the Sub-Clause

"There Contractor shall detect and verify the location of the of the following existing services to be exposed for rerouting;

- (a) 150mm nominal diameter Sludge pump main
- (b) Electricity transmission line, and
- (c) 315mm nominal diameter Sewage Rising Main."

PSD 5.1.4 Nuisance

PSD 5.1.4.3 Disposal

Amend this Sub-Clause as follows:

"The Contractor shall not spoil, stockpile or waste any material without approval. *Unsuitable material from stockpiles or excess material shall be removed from site and transported to a suitable disposal site approved by the Engineer.* Spoil heaps shall be flattened to present a neat level or graded surface.

Dumping shall proceed in an orderly manner with coarse material placed at the bottom and covered with finer material, where possible. Upon completion of dumping the material shall be shaped to provide free-draining surfaces and slopes and finished off to the satisfaction of the Engineer."

PSD 5.1.6 Road Traffic Control

In the 4th line of Sub-Clause 5.1.6 amend "South African road traffic signs manual¹⁾" to read: "Southern African Development Community: Road Traffic Signs Manual¹⁾ and Chapter 13: *[Road works Signing]* of the South African Road Traffic Signs Manual¹⁾ ", **and amend the footnote to read:** "¹⁾ Published by the Department of Transport, Pretoria."

Where traffic signals are required, they shall be provided and operated in accordance with the applicable requirements of the South African Road Traffic Signs Manual.

Where work is to be carried out while half of the roadway is closed to traffic, flagmen shall be provided and temporary road signs shall be erected, maintained and operated.

PSD 5.2 Methods and Procedures

PSD 5.2.1 Site Preparation

PSD 5.2.1.1 Clearing or clearing and stripping of site

Delete the last sentence and substitute with the following:

"Material so removed shall be disposed of by the Contractor to the designated landfill identified by the Contractor and approved by the Engineer".

PSD 5.2.2 Excavations

PSD 5.2.2.1 Excavation for general earthworks and for structures

Add the following to sub-clause (d)

"In order to minimize potential differential settlement of the shallow foundations for the proposed new works in relation to existing or new valve chambers or undermining of the existing structures, it may be necessary to carry out ground improvement.

Once excavation to the base of the existing structure has taken place, a Dynamic Cone Penetration Test (DCP) shall be carried out to a minimum depth of 1m to ascertain the necessity or otherwise to

carry out the ground improvement. DCP results of ≥ 5 blows per 100 mm are deemed to indicate the presence of stiff clays.

Where stiff clays are encountered in the 1m zone below the existing structure, it is recommended that the clay is immediately blinded with a lean mix of concrete and construction proceed on the basis of a "raft" type foundation / base slab supporting the sidewalls of the new structure.

If the clays are soft or loose sand is encountered, vertical lightweight trench sheeting is to be vibrated or driven down as close as possible to the existing foundations for a distance of at least 1,0 to 1,2 m below founding level.

The base area shall then be over-excavated, both vertically and horizontally, and the material shall be replaced with well compacted granular material (G6 minimum). The surface shall be blinded with a lean concrete mix after removal of the trench sheeting, following which the base slab to support the sidewalls shall be cast."

Add the following new Sub-Clauses 5.2.2.1f, 5.2.2.1g:

***PSD 5.2.2.1 (f) Extra Excavation (work space)**

"Where outside shuttering is ordered by the Engineer, the excavations shall be carried out for an extra width of not more than 600 mm all around the structure, measured from the base of the face to be shuttered, to allow for the shuttering to be fixed, this extra excavation and refilling where necessary is to be measured and paid for under quantities allowed for this purpose in the Bills of Quantities. Outside shuttering shall be used for the construction of all major structures unless ordered otherwise by the Engineer."

***PSD 5.2.2.1 (g) Permanent Concrete against excavated face**

"Where permanent concrete is to be placed against an excavated face, the excavation shall be trimmed to ensure that there is no projection greater than 20 mm protruding into the excavation profile."

PSD 5.2.2.3 Disposal

Amend the Sub-Clause as follows:

"The Contractor shall not spoil, stockpile or waste any material without approval-

Unsuitable material from stockpiles or excess material shall be removed from site and transported to a suitable disposal site approved by the Engineer. Spoil heaps shall be flattened to present a neat level or graded surface.

Dumping shall proceed in an orderly manner with coarse material placed at the bottom and covered with finer material, where possible. Upon completion of dumping the material shall be shaped to provide free-draining surfaces and slopes and finished off to the satisfaction of the Engineer."

PSD 5.2.3 Placing and Compacting

PSD 5.2.3.1 Embankments

Amend the Sub-Clause as follows:

In the fourteenth line delete "600 mm" and substitute "300 mm"

In the seventeenth line delete "300 mm" and substitute "150 mm"

Delete the twentieth line and substitute the following:

"Each layer shall be compacted to achieve 90%"

PSD 5.2.3.2 Backfilling of Trenches and backfilling or filling against Structures

Add the following paragraphs under the Sub-Clause:

"(a) General.

Where ordered by the Engineer, the Contractor shall bench the foundations of the structures using cement-stabilized G5 gravel from commercial sources compacted to 98% Mod AASHTO density. The saturated UCS value shall not be less than 3 MPa.

After construction, backfilling and compaction of material shall commence as follows:

General backfill material shall be placed in layers of maximum thickness 250 mm and each layer compacted to 90% Mod AASHTO

Restricted backfill material shall be placed in layers of maximum thickness of 250 mm and each layer compacted to 90% Mod AASHTO

Topsoiling: Topsoil material shall be spread over areas designated for topsoiling to a layer thickness of 150 mm modified AASHTO density except where indicated otherwise on the Drawings."

PSD 5.2.5 Transport of Earthworks

Delete the wording of Sub-Clause 5.2.5 and replace with the following:

"All haul within the site and up to 500m beyond the Site perimeter will be regarded as freehaul.

Overhaul will be measured for payment where spoil to a designated spoil site is specified or instructed by the Engineer. The overhaul distance shall be measured from the point of exit of the site perimeter to the agreed centre of the designated spoil area."

PSD 5.2.6 Selection of Material from on-site excavations and temporary stockpiling

Add the following paragraphs to the Sub-Clause:

"All soft material to be excavated (weathered upper layer) shall be carefully selected during excavation and conserved in temporary stockpiles or placed directly in fill embankments as appropriate. Fill embankments for sludge ponds such be constructed from such material. At least the upper 300mm of all general landscape or fill areas shall be uncontaminated soft material from the temporary stockpiles.

Permanent gravel access roads and the subbase of permanent surfaced roads shall be constructed from durable mudstone / sandstone carefully selected from necessary bulk or restricted excavations (ie neither too-weathered nor too-unweathered mudstone / sandstone as agreed with the Engineer).

Suitable volumes of excavated mudstone / sandstone shall be temporarily stockpiled for backfill of structures or fill embankments (as agreed with the Engineer). All material excess to requirements shall be disposed of at the designated spoil site. The Contractor shall carry-out a pre-planning exercise to determine what volumes to stockpile and what to directly spoil and agree these volumes with the Engineer.

'Excavation to temporary stockpile', 'excavation from stockpile to backfill / fill / landscape', 'excavation to spoil' and 'excavation from stockpile to spoil' will be measured separately as scheduled.

As noted in PS 8.3.14, where cross-contamination of the different excavated materials has occurred, the Contractor shall, on the instruction of the Engineer, remove and spoil such material at the designated spoil site at his own cost."

PSD 8 MEASUREMENT AND PAYMENT

PSD 8.1.3 Restricted excavation

Add the following paragraph to the Sub-Clause:

"The provision of working space (see Sub-Clause 8.3.5) will not be measured for payment. Notwithstanding the provisions of Sub-Clause 8.1.3, the Contractor shall make his own allowance for the excavation of any working space required for formwork or other purposes. The rates for restricted excavation shall also cover the costs of providing working space. All restricted excavation will be measured to the net dimensions of concrete floor slabs or other dimensions ordered by the Engineer."

PSD 8.3.2(b) Extra-over for

Delete the Sub-clause and substitute with the following:

"No extra-over payment will be made for excavation in material classified in terms of Sub-clause 3.1.2, as amended, as intermediate excavation and boulder excavation. The tendered rate for excavation in all materials shall include for the cost of such excavation. Refer to PSD 3.1.2 as amended.

Extra-over item will be made for:

- a) Material classified as "hard rock". Refer to PSD 3.1.2, as amended."

PSD 8.3.6 Overhaul of spoil material

Add the following paragraph to the Sub-Clause:

"The overhaul distance shall be measured from the point of exit of the site perimeter to the agreed centre of the designated spoil area."

Add the following new Sub-Clauses PSD 8.3.14 and PSD 8.3.15:

***PSD 8.3.14 Selection of Material from Excavations**

"No separate measurement for payment will be made for the costs associated with complying with the requirements for selecting and separating soft material from mudstone / sandstone and for selecting suitable durable material for temporary and permanent roadworks from the more-weathered or too-hard mudstone / sandstone material. Such costs shall be deemed to be included in the as-scheduled rates.

Where cross-contamination of the different excavated materials has occurred, the Contractor shall, on the instruction of the Engineer, remove and spoil such material at the designated spoil site at his own cost."

***PSD8.3.15 Shoring**

Unit: m

"Excavations must be safeguarded as per clause PSD 5.1.1.2, as amended.

The rate shall cover all the cost of the design (by a suitably experienced and qualified professionally registered geotechnical engineer), supply, placing, maintenance and removal of the shoring system and other support measures together with any cost that results from the inconvenience of working in the supported excavation and the cost of any risks inherent in the operation."

PSDB EARTHWORKS (PIPE TRENCHES) (SANS 1200 DB)

PSDB 3 MATERIALS

PSDB 3.3 Selected Granular Material

“(for bedding material (padding) for steel pipes see PSLB 3.3)”

PSDB 3.4 Selected Fill Material

“Not required. All material up to the underside of backfill shall be measured as selected granular. (for bedding material (padding) for steel pipes see PSLB 3.3)”

PSDB 3.5(a) Backfill Material

In the third line delete "150 mm" and substitute "100 mm".

PSDB 3.5(b) Backfill Material

In the second line delete “PI not exceeding 12” and substitute “PI not exceeding 6”.

Add the following new Sub-Clause:

***PSDB 3.5(c) Cement Stabilised Backfill**

“Where scheduled, or directed by the Engineer, backfill shall be stabilised with 8% cement by mass. The backfill material shall have a plasticity index not exceeding 10 and all material shall pass through a sieve of aperture size not exceeding that specified in SABS 1200 LB, Sub-Clause 3.2, as amended.

The dry materials shall first be mixed in a concrete mixer thereafter sufficient water is to be added to produce the stiffest consistency available for placing and compacting with vibrators.”

PSDB 3.6 Materials for Reinstatement of Roads and Paved Areas

Delete the Sub-Clause and substitute:

“Material used in the reinstatement of roadways shall fall into the following relevant categories:

- (a) Foundation material recovered from the excavation of trenches across existing roadways which, if so instructed by the Engineer, shall be set aside and re-used as sub-base material.
- (b) New material which shall conform to the requirements of:
 - (i) Clause 3.2.1 of SABS 1200 ME for the Subbase
 - (ii) Clauses 3.2 and 3.3 of SABS 1200 MF for the Basecourse
 - (iii) Clause 3.2.2 of SABS 1200 ME for the Gravel Wearing Course
 - (iv) Clause 3 of SABS 1200 MH for the asphalt surfacing”

PSDB 3.7 Selection

Delete the second sentence and substitute the following:

“The Contractor is not required to use selective methods of excavating but shall, if so instructed by the Engineer, screen or otherwise treat excavated material in order to produce material suitable for the bedding cradle or the bedding blanket.”

PSDB 4 PLANT

PSDB 4.1 Excavation Equipment

In the first line delete “The Contractor” and substitute: “In sections deemed to be excavated by mechanical means, the Contractor”

Add the following to the Sub-Clause:

“Should any portion of a pipe trench exceed the specified depth, the Contractor will be held responsible for any additional costs which may arise as a result of such over-excavation. Concrete

filling or imported compacted fill may be ordered by the Engineer to be placed below the bottom of the trench."

PSDB 5 CONSTRUCTION

PSDB 5.1.2.3 Sloping Ground

Delete the Sub-Clause and substitute:

"The Contractor shall be responsible throughout the duration of the Contract, inclusive of the Defects Liability Period, for the provision of all soil erosion preventative measures necessary to protect the trenches, pipeline(s) and land utilised by the Contractor during the Contract from any adverse effects of soil erosion, settlement, scour, etc., resulting from the construction of the Works.

Cross embankments, generally extending across the full width of the working strip, consisting of low earth mounds shaped to rounded form and so oriented as to have a fall of 1% along their length, shall be constructed with compacted material having a minimum density of 90% modified AASHTO density and minimum dimensions and maximum spacings dependent on the slope of the ground along the length of the pipeline, as indicated in the following table:

Slope of Ground	Minimum Height	Minimum Base Width	Maximum Spacing
0% - 5%	No cross-embankments required		
5% - 10%	300 mm	1,2 m	40 m
10% - 15%	375 mm	1,5 m	30 m
Greater than 15%	450 mm	1,7 m	20 m

The height of the cross-embankments for a distance of 1 metre on either side of the trench centreline shall be raised 150 mm above the remainder of the cross-embankment to allow for settlement. In order to form a satisfactory drainage channel upstream of each cross-embankment (at a slope of 1%) the crown over the backfilled trench shall be removed for a distance of 0,5 m upstream of the cross-embankment.

Cross-embankments shall be constructed to the same minimum standards and dimensions indicated above wherever artificial slopes have been formed on the working strip or other areas used during construction and, with the approval of the Engineer, are permitted to be so left.

Payment will be made for the construction of cross-embankments in accordance with Sub-Clause 8.3.4(c), provided construction thereof has been either ordered or approved by the Engineer prior to the commencement of such construction."

Add the following new sub-clause PSDB 5.1.2.4:

*PSDB 5.1.2.4 Cross-Walls in Trenches

"In steeply sloping trenches (longitudinal slope > 15 %) and where otherwise ordered by the Engineer, the Contractor shall place sacks of earth as sack breakers or cross walls around and above the pipe up to ground level, prior to backfilling, as a soil erosion measure. Such sacks shall be filled with selected material free of stones in excess of 50 mm maximum dimension. One sack breaker shall consist of these sacks packed tightly against the trench bottom, pipe and actual trench sides, and against each other to form a solid cross wall at least 0,5 m thick from the bottom of the trench to the surface.

Where required, an item will be included in the Bill of Quantities to cover the cost of the supply, installation and maintenance of sack breakers."

PSDB 5.2 Minimum Base Widths

Add the following to the Sub-Clause:

"Trench sides shall be as near vertical as possible in order to minimise the quantity of backfill material required and to avoid possible difficulties where pipelines have to be installed parallel to existing services, fences, hedges, etc and to minimise the loading on the pipe.

The base width for trenches for cables, ducts and unbedded flexible continuous piping, of external diameter less than 125 mm laid at a depth not exceeding 1,5 m, shall be equal to the external diameter of the cable, duct or pipe, plus a side allowance of 200 mm on either side."

PSDB 5.4 Excavation

Add the following to the Sub-Clause:

"Where the pipe trench crosses surfaced roads the Contractor shall neatly cut two parallel grooves into and through the "black top" before excavating between the grooves. The grooves are to be set back at least 200 mm from the edge of the excavation face to prevent ravelling of the cut edge. The cost of this operation, where not scheduled separately, will be held to be covered in the general rates for excavation."

PSDB 5.5 Trench Bottom

Add the following to the Sub-Clause:

"In waterlogged conditions and/or where so instructed by the Engineer a 150 mm thick layer (See PSLB 5.2.5) of imported single sized stone (19 mm size unless otherwise instructed by the Engineer) with a geofabric filter surround ("Bidim" Grade A4 or similar approved) shall be constructed under the bedding layer specified for the pipes."

Add the following new Sub-Clause PSDB 5.5.1:

***PSDB 5.5.1 Jointing Holes**

"Jointing holes shall be cut of sufficient length and depth to allow for the proper making or bolting of pipe joints and to ensure that joint collars or sleeves do not rest on the trench bottoms. After the pipework has been inspected, tested and approved by the Engineer, the jointing holes shall be refilled with selected soft material free from stone (padding materials as specified under PSLB in the case of coated steel pipes) and then rammed to provide a continuous uniform support for the pipework. No specific payment will be made for forming and refilling holes, the cost of which will be deemed to be included in the tendered rates."

PSDB 5.6.1 Backfilling - General

Add the following to the Sub-Clause:

"Notwithstanding the requirements of Sub-Clauses 5.6.1 and 5.6.6, no pipe joint or pipe fitting shall be covered by either blanket or backfill material prior to the successful completion of the visual inspection and pressure testing of the relevant section of the pipeline.

All backfilling shall be carried out by hand and the Contractor shall price his tender accordingly. No mechanical plant shall be used in backfilling without prior written consent of the Engineer."

PSDB 5.6.2 Material for Backfilling

Delete fourth, fifth and sixth lines and substitute the following

"Hard rock material shall not be used for, or incorporated into, the backfill above the bedding layers without the Engineer's approval."

PSDB 5.6.3 Disposal of Soft Excavation Material

Add the following to the Sub-Clause:

"Surplus material or unsuitable material shall be disposed of offsite by the Contractor."

PSDB 5.6.4 Disposal of Intermediate and Hard Rock Material

Add the following to the Sub-Clause:

"Surplus intermediate and hard rock material from trench excavations shall be disposed of offsite by the Contractor."

PSDB 5.6.8 Transport for Earthworks for Trenches

Delete the Sub-Clause and substitute with the following:

"The requirements of Sub-Clause 5.2.6 of SABS 1200 DA as amended and as applicable shall apply."

PSDB 5.7.2 Areas subject to Traffic Loads

Add the following to the Sub-Clause:

"for an extent of 2 m on either side of the carriage-way at each crossing."

PSDB 5.9.4 Bitumen Roads, Sub-Base and Base

Add the following to the Sub-Clause:

"Each Tenderer shall include in his tender allowances to cover the costs of reinstating all surfaces and inclusive of all layers to their conditions pertaining before the commencement of construction.

Items have been included in the Bill of Quantities to cover the reinstatement of certain surfaces (grassed lawns, concrete and/or asphalted/gravel driveways and/or roads) and for payment purposes, the area of those specific surfaces shall be calculated from the product of the length of the trench and the specified trench width plus 400 mm (refer PSDB 5.4)."

PSDB 8 MEASUREMENT AND PAYMENT

PSDB 8.1.4 Basic Principles

Delete Sub-Clause and substitute with the following:

"Except that the volume will be computed as specified in 8.2.3, the requirements of Sub-Clause 5.2.6.1 (Freehaul) of SABS 1200 DA as amended and as relevant, shall apply to freehaul.

No additional payment will be made for excavating and backfilling bell (fox) holes as the cost of that work will be deemed to be included in the rates for trenching."

PSDB 8.3.2(b) Extra-over for

Delete the Sub-clause and substitute with the following:

"No extra-over payment will be made for excavation in material classified in terms of Sub-clause 3.1.2, as amended, as intermediate excavation. The tendered rate for excavation in all materials shall include for the cost of such excavation. Refer to PSD 3.1.2 as amended.

Extra-over item will be made for:

- a) Material classified as "hard rock". Refer to PSD 3.1.2, as amended."

PSDB 8.3.3.1 Deficiency in Backfill Materials

Add the following to the sub-clause:

"Payment for imported, graded stone laid under pipelines in accordance with PSDB 5.5 shall be paid for under either Sub-Clause 8.3.3.1(c) or as scheduled."

PSDB 8.3.3.4 Overhaul

Delete the Sub-clause and substitute with the following:

"All haul will be regarded as free haul."

Add the following new Sub-Clause PSDB 8.3.4(c)

***PSDB 8.3.4(c) Cross Embankments**

Unit : m³

"Payment for cross embankments will be by volume of embankment constructed in accordance with the specification."

PSDB 8.3.5 Existing Services that Intersect or Adjoin a Pipe Trench

Add the following to the end of the Sub-Clause:

- “(v) all work involved in locating the service by hand excavation
- (vi) notifying and attending upon the owner of the service
- (vii) supporting and protecting the service while the pipeline is installed, inspected, tested and backfilled.”

PSDK GABIONS AND PITCHING (SANS 1200 DK)

PSDK 5 CONSTRUCTION

PSDK 5.1 Gabion Cages

Add the following new Sub-Clauses 5.1.3 and 5.1.4:

***PSDK 5.1.3 Type of cage**

"The size of cages for gabions shall be a maximum of 3 000 x 1 000 x 1 000 mm and shall be divided into cells having a volume not greater than one cubic metre. The size of cages for mattresses shall be a maximum of 2 000 x 1 000 x 300 mm and shall be divided into cells having a volume not greater than 0,3 m³."

***PSDK 5.1.4 Diaphragms**

"Each diaphragm shall be connected in the same manner to the sides and top panels in addition to the bottom panel."

PSDK 5.2 Gabion Walls and Aprons

PSDK 5.2.3 Assembly

Add the following to the Sub-Clause:

"All gabion and mattress cages shall be connected to adjacent gabion and/or mattress cages by lacing the adjacent selvages together with 2,0 mm dia. galvanised steel wire. The lacing shall be in accordance with Sub-Clause 5.1.2."

PSDK 5.2.4 Rockfilling

PSDK 5.2.4.1 Gabion boxes in retaining walls

Add the following paragraph to the Sub-Clause:

"Particular care shall be taken in the filling gabions and mattresses so as to ensure that the voids in the rockfill are reduced to the minimum that can be reasonably achieved. In order to minimise the voids in the rockfilling, the filling shall proceed in layers not exceeding 300 mm deep and each layer shall be rodded and barred so as to compact the rockfill before filling of the next layer commences. Where appropriate, hand packing of selected rock particles shall be carried out."

PSDK 5.2.4.2 Mattresses used in revetments and aprons

Add the following paragraph to the Sub-Clause:

"Where gabions and mattresses are placed in exposed positions the rock particles forming the exposed faces shall be specially selected so as to present a fair and even surface."

PSDK 5.3.4 Wired Pitching

Add the following paragraph to the Sub-Clause:

"The areas in which wired or grouted wire pitching is to be used will be indicated on site by the Engineer."

PSDK 8 MEASUREMENT AND PAYMENT

PSDK 8.2.3 Extra Over 8.2.2 for Packing Selected Stone for Exposed Face

Add the following paragraph to the Sub-Clause:

"The method of selecting and packing stone for exposed faces as scheduled shall be as specified in Sub-clause 5.2.7 - Special Finish."

PSG CONCRETE (STRUCTURAL) (SANS 1200 G)

PSG 2 INTERPRETATIONS

PSG 2.4.2 Strength concrete

Add the following to Clause 2.4.2:

“With the exception of mixes weaker than 15 MPa, all concrete for the Works shall be considered to be strength concrete.

Unless otherwise specified on the drawings or in the Schedule of Quantities, all structural concrete shall be Grade 35 MPa/19.

To ensure uniformity of colour of the formed surfaces of all concrete which will be visible on the exterior of the structures, the cements shall be supplied by a single cement factory. Tenderers are to make allowance for this in concrete rates.”

PSG 3 MATERIALS

PSG 3.2 Cement

Add the following to Clause 3.2:

“With the exception of non-structural concrete, all binders used in the works shall be either an approved blend of CEM II/A 52,5N and PFA, or CEM III/A 42,5N. Cement type CEM II 32,5N may be used for non-structural concrete. In all cases the cements shall comply with SANS 50197- 1.”

PSG 3.2.3 Storage

Add the following to Clause 3.2.3:

“Cement shall be used in the order in which it is received (first in, first out basis)

Cement kept in storage for longer than 6 weeks shall be removed from site and not used in the Works. Replacement of cement will be for the Contractor’s account.

Any cement that shows signs of hydration, such as the formation of lumps, may not be used and is to be immediately removed from site. Replacement of cement will be for the Contractor’s account.”

PSG 3.3 Water

Replace the contents of Clause 3.3 with the following:

“Only potable quality water from an approved source may be used for mixing concrete. Water from a river or stream may not be used in any construction/on-site activities.”

PSG 3.4 Aggregates

PSG 3.4.1 Applicable Specification

Add the following to Clause 3.4.1:

“The maximum aggregate size shall be 19 mm. The nominal stone size specified in the concrete grade shall mean stone conforming to SABS 1083 for the nearest equivalent size.

Any aggregate may be used provided the free sodium alkali content in the concrete mix does not cause an alkali-aggregate reaction.

Coarse aggregate may be obtained from the nearest available commercial sources, and shall be subject to the Engineer’s approval.

Fine aggregate may be obtained from local sources subject to testing of its suitability by an approved laboratory and approval by the Engineer.

Aggregates shall be tested periodically for reactivity, and shrinkage, the costs of which shall be deemed included in the rate tendered for concrete. A trial design mix is to be prepared and the results submitted to the Engineer for approval before construction begins.

At least one month before commencement of concrete work the Contractor shall supply at his own cost representative samples to the Engineer of the aggregates he intends using, together with certificates from an approved laboratory indicating that the aggregates comply with the specifications. Approximately 50 kg of each sample of aggregate shall be supplied.

After approval, these samples shall be taken as standard for the agreed aggregates to be used in the Works. If at any time during the course of the Contract the Engineer considers that there has been any deviation from the approved standard the Contractor shall submit further tested samples of material to the Engineer for approval.

Aggregates for grouting

Notwithstanding the requirements of Sub-clause 3.4.1, the grading of the fine aggregate (sand) and coarse aggregate (stone or pea gravel) to be used for grouting shall conform to the grading given in Tables 1 and 2 respectively, below.

TABLE 1 - SAND	
Test sieve nominal aperture size, mm	% Passing (by mass)
9,5	100
4,75	95 - 100
1,18	45 - 65
0,3	5 - 15
0,15	0 - 5

TABLE 2 - STONE OR PEA GRAVEL	
Test sieve nominal aperture size, mm	% Passing (by mass)
9,5	100
4,74	95 - 100
2,36	0 - 5

Dolomitic Aggregate

Coarse and fine dolomitic aggregate may be used. When tested in accordance with the method specified in Appendix C of SANS 677, not more than 25% by mass of the dolomitic aggregate shall be insoluble in hydrochloric acid."

PSG 3.5 Admixtures

PSG 3.5.1 Approval of admixtures requirements

Add the following to SANS 1200 G, sub-clause 3.5.1:

"The use of admixtures will be subject to the approval of the Engineer. The information listed in SANS 1200 G, sub-clause 3.5.1 shall be provided.

In addition all water retaining structures will include the following admixture: Crystalline Waterproofing Additive (Zypex Admix C- 500 NF) added at the rate of 5kg per 1m³ of concrete during mixing, all to manufacturer's specification.

If two or more admixtures are to be used, the Contractor shall submit all necessary and available data for assessing the interaction and compatibility of the admixtures."

Add the following new sub-clauses to SANS 1200 G, sub-clause 3.5:

***PSG 3.5.3 Pulverized fly ash (PFA)**

***PSG 3.5.3.1 General**

"Concrete containing a percentage of FA shall be termed FA concrete. Pulverized fly ash (PFA) shall conform to the requirement of SANS 1491-2.

All concrete used shall consist of FA in the concrete unless otherwise shown on the drawings or ordered by the Engineer.

FA concrete shall conform to the requirements of SANS 1200 G for concrete and the additional requirements specified below."

***PSG 3.5.3.2 Source and quality**

"Fly Ash shall be procured from an approved source and shall be of a consistent quality conforming to SANS 1491-2. In particular it shall be tested for and shall conform to the following:

- a) the loss on ignition shall not exceed 5%
- b) the percentage by mass retained on 45 micron screen shall not exceed 12.5%"

***PSG 3.5.3.3 Cementitious material**

"The cementitious material used for FA concrete shall consist of a mixture of between 75% and 80% by mass of ordinary Portland cement and of between 25% and 20% by mass of FA.

If instructed by the Engineer, all concrete used for construction of water retaining structures shall contain a post surface treatment that waterproofs by crystallization (Xypex or similar approved) at a rate and application in accordance with manufacturer's recommendation. Reference made to PSG 5.5.8, Curing and protection."

***PSG 3.5.4 Crystalline Waterproofing Additive**

"The Contractor shall be responsible for furnishing all labour, materials, services and equipment necessary for the supply and installation of crystalline waterproofing additive to concrete structures as indicated on the drawings, and as specified herein. The crystalline waterproofing material shall be added to concrete during the mixing cycle, and shall be used in above and below grade walls and slabs including liquid retaining structures where enhanced chemical resistance is required.

The concrete waterproofing system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the set concrete. The system shall cause the set concrete to become sealed against the penetration of liquids from any direction, and shall protect the concrete from deterioration due to harsh environmental conditions.

Prior to installation of waterproofing, the Contractor shall conduct a meeting with the Engineer, concrete supplier, concrete placer and waterproofing manufacturer's representative to verify and review the project requirements for waterproofing as well as the manufacturer's product data including application instructions.

After this meeting, the Contractor shall obtain approval to install the crystalline waterproofing additive in writing from the product manufacturer, which written approval shall be given to the Engineer. This requirement shall not absolve the Contractor of his/her obligations in accordance with the contract and project requirements.

The admixture shall be added to the concrete mix at the time of batching. The Contractor shall obtain a completely homogeneous mixture by thoroughly blending the admixture with the concrete mix."

PSG 3.6 Reinforcement

Add the following paragraph to the Sub-Clause:

"Mild steel shall be in accordance with SABS 920 – Type A 250MPa yield and high yield stress steel according to SABS 920 – Type C, Class 2, Grade 1, 450MPa yield."

Add the following Sub- Clauses PSG 3.9, PSG 3.10, PSG 3.11, PSG 3.12 and PSG 3.13:

***PSG 3.9 Granolithic Screed**

"Granolithic screed shall consist of:

Cement	1 part by mass
Sand	1,25 parts by mass
Coarse aggregate	2 parts by mass

The coarse aggregate shall consist of granite or other approved chips which shall pass a 10 mm sieve and be retained on a 5 mm sieve.

The water/cement ratio of the mix shall not exceed 0.5."

***PSG 3.10 Bond Breaker**

"The bond breaker between the top of the blinding layer or dry packed mortar screed and the underside of the floor slabs for civil structures shall be either a double coat of a spray grade bitumen emulsion complying with SANS 309 applied at a rate of 1,0 ℓ/m^2 of net bitumen or a (minimum) 250 micrometre polythene sheet complying with SANS 952, Type D.

Where bitumen-impregnated resilient fibreboard is specified, it shall comply with American Federal Specification HH-F-341a for Type 1, Class B."

PSG 3.11 Materials For Movement Joints**PSG 3.11.1 General**

"The various jointing materials, the manufacturers of the materials and the methods of application shall be as approved by the Engineer. Materials shall be stored and protected to avoid damage, degradation, distortion or contamination.

The joint materials shall be resistant to ultraviolet light and to biological degradation."

***PSG 3.11.2 Waterstops**

"Waterstops shall be of approved manufacture and of the pattern and the material and widths scheduled and specified and shown on the drawings. They shall comply with the tolerances specified in clause 6.1 of SANS 1200G.

The waterstops shall conform to the Specifications as set out in CKS 388 for Rubber
They shall conform to Specifications CKS 388 or 389, for natural rubber or PVC respectively, and have the appropriate physical properties as set out below:

	PVC	Rubber
Tensile strength (@ 25°C)	12,2 MPa	20,7 MPa
Elongation at break (@ 25°C)	250%	500%
Hardness BS degrees (IRHD @ 25°C)	-	60 to 65°
Softness (BS)	28 to 52°	-

All intersections between waterstops shall be pre-fabricated in the factory in accordance with the manufacturer's instructions and to approval of the Engineer. Only straight lengths of waterstop may be field-welded using the appropriate jigs and tools.

Where required, waterstops shall have eyelets so that they may be tied securely to the adjacent reinforcement. Waterstops shall be centre bulb unless specified otherwise elsewhere."

***PSG 3.11.3 Joint Formers**

"Closed cell expanded polyethylene joint formers shall have the following typical properties:

Nominal Density	90 - 110 kg/m ³
Compression set after 24 hours recovery	14 %
Tensile Strength	Minimum 680 kPa
Elongation at Break	98 %
Max. water absorption after 24 hours by volume	0,1%

Joint formers shall be pre-cut to suit the application as per drawings with a tear-out strip for forming the specified recess for the sealant. The joint formers shall be developed for use in applications with a head of water of at least 10m. If so required the filler shall be glued into position with approved epoxy glue.

Joint formers will be used for expansion joints in the walls and roof and as indicated on the drawings.

Joint formers will also be used where the perimeter walls are cast up to the beams and shall have a thickness of 12mm. Where this is the case, the joint formers will be cut out to a depth of 12mm to allow a cavity for the application of an approved 12mm x 12mm UV resistant polyurethane sealant."

***PSG 3.11.4 Bond Breakers, Primers and Sealants**

"The bond breaker (if specified) shall be self-adhesive PVC tape (or equal, approved material) with a width the same as the joint recess into which it is to be applied.

The primer, if required for the sealant, shall be fully compatible with the sealing compound that is to be used.

The elastomeric sealant shall be a one-component polyurethane liquid polymer base complying with the requirements of SABS 110. The polymer shall be pouring grade for horizontal or near horizontal joints and gun grade for vertical/overhead joints and joints steeper than 1 in 10 to the horizontal. Sealants shall have a movement tolerance of 25%. Sealants shall have been tested to ensure that they are non-toxic and do not impart any odour or taste to, or otherwise taint, the water.

These sealants shall be suitable for indoor as well as outdoor applications and shall be UV resistant. The sealant shall be suitable for use at movements and connection joints in floors as well as for joints in contact with potable water.

Sealant samples shall be timeously submitted for testing upon the request of the Engineer.

Selected contraction and expansion joints will be waterproofed by an approved high performance tape/bandage placed over the joint as indicated on the drawings. This tape shall have a minimum thickness of 2 mm and dimensions as indicated on the drawings.

The tape shall be bonded to the concrete and covered with an approved epoxy-paste adhesive which is not sensitive to moisture.

This tape shall have the following typical properties:

Suited for use in Potable water
High water pressure resistance
High Durability and chemical resistance
UV- and weather resistant
Root-Resistant
Plasticizer free"

***PSG 3.11.5 Joint Protectors**

"Joints protectors shall be installed on joints at the vicinity of inlets to protect floor slab joints from erosion as indicated on the drawings. Joint protectors shall consist of a HDPE strip with a 45° bevel on the upstream side. The joint protector shall be secured with chemical anchor bolts into the concrete at 200 mm centres as indicated on the drawings."

***PSG 3.12 Waterproofing Slurry**

"An approved cementitious in-depth waterproofer shall be used on planned construction joints as indicated on the drawings. Surfaces shall be prepared and the product shall be applied as per the approved manufacturer's instructions.

The waterproofing slurry shall be suitable for use on concrete substrates and should be suitable for use in potable water structures.

The slurry shall have the following typical properties:

Appearance	Grey Powder
Workability at 20°C	Approximately 30min
Setting time at 20°C	1-2 hours"

***PSG 3.13 Precast Paving Slabs**

"The paving slabs shall comply with the requirements of SANS 541, shall be as scheduled and with patterned surface, or equal approved. Samples of the types which the Contractor proposes to use shall be submitted for approval prior to construction."

PSG 4 PLANT

PSG 4.3 Mixing Plant

PSG 4.3.1 General requirement for mixing plant

Add the following to the Sub-Clause:

"Stand-by mixers of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular mixers failure of the power supply."

PSG 4.4 Vibrators

Add the following to the Sub-Clause:

"Stand-by vibrators of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular vibrator failure of the power supply."

Vibrators for in-situ concrete shall be of the internal or immersion type."

PSG 4.5 Formwork

PSG 4.5.1 Design

Add the following to the Sub-Clause:

"Detailed drawings of the formwork shall be issued by the Contractor for its fabrication. All such design and drawings shall be available for inspection by the Engineer if so required."

No formwork which is in the opinion of the Engineer major formwork shall be erected without the Engineer's prior written approval of the design and moving or handling arrangements. The Contractor's proposed design and drawings shall be submitted to the Engineer in ample time to permit examination without delay to the works, and in any event not less than three clear days before the date when the Contractor proposes to commence fabrication of the formwork. The Engineer's approval for use shall not be deemed to relieve the Contractor of his responsibility for the adequacy of the formwork."

Where smooth or special formwork is required, only new or as-new steel shuttering shall be used. Where steel is definitely impractical, an alternative may be used but only as approved by the Engineer."

PSG 4.5.3 Ties

Add the following to the Sub-Clause:

"The use of sleeves for formwork ties through the walls of water retaining structures will not be permitted. Ties, when cast in, shall have some form of positive anchorage to prevent any rotation when loosening formwork and some form of water bar to restrict seepage along the tie. Details of the ties proposed shall be submitted to the Engineer for approval prior to the erection of the formwork."

For Watertight concrete structures the shutters shall be fastened using an approved imbedded fastening system. Open ferrules will not be permitted."

Where practical, cone recesses shall be plugged with well-rammed dry 3:1 mortar within 48 hours of casting the concrete. Surfaces of the recesses shall first be roughened by wire brushing."

Tie cone recessed which cannot be plugged within 48 hours of casting shall be roughened by scabbling and a wet to dry epoxy shall be applied before plugging the recesses with mortar."

PSG 5 CONSTRUCTION

PSG 5.1 Reinforcing

PSG 5.1.2 Fixing

Add the following to the Sub-Clause:

“Fixing of reinforcing bars by welding and heating of bars will not be permitted.

Any bars which are severely rusted or with a cross-section which is, in the Engineer's opinion, reduced by rusting or other cause, shall be rejected and immediately removed from site, and replaced by the Contractor at the Contractor's expense.

Fixing blocks for the attachment of fixtures may be embedded in concrete provided that the strength or any other desirable feature (such as appearance of the member) is not, in the opinion of the Engineer, impaired thereby.

Supports shall be of approved precast concrete blocks properly shaped to maintain position or proprietary supports of an approved type. Concrete blocks shall be adequately cured as specified. Wooden supports shall not be used nor shall bars be placed in succeeding layers of fresh concrete nor shall bars be adjusted during the placing of concrete. Tie-wire shall point away from the nearest formwork face.

Where clips, stools and other supports are not shown on the drawings and are structurally not required, the Contractor shall provide those supports he deems necessary to ensure the correct positioning of the reinforcement, to the satisfaction of the Engineer. The cost of such steel, labour, and other fixing materials shall be inclusive in the rate for the scheduled reinforcement and no additional payment shall be made.”

PSG 5.2 Formwork

PSG 5.2.1 Classification of Finishes

Add the following to the Sub-Clause:

“Formwork panels or forms shall be free from surface markings. The form surface shall be so lined that it is free from nail, screw, rivet, weld or other marks. Special care shall be taken to avoid form oil, curing water or other stains on exposed surfaces. The forms shall not be re-used unless in perfect condition and capable, in the opinion of the Engineer, of producing exactly the same surface pattern texture and finish as the previous cast.

Rough formwork Degree of Accuracy III may be used on the outside faces where the concrete is more than 500 mm below the final ground level.

Smooth formwork Degree of Accuracy II will be used elsewhere unless specified otherwise.

Where specified special finishes shall be to Degree of Accuracy I.

All honeycombing shall be repaired by cutting back to sound concrete and patching with a suitable epoxy mix, following strict concrete repair methodologies (including not creating any feather edges, and ensuring adequate bond to the existing concrete) to the approval of the Engineer.

Concrete for manholes shall be finished with a steel float or against a steel shutter which has been cleaned and oiled before use.”

PSG 5.2.2 Preparation of Formwork

Add the following to the Sub-Clause:

“All exposed external angles in concrete work shall have 20 mm x 20 mm chamfers unless otherwise specified or ordered, but the top edge of a slab that is to receive an applied finish shall not be chamfered.

Formwork shall be completely grout-tight under vibration.”

PSG 5.2.5 Removal of Formwork

Add the following to the Sub-Clause:

“The minimum stripping times for shuttering shall be the following:

Columns and Walls:	1.5 days
Suspended Slabs:	14 days
Slab Props:	14 days
Beam Props:	21 days

The stripping of formwork on all other elements shall adhere to table 2 in SABS 1200G section 5.2.5.2 unless specified otherwise elsewhere."

PSG 5.5 Concrete (Watertight)

PSG 5.5.1 Quality

Add the following to the Sub-Clause:

"35 MPa concrete with the minimum and maximum cementitious contents of 325 kg/m³ and 450 kg/m³ respectively shall be used. For concrete containing extenders the maximum cementitious content shall be 450 kg/m³. The water to cement ratio shall not exceed 0.50. All concrete mix designs shall be approved by the Engineer in advance.

The mix design and casting procedure shall be approved by the Engineer prior to casting. All excavations and foundations must be checked and approved by the Engineer or delegated Geotechnical Engineer prior to casting.

All Water Retaining structures, manholes and valve and other chambers shall be constructed using watertight concrete. The Contractor shall abide by all conditions set out in sub-clause 5.5.11 of SABS 1200 G, and pay particular attention to this aspect of the works.

Cubes shall be taken on all pours in accordance with SABS 1200 G. Payment shall be included in the rate tendered for the supply of concrete. No payment shall be made for concrete pours on which no cube tests have been performed. A single cube test comprises the mean crushing strength of 3 cubes taken from the same batch of concrete and cubes must be taken at the frequency specified SANS 1200 G

The concrete shall be tested for water sorptivity, oxygen permeability, chloride conductivity, depth of cover and shrinkage; the details of the tests are given in the specification."

PSG 5.5.1.4 Chloride Content

Add the following to the Sub-Clause:

"Efflorescence will not be acceptable on any exposed concrete surface"

PSG 5.5.1.5 Durability

Add the following to the Sub-Clause:

"The water/cement ratio, as specified in Table 5 in SANS 1200 G, but shall not exceed 0.5."

PSG 5.5.1.6 Prescribed Mix Concrete

Add the following to the Sub-Clause:

"Notwithstanding the requirements of Sub-clause 5.5.1.6, samples of aggregates will not be made available by the Engineer. The Contractor shall supply aggregates from commercial sources located by him, complying with the requirements of Sub-clause 3.4.1, as amended, for the production of prescribed mix concrete.

"No-fines" concrete:

A nominal aggregate size of 19 mm shall be used in the manufacture of "no-fines" concrete.

No-fines concrete shall be laid where specified and shall consist of coarse aggregate, cement and water only. No-fines concrete shall have a 28-day characteristic strength of 15MPa unless specified otherwise elsewhere. No fine aggregate shall be used. Sandwiching or layering of pours will not be permitted. The Contractor shall cast to the profile depth in one pour.

The mixing of the cement and water paste shall have the consistency of paint capable of coating each coarse aggregate particle uniformly and sufficiently to form a small fillet at all the contact points of each stone in the aggregate.

Between 24 and 48 hours after the no-fines layer has been laid it shall be covered with 1:4 cement: sand mortar layer with a nominal thickness of 2 mm. The mix shall be comparatively dry to ensure that it does not penetrate and block the cavities in the no-fines concrete. The surface shall be steel floated to form a plane surface.

The mortar skim shall be cured in the same manner as concrete for a period of not less than 2 days.

Payment shall be per cubic metre of no-fines concrete placed. The rate shall include compaction and skimming to the approval of the Engineer."

PSG 5.5.1.7 Strength Concrete

Add the following to the Sub-Clause:

"The concrete mix design for strength concrete must be prepared in an approved laboratory and the results of actual test mixes must be submitted for approval together with 7-day and 28-day strength test results at least 14 days prior to casting of the concrete. Special attention is drawn to the fact that the concrete mix must provide a very dense and impervious concrete.

The Contractor shall submit details of the proposed concrete aggregates and design mix to the Engineer for approval, after which he shall be required to make a trial mix and obtain cube test results to validate the proposed mix. Only after receipt of satisfactory cube test results, the Contractor shall be permitted to use the mix in the construction of water retaining structures. The cost of designing and proving the proposed concrete mix shall be deemed to be included in the tendered rates.

The Engineer may call for revised mix designs at any stage during the Contract.

Unless otherwise stated on the drawings, the 28-day characteristic strength of the concrete for the pump station and chambers shall be as follows:

- Foundations: 35MPa/19mm concrete
- Walls, Floors: 35 MPa/19mm concrete
- Columns: 35MPa/19mm concrete
- Benching, Screeds: 20MPa/19mm concrete
- Thrust Block: 15MPa/19mm concrete
- Encasements: 15 MPa/19mm concrete
- Mass Concrete: 15MPa/19mm concrete
- No-Fines concrete: 15MPa/19mm concrete
- Blinding Layer: 15MPa/19mm concrete

In order to facilitate or increase the workability of concrete in the fresh/plastic state, to ensure water tightness without increasing the water/cement ratio, the Engineer may approve the use of an additive.

The workability of concrete shall be assessed by means of the slump test. The slump shall be 75 ± 25 mm. Higher slumps for use in for example pumped mixes will be permitted subject to approval by the Engineer.

The slump for concrete on the sloping floors may be of a lesser value to facilitate casting and vibrating these elements on the slope. The Contractor shall provide a detailed method statement together with an appropriate mix design that will ensure that these elements can be cast to produce dense, watertight concrete. A test panel of an appropriate size is to be cast to demonstrate the effectiveness of the proposed method. No concrete may be cast, with the exception of the test panel, prior to written approval of the method by the Engineer."

PSG 5.5.2 Batching

Add the following to the Sub-Clause:

"Batching of all strength concrete shall be by mass. Prescribed concrete may be batched by volume. Batching shall not be done by wheelbarrow.

All concrete shall be mechanically mixed.

Stand-by mixers of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular mixers failure of the power supply."

PSG 5.5.3.2 Ready-Mixed Concrete

Replace the contents of Clause 5.5.3.2 with the following:

"Concrete from a central concrete production facility other than on the construction site will be permitted if the facility is within a 40 km radius of the site and, apart from test results in terms of Sub-clauses 7.3.1, 7.3.2 and/or 7.3.3, test results obtained by such a production facility as part of its quality control system will be accepted for evaluation in terms of Sub-clause 7.3.4, provided the cubes are stored and cured on site."

PSG 5.5.5 Placing

Add the following to the Sub-Clause: 5.5.5.1

"No cast shall be started when rain is falling or, when in the Engineer's opinion, heavy or continuous rain is probable. Should rain occur after the commencement of casting, the Contractor shall provide all measures necessary to ensure satisfactory completion and protection of that section of the works being cast. No cast shall be started when weather conditions are such that sand or salt spray is blown onto steel, formwork or concrete."

PSG 5.5.5.10 Casting of Concrete in Excavation

Add the following to the Sub-Clause:

"Structural concrete shall not be cast directly against the side of any excavation without the use of formwork unless prior approval has been obtained in writing from the Engineer.

Concrete used in pipe trenches for encasement and for the thrust / anchor blocks may be cast directly against the side of the excavation.

After vibration, the concrete shall be spaded in corners, in angles and against forms to release air bubbles which may have been trapped in these positions."

PSG 5.5.6 Compaction

Add the following to the Sub-Clause:

"All concrete shall be vibrated with approved internal vibrators of minimum 65mm diameter and ample power to maintain a speed of at least 7000rpm when immersed. Electrically driven vibrators shall be used when practicable. Smaller diameter vibrators may be used subject to the approval of the Engineer where areas of rebar congestion restrict the use of large diameter vibrators.

Vibrators shall be inserted only at a sufficient distance from the sloping face of an advancing layer to prevent undue slumping or flow of the face."

PSG 5.5.7 Construction Joints

Add the following new Sub-Clauses PSG 5.5.7.1:

***PSG 5.5.7.1 General**

"The edge of joints, exposed to view in the finished structure, shall be so formed as to provide a straight edge true to line and level.

All joints, other than expansion, contraction and other movement joints shall be treated as follows:

As soon as practical the construction joint surface shall be prepared to receive fresh concrete. This preparation, as specified in Sub-clauses 5.5.7.3(a) to (d), shall be such as to remove all laitance or inert and strengthless material which may have formed by high pressure water jets or sand blasting and the specified chipping or sand blasting shall be such as to produce a roughened surface all over. The timing of this operation is important in order to obtain the required finish. Each joint shall be inspected by the Engineer before it is rendered inaccessible by the erection of further shuttering.

Construction joints shall be covered with a waterproofing slurry as indicated on the drawings.

When concreting is interrupted concrete surfaces shall be protected from the sun as specified in Sub-clause 5.5.8(d) or by means of hessian kept damp until concreting is resumed.

About ½ hour before placing concrete or mortar, construction joints shall be saturated with water and immediately prior to placing concrete or mortar on any part of the joint, all surplus water shall be removed by compressed air jets or other approved method.

Unless construction joints between designated joints shown on the drawings are authorized by the Engineer in writing, concrete in the floor and wall shall be cast continuously between the designated joints shown on the drawings.

All costs connected with the forming of construction joints shall be deemed to be included in the relevant concrete rates."

Add the following new Sub-Clauses PSG 5.5.7.4, PSG 5.5.7.5, PSG 5.5.7.6, PSG 5.5.7.7, PSG 5.5.7.8, PSG 5.5.7.9, PSG 5.5.7.10, PSG 5.5.7.11 and 5.5.7.12:

***PSG 5.5.7.4 Formed Joints (Generally Vertical or Near Vertical)**

"Formed joints will be considered to be designated joints as defined in Sub-clause 2.4.3. (The forming of a straight edge to a construction joint as specified in [PSG 5.5.7.1, as amended](#), does not constitute a formed joint).

Each joint shall be formed as shown on the drawings, complete with rebates, formwork, waterstops, sealants, approved joint filler, dowel bars and their PVC tubes, etc. as indicated."

***PSG 5.5.7.5 Non-Designated Joints**

"Any non-designated joints shall be identical to designated joints, as shown on the drawings, which would be used in similar positions and shall perform the same function."

***PSG 5.5.7.6 Joints between Footings or Floors and Walls or Columns**

"Construction joints between foundations, footings or floors and walls, columns or piers connected to them, shall not be made flush with the supporting surface, but shall be made at a distance above the footing or floor shown as on the drawings or approved by the Engineer. The "kicker" shall be cast as an integral part of the foundation, footing or floor."

***PSG 5.5.7.7 Construction Joints**

'Construction Joints In Walls Or Footings

Construction joints may only be placed where shown on the drawings or to the approval of the Engineer.

The entire contact surface along the joint in the concrete already cast shall be chipped or water jetted to expose the coarse aggregate to 5 mm beyond the surrounding matrix. Care shall be taken to ensure that the concrete structure is not damaged and that all loose material is removed. The surface must be thoroughly cleaned and wetted before casting against the joint.

All construction joints in walls and footings shall be cast with water stops. Water stops shall be as per detail drawings.

Payment shall be per linear meter. The rate shall include the cost of all material and labour for the construction of the joint as indicated on the drawings, including formwork, testing and making good. Rates shall also include the cost of the supply and placing of any waterstops, dowels or other insets."

***PSG 5.5.7.8 Application of Primers and Adhesives**

"The concrete to which the primer or adhesive is to be applied shall be dry and shall be cleaned of all dust, grit, grease, surface laitance and foreign matter by compressed air and/or water, solvents, or other suitable approved means. The Contractor shall provide on Site an approved moisture meter to measure the degree of dryness of the joint. This meter shall be made available to the Engineer for testing. The joint shall be approved for the application of the primer and adhesive if the moisture content of the concrete is less than or equal to 5%. It may be necessary to dry the concrete surfaces locally to reduce the moisture content to 5% or less.

All application and drying times shall be included in the Tender Programme.”

***PSG 5.5.7.9 Contraction and Expansion Joints**

“Expansion and contraction joints shall be constructed as detailed on drawings using PVC or rubber water stops.

Water stops extruded from recycled material shall not be permitted.

Prior to bandaging, concrete surfaces shall be scabbled with a mechanical scabbler and water jetted with a 200 bar water jet. All joints shall be butt jointed and patched over.

The waterproofing bandage shall comprise of two elements:

- (i) A 2 mm thick Hypalon or Combiflex strip
- (ii) (For Expansion joints) A 2 mm x 60 mm stainless steel strip with polythene backing bond breaker to the detail shown on the drawing.

The bandage shall be applied by coating the concrete and underside of the hyperlon bandage with an epoxy adhesive. The stainless steel strip is first positioned over the joint and the bandage with epoxy adhesive placed over the stainless steel strip. All trapped air shall be eliminated by hand rolling the bandage until the epoxy is fully cured.

Payment shall be per linear meter. The rate shall cover all costs for the supply and application of water stops and bandaging including the installation of the stainless steel strip.”

***PSG 5.5.7.10 Installation of Waterstops in Joints**

“Waterstops shall be held in the formwork so as to prevent air pockets forming underneath them. Special precautions shall be taken, to the approval of the Engineer, to ensure that all flexible waterstops are in perfect contact with well compacted void-free concrete.”

***PSG 5.5.7.11 Installation of Joint Filler in Expansion Joints**

“Filler in the joints shall be neatly butted so as to exclude mortar from the joint. Edges of filler strip against waterstops, concrete, formwork, projections, etc., shall also be closely fitted to exclude mortar, so that there is no resistance (other than the compression of the filler) to the expansion movement for which the joint is designed.

Joint filler shall be fixed to the first cast of concrete with an approved adhesive and as directed by the Engineer.”

***PSG 5.5.7.12 Application of Joint Seals**

‘Rebates shall be cleaned as required by PSG 5.5.7.6 Application of primers and adhesives and shall be inspected and approved by the Engineer's Representative before filling.

Joint sealants and primers shall be applied strictly in accordance with the approved manufacturer's instructions. Flow and non-slumping grades shall be used for horizontal and vertical joints respectively unless indicated otherwise. Immediately after the compound is applied the joint shall be protected against damage until completion of the Contract.

Batch numbers of sealants shall be recorded. Only skilled workmen, experienced in this type of work shall be employed to apply the sealant.

Immediately after the compound is cold the joint shall be protected against damage until completion of the contract.”

PSG 5.5.8 Curing and Protection

Add the following new sub-clauses to SANS 1200 G, sub-clause 5.5.8:

***PSG 5.5.8.1 Post-Crystallization (Concentrate & Modified) slurry coat and curing**

"The Concrete surfaces to receive a concentrate slurry coat treatment shall have an open capillary system to provide 'tooth and suction', and shall be free from scale, excess form oil, laitance, curing compounds and foreign matter.

In order to improve the effectiveness of the crystallization treatment, the specified minimum time for the removal of the formwork shall be three days. All surfaces shall be pressure cleaned in accordance to the product manufacturer's requirement to remove all oil, laitance, curing compound and foreign matter.

Concrete surfaces must be thoroughly saturated with clean water prior to application in order to ensure the growth of the crystalline formation deep within the pores of the concrete. Wetting to be done must be at least 1 hr before application. If concrete surface dries out before application, it must be re-wetted.

The concentrate slurry is applied at a coverage rate of 1kg/m² using a semi-stiff nylon bristle block brush – work slurry well into the surface, filling surface pores and hairline cracks. The coating must be uniformly applied at approximately 1.25 mm thickness. The second modified slurry coat with the same application rate must be applied within 48 hours of the first coat. Light pre-watering between coats may be required when drying out signs appear. Detail coating applications shall be confirmed by the manufacturing.

Cure by spray for minimum of 3 days must be established once the final coat has been applied. Protect from rainfall, puddling of water, wind & frost for at least 48 hours after application. When plastic sheeting is used as protection allowance must be made for the coating to breathe."

Add the following new Sub-Clauses PSG 5.5.8.2 and PS 5.5.8.3:

***PSG 5.5.8.2 Horizontal Surfaces**

"Horizontal surfaces shall be wet cured only. The Contractor shall provide a method statement describing his proposed method of curing. This method statement is to be approved by the Engineer prior to construction."

***PSG 5.5.8.3 Curing for Normal Concrete Surfaces**

"In order to achieve durable, impermeable concrete, all exposed surfaces (including joint surfaces) of strength concrete shall be properly and carefully cured. Curing shall take place from the time that the concrete has taken its initial set. (The length of time when formwork is in place may be deducted from the curing period).

The use of membrane curing compounds will be allowed on vertical faces or steeply inclined faces (i.e. steeper than 15° to the horizontal) of cast in situ members of the structures. Approval will be subject to the Contractor producing sufficient, satisfactory cube crushing strength test results where the crushing strength of cubes which have been cured with the proposed curing membrane and left exposed to the elements are compared with those of an equal number of water cured cubes. The crushing strength of cubes cured with the proposed membrane shall be at least 85% of the crushing strength of the water cured cubes.

Before any membrane curing compound is used, each batch shall be tested on a trial surface to ensure that it forms a satisfactory membrane, and any compound which is unsatisfactory in the opinion of the Engineer, shall be rejected. Curing membranes will be disallowed if permanent discolouration of the concrete takes place. Surfaces where curing membranes are used shall be treated in such a manner that the final concrete texture and colour blends in with the rest of the concrete work. Furthermore, the Engineer shall, at his discretion, require the Contractor immediately to adopt an effective alternative means of curing any area of the structure to which a membrane has been applied which, in the opinion of the Engineer, is unsatisfactory. The curing compound used shall be to the approval of the Engineer. Wax based curing compounds will not be permitted.

The curing compound shall be applied immediately as formwork is progressively stripped or, in the case of unformed surfaces, when the concrete has taken its initial set. It shall preferably be applied by spraying and the rate of application shall be strictly in accordance with the manufacturer's recommendations. A method of monitoring the area to which curing compound has been applied and the application rate shall be as approved by the Engineer and rigidly applied by the Contractor.

Surfaces of joint rebates, where elastomeric sealant is to be applied, shall be protected from contamination by curing compound by the use of masking tape.

Curing times shall be included in the Tender Programme.

The Contractor shall immediately adopt an effective alternative means of curing any area of the structure where, in the opinion of the Engineer, curing is unsatisfactory."

PSG 5.5.9 Adverse Weather Condition

Replace the contents of Sub-clause 5.5.9.2 with the following:

"No placing of concrete shall take place if the ambient temperature exceeds 32°C, or is likely to rise to above 32°C during the casting period or within eight hours after casting is completed.

If concrete is to be cast during times of high ambient temperature or hot drying winds, the Contractor shall be responsible for taking the necessary steps to keep the placement temperature as low as possible. Such steps include the spraying of the coarse aggregate with potable water, the painting of silos with a reflecting aluminium paint, the insulation of tanks and pipelines, and the protection of concrete ingredients against the direct rays of the sun. The area of the pour shall be shaded before and during concreting and the concrete shall be shaded from the time of mixing until eight hours after placing.

Windbreaks shall be erected if necessary."

PSG 5.5.10 Concrete Surfaces

Replace the contents of Clause 5.5.10 with the following:

PSG 5.5.10.1 Screeded Finish

"After placing and compacting the concrete on a top (unformed) surface shall be struck off with a template to the designated grades and tamped with a tamping board to compact the surface thoroughly and to bring mortar to the surface, leaving the surface slightly ridged but generally at the required elevation. No mortar shall be added, and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after the interfering aggregate has been removed or tamped."

PSG 5.5.10.2 Wood-Floated Finish

"Where wood-floating is ordered or scheduled, the surface shall first be given a finish as specified in Sub-clause PSG 5.5.10.1, as amended, Screeded finish and, after the concrete has hardened sufficiently, it shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screeding marks. "

PSG 5.5.10.3 Steel-Floated Finish

"Where steel-floating is specified or scheduled, the surface shall be treated as specified in Sub-clause PSG 5.10.1, as amended, Screeded finish except that, when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be steel-trowelled under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.

Add the following new Sub-Clauses PSG 5.5.10.4, PSG 5.5.10.5, PSG 5.5.10.6 and PSG 5.5.10.7:

***PSG 5.5.10.4 Brushed Finish**

"Where brushed finish is specified or scheduled, the surface shall be treated as specified in Sub-clause PSG 5.10.1, as amended, Screeded finish except that, when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be finished/brushed by dragging a broom across the surface of the concrete in order to obtain a non-slip surface."

***PSG 5.5.10.5 Power-Floated Finish**

"Where a power-floated finish is specified, the surface shall be trowelled smoothly with a well-balanced power trowel. Care shall be taken to ensure the surface is trowelled when it is at the optimum trowelling consistency."

***PSG 5.5.10.6 Rough Finish**

"In certain special cases where a rough finish is desired or specified on the drawings, the surface shall be screed-tamped to an approximately even dense surface, and shortly after final set of cement the surface shall be wire broomed and washed down to remove any laitance, leaving a clean rough surface with coarse aggregate partially exposed, but not disturbed."

***PSG 5.5.10.7 Granolithic Screeds**

***PSG 5.5.10.7.1 General**

"Before placing any granolithic screeds the base concrete shall be chipped to expose the aggregate over 100% of the area to be screeded and soaked with water for at least 24 hours.

The base concrete shall be thoroughly cleaned by scrubbing and all standing water removed after soaking. A 1:2 cement/sand grout shall then be brushed into the prepared surface followed by the granolithic screed before the grout sets. The granolithic screed shall be of the driest feasible consistency with a slump not exceeding 50 mm and shall be formed true to profile and shape as required and shown on drawings. Before placing granolithic screed against an adjacent band of granolithic screed the edge of the latter shall be prepared by chipping back to firm material, wire brushing and brushing with grout as for the base concrete.

Granolithic screed shall be compacted to remove all air and shall be screeded and finished with a steel trowel to Degree of Accuracy 1.

The trowelling shall be carried out in the following stages:

First - as soon as the granolithic screed has been compacted and screeded.

Second - after 2 hours to close the surface and remove laitance.

Third - after a further 4 hours.

The time intervals are estimated as appropriate to normal temperature conditions and shall be varied by the Contractor to ensure a smooth dense finish.

Granolithic screed shall be cured as specified in Sub-clause 5.5.8(b), as amended, but shall additionally be protected from direct sunlight and drying winds as it is being placed.

All screeding necessary to accommodate mechanical equipment shall be done under the equipment supplier's supervision and in strict accordance with his instructions. It shall be commenced as soon as the equipment supplier gives notice on completion of erection and shall be finished expeditiously."

PSG 5.5.14 Defects

Add the following to the Sub-Clause:

"All defects shall be repaired as soon as possible after the formwork has been removed and the Engineer has inspected the concrete. A statement of the method to be used for each repair shall be submitted to the Engineer for his approval before any work is carried out. The Engineer may prohibit the further placing of concrete in the particular area concerned until he is satisfied that the repair has been satisfactorily executed.

Honeycombed or otherwise defective concrete shall be cut out, together with part of the sound concrete, as directed by the Engineer; anchor reinforcement drilled into holes into sound concrete shall be provided if and as ordered by the Engineer. The cavities shall then be filled in flush with the concrete of the same mix but in general a smaller maximum aggregate size to be specified by the Engineer, placed against special formwork; the joint being treated as a construction joint. For minor honeycombing and defects, the Engineer may order a shallower cut-out, the edges of which shall be square to the face, or preferably undercut to a depth of at least 25mm. Such cut-outs shall be filled with mortar of composition and colour similar to the concrete mortar, and applied by a tradesman or suitably skilled personnel.

Exposed corners, etc., which are patched shall be bonded to sound concrete by approved epoxy resin or similar bonding agents applied in accordance with the manufacturer's instructions. An

approved experienced specialist sub-contractor shall be employed for critical work, such as the above, if directed by the Engineer.

Special care shall be taken to ensure that any repair exactly matches the formed surface in colour and texture.

No patching or filling of surface defects other than air holes shall be permitted. If the exposed surface has defects which are in the opinion of the Engineer detrimental to the desired architectural effect, that cast of concrete shall be removed and reconstructed at the Contractor's cost; any adjacent casts damaged in this process shall also be reconstructed."

Add the following new Sub-Clauses PSG 5.5.16, PSG 5.5.17 and PSG 5.5.18:

***PSG 5.5.16 Casting Pipes and Specials in Concrete**

"Where the pipe or specials is to be cast into a valve or other chamber or manhole, the Contractor may elect to provide a box-out in the wall and cast the unit in at a later stage. When constructing such box-outs reinforcement shall not be cut but shall run through the opening. Reinforcement shall be cut and/or bent out at a later stage to suit the item being cast in. After installation of the item the remaining reinforcement shall be bent back in position.

Before commencing the positioning in holes of any pipes/specials the Contractor shall:

- remove all formwork and boxing remaining in the holes;
- make any alternations required to the position and shape of the holes and cut reinforcement to suit the item, as directed by the Engineer; and
- thoroughly scabble and water jet the sides of the holes so as to obtain a satisfactory bond surface for the new concrete and treat the surface as specified in Sub-clause 5.5.7.3, as amended.

Immediately prior to the placing of mortar and concrete around the pipes, the surface of the existing concrete shall be saturated with water. All surplus water shall be removed and the surface covered with a layer, approximately 12 mm thick, of mortar made of the same mix as the concrete in which the pipes/specials are to be placed.

The concrete ingredients shall be mixed and placed as dry as possible to obtain a dense, waterproof concrete. The concrete shall be carefully worked around the puddle flange, if any, and the pipe barrel or body of the special, and shall be vibrated in layers so as to obviate a falling away from pipe/special surfaces of the concrete already placed. The whole shall, when set, form a dense, homogeneous, and waterproof mass."

***PSG 5.5.17 Precast Paving Slabs**

"The area to be paved shall be compacted to 93% of Mod AASHTO, trimmed and then treated with an approved weed killer, with care being taken to avoid contaminating surrounding areas. The paving slabs shall be laid on a sand bed approximately 25mm thick, which shall be graded to the required levels and slopes as approved by the Engineer. The joints between the slabs shall be 2mm to 6mm wide and shall be grouted with cement mortar. Gaps in the pattern of slabs shall be filled with grade 15MPa/19mm concrete and given a wood floated finish."

***PSG 5.5.18 Holding Down Bolts & Other Fixings**

***PSG 5.5.18.1 Fixings for Items Supplied Under this Contract**

"Holding down bolts or other fixings required for the installation of items supplied under this Contract shall be provided by the Contractor. These fixings shall be cast in or grouted into pockets or installed by other means as approved by the Engineer.

Where anchor bolts are used which are installed into holes drilled into concrete or masonry these shall be of a type approved by the Engineer. All such bolts used shall be manufactured from stainless steel or a metal with a resistance to corrosion equal to that of grade 304 stainless steel. Precautions to be taken when stainless steel fixings are used on galvanised steel members.

Anchor bolts shall have mean ultimate tensile resistance and mean ultimate shear resistance at least equal to those specified below:

Specified Anchor Size	Mean Resistance	Ultimate Tensile	Mean Resistance	Ultimate Shear
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	(kN)	(kN)
M10	36.8	18.9
M12	53.3	28.4
M16	72.4	53.6
M20	149.2	92.4

***PSG 5.5.18.2 Supervision**

"The Contractor shall be responsible for ensuring that the erection of the concrete work is carried out under the supervision of a person with adequate knowledge of the mixing, transporting, placing and curing of concrete."

***PSG 5.5.18.3 Programme and Plant**

"Prior to carrying out any concrete work, the Contractor shall obtain the approval of the Engineer in respect of:

- Structural programme,
- Concrete plant details,
- Materials to be used in concrete,
- Details of concrete (including proposed materials and mix design), and
- Construction joints"

***PSG 5.5.19 Levelling out of tops of walls**

Where the existing concrete top of wall levels of the new partially constructed structures fall outside the required tolerances, the contractor shall measure and grind the top of walls of these structures to comply and measure within the required degree of accuracy. This will be measured in square meters (m²)

***PSG 5.5.20 Cleaning of rebar**

Where steel fixing has been done by the previous contractor and left to corrode, the Contractor will supply a method statement to either sand blast the steel which is fixed in-situ as well as accept the responsibility for this steel fixing as per the drawings OR dismantle the fixed steel and clean off the surface rust, to be used and re-fixed into place. This will be measured per square meter (m²) of the erected steel fixing for the intended structure for payment for either method and will be fixed at the rate in the priced BOQ for this operation.

PSG 5.5.21 Breaking into concrete to expose corroded reinforcing

The subsurface corrosion of cast reinforcing at the joints, must be exposed by chipping the concrete back to a point where this corrosion is exposed to enable the contractor to then also remove this corrosion surface with a steel brush.

This total operation will be measured per square meter (m²). This area will be the square meterage of the concrete face of the joint perpendicular to the direction of the reinforcing steel and shall cover the cost of chipping back the concrete and removing the corrosion off the protruding steel fixed in the concrete. It will also include getting this concrete face ready for the construction joint to be formed.

PSG 7 TESTS**PSG 7.1.1 Facilities**

Add the following to the Sub-Clause:

"Water-Bath

A temperature-controlled water-bath with a sufficient capacity to cure the amount of cubes required shall be provided on site. The water-bath shall be located under cover.

Concrete cubes containing different admixtures (especially admixtures with fibre content) shall not be kept in the same water-bath as these can have an impact on other concrete cubes. The rate shall include the cost for more than one water-bath where required to adhere to this requirement. "

PSG 7.1.2 Frequency of Sampling

Add the following to the Sub-Clause:

"One sample shall consist of three concrete test cubes.

For each sample taken the position in the structure shall be recorded where the batch represented by that sample is placed as also the date and temperature of the day sampled.

Sampling of concrete of a particular grade shall be as specified in Sub-clause 7.1.2 with the following frequency of sampling referred to in Sub-clause 7.1.2.2 being amended to read as follows:

"A minimum of 4 samples per day of each grade of concrete placed or 6 samples for pours in excess of 10 m³ shall be taken."

PSG 7.2 Testing

Add the following new Sub-Clauses PSG 7.2.5 and PSG 7.2.6:

***PSG 7.2.5 Testing Watertight Concrete**

"The structures shall be tested for water tightness in accordance with BS 8007: 1987 Section 9 unless specified otherwise elsewhere.

Testing of the Watertight Structure:

The structure shall be tested as follows:

The structure shall be filled with clean water up to full supply level. When first filled, the water level should be maintained by the addition of further water for a stabilising period while absorption and autogenous healing take place. After a stabilization period of 21 days, refill (top up) and record the water level at 24 hour intervals for a test period of 7 days. During this 7 day test period the total permissible drop in level, after allowing for evaporation, should not exceed 10 mm.

Notwithstanding the satisfactory completion of the test, any evidence of seepage of the liquid to the outside faces of the liquid-retaining walls shall be assessed by the Engineer against the requirements of the specification. Any necessary remedial treatment of the concrete, cracks, or joints shall be carried out by the Contractor from the liquid face where practicable. If a lining is used for this purpose, it shall be sufficiently flexible and not be in any way detrimental to the water quality.

In the event of any leakage or dampness being evident at any stage of the filling or testing or in the event of the Engineer considering the final degree of water-tightness to be unsatisfactory, the Contractor when ordered by the Engineer shall discontinue such filling or testing and shall, at his own expense, immediately take approved steps to rectify the leakage and to make the work thoroughly sound to the complete satisfaction of the Engineer. All such rectification work shall be continued assiduously until a satisfactory test is obtained, which shall prove to the Engineer that watertightness has been obtained. Water shall be supplied free of charge for the first filling only.

If required by the Engineer, the structure shall be retested before the expiry of the Defects Liability Period. The Works will not be certified complete until the structure has been proved by testing to be watertight to the satisfaction of the Engineer.

The cost of the above tests will be deemed to be included if the rates for the relative concrete to be provided by the contractor. Payment shall be a lump sum. The rate shall cover the costs of all materials, labour and water used.

The time required for testing and all remedial work shall be part of the contract time.
Testing of the Roof of water retaining structures

The roof shall be tested on completion by using a hose or sprinkler system to obtain a sheet flow over the whole area of the roof for a period of not less than 6 hours.

The roof shall be considered satisfactory if no leaks or damp patches appear on the soffit."

***PSG 7.2.6 Durability Testing**

"Concrete shall comply with the durability parameters defined below:

Water Sorptivity:

Sorptivity is sensitive to surface effects and may be used to assess the effectiveness of initial curing.

Oxygen Permeability:

Permeability is sensitive to changes in the coarse pore fraction and is thus a means of assessing the degree of compaction of concrete. It may be used to quantify the microstructure of the concrete and is sensitive to macro-defects such as voids and cracks. Permeability shall be tested in a manner approved by the Engineer.

Chloride Conductivity:

Chloride conductivity provides a method of characterisation of concrete in the marine environment and may be used to assess the chloride resistance of concrete.

Unlike oxygen permeability and water sorptivity, chloride conductivity is not really a measure of construction quality, but it shall be used for materials selection and design of mixes in aggressive chloride conditions. It will therefore only be used as a check on mix designs during the initial stages of construction.

Concrete Cover:

Concrete cover is a dimensional indicator of cover concrete depth. Cover concrete is the outer concrete layer which protects the internal reinforcing steel, and its depth varies according to the requirements of the different environmental exposure classes.

Test for cover shall be conducted using an approved calibrated electromagnetic cover meter.

This test shall be conducted when instructed by the Engineer to confirm that the specified depth of concrete cover has been achieved. The cover meter tests shall cover at least 1 m² for every 10 m² exposed. The average cover of the 1 m² subjected to the test shall be used to determine the payment, unless the Contractor chooses to carry out additional tests as detailed under clause PSG 7.3.8. The cover meter must be calibrated for each project by drilling and measuring actual cover in at least 3 locations to validate the readings.

Minimum cover to reinforcing for the utility building and guard house shall be as indicated on the drawings.

General:

Durability predictions will be based on the following tests that shall be arranged by the contractor. The durability testing shall be carried out by a laboratory approved by the Engineer.

Shrinkage

The dry shrinkage tests shall be conducted in accordance with SABS 1085. The drying shrinkage shall not exceed 0.04%."

PSG 7.3 Acceptance Criteria for Strength Concrete

Add the following new Sub-Clauses PSG 7.3.6, PSG 7.3.7, PSG 7.3.8, PSG 7.3.9 and 7.3.10:

***PSG 7.3.6 Durability Index Tests**

"Testing for durability shall be carried out using test panels which are constructed with the same concrete mix, formwork type, and compaction and curing methods as the actual concrete drums. The test panel shall be 150 mm thick, and of at least 0.5 m sides. Samples for testing shall be obtained from the face of the test panel that mimics the cast face of a drum, after a period of 28 days curing. The test panels required for durability testing shall be constructed:

At the start of production

Initially for the first 50m³ batch of concrete.

Thereafter 2 sets for every discreet element namely floors, sloped floors and walls.

The durability tests are to be carried out by an accredited laboratory approved by the supplier in terms of his Quality Management System and shall be:

- Oxygen permeability index test (OPI)
- Water sorptivity index test (including porosity)
- Chloride conductivity index test

The test procedures for these tests are obtained from the University of Cape Town Durability Index Test Manual.

Two sets of four cores each (70 mm diam) are required from a test panel: four cores for the oxygen permeability and water sorptivity tests; four cores for the chloride conductivity test.

The required target values for the tests are summarized in the table below. (These are the average values for the four core specimens used for the testing on each occasion). These values are required to be met simultaneously for both sets of cores, i.e. the cores must pass the requirements for both OPI and chloride conductivity."

***PSG 7.3.6.1 Durability Test Parameters**

"DURABILITY INDEX TEST	TARGET VALUE
Oxygen permeability index	≥ 10 (log scale)
Chloride conductivity index	≤ 0.6 m.sec/cm
Water Sorptivity	≤ 8 mm / hr0.5

In the case that the results do not comply with the above values in the above table, another set of cores shall be drilled from the test panel. Where the second set of cores fails to comply with target values, a drum from that batch of concrete shall be sampled by way of drilling four cores for each of the oxygen permeability test and the chloride conductivity test. If these sets of cores fail either of the target values for OPI or chloride conductivity, all drums from that batch of concrete shall be discarded. The contractor shall keep records of all tests results relating to the samples tested.

The contractor shall ensure that site testing is carried out by a trained person. The contractor shall ensure that all off-site laboratory testing is performed in an approved laboratory approved in terms of their Quality Management System."

***PSG 7.3.7 Criteria for the Compliance with the Requirements**

"No extra payment shall be made for cube strength testing. The cost of cube strength testing shall be included in the rates tendered for concrete.

Water used for testing shall be free of charge except for failed tests when water will be charged at standard municipal rates.

In the event that the actual achieved average cube strengths of an element are less than 85% of the target mean strength, the Engineer may instruct the taking of cores for additional strength testing. The cost of taking the cores and repairing the holes in the structures shall be for the Contractor's account.

The Engineer will conduct routine tests for the durability parameters on cores taken from the completed elements during the construction, the costs for which shall be to the Employer's account unless the parameters are not met.

The test results shall be accepted or rejected based on the criteria as set out in PSG 7.3.6.1 based on the following categories:

Full Acceptance:

Concrete shall be accepted unconditionally and full payment shall be made.

Conditional Acceptance:

Concrete may be accepted at the Engineer's discretion with a warning that construction methods be examined to improve the durability criteria. A reduced payment shall be applied to all the relevant pay items under SABS 1200 G for the non-conforming element or concrete pour. Alternatively, the Contractor may elect to carry out remedial work to improve the durability of the concrete to the criterion of "Full Acceptance" to the satisfaction of the Engineer, and receive full payment. All

proposed remedial measures shall be subject to the approval of the Engineer. The cost of all such remedial work shall be for the Contractor's account.

Rejection:

The concrete shall be removed and replaced with fresh concrete at the expense of the Contractor, as directed by the Engineer.

Should the test result(s) indicate conditional acceptance or rejection of the item tested, the Contractor shall have the option of carrying out additional tests on that item, at his own expense, to confirm or disapprove the original test result(s). Not more than two such additional tests shall be carried out."

***PSG 7.3.8 Procedure in the Event of Non-Compliance with the Requirements**

"Structural concrete elements or concrete pours shall be represented by test cubes and extracted cores, which shall be tested for strengths and the appropriate durability parameters.

If the durability parameters have been proved acceptable, the costs for such testing shall be borne by the Employer. However, where non-compliance to the specified parameters has been identified, the assessed element shall be rejected and at the Engineer's sole discretion any of the following measures may be considered at the Contractor's expense:

Coating with an approved product specifically designed to improve the non-conforming parameter depending on the severity of the test results.

Acceptance at reduced payment.

Demolition and rebuilding."

***PSG 7.3.9 Tests Ordered By the Engineer**

"One concrete cube strength test shall comprise the results of tests carried out on three standard test cubes made from concrete sampled from one batch of concrete in accordance with these specifications.

Percentage payment for concrete cover shall be based on the average result of the total number of cover meter tests performed on a particular concrete element.

The overall percentage payment applied to a concrete member shall be based on the average of the percentage payments applicable to each durability parameter, together with the percentage payment based on the strength requirements described in the project specifications.

The reduced payments shall apply to the relevant payment items scheduled in the Schedule of Quantities."

***PSG 7.3.10 Grouting**

"The Contractor shall, where so ordered, carry out a site test for each grouting procedure. The tests shall be carried out on a dummy bedplate similar in configuration to that which is to be grouted, but not exceeding 1 m² in area unless otherwise ordered. When the dummy bedplate is dismantled, the underside shall show a minimum grout contact area of 80% with reasonably even distribution of the grout over the surface grouted except that, in the case of expanding grout, the minimum grout contact area shall be 95%. The test shall show evidence of good workmanship and materials and the results shall be to the satisfaction of the Engineer.

The Contractor shall, when so ordered, make standard test cubes from various grout mixtures and also subject them to compression tests to determine whether the specified strength has been achieved. Test procedures shall comply with the relevant requirements of Sub-clauses 7.2.1 to 7.2.3."

PSG 8 MEASUREMENT AND PAYMENT

PSG 8.1 Measurement and rates

PSG 8.1.1 Formwork

Add the following new Sub-Clauses PSG 8.1.1.7, PSG 8.1.1.8 and PSG 8.1.1.9:

***PSG 8.1.1.7 Edges of blinding layer**

"No separate payment will be made for formwork to the edge of the blinding layer. The rates tendered for concrete to the blinding layer shall cover the cost of such formwork."

***PSG 8.1.1.8 Chamfers and fillets**

"No additional payment will be made for chamfers and fillets up to 20mm x 20 mm. Larger fillets and chamfers will be measured by length in accordance with Sub-clause 8.2.5."

***PSG 8.1.1.9 Kickers**

"No additional payment will be made for plane (or circular) vertical (not as narrow widths) kickers."

PSG 8.1.2 Reinforcement

Add the following to Clauses 8.1.2.2 and 8.1.2.3:

"Notwithstanding the method of measuring and paying for reinforcement specified in Sub-clauses 8.1.2.2 and 8.1.2.3, reinforcement will be measured and paid for as scheduled."

PSG 8.1.3 Concrete

Add the following to Clause 8.1.3.3:

"The rates for concrete shall also cover:

- the use of dolomitic aggregate where prescribed,
- the cost of the preparation of design mixes by an approved laboratory and submission for approval by the Engineer,
- screeded finish of unformed surface as specified in PSG 5.5.10.1, as amended, Screeded finish, and
- Inclusion of admixtures where specified."

PSG 8.2 Scheduled Formwork Items

Add the following to Clause 8.2:

"Rates for formwork shall include any additional items required for the fastening of formwork such as embedded fastening systems."

PSG 8.4 Scheduled Concrete Items

Add the following to Clause 8.4.4:

"The rates for unformed surface finishes shall cover the cost of providing the respective surface finish as specified in PSG 5.5.10, as amended, Concrete Surfaces."

Screeded Finish .

Unit: m²

PSG 8.5 Joints

Add the following to the Sub-Clause:

"Only designated joints as shown on the drawings will be measured for payment according to the length of each type of joint constructed. The rate shall cover the cost of all materials, labour and plant required to construct each type of joint specified on the drawings, including the cost of all shuttering, treatment of the joint as specified in Sub-clause 5.5.7.3, as amended, the provision of chamfers as specified where concrete is exposed, as well as testing and repairing where necessary. The rate shall also include any waterbars, dowels or other inserts as indicated on the drawings."

Non-designated joints will not be measured for payment."

Add the following new Sub-Clause to this payment clause:

***PSG 8.5.1 Formed joints**

Unit: m

"Formed joints will be measured by the length of the joint."

The rates shall cover the cost of all operations and materials specified in Sub-clause 5.5.7, as amended, and Sub-clause PSG 5.5.7.2, as amended, Formed joints (generally vertical or near vertical), and detailed on the drawings such as joint filler, dowel bars and tubes, joint sealant, bitumen coats, etc., including waterstops or water bars as detailed. The rates shall also include the treatment of the surfaces before applying sealants, fillers, slurries or any other coatings.

Formed joints shall be classified in the bill as on the drawings.

Construction joints which shall be covered with a waterproofing slurry as indicated on the drawings, shall include the rates of the waterproofing slurry and the application thereof."

Add the following new Sub-Clause Payment Items to SANS 1200 G, clause 8:

*PSG 8.9	No-Fines Concrete	Unit: m³
	<p>"No-fines concrete will be measured by volume. The volume measured shall be based on the neat dimensions as shown on the drawings. The Contractor shall make provision in his rates for additional volume which may be required as a result of any overbreak during excavation.</p> <p>The rate shall cover the cost of supplying materials, constructing and placing in position the no-fines concrete, and shall include for the steel floated 2 mm mortar skim."</p>	
*PSG 8.10	Items Cast In Concrete	Unit: No.
	<p>"Items cast in concrete will be measured by number separately for each type of item.</p> <p>Notwithstanding Sub-clause 8.2.6, the rate shall cover the cost of fixing in position and casting in the item as construction proceeds, irrespective of whether the Contractor chooses to fix the item in the formwork and cast it in directly or to box out a hole and grout the item in subsequently.</p> <p>The item will be measured and paid separately."</p>	
*PSG 8.11	Granolithic Screeds	Unit: m²
	<p>"Special floor finish will be measured by area. The rate shall cover the cost of the supply and application of the specified material, complete as specified by the manufacturer and to the approval of the Engineer. Repairs to unsatisfactory work will not be paid for.</p> <p>Measurement of granolithic screeds will be by the surface area covered.</p> <p>The unit rate or lump sum shall cover the cost of all materials, labour and equipment required to provide the screed as specified in Sub-clause PSG 5.5.10.7, as amended, Granolithic screeds. The rate shall include the steel float finish."</p>	
*PSG 8.12	Watertightness Test	Unit: Sum
	<p>"The watertightness test will be paid by a lump sum separately for each structure.</p> <p>The sum shall cover the cost of all labour, equipment and materials to carry out the tests, as specified in PSG 7.2.5 to rectify faults and to achieve a test result to the satisfaction of the Engineer.</p> <p>The sum shall include for all water required over and above that required for one filling of the structure based on the assumption that water will be available in time as part of this Contract."</p>	
*PSG 8.13	Bondbreaker	Unit: m²
	<p>"A 250 micron black continuous polyethylene sheet is to be laid over the no-fines concrete under the structure floor. The side and end laps shall not be less than 100mm. Just before casting the sheeting shall be perforated at one meter centres along the joints.</p> <p>Payment shall be by the square meter laid. Care shall be taken not to rip or tear the sheeting. All repairs shall be at the Contractor's expense."</p>	
*PSG 8.14	Joint Protectors	Unit: m
	<p>"Joint Protectors will be provided as per the drawings. Rates supplied for joint protectors shall include all fabrication, labour such as welding, material and installation costs.</p>	

Rates for joint protectors shall include bolts, washers, HDPE strips and Stainless Steel flat strip as indicated on the drawings."

***PSG 8.15 Durability Tests Unit: Sum**

"The durability test will be paid by a lump sum separately for the reservoir structure.

The sum shall cover the cost of all labour, equipment and materials to carry out the tests, as specified in PSG 7.2.6, to rectify faults and to achieve a test result to the satisfaction of the Engineer. Durability tests will include tests for Sorptivity, Oxygen Permeability, Chloride conductivity, Concrete Cover and Shrinkage as specified in PSG 7.2.6."

***PSG 8.16 Bitumen Emulsion Unit: m²**

"Bitumen Emulsion will be used as a bond breaker between surfaces and joints. The rate for the emulsion shall be per square meter and shall include the rate for the cleaning of surfaces, materials and labour required for application."

***PSG 8.17 Slurry coat and curing Unit: m²**

"Supply & apply waterproof treatment with Xypex Concentrate and Xypex modified to all areas as specified.

The rate shall cover for the supply and surface treatment of specified concrete surfaces according to *PSG 5.5.8.1, Post-Crystallization (Concentrate & Modified) slurry coat and curing."

***PSG 8.18 Levelling out of tops of walls Unit: m²**

Refer to **PSG 5.5.19**

***PSG 8.19 Cleaning of rebar Unit: m²**

Refer to **PSG 5.5.20**

***PSG 8.20 Breaking into concrete Unit: m²**

Refer to **PSG 5.5.21**

PSH STRUCTURAL STEELWORK (SANS 1200 H)

PSH 3 MATERIALS

PSH 3.1 Structural Steel

Add the following to the Sub-Clause:

“All hot-rolled structural steel is to be in accordance with SANS 1431 and to conform to the following grades:

Hot-rolled Sections: S355JR

Hot-formed Hollow Sections: S355JR

All steelwork not specified as Stainless Steel to be sand blasted to SA 2.5 and hot-dip galvanised to SABS 763.”

PSH 3.3 Steels Used For Cold-Formed Sections

Add the following to the Sub-Clause:

“Cold formed sections are to be provided in accordance with BS 2994: 1967.”

PSH 3.5 Welding Consumables

Add the following to the Sub-Clause:

“All welds to be designed to transmit full member strengths and to be 6mm fillet welded unless specified.”

PSH 3.6 Bolts, Nuts And Washers

Add the following to the Sub-Clause:

“All bolted connections to be designed in accordance with SABS 0162-1:2005.”

PSH 5 CONSTRUCTION

Add the following to the Sub-Clause:

“All structural steel works to be carried out in accordance with SABS 2001 – CS1:2005 unless specified otherwise elsewhere.”

PSH 5.2 Fabrication

Add the following to the Sub-Clause:

“Fabrication of steelwork shall be sequenced so as to limit welding distortion and the possibility of locked-in stresses.”

PSH 5.3.4 Welding

Add the following to the Sub-Clause:

“Details of the weld procedures, consumables to be used in the welding process as well as shop drawings shall be submitted to the Engineer for approval at least 14 days prior to fabrication.

All welding is to be carried out by suitably qualified coded welders. No welding is to take place without the approval of the Engineer.”

PSHA STRUCTURAL STEELWORK (SUNDRY ITEMS) (SANS 1200 HA)

PSHA 3 MATERIALS

PSHA 3.1 Structural Steel

Replace the contents of Clause 3.1 with the following:

“Except where scheduled to the contrary or shown on the drawings, the grade of steel to be used in the manufacture of the following shall be that grade normally supplied by reputable manufacturers approved by the Engineer:

All structural steelwork fabricated from plates, which shall include ladders, safety cages and platforms, shall be manufactured from 300W grade steel in conformity with SABS 1431, except where shown to the contrary on the drawings or in the schedule of quantities.

All stainless steel shall be grade 316, except where shown to the contrary on the drawings or in the schedule of quantities.”

PSHA 3.3 Bolts, Nuts and Washers

PSHA 3.3.1 Bolts and Nuts

Add the following to the Sub-Clause:

“Gr 8.8 mild steel bolts, nuts and washers shall be used with mild steel and cast iron steelwork and shall be hot dip galvanized in accordance with the requirements of SABS ISO 1461 unless indicated otherwise on the drawings. Stainless steel bolts and nuts shall be used with stainless steel steelwork. The bolts and nuts shall be hexagonal head type with threads of coarse pitch series. Two washers shall be used with every bolt and nut. Before assembly, all bolts shall be coated with an approved nickel based anti-seizure/corrosion protection compound.

To prevent galvanic corrosion between dissimilar metals (e.g. between stainless steel and mild steel or cast iron) suitable isolation shall be provided between bolts, nuts and washers. Payment for isolation shall be included in the rates for the scheduled pipes, fittings and specials.

Holding down bolts shall be chemical anchors.”

PSHA 5 CONSTRUCTION

PSHA 5.1 Drawings and Shop Details

PSHA 5.1.2 Contractor to Provide Shop Details

Add the following to the Sub-Clause:

“The Contractor shall prepare his own shop details based on the dimensions and details given on the drawings and will be required to submit his shop details to the Engineer at least 3 weeks prior to fabrication. Written consent must be obtained from the Engineer, prior to commencing fabrication. The Contractor is still responsible for ensuring that the shop details are dimensionally correct.”

PSHA 5.2 Fabrication And Assembly

PSHA 5.2.5 Bolting

Add the following to the Sub-Clause:

“All bolts must be of equal length and the length of each bolt shall be such that, after the nut has been tightened, the end of the bolt shall project above the nut by not less than one full thread and not more than three full threads.”

PSHA 5.2.6 Handrails

Add the following to the Sub-Clause:

“Handrailing shall be of tubular construction in Grade 304L stainless steel of an approved proprietary make.

Hand and knee rails shall be not less than 32 mm O.D. (wall thickness not less than 1,6 mm) and the height of the handrails (centre) shall be 1 000 mm above walk-way level, with knee rails located approximately midway between.

Stanchions shall be not less than 44 mm O.D. (wall thickness not less than 1,6mm) and shall have ball type or spun and flared connectors to suit horizontal or angled handrailing as required. The base plates shall not be less than 8mm thick.

In general all bends in the hand and knee railing shall be 140 mm radius. Handrails shall be either side or top mounted and shall be fastened with stainless steel nuts, bolts and washers.

Spacing between stanchions shall be determined by site conditions but in no case shall it exceed 1 800 mm c/c. At bends, stanchions shall be provided on either side at a distance of 300 mm from mid-bend.

Finished handrailing shall be true to line and level and connections shall be securely fixed by means of 2 No. stainless steel pins, finished flush on each side of the joints (to the approval of the Engineer).

All ends shall have closures joining the hand and knee railing.

The rate quoted per metre is to include for the supply and installation of the handrail, knee rail, portion of a stanchion, footing, holding down bolts and nuts and is to be inclusive of all cutting, mitring, welding, grinding and waste.

The rate quoted is to include for the supply and installation of the handrail, knee rail, portion of a stanchion, footing, holding down bolts and nuts and all bends required and is to be inclusive of all cutting, mitring, welding, grinding and waste."

PSHA 5.2.7 Ladders

Add the following to the Sub-Clause:

"Stairs and ladders are to be provided in accordance with the details shown on the drawings."

PSHA 5.2.8 Open Grid Floors

Add the following to the Sub-Clause:

"Open grid steel flooring is to be cut and framed to the required panel shapes and sizes all in accordance with the details shown on the drawings."

PSHA 5.2.10 Protective Treatment

Add the following to the Sub-Clause:

"All mild steel shall be hot-dip galvanised except where shown to the contrary on the drawings or in the schedule of quantities. Hot-dip galvanising shall conform to SANS 121:2000 for heavy duty coatings or equivalent. Screwed and socketed tubing shall be galvanised in compliance with BS 1387. Galvanised malleable cast iron fittings shall comply with SABS 509."

Add the following new Sub-Clause:

***PSHA 5.2.11 Pipe Clamps and Brackets and/or Supports**

"Clamps and brackets around pipes and supports under pipes and valves are to be constructed to the details shown on the drawings and are to be provided with all necessary bolts for fixing to concrete.

Where pipes and valves are supported inside concrete chambers on fabricated steel pipe supports, a layer of 6 mm thick GP rubber sheet (Shore hardness 65) shall be attached to the top surface of the steel support by contact adhesive prior to receiving the pipe or valve to be supported. The rubber is to extend 20mm beyond the edges of the plate."

PSHA 5.3.6 Grouting

Add the following to the Sub-Clause:

"The Contractor will be fully responsible for all grouting work under this Contract."

PSHA 6 TOLERANCES

PSHA 6.1 Fabrication And Assembly Tolerances

PSHA 6.1.3 Accuracy of Erection

Add the following to the Sub-Clause:

"The accuracy of erection shall be the degree of accuracy II as tabulated but amended as follows:

In items d)1) and d)2) of the table the Degree of Accuracy given as "+ 5" shall be read as "+ 3".

PSHA 7 TESTING

PSHA 7.1 Test Certificates

Delete the part sentence "in terms of the project specification" from the wording of the Sub-Clause and add the words "when so requested by the former" at the end of the sentence.

PSHA 8 MEASUREMENT AND PAYMENT

PSHA 8.3 Scheduled Items

Add the following to the Sub-Clause:

"The tendered rates shall cover the cost of preparing shop details (where applicable), the supply of all materials, fabrication, process control, loading, transporting to Site, off-loading, erection (unless separately included), setting into concrete or brickwork and grouting in. They shall also include for the supply of all nuts, bolts, holding down bolts, washers, rivets, cutting to waste, all temporary bracing, templates and shuttering necessary for installing, transporting and erecting.

All scheduled items for steelwork is to include corrosion protection, the price stated shall also include for such protection as specified in SABS 1200 HC. Similarly the materials and corrosion protection for nuts, bolts, washers etc. shall match the steelwork ordered.

Where the requirements of the above introduction conflict with the requirements of Sub-Clauses 8.3.1 to 8.3.6 inclusive the requirements of the introduction shall take precedence."

PSHC CORROSION PROTECTION OF STRUCTURAL STEEL (SANS 1200 HC)**PSHC 5 CONSTRUCTION****PSHC 5.3 Dressing and Repairs During Fabrication**

Add the following to the Sub-Clause:

“Edges shall be ground to a smooth radius of at least 1 mm unless otherwise indicated.”

PSHC 5.4.1 Preparation for Coating-General

Add the following to the Sub-Clause:

“The work of surface preparation prior to painting shall be carried out at the manufacturer’s works.
The work of surface preparation prior to galvanising shall be carried out at the galvaniser’s works.”

PSHC 5.4.3.1 Abrasive Blast Cleaning

Add the following to Sub-Clause (a) General:

“The standard of blast cleaning required in terms of Swedish Standard SIS-05-59-00 is Sa 2 1/2.
The surface profile after blasting shall be in accordance with the paint manufacturer’s requirements for the particular paint system being used.”

Add the following to the Sub-Clause (b) Dry Abrasive Blast Cleaning

“The blast cleaning media shall not be recycled.”

PSHC 5.4.3.2 Cleaning by Hand or with Power Tools

Add the following to the Sub-Clause:

“Cleaning by hand or power tools, where permitted or ordered by the Engineer, shall be to standard St 3 of SIS-05-59-00.”

PSHC 5.7 Coating system for New Steelwork

Add the following to the Sub-Clause:

“All structural steel members shall be hot dip galvanized. The coating system to be applied under this Contract shall be carried out strictly in accordance with the manufacturer’s instructions which written instructions shall be obtained by the Contractor and a copy handed to the Engineer’s Representative prior to commencing painting operations.

The paint system to be used shall be selected by the Contractor from the following alternative systems:”

Add the following new Sub-Clauses PSHC 5.7.1, PSHC 5.7.2 and PSHC 5.7.3:

***PSHC 5.7.1 Painting System No. 1**

“For structural steelwork coastal regions - exterior work.

AECI Dulux	DFT (µm)	Plascon	DFT (µm)
Zinc galv 6 ⁽²⁾	75	Zinc rich primer M1 233	70
Zinc galv 1	touch up	Chemcote High Build CHC 101 – light grey	70
Chlorinated Rubber – Kemrist	<u>90</u> <u>165</u>	Chemcote enamel CHC 3000 series	<u>30</u> <u>170</u>

***PSHC 5.7.2 Painting System No.2**

"For structural steelwork coastal regions - interior work

AECI Dulux	DFT (µm)	Plascon	DFT (µm)
Zinc galv 6 ⁽²⁾	60	Degrease with Aquasolv GR	-
Zinc galv 1	touch up	Zinc phosphate Primer UC 182	55
Chlorinated Rubber – Kemrist	<u>60</u> <u>120</u>	Alkyd undercoat UC 189	35
		Enamel	<u>30</u> <u>120</u>

***PSHC 5.7.3 Painting System No.3**

"For overcoating galvanised work

AECI Dulux	DFT (µm)	Plascon	DFT (µm)
Prepare surface Galvkleen	-	Prepare surface cleaner GIC	-
Corrocote 2(2)	10	Galvogrip metal Primer	30
Chlorinated Rubber – Kemrist	<u>70</u> <u>80</u>	Universal undercoat UCI	30
		Supergloss Enamel Code G	<u>25</u> <u>85</u>

PSHC 5.8 Application of Painting Coatings

Add the following to the Sub-Clause:

"No application of paint shall be carried out before the paint manufacturer has approved the firm of applicators and the plant to be used, except where instructed to the contrary by the Engineer.

Where applicable, the range of temperature, outside the range of +5° to 35°C, within which paint may be applied, shall be that range which the Contractor shall obtain in writing from the manufacturer of the paint.

The embedded lengths of irremovable fasteners which penetrate deeper than 75mm from the concrete face may be left as base metal. The remaining portion shall comply with the paint system specified for the adjacent steelwork.

Surfaces which will become inaccessible for coating after fabrication or erection shall be given the full paint treatment specified plus one further top coat prior to the surfaces becoming inaccessible."

PSHC 5.9 Application of Metal Coatings

Add the following to the Sub-Clause:

"The grade of HDG (hot dipped galvanising) required shall be carried out in accordance with SABS 121:2000, and shall be that for heavy duty coatings. This shall be applicable to all metalwork where HDG is called for either on the drawings or in the Schedule of Quantities."

PSHC 7 TESTING

PSHC 7.1d) Testing by the Contractor

Add the following to the Sub-Clause:

“Tests are not required to be carried out after the application of each intermediate coat.”

PSHC 7.3 Tests, Instruments, Methods and Criteria

PSHC 7.3.8 Dry Film Thickness

Add the following to the Sub-Clause:

“The frequency of DFT test readings required is to be in accordance with SABS Method 141.”

PSL MEDIUM PRESSURE PIPELINES (SANS 1200 L)

PSL 1 SCOPE

PSL 1.1 Add the following to the Sub-Clause:

“uPVC : Unplasticised Polyvinyl Chloride
GRP : Glass Reinforced Polyester
GCS : Galvanised Carbon Steel

Supply, lay, bed and commissioning of pipelines, which include the following: Completion of a 1m diameter HDPE pipeline from the Head of Works to the Raw Water Pump Station, the completion of a 600mm diameter pipeline from the Raw Water pump station to the Biological reactor, the completion of a 500mm diameter pipeline from RAS pump station to Biological Reactor, the completion of sewer reticulation for all buildings including the construction of a septic tank, completion of sub-surface drains from the Biological Reactor and Secondary Sedimentation Tank, Construction of over flow pipe for the Irrigation pump station, construction of pipework from the Biological Reactor to the Sludge drying beds, the construction of a return pipeline from the Irrigation pump station to the Biological reactor unit, and completion of water reticulation on site.”

PSL 3 MATERIALS

PSL 3.1 GENERAL

Add the following to the Sub-Clause:

“Pipes and fittings shall be of the types specified in the schedule or in the project specification and, unless otherwise required in terms of the project specification, they and their couplings shall be capable of withstanding the applicable test pressure. All pipes and fittings shall be supplied complete with couplings and jointing material.

Satisfactory temporary end covers shall be provided for the protection of threads, flanges, and prepared ends of plain ended pipes and fittings, and to prevent damage to internal lining during transportation and during on site.

The materials and construction of all pipes, fittings, valves and specials shall comply with the appropriate SANS, BS or other appropriate specification, whether stated or not, and shall be approved by the Engineer. Only full-length pipes bearing the relevant standard's mark will be acceptable. Cut pipes shall only be used at pipe junctions to position valves and specials as shown on the drawings, and at connections to structures. When laying the pipes the markings shall be visible from above.

The Contractor shall be responsible for the structural and hydraulic design of all bends and fittings where these are not standard off the shelf items designed and guaranteed by the manufacturer for the purpose intended.

The Engineer shall at all reasonable times have free access to the place where the goods are manufactured for the purpose of examining and sampling the materials and goods, and if necessary for supervising the testing and marking of goods. The manufacturer shall supply free of charge every facility and all labour required for such examination, sampling, inspection, testing and marking before delivery and shall provide and maintain in good order suitable, convenient and accurate apparatus for testing goods.”

Add new sub-clause:

***PSL 3.1 uPVC Pipes**

“uPVC pipes and fittings shall be fitted with spigot and socket rubber ring joints and shall comply with the requirements of SANS 966-1: 2014 (uPVC).”

***PSL 3.1.3 Fittings and Specials**

“The Contractor will prepare the shop drawings and design of all steel special according to AWWA C200, C206 – C216, ANSI/ AWWA C222 and AWWA M11. Specials and fittings, unless otherwise shown on the drawings, shall be made of segmentally welded sections with ends compatible with the type of joint or coupling specified for the pipe.”

PSL 3.2 AC PIPES AND PIPE SPECIALS

Remove the sub-clause and replace with the following:

PSL 3.2 GRP pipes (SANS 1748-1: 1998)

"Glass reinforced pipe and fittings shall conform to ASTM D3262, ASTM3754, AWWA C950 and SANS 1748 -1 : 1998 Glass Fibre Reinforced Thermosetting Plastics (GRP) pipes Part 1 : Pipes for Water Supply , Sewerage or drainage. GRP pipe shall be jointed with Double Bell couplings. Pressure rating, stiffness and diameter as detailed in the bill of quantities and drawings.

Asbestos Cement or Fibre Cement production shall not be used."

PSL 3.4 STEEL PIPES, FITTINGS AND SPECIALS

PSL 3.4.1 General

Add the following to the sub-clause:

-"The Contractor shall, if so instructed, make available to the Engineer the maker's certificates covering 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.

The pipes shall be hydraulically tested before leaving the factory to the test pressure specified in Sub-Clause 7.3 of SANS 1200 L. The methods of sampling and testing of the manufactured pipes shall comply with Sections 6 and 7 of SANS 719.

The tests shall be carried out at the place of manufacture and at the expense of the Contractor. Upon delivery of the goods concerned the Contractor shall submit a signed certificate giving results of the tests and certifying that the goods concerned have been manufactured in accordance with this specification."

-"Standard steel pipes joints shall be groove ended galvanised carbon steel pipes with Klambon type cast galvanised SP couplings or similar approved and shall comply with the requirements of SANS 62.

All steel pipes and specials for reservoirs and sedimentation tanks, irrespective of diameter, shall be fabricated from plain ended pipes. The use of screwed flanges and fittings shall be limited and minimised, except for use on air-valve assemblies. All fabrication shall take place in a suitable workshop prior to galvanising, and no cutting or welding of pipes on site shall be permitted."

PSL 3.4.4 Fittings and Specials

Add the following to the sub-clause:

"The sides of taper pieces shall diverge at an angle of not more than 19° to each other.

The bend, fitting, and special fabricator shall supply written confirmation that all hand welding has been carried out by coded welders.

Bends, fittings, and specials ≥DN600 shall have the internal lining and external coating made continuous ("made good") for welded joints on coated and lined pipes.

Bends, fittings and specials shall be manufactured and tested in accordance with the specification for straight pipe and additionally with Section 8 of BS 534. The nominal dimensions of each bend, fitting and special required are itemised in the Bill of Quantities and/or on the drawings and 'exact length' tolerances shall be adhered to. All plain ends on bends, fittings and specials shall have the plain ends prepared for butt welding except those plain ends that are to be jointed with adaptor joints.

Bends shall generally be of the segmented type except where otherwise stated or shown on the drawings.

The Contractor will be responsible for providing and fixing strengthening webs, crotch plates, gussets, etc. as shown on the drawings and in accordance with the requirements of AWWA M11 and as may be necessary to prevent excessive deflection or deformation of fittings and specials when subjected to hydraulic tests and the rate for the work will be deemed to include for the provision of this reinforcing wherever necessary.

Bends shall be fabricated in accordance with the Table below.

Deflection of Angle	
Up to and including 3 °	One pipe end scarfed on site
Exceeding 3 ° and up to and including 9 °	Mitre cut (two pipe ends scarfed on site)
9 ° and larger but less than 15 °	2 segment bend
15 ° and larger but less than 45 °	3 segment bend
45 ° and larger but less than 60 °	4 segment bend
60 ° and larger but less than 75 °	5 segment bend
75 ° and larger but less than 90 °	6 segment bend

Bends greater than 90° shall be fabricated from combinations of items from the table above.

Shop drawings of bends, fittings and specials shall be submitted to the Engineer for approval prior to manufacture.

All flanged bends, fittings and specials shall be hydraulically tested at the fabricator's premises to the same pressure that they will be subjected to during the hydraulic testing of the completed pipeline. No visible signs of leakage will be permitted."

Add new sub-clause

***PSL 3.4.5 Puddle Collars and Anchoring Flanges (New Sub-Clause)**

"Puddle collars and anchoring flanges used as pipe anchorages shall be of the same dimensions as corresponding flanges but those cast into concrete walls are to be undrilled. The collar/flange shall be capable of transmitting a longitudinal force 33% greater than the internal hydraulic pressure to be applied when testing, multiplied by the area of the bore and, under that condition, the stress in the material shall not exceed its yield stress.

Where puddle collars are shown on the drawings as being 20 mm thick, those collars are not required to transmit thrust, their purpose being to assist with the waterproofing of the concrete chambers by increasing the path that ground water might have to take to enter the chambers.

Where polyethylene pipes are cast into concrete structures, they shall be specially prepared and adapted by positioning a custom-made tight-fitting natural rubber sealing sleeve around the circumference of the pipe and in the case of structured-wall pipe creating shear keys through removing small segments of the outer wall. The rubber seal shall be 10 mm thick and 200 mm wide or 80% of the width of the wall and shall be 60-65 shore hardness, with a vulcanised joint. It shall need to be stretched over the pipe circumference to ensure a tight fit."

PSL 3.7 OTHER TYPES OF PIPES

PSL 3.7.1 uPVC Pipes

Add the following to the sub-clause:

"uPVC pipes and fittings shall be fitted with spigot and socket rubber ring joints and shall comply with the requirements of SANS 966-1: 2014 (uPVC)."

PSL 3.7.2 POLYETHYLENE PIPES

Replace sub-clause 3.7.2 with the following:

"Polyethylene pipes shall be of high density type complying with the requirements of this specification and shall be of types and classes as specified for each application.

The manufacturer shall maintain a quality system that conforms to the requirements of the SABS ISO 9001: 2000 or national equivalent.

The Employer or Engineer may, at its discretion appoint an inspection officer to carry out pre-delivery tests at the manufacturer's / supplier's works.

The manufacturer / supplier shall allow the inspection officer access to its works for the purpose of inspecting either during the course of manufacture or when completed and shall afford the inspection officer all reasonable facilities.

Copies of all test schedules and manufacturer's quality control records shall be available for examination by the Engineer or Engineers Representative.

The following certificates are to be submitted for pipes supplied:

- Certificate of registration – SANS ISO 9001:2000
- Permit certification – SANS ISO 4427 for PE 100
- Quality control plan (to include raw materials and product test certificates)
- SANS Quality system audit reports – last 2 audits

Pipe raw material composition shall be PE 100.

Polyethylene pipes and fittings, welding (heated tool butt welding) and installation practices shall comply with the relevant requirements of the following, as well as installation practices for steel pipe where not covered in the specifications mentioned below:

SANS 1671-1 - Welding of thermoplastics - Machines and equipment Part 1: Heated-tool welding

SANS 1671-2 - Welding of thermoplastics: Machines and equipment Part 2: Electrofusion welding

SANS ISO 4427 - Polyethylene (PE) pipes for water supply – Specifications

SANS ISO 4427-1 - Plastics piping systems – Polyethylene (PE) pipes and fittings for water supply Part 1: General

SANS ISO 4427-1 - Plastics piping systems – Polyethylene (PE) pipes and fittings for water supply Part 2: Pipes

SANS ISO 4427-5 - Plastics piping systems – Polyethylene (PE) pipes and fittings for water supply Part 5: Fitness for purpose of the system

SANS 10268-1: Welding of thermoplastics - Welding processes Part 1: Heated-tool welding

SANS 10268-2: Welding of thermoplastics - Welding processes Part 2: Electrofusion welding

SANS 10268-10: Welding of thermoplastics - Welding processes Part 10: Weld defects

SANS 10269: Welding of thermoplastics - Testing and approval of welders

SANS 10270 - Welding of thermoplastics - Approval of welding procedures and welds

ISO 12176-1: Plastics pipes and fittings - Equipment for fusion jointing polyethylene systems - Part 1: Butt fusion

DVS 2207-1: Welding of thermoplastics - Heated tool welding of pipes, pipeline components and sheets made of PE-HD"

PSL 3.8 JOINTING MATERIALS

PSL 3.8.2 Flexible Couplings

Delete the sub-clause and replace with the following:

"Where ordered, steel flexible couplings are to be of the "Viking Johnson"/"Klamflex"/ "Aqualok" or similar approved type without central registers, each comprising one centre collar, two special flanges, two rubber rings and hot dipped galvanised mild steel bolts.

Steel couplings shall be assembled strictly in accordance with the manufacturer's instructions and all bolts shall be torqued to the value recommended by the manufacturer. On completion of hydraulic pressure testing of the installation, the entire joint shall be protected as described in Clause PSL 3.9.3.8.

The tendered prices for laying and jointing are to include for the supply of all necessary materials, plant and labour to complete the joint.

Flexible couplings shall conform generally to Clause 15 of BS 534 for slip-on type couplings and shall be of approved manufacture. They shall be capable of being tightened and released without damaging or improperly distorting the rubber seating rings and shall be designed to prevent the rubber rings being blown out under pressure or sucked in under vacuum.

The steel used shall conform to the appropriate British Standard Specification and each coupling is to be capable of withstanding the test pressure applicable to the pipes with which they are to be used without exceeding a stress in the steel of 67% of the yield point.

Mild steel couplings shall be protected by an approved epoxy coating system such as "Polyclad 777" (or similar approved) within 4 hours of abrasive blast cleaning the metal surfaces of the coupling in accordance with Swedish Standard SIS 05 59 00 Grade SA 2,5. Nuts, bolts and washers shall be hot dipped galvanised. The plain end of the pipe shall be properly prepared, and in the case of steel pipes before corrosion protection, so as to accept the flexible coupling.

Adaptor couplings and anchoring adaptor joints shall comply with the above specification for flexible couplings and be of a similar design, but one end shall be flanged to enable connection of plain ended pipes to flanged joints. The adaptor joints are to be complete with bolts and nuts for connecting the flanged joint to the anchoring flange situated generally 300 mm to 400 mm from the plain end of pipe. All bolts, nuts and washers are to be hot dipped galvanised. In order to anchor the plain ended pipe to the flanged joint all of the bolts for the flanged joint are to pass through the anchoring flange and are to be fitted with nuts and washers at the flanged joint and on either side of the anchoring flange."

PSL 3.8.3 Flanges and accessories

Add new sub-clause PSL 3.8.3.1:

***PSL 3.8.3.1 Bolted Connections**

"All flanges, gaskets, bolts, nuts washers and other appurtenances required for the execution of the work under this Contract shall be supplied and installed by the Contractor under this Contract.

Flanged bolted connections shall comply with the following:

All flanges shall have a raised face.

Temporary end covers shall be provided by the Contractor for protection of flanges, and prepared plain ends of pipes and fittings to prevent damage to internal lining during transportation and during handling on site.

All piping and flanged surfaces shall be cleaned before connections are made.

The (raised) faces of flanges that are in to be in contact with gaskets shall be masked and shall not be painted or coated. The mating flange shall then receive one coat of rust inhibitor (Plascon Rustix 84 or equal approved). Care shall be exercised to ensure that after the application of all coatings there are no runs or drips on the mating surfaces of the flanges and that the flange profiling is clearly

visible over the entire face. Excessive coating build up in flange bolt holes that could snag bolts will not be permitted.

Flanged joints shall be connected with the specified bolts, nuts and washers all of which are to be supplied by the Contractor.

All bolts, tie-bolts, nuts and washers shall be galvanised to SABS 121:2000 and shall comply with the relevant requirements of SABS 135 – 1985 and SABS 136 – 1985 where applicable.

The length of each bolt shall be such that after the bolt has been tightened, the end of the bolt shall project beyond the outer face of the nut, but not by more than two threads. Tie-bolts on restrained/anchoring couplings shall be fitted with “backing nuts” and washers.

Each flanged joint is to be fitted with an approved and suitably rated gasket and sealed watertight such that there will be no visible sign of leakage under the specified factory and field test pressures and under the in-service working conditions (pressures).

All bolts are to be tightened in a predetermined pattern with opposing bolts being tightened sequentially. When all bolts are tight, each bolt is to be torqued to the required/recommended torque in a predetermined pattern with opposing bolts being tightened sequentially.

All bolt threads shall be liberally coated with “Copper slip” or similar approved compound prior to assembly. Upon completion, bolt heads, washers and nuts shall be wrapped with the “Denso Mastic Blanket System” comprising of a priming solution, mastic blanket, petrolatum tape and lay-flat sheeting as described in Clause PSL 3.9.3.8.”

PSL 3.9 CORROSION PROTECTION

PSL 3.9.2 Steel Pipes

PSL 3.9.2.1 Steel Pipes of Nominal Bore up to 150mm

Add the following to the sub-clause:

“All steel pipe specials of nominal bore up to 150 mm shall be factory coated and lined with hot-fused Rilsan (nylon polyamide 11) coating to a DFT of at least 350 microns generally in accordance with Subclause 3.9.2.2 and in accordance with the epoxy manufacturer’s specifications for preparation of the receiving surface and application of the product.”

PSL 3.9.2.2 Steel Pipes of Nominal Bore over 150mm

Add the following to the sub-clause:

“Unless otherwise scheduled, all mild steel specials up to DN500 in size shall be factory coated with a rigid polyurethane (Polyclad 777 or similar approved product) and lined with solvent free polyamine (carboguard 891 or similar approved) coating to a DFT of at least 1500 microns and 500 microns respectively in accordance with Sub-clause 3.9.2.2 and in accordance with the epoxy manufacturer’s specifications for preparation of the receiving surface and application of the product.

Unless otherwise scheduled, all mild steel specials larger than DN500 shall be factory coated and lined with a solvent-free two-pack glassflake surface-tolerant epoxy paint (DENSO S.T. 100 or similar approved) applied in two layers to a total DFT of at least 350 micrometres and lined with twin pack epoxy polyamide (Pipecoat SFX or similar approved) in accordance with Sub-clause 3.9.2.2 and in accordance with the epoxy manufacturer’s specifications for preparation of the receiving surface and application of the product.

Unless otherwise specified, all steel pipes, fittings and specials with a cement mortar lining shall be in accordance with the requirements of the Australian Standard ASW 1281:2001 with thicknesses as stated in Clause 3.9.1 (and 3.9.2 for DN 250 pipes).”

***PSL 3.9.2.4 Preparation of Steel Surfaces for Repairs and/or Reinstatement of Internal Lining and/or External Coating (Ne Sub-Clause)**

“The following method is applicable for the preparation of all exposed steel surfaces prior to the carrying out of any repair procedure to internal linings and/or to external coatings. This specification

is applicable to all pipe steel surfaces which have been stripped of their corrosion protection layers, internally or externally, as a result of the manufacturing of specials, construction activities or pipe laying, welding and/or damages caused by handling or latent defects in application.

Degreasing:

All bare metal surfaces shall be degreased in order to remove grease and oil from the pipe surface as a first step in the preparation process i.e. before grit blasting and/or power brushing starts. Degreasing shall be carried out using a non-volatile solvent (e.g. "Aquasolve", "Chesterton Nr. 261 Safety Solvent Cleaner" or similar approved substance). The surface shall then be cleaned with potable water and left to dry completely before the next step is taken.

Grit Blasting – Internal Lining Repair:

Grit blasting of bare metal surfaces shall take place after degreasing of the area. The finished grit blasted surface shall be 75 micron with an angular profile.

Transition areas from EPOXY internal lining, to bare metal which have been grit blasted, shall be smooth without rough edges or flaking appearances.

All grit blasting within the pipe line that is under construction, shall be performed by way of a "vacuum blast" process in order to limit the generation of dust.

Grit blasting shall, under all circumstances, be carried out using equipment suitable for the size of the work to be undertaken.

The Contractor shall provide the Engineer with a method statement for approval for each type/location of grit blasting, before work commences.

Power Brush – External Coating Repair:

Power brushing of bare metal surface shall take place after degreasing of the area as specified. The area that has been power brushed shall be free from rust, laitance, dust, oil or other deleterious matter before the application of primer. Any areas in the region where power brushing took place shall be free from signs of disbonding of lining and/or coating, once power brushed. The surface finish, once power brushing has been completed, shall conform to minimum St2 standard."

***PSL 3.9.2.5 Holiday Testing – Epoxy Linings and Coatings (New Sub-Clause)**

"All Holiday Testing of epoxy linings and coatings shall be carried out with an instrument approved by the Engineer. The sparking detection test shall conform to the standards as set out in SANS 1217:2001 and BS 3003 Part 1. The Contractor shall familiarise himself with the dielectric strength (breakdown strength) of all the coatings and linings he works with for the different pipe sizes. The Contractor shall also have an in depth knowledge of the Holiday Testing equipment he works with, in order to calculate the Corona discharge effect for the typical brush being utilised, with reference to the specific ambient conditions for any specific test.

All Holiday Testing shall be executed at a voltage which is set at 50% of the value of the dielectric strength of the lining or coating being tested. The Contractor shall carefully analyse the loss in test voltage as a result of the Corona Effect, specific to the ambient conditions surrounding the test. The test voltage of the Holiday Testing equipment shall be adjusted such that the voltage drop as a result of the Corona Effect will be taken into account when the actual 50% threshold of the dielectric strength is calculated.

The Holiday Test equipment shall be calibrated by an approved supplier and checked every 30 minutes or every time a test at a different location is started. Each piece of equipment shall have a unique identification number with calibration certificates and detail of equipment utilized shall be submitted to the Engineer for approval. Method statements for the process of holiday testing shall be submitted to the Engineer for approval.

The correct equipment for the type of application shall be utilized. For example, where pin holes have been repaired and re-testing for effectiveness of repair work being done, the Contractor shall utilize the correct equipment to effect same and this shall include the use of a pencil brush which concentrates the efforts of holiday testing at the repair. Where spark tests are performed on Tape

Wrap systems, the minimum brush width shall be 300 mm. The brushes utilized shall be brass bristle cone brushes. The typical brush speed shall be 200 to 300 mm/sec when doing spark tests

The Contractor shall, at his expense, test each and every surface area, that is internal lining as well as external coating, during construction as per this specification. Testing for holidays shall be done after inclusion of materials, manufactured specials and equipment, as well as pipes, into the permanent works. Any defects found shall be repaired and the costs for remedial work shall be deemed to be included in the tendered rates for the construction of the pipeline. These tests and results shall be recorded on the quality control plan as approved by the Engineer."

PSL 3.9.3 Protection against Electrolytic Corrosion

Add new Sub-Clauses:

***PSL 3.9.3.2 Preparation Mixing and Application of Epoxy Compounds**

"When mixing two part epoxies the base and activator shall be mixed in accordance with the manufacturer's specifications. Mixing in the original container will only be permitted by means of methods that ensure full integration of different parts of the compound into a homogeneous compound with the characteristics as intended by the manufacturer. The different parts of the compound shall not be diluted. Mixing shall only be allowed with full batches and reduction of volumes from mixing packs by means of weight or volume measurement, which will result in smaller portions to be mixed, will not be allowed. In the application of the epoxy the following shall be strictly in compliance with the manufacturer's instructions:

- Method of application (Type of Brush or roller.)
- Over coating time.
- Temperature range for application.
- Method of mixing base and activator.
- Number of coats to achieve the specified thickness.
- Safety aspects e.g. Eye and hand protection, ventilation, fire precautions, etc.
- Note that roller and brush applicators shall be replaced once the product application expiry time has been reached on any specific applicator tool.

Uncured epoxy shall be regarded as being toxic and shall be handled in accordance with the manufacturer's instructions. Adequate lighting and ventilation shall be provided whilst working within the pipeline.

Only solvent free epoxy repair kits shall be utilized to repair the internal linings of the pipe line. This specification refers to "two part epoxy" as an epoxy repair kit which consists of a base and an activator approved by the Engineer and could be products similar to "Denso ST100", "Sigma SF 523", "Nordbak", etc.

For the repair of cement mortar linings, "Epidermix 338" or similar approved will be required.

The Contractor's tendered rates for the laying of the pipe shall be deemed to include for all the repairs and make-goods that have to be effected in order to deliver a serviceable and acceptable pipe line. (This excludes such repairs as instructed by the Engineer as a result of manufacturing defects, if any).

Two part epoxy may only be applied on steel surfaces prepared as specified in PSL 3.9.3.1."

***PSL 3.9.3.3 Making Good of Cement Mortar Lining at Welded Joints**

"When straight steel pipes are cut, the cement mortar lining is to be cut back between 50 mm and 75 mm from the cut end of the pipe and "chamfered" by approximately 15 degrees to provide a positive dove-tail joint for the epoxy mortar repair plug after butt welding.

The surfaces are to be prepared as specified in PSL3.9.3.1.

A 50 mm wide by 20 mm thick band of "Epidermix 338" or similar approved epoxy, shall be applied internally on the uncoated steel adjacent to the cement mortar lining. For pipes that are too small for internal access for hand repairs, the plain end of the adjoining pipe shall be pushed into the bellmouth (or into the external sleeve when there is no bellmouth) in such a way that the epoxy band is compressed and makes contact with the transverse face of the cement mortar lining of both pipes. The excess material that is squeezed into the bore of the pipes is to be removed by drawing a suitable plug that is 5 mm smaller than the bore of the cement mortar lining across the joint. The plug that is used shall be such as to render an even and smooth finish to the epoxy at the joint. The timing of when the plug is pulled through is critical and shall be carefully controlled.

For pipes large enough for safe internal access, the cement-mortar lining shall be made-good with the same materials, but by hand."

***PSL 3.9.3.4 Repair and Making Good of Solvent Free Epoxy Linings**

"Pipes with linings damaged prior to acceptance by the Contractor shall be marked and recorded by both the Contractor and the Engineer's Representative and then repaired by the Contractor. The payment rate for repair shall be made at the scheduled rate.

Once the Contractor has accepted pipes with undamaged linings from the Employer, any subsequent damage to the lining in the pipes shall be repaired by the Contractor at his expense.

All making good of internal solvent free epoxy linings at welded and flanged joints that is required to ensure continuous internal corrosion protection to steel surfaces shall be carried out strictly in accordance with the manufacturer's specifications. The Contractor shall ensure that making good of linings is carried out progressively as the pipe is being laid and shall not be permitted to lag behind for more than three pipe lengths at each working front."

***PSL 3.9.3.5 External Corrosion Protection of Factory Welded Joints and Coating Repairs**

"All steel pipes that are to be field-welded shall be supplied with the external coating cut back 100 mm from each pipe end. Where pipes are to be cut, either on site, or for the purpose of fabricating bends, fittings and specials, or in the event of the pipe coating being damaged, the pipe coating shall be cut back 100 mm from the intended cut area before the pipe is cut. Damp hessian sacking or other suitable material is to be temporarily fixed around the pipe to prevent damage to the pipe coating during welding operations. Once welding is complete, and all weld splatter and burnt coating has been removed, the welded pipe joints shall be wrapped in the following manner.

The following specification is based on "Denso" products and systems. Alternative products and procedures may be proposed by the Contractor and, if approved by the Engineer, they may be used. Irrespective of which products are approved by the Engineer and used by the Contractor, all procedures shall be carried out strictly in accordance with the Contractor's method statements which shall conform to the manufacturer's recommendations.

A fundamental outcome is a sound and continuous coating that is free from wrinkles and that does not have any entrapped air pockets or any air bubbles.

Surface Preparation

The bare metal shall be cleaned and wire brushed to minimum St.2 standard and, degreased with white spirit. The adjacent pipe coating shall be cleaned to a minimum of 300 mm either side of the joint and the edges "feathered" to achieve a tapered transition over a distance of 100 mm. The sound, parent coating surface shall be roughened with sandpaper over an area 250 mm either side of the joint.

Priming

The entire pipe and coating surface over a length of 250 mm on either side of the joint shall be primed using "Denso Primer D" (or equivalent approved). Care shall be taken to obtain a thin even film with no runs or sags. The primer shall be allowed to cure until "tack dry" before the application of the tape commences. Priming may only be carried out on those areas that are to be wrapped that same day. If primed areas are to be left overnight, those areas shall be re-primed before wrapping.

Profiling Tape

A 1.5 mm thick x 50 mm wide “Denso Mastic Sealing Tape” (or equivalent approved) shall be applied to the full circumference of the weld bead in accordance with the manufacturer’s specifications. Care shall be taken to ensure a smooth profile and to avoid air bubbles being trapped beneath the tape. (Note: The profiling tape may be omitted at the discretion of the Engineer. Tenderers shall nonetheless allow for the profiling tape in their tendered rates).

Tape Wrapping

The joint shall then be wrapped (minimum 55 % overlap) with “Denso CPT 1250/300 Polyethylene/Bitumen” tape starting at the roughened section (250 mm from the welded joint) in accordance with the manufacturer’s requirements to create a 500 mm wide wrapping, centred over the welded joint. A 100% overlap is required on the first and last revolutions of the tape wrapping operation. It is important that tension in the tape be released when the wrapping of the last half circumference of the pipe. The Contractor shall ensure that the wrapping overlaps or covers a minimum of 150 mm of the pipe coating. A secondary or outer tape wrap layer is then to be applied over the first layer with a 10% tape overlap.

An alternative tape wrapping system that may be used is the “Densotherm 35 Hot Applied Bitumen Tape” system. The procedures are similar to those for the “Denso” system described above except that the underside of the tape shall be heated as it is applied and the overlaps and seams of the tape are to be sealed by means of a heated tool.”

***PSL 3.9.3.6 External Corrosion Protection of Shop-Fabricated Pipe Bends and Fittings**

“The external coating of shop fabricated bends and fittings shall be carried out as follows:

- Where a substantial part of the external coating on the parent pipe is intact, the coating repairs/make good shall be carried out in accordance with PSL 3.9.3.5 or
- Where black (uncoated pipe has been used), the coating shall be carried out in accordance Umgeni Water’s specification for “Pipe Lining System 2: Solvent-Free Epoxy Lining” or
- Where only a relatively small proportion of the external coating on the parent pipe remains, all of the remaining coating shall be removed and the entire bend/fitting shall be coated in accordance Umgeni Water’s specification for “Pipe Lining System 2: Solvent-Free Epoxy Lining”.

All crotch plates and wrappers/collars shall be coated in accordance with project specification for “Pipe Coating System 1: Solvent-Free Epoxy Lining”.

After application of the SFE coatings to the crotch plates and collars/wrappers, approved mastic (refer PSL3.9.3.8) shall be placed in all crevices that may become moisture traps.

No additional payment will be made for any of this work as the costs are deemed to be included in the scheduled rates for pipelaying.”

***PSL 3.9.3.7 External Corrosion Protection of Site-Fabricated Pipe Bends and Fittings**

“The coating repairs/make good shall be carried out in accordance with PSL 3.9.3.5.”

***PSL 3.9.3.8 Corrosion Protection of Buried Flanges and Flexible Adaptor/Anchoring Joints**

“All buried flanges and flexible joints and adaptor/anchoring joints and their associated bolts, nuts and washers, shall, notwithstanding that the flexible and adaptor/anchoring joints will be epoxy coated as specified elsewhere, be protected as described below.

(Note: This specification is based on a “Denso” system. Alternative products may be used, subject to approval by the Engineer).

Surface Preparation:

The entire surface area of the flange/adaptor/anchoring joint, and its bolts, nuts and washers, up to no less than 250 mm either side of the joint, shall be cleaned of all dirt and other deleterious matter. The cleaned area, up to 200 mm either side of the flange/adaptor/anchoring joint, shall then be wire brushed.

Priming:

The cleaned flange/adaptor/anchoring joint, bolts, nuts, washers and the adjoining 200 mm length either side shall be primed with "Denso Priming Solution", or if moisture is present, with "Denso S105 Paste".

Application of Mastic Blankets:

Narrow strips cut from "Denso Mastic Blanket" shall be applied to the flange/adaptor/anchoring joint to achieve a smooth profile with a 50 mm splayed fillet being formed at the joint/pipe interface. Care shall be taken, particularly at bolts, to avoid the formation of air pockets. Complete "Denso Mastic Blankets" shall then be applied (mastic side down) to the flange/adaptor/anchoring joint until the flange/adaptor/anchoring joint is completely enveloped.

The blanket shall be overlapped at least 50 mm and shall extend at least 150 mm along the pipe barrel on each side of the flange/adaptor/anchoring joint. The ends of the blanket shall be bound to the barrel of the pipe on each end with 100 mm wide "Denso Tape". The "Denso Tape" overlaps shall be 50 mm and shall extend 100 mm onto the blanket and 150 mm onto the pipe barrel.

Application of Protective Sheeting:

The entire flange/adaptor/anchoring joint shall then be wrapped with 350 micron polyethylene sheeting which shall end 400 mm beyond the joint. The protective sheeting shall be secured to the pipe barrel and along the seam with 48 mm wide "Denso Adhesive Tape".

***PSL 3.9.3.9 Coating of Permanently Exposed Pipes/Fittings**

"All pipes which are to be permanently exposed shall, in addition to the specified corrosion protection at flange/adaptor/anchoring joints, be protected with the "Denso Acrylic Pipeline Tape (Steelcoat 500)" system or similar approved UV resistant coating. The pipe surface shall be prepared and the coating applied in strict accordance with the manufacturer's instructions.

Surface Preparation:

The pipe surface to be wrapped shall be cleaned of dirt, grime, grease and other deleterious matter, using white spirit if necessary and then allowed to dry thoroughly.

Priming:

"Denso Primer D" shall be applied to the prepared surfaces at a nominal coverage rate of 8 m² per litre. Care shall be taken to obtain an even film with no runs or sags. Only those areas that are to be wrapped the same day shall be primed. If primed areas are to be left overnight, these areas shall be re-primed before wrapping.

Tape Wrapping:

The joint shall be spirally wrapped (minimum 55% overlap) with "Denso Acrylic Tape" (or approved equivalent) in accordance with the manufacturer's requirements such that the start and end points are located at buried sections of the pipe, before it daylights. A 100% overlap is required on the first and last revolutions of the tape wrapping operation. It is important that tension in the tape be released when the wrapping of the last half circumference of the pipe.

Final Coating:

One coat of "Densoflex Fire Retardant" shall be applied to the exposed pipe at a nominal application rate of 3 m² per litre."

PSL 3.10

VALVES

Replace the contents of this sub-clause with the following:

"Valves shall comply with the following requirements:

- (a) They shall close clockwise and shall have a rising spindle and handwheel.
- (b) They shall be class 16 valves complying with SANS 664.
- (c) They shall comply with the requirements of SABS 1123 table 1600."

PSL 4 PLANT

Add new Sub-Clause:

***PSL 4.4 PACKING**

"Goods should be suitably packed in such manner as will ensure safe and efficient transport by road or rail, and the Contractor shall include in his prices for whatever packing may be necessary in this respect. Small items particularly liable to damage or loss in transit should be crated. All crates and packing material shall, after use, become the property of the Employer, unless distinctly specified otherwise, or if returnable, shall be so at the Contractor's expense."

PSL 5 CONSTRUCTION

PSL 5.1 LAYING

PSL 5.1.3 Keeping Pipelines Clean

"The Contractor shall take all of the steps necessary to prevent flooding of the Works and hence ensure that all work is carried out in the dry, and that the ingress of dirt and or dirty water into the pipes is prevented."

Add new Sub-Clauses:

***PSL 5.1.3.1 Cleaning Pipe Internals**

"The Contractor shall ensure that all pipe work is installed internally free of any contaminants. All traces of dirty water, slag, splatter, swarf, cuttings, coupons, welding rod ends, grinding dust, dirt and other debris are to be removed from the inside of the pipe as it is installed.

The Contractor's attention is drawn to the fact that a rubber mat is to be provided for walking on inside the pipe. On steep slopes, the mat is to be restrained from sliding down the pipe. Care shall also be taken on steep slopes to restrain equipment and hand tools from sliding down the pipe during construction.

The relevant safety procedures are to be followed when entering pipes.

The Contractor shall ensure that all dust, grit and powder that accumulates in the pipe as a result of grit blasting for the repair of internal linings, is removed from the pipe in an acceptable manner before the internal lining repairs are carried out.

Once the lining repair has been completed, cleaned off and inspected, that specific section of the pipe shall be blocked off to prevent any further access by workers.

The Contractor shall take note that flushing of the completed pipeline may not be ~~allowed~~ possible immediately after construction has been completed and therefore clean house keeping practices will be required under all circumstances during construction. The tendered rates for pipe laying shall include for the clean house keeping practices required.

Each section of the pipeline is to be internally inspected and passed by the Engineer once construction has been completed. If the pipework is not satisfactory, the Contractor shall re clean the pipe at his own expense until the pipe is passed clean. The Engineer reserves the right to utilize cameras or any other means to inspect inaccessible areas."

***PSL 5.1.3.2 Cleaning of Valves and Fittings**

"All flanges, valves, fittings and equipment are to be installed in pipe work only after they have been thoroughly cleaned. Flange faces shall be checked for damage before being incorporated into the permanent works and any damage shall be reported to the Engineer."

***PSL 5.1.7 Pipe Support**

"Temporary pipe supports may be used to assist setting up and assembly. However, it is preferred that permanent pipe supports are installed as soon as possible to minimize double handling and/or omission during construction.

Permanent pipe supports shall be constructed as indicated on the drawings or as directed on site.

Before testing, all permanent supports shall be complete and all temporary supports removed, unless otherwise agreed by the Engineer."

***PSL 5.1.8 End Caps**

"The Contractor shall, at the end of each day's work, fit end caps to the open ends of the pipeline under construction. The end caps shall be manufactured in such a manner that they can be fitted to seal off the pipeline to the extent that it is totally dust and water proof. The end caps shall be able to withstand a pressure of 5 m head of water externally when fitted.

End caps shall be maintained during non-working periods.

The tendered rates for the laying of pipe shall be deemed to include for the supply, fitment, and maintenance of the end caps."

***PSL 5.1.9 Marker Posts**

"Pre-cast concrete marker posts as shown on the drawings and painted white in colour shall be set at all horizontal direction changes and where otherwise indicated by the Engineer.

The standard marker post rate shall include the supply and erection of painted, inscribed posts. The rate shall be inclusive of erection and shall include for all necessary excavation, mass concrete footing and formwork."

PSL 5.2 JOINTING METHODS

PSL 5.2.2 Flanged (Steel Pipelines)

Add the following to the Sub-Clause:

"Before being brought together, the ends of the pipes, fittings, couplings and flanges are to be inspected and cleaned to ensure that all parts forming the joint are undamaged and clean.

When jointing flanges, the faces shall be cleaned thoroughly and approved jointing material (cement fibre or other approved gaskets on flanged joints), cut properly to size, is to be inserted immediately before bringing the two flanges together. Before closing the joints, the flanges shall be parallel to each other, with all bolts inserted in the bolt holes. After the fittings have thus been aligned and well supported, the joint shall be bolted up to a uniform tightness using torque wrenches to achieve the required compression force on the gasket.

If and where full face gaskets are used, the jointing material shall be flush with, or protrude beyond, the outer circumference of the flange (this is not applicable to raised face flanges). On completion of the joint, the flanges and bolts shall be protected as described in Clause PSL 3.9.3.8."

PSL 5.2.3 Welding (Steel Pipelines DN 600 or Greater)

Delete the title and replace with: "Welding (Steel Pipelines)".

Delete the 1st sentence and replace with:

"Field welding of steel pipelines shall be carried out in accordance with the relevant requirements of the latest version of API 1104. The Contractor, prior to commencement of welding, shall produce a qualified welding procedure in accordance with the latest version of API 1104, for the intended sizes, processes, positions and consumables to be used on this project.

Welding shall be carried out by welders who are competent in terms of the procedure approval test given in API 1104. Prior to commencement of welding, the current qualification of each welder shall be produced in accordance with the welding procedure. Should constant repairs be required on welds carried out by one particular welder, the Engineer may request that the welder be re-tested or removed from the project."

Add the following to the Sub-clause:

“Radiographic Examination of Shop Welds

The Contractor shall provide a manufacturer's certificate proving that the following examinations were carried out in the factory:

- i) ONE HUNDRED percent radiographic examination of all welds deposited by an approved automatic process.
- ii) ONE HUNDRED percent radiographic examination of all welds deposited manually or semi-automatically, and repairs to welds done by an automatic process.

In addition the Contractor shall include in his prices for the manufacture of pipes, bends, fittings and specials for the cost of carrying out, under the supervision of the inspector appointed by the Employer, examination of shop welds on the following basis:

(a) Field Welds

Radiographic testing will be performed on butt welds and dye penetrant testing on fillet welds. All welds will be tested and adjudicated in accordance with API 1104. Radiographic testing of butt welds is to be carried out on 100% of the welds.

Repairs of welds will be permitted in accordance with approved repair procedures. Repairs shall be re-examined using the relevant non-destructive testing method. All costs associated with the repair of defective welds will be borne by the Contractor.

(b) Fabrication of Bends, Fittings and Specials

- i) ONE HUNDRED percent radiographic examination of all weld deposited manually or semi-automatically in bends, fittings and specials which cannot be hydraulically tested because they have a plain end.
- ii) TEN percent radiographic examination of all welds deposited manually or semi-automatically in all flanged bends, fittings, and specials which are to be tested hydraulically.

The Engineer shall in all cases determine which welds are to be radiographed on the quantity basis specified above. All radiographs and records thereof made by the Contractor shall be made available to the Engineer to enable him to determine whether the welds are acceptable or not and no lining or wrapping of pipes shall be permitted until the welds have been accepted by the Engineer. To avoid any unnecessary delays, at the option of the fabricator, radiographs may be approved by the manufacturer's inspectors subject to them being subsequently submitted to, and approved by the Engineer.

When a section of the weld is shown by radiography to be unacceptable and, if the limits of the deficient weld are not defined by the radiograph, additional radiography shall be carried out at the Contractor's expense until the limits of the deficiency are determined.

Repairs shall be made to defective welds at the Contractor's expense. All repair welds shall be identified with a stamp marking, indicating which welder conducted the repair. Repaired welds shall be radiographed at the Contractor's expense but, after any repair welder has had ten consecutive repairs approved, the extent of the radiography of the repairs conducted by the welder may be decreased by agreement between the Engineer and the Contractor.

Production Testing of Welds (Not applicable to pipes supplied by the Employer)

The Contractor shall also include in his prices for the supply of pipes the cost of carrying out at the factory, non-destructive tests of shop production welds (additional to the qualification tests for welding procedure) on the following basis:-

One pipe from each one hundred pipes produced shall be selected at random and specimens for two guided cold bend tests and one transverse tensile test shall be cut therefrom and tested in accordance with SABS 719:1971, Section 7.

In the case of the guided cold bend tests, where welding is carried from one side only, bend - specimens shall be tested with the rest of the bend in tension; where welded from both sides the specimens shall be tested with the inner and outer welds in tension alternately.

Tensile tests shall be carried out as for the qualification tests.

The pipes from which successfully tested specimens have been taken shall be trimmed to the maximum possible length and shall be accepted by the Employer for payment purposes as full standard pipe lengths.

In the event of the welds of any pipe failing to reach the standard of acceptance, such pipe shall be rejected. Two further plate coupons shall be prepared from different pipes, selected at random by the Engineer, for each specimen that has failed to reach the required standard. In the event of such additional tests proving to be satisfactory repairs to the pipe originally failing any test will be permitted by the Engineer and such repairs and subsequent re-test shall be at the Contractor's expense. In the event of the additional tests also failing to reach the required standard the Engineer shall have the right to reject the entire batch of pipes from which the coupon plates were cut."

Add new Sub-Clauses:

***PSL 5.2.3.1 Welding Procedure**

"Welding shall, unless otherwise prescribed in the approved welding procedure, commence at the top of the joint and proceed downwards. In addition to the root weld, at least two further passes shall be made, none of which is to exceed 3 mm in depth but this is subject to the approved welding procedure."

***PSL 5.2.3.2 Aligning**

"The alignment of abutting ends shall be such that the offset does not exceed 1,5 mm. Line-up clamps ("dogs") shall not be used for the "fit-ups". The use of "bridges and wedges" or any other method that may reduce the pipe wall thickness when removed or in any way introduce unnecessary stresses into the pipe is forbidden."

***PSL 5.2.3.3 Weather Conditions**

"Welding shall not be performed under conditions that could affect the quality of the welded joint (e.g. high moisture or windy conditions). Windshields may be used where practical."

***PSL 5.2.3.4 Clearance**

"The minimum clearance around the pipe during welding shall be 500mm or such other minimum distance that may be required to facilitate compliance with the approved welding procedure. When welding in a trench, adequately sized "fox holes" shall be excavated/formed so as to provide adequate access for the welders."

***PSL 5.2.3.5 Visual Inspection**

"100% of each joint will be examined and the following criteria shall be met:

All welds shall be substantially uniform in appearance with the inner and outer weld beads not exceeding 1 mm and 3 mm in height respectively unless otherwise required in terms of the approved welding procedure.

Undercut will not be permitted under any circumstances.

The weld, heat affected zone, and surrounding parent metal shall be free from cracks, porosity and trapped slag.

All weld splatter shall be removed prior to corrosion protection application."

***PSL 5.2.3.6 Non-Destructive Testing After Construction**

"For applicable pipelines, the Employer's Professional Services Provider will carry out coating integrity surveys along the full length of the pipeline after laying and backfilling of the pipe up to 300

mm above the crown of the pipe. The PCM testing (Pipe Current Mapping) method will be used except in the vicinity of Eskom's HV overhead power lines where the DCVG (direct current voltage gradient) method of testing will be used.

Any defect(s) found in the pipeline coating, as a result of the PCM or DCVG testing shall be located and repaired by the Contractor at his expense.

In the case of PCM testing, all coating defects identified with an area greater than 0,5 square centimetre per 12 metre length of pipeline shall be located and repaired.

In the case of DCVG surveys, all coating defects identified with a value greater than 3% IR (or such other value as may be determined and agreed following analyses of the results of the first section which undergoes DCVG testing) shall be located and repaired. The agreement between the Contractor and the Engineer on this baseline, will be set as the criteria for the coating repair requirements by the Contractor on the whole pipeline.

Depending on the extent of the defects identified during PCM or DCVG testing, the Engineer may call for a further survey after the initial defects have been repaired by the Contractor, the cost of which testing shall then be borne by the Contractor."

***PSL 5.2.3.7 Quality Control**

"Records of which welds were carried out by each individual welder as well as non-destructive testing results shall be submitted to the Engineer monthly. Should there be repetitive or serious defects, this information shall be forwarded to the Engineer immediately."

PSL 5.2.4 Concrete Spigot and Socket Pipelines

Add new Sub-Clause:

***PSL 5.2.4,1 Cut Pipes**

"Cut pipes shall be used where required as closure lengths. The cut ends shall be dressed square and to a smooth even finish and prepared for butt welding preparation which shall not be inferior to that of the ends of uncut pipes. The finished dimensions of ends cut on site shall be within the tolerances applicable to the ends of the particular types of pipe to be laid. The cost of cutting and trimming of pipes shall be included in the rates tendered for laying and jointing pipes."

PSL 5.5 ANCHOR/THRUST BLOCKS AND PEDESTALS

Add the following to the Sub-Clause:

"If the steel pipelines that to be laid under this Contract are to be continuously welded or flanged, anchor/thrust blocks will not require at tees, bends, terminal valves and end caps."

Add new Sub-Clauses:

***PSL 5.11 STANDPIPES**

"Standpipes shall be erected in the positions and to the details shown on the Drawings."

***PSL 5.12 MARKER BLOCKS**

"Marker block types shall be manufactured and positioned as shown on the Drawings."

***PSL 5.13 PIPELINE ROUTE MARKERS**

"Route markers for the various water pipelines shall be erected in the positions and shall be manufactured according to the details shown on the Drawings."

PSL 7.3 STANDARD HYDRAULIC PIPE TEST

Add the following paragraphs:

"Water used for one filling of the pipeline for hydraulic testing will be provided by the Employer free of charge. Water will be made available from the nearest operational reservoir. Additional water used due to unsuccessful hydraulic tests will be charged at the Employer's bulk rate per kilolitre. Filling of the pipeline for hydraulic testing shall be carried out slowly to enable air to escape and under the direction of the Engineer.

An item has been provided in the Bill of Quantities to cover the cost of conveying water from the supply point to the test section of pipeline."

PSL 7.3.1 Test Pressure and Time of Test

Add the following to the Sub-clause:

"Pipeline shall be subjected to field test pressures equivalent to the heads or pressures shown on the drawings.

The sections in which a pipeline may be tested will be at the discretion of the Contractor, except that a pipeline shall not be tested in sections exceeding a maximum allowable length of 2 000 m unless otherwise agreed by the Engineer. Notwithstanding the foregoing, all stream and river crossings that are to be encased in concrete shall be successfully pressure tested prior to the placing of the concrete encasing. The Contractor shall make due allowance in the construction programme and in the tendered rates for the entire testing operation including for the provision of temporary end stops (flanges or bullnoses) and any other costs incurred as a result of testing the pipeline in intermediate sections.

The pipe shall not be tested until the associated structural concrete for anchorage has cured for 28 days or until such concrete has attained the specified design strength. Once filled, cement mortar lined pipe shall be left for 24 hours to permit maximum saturation of the linings.

The section to be tested shall be pressurised to the specified pressure and left for 24 hours, during which period, the pressure drop (if any) and the quantity of water required to be pumped in to restore the test pressure shall be measured and recorded. In addition, all flexible and flanged joints shall be visually inspected and there shall be no sign of leakage.

The permissible leakage for welded and flanged steel pipelines is zero (0) litres.

At all times when there is water in the pipeline, and particularly during filling, testing and draining of the pipeline, all air valves shall be in operation and their individual isolating valves shall be open."

PSL 7.3.1.2 *DELETE THE SUB-CLAUSES 7.3.1.2*

PSL 7.3.1.3 *DELETE THE SUB-CLAUSES 7.3.1.3*

Add new Sub-Clauses:

***PSL 7.3.4 Initial Filling of Pipeline**

"The entire process for filling the pipeline at any time during testing or disinfection shall be carried out under the supervision of the Engineer and will also be monitored by local authority and Employer personnel. Under no circumstances will the Contractor be allowed to carry out filling of the pipeline without the supervision of the Engineer, neither shall he/she permit any other persons to carry out such filling without the written permission of the Engineer.

Any damage to the pipeline caused by non-compliance with this clause shall be rectified at the Contractor's expense."

***PSL 7.3.5 Connections after Testing**

"The connections of the new pipework to the existing pipework shall only be carried out after the pipeline testing has been completed and accepted by the Engineer. For this reason, testing shall be carried out against a blank flange or bullnose end cap at these locations."

***PSL 7.3.6 Remedial Measures**

"In the event that a pipe section fails a test, the Contractor shall carry out all remedial measures necessary to obtain a successful test of each individual section and the entire pipeline, at his/her own expense. Such remedial measures shall in no way compromise the original pipeline specifications."

***PSL 7.3.7 Draining of the Pipeline**

"The pipeline may have to be drained to carry out remedial measures. The pipeline shall be drained via the scour valves or a sluice gate (in wastewater treatment works) in a manner that does not cause erosion of the streambeds or negatively impact on the environment in any way. All such drainage of the pipeline shall be carried out under the supervision of the Engineer."

***PSL 7.6 Commissioning**

"The pipeline will be considered to have been commissioned and practically complete once all the associated structures are sufficiently complete to carry out their structural and hydraulic function and the hydraulic test of the entire pipeline has been successfully completed."

***PSL 7.7 Water Tightness Test for Chambers**

"On completion of each concrete valve chamber, and prior to completion of the backfilling around the chamber, a water tightness test shall be undertaken by the Contractor. This shall be carried out by excavating a trench approximately 0,5 m deep around the periphery of the chamber and continuously (for at least 4 hours) maintaining it full of water. Should there be any noticeable leaks into the chamber, the Contractor shall carry out at his/her own expense whatever measures are necessary to waterproof the chamber to the Engineer's satisfaction."

PSL 8 MEASUREMENT AND PAYMENT

PSL 8.2.1 Inspection, Acceptance, Loading and Transporting from Employer's pipeyard, Lay and Bed Pipes Fittings, Specials and Couplings

Add to sub-clause:

"Where pipes are supplied 'free-issue' by the Employer, the rate for 'supply, lay, bed ...etc' shall exclude the cost of supplying the pipes. A separate per meter length of pipe item will be scheduled for inspecting the pipes in the Employer's pipeyard together with Engineer, identifying and documenting any defects, acceptance of responsibility for pipes from Employer, loading, transporting to site and off-loading alongside the trench.

The tendered rate for inspection, accepting, loading, transporting and offloading on site shall cover the cost of inspecting in Employer's pipeyard, documenting any defects, formal acceptance (signing of acceptance certificate) of the pipes supplied to the Contractor by the Employer, taking full responsibility for the pipes thereafter, loading, transporting to site and off-loading and making good any damage, to the satisfaction of the Engineer, incurred in the process.

Where separate rates in respect of water for testing, disinfection and the hydraulic test itself are provided, the rate for "lay and bed pipes" excludes the cost associated with conveyance of water to fill the pipeline, the field pressure testing and disinfection of the pipeline. Separate items have been included in the Bill of Quantities for the cost associated with the conveyance of water required for testing, pressure testing, and disinfection of the pipeline.

A maximum payment of 65 % of the tendered rate may be made for the completed section of pipeline which has not yet been hydraulically pressure tested. A further payment of 35% of the tendered rate will be made upon successful completion of the pressure testing for the relevant section of pipeline."

PSL 8.2.15 Special Wrapping in Corrosive Soil

Delete the heading and substitute with "CORROSION PROTECTION"

Delete the sub-clause and substitute the following:

"The costs of making good the internal linings and external coatings on all butt welded and fillet welded joints on the pipeline are to be included in the tendered rates.

External corrosion protection to flanges, adaptor joints, valves..... Unit : No

Separate items will be scheduled for each item by pipe nominal diameter.

In the case of valves, the rate shall include for protection of the whole of the valve body, all flanges integral to the valve, the connecting flanges to the valve (i.e. including the two flanges of the pipework connected to either side of the valve) and the packing of mastic (without tape or sheathing) over the gland adjusting bolts and nuts."

Add new Sub-Clauses:

***PSL 8.2.16 Cut Pipes**

"Extra over for forming scarf joint.....Unit : No

Add new item:

Extra over for forming mitre cut joint.....Unit : No

Add new item:

Extra over for cutting pipe as closure.....Unit : No

The rates shall cover the cost of the cutting of the pipes and forming the joint and welding and making good of the internal lining and external coating, testing, and forming joint holes in trench in all materials to facilitate in-situ welding."

***PSL 8.2.17 Cutting into and Connecting to Existing Pipeline**

"Cutting into and connecting to existing pipelineUnit : Sum

The rate for cutting into and connecting to existing pipelines shall cover the cost of exposing the existing pipeline, making arrangements with the Employer's staff to temporarily shut off the existing pipeline whilst effecting the connection, cleaning and preparing the pipe for cutting, cutting, dealing with all water (including that from possible leaking valves), preparing the pipe ends for jointing, welding / jointing and connecting the new pipework, making good internal linings and external coatings, re-commissioning the pipeline, and including all temporary supports, bedding and backfilling."

***PSL 8.2.18 Standpipes complete**

(a) Give description and reference drawing Unit : Number

The tendered rate shall include full compensation for all excavations for the pipe, for the drain, if required; the base of the concrete pedestal (for the tap); the supply and installation of all pipework and fittings including a 1,2 m long section of the supply pipe measured from the rising pipe; the supply and installation of the taps; backfilling the drain with stone, and the trench with approved backfill material; all formwork and concrete, and; all equipment, labour and diverse material required to complete the standpipe as shown on the Drawings."

***PSL 8.2.19 Marker Blocks**

(a) Give description and reference drawing Unit : Number

The tendered rate shall include full compensation for all excavation and backfill, labour, equipment and materials to manufacture and install the blocks as shown on the Drawings."

***PSL 8.2.20 Connection to existing infrastructure**

(a) Give description and reference drawing Unit : Number

The tendered rate shall include full compensation for the cost of excavation, breaking into, and connection to the existing outfall sewer, removal of surplus material, all labour and equipment necessary to make the connection and all liaison with the local authorities. Contractor to determine the invert level of the outfall sewer pipe before commencing with construction."

PSLB BEDDING (PIPES) (SANS 1200 LB)**PSLB 2.3 DEFINITIONS**

Main fill:

Delete "150 mm" in second line and substitute "300 mm".

PSLB 3 MATERIALS**PSLB 3.1 SELECTED GRANULAR MATERIAL**

Add the following to the sub-clause:

"All bedding used for the cradle beneath and surrounding the pipes shall comply with the following requirements:

GRADING ANALYSIS RANGE	
SIEVE SIZE (mm)	PERCENTAGE PASSING
6,7	98 to 100
4,76	85 to 100
2,36	55 to 95
1,18	30 to 75
0,60	20 to 50
0,425	16 to 38
0,30	13 to 27
0,15	5 to 18
0,075	0 to 12

The material shall be free of organic matter and shall have a compactibility factor of not more than 0.4. The material shall be classified as silty to fine sand having a stiffness ratio of not less than 5,0 MPa. Furthermore, the materials shall, preferably, be obtained from river transported deposits since it is preferable that the larger grains (3,0 to 4,8 mm in size) be rounded and not sharp and angular.

The Contractor will be required to carry out his/her own quality control testing of the material to ensure that it meets the padding sand requirements and complies with this specification at all times. At least one grading analysis shall be carried out for every 100 lineal metres of bedding placed. The results of these tests shall be forwarded to the Engineer within 24 hours of completion of the test. Should the material not comply with the specification, the Contractor shall remove and replace it with approved material at his/her own cost.

Depending on the actual material supplied by the Contractor, the moisture content may be critical to enable satisfactory placing and compaction and the Contractor will be deemed to have allowed in his tendered rate for any and all adjustments required to the moisture content of the bedding material at all times."

PSLB 3.2 SELECTED FILL MATERIAL

Delete the sub-clause and add the following:

"All material up to the underside of backfill shall be measured as selected granular from commercial sources."

PSLB 3.4 SELECTION**PSLB 3.4.1 Suitable Material Available from Trench Excavation**

Delete the Sub-Clause and substitute the following:

"The excavation of a pipe trench shall comply with the requirements of Sub-Clause 5.4 of SABS 1200 DB and the provisions of Sub-Clause 3.7 of SABS 1200 DB (in terms of which, for the purposes of providing bedding materials, the Contractor is not required to use selective methods of excavating) shall apply. Nevertheless the Contractor shall take every reasonable precaution to avoid burying or contaminating material that is suitable and is required for bedding or covering the pipeline. If, in the opinion of the Engineer, bedding material can be produced from the excavated material, the Contractor shall, if so ordered by the Engineer, screen or otherwise treat (as scheduled) the excavated material in order to produce material suitable for bedding (see also Sub-Clause PSLB 8.1.2)."

PSLB 5 CONSTRUCTION

PLSB 5.1 General

PSLB 5.1.2 Details Of Bedding

Delete and replace with:

"Pipes shall be bedded and protected in accordance with the details shown on the drawings."

Add the following new sub-clause PSLB 5.1.2.1:

***PSLB 5.1.2.1 Stone Drainage Layer beneath Bedding**

"Where indicated on the drawings, or as otherwise indicated by the Engineer, a 200 mm thick layer of 19 mm stone shall be placed beneath the bedding layer to act as a drainage channel for excessive groundwater. This layer shall be wrapped in bidim and provided with outlet pipes if and where indicated."

PSLB 5.1.4 Compacting

Delete the second line and substitute:

"top of the pipeline) shall be 93% mod AASHTO."

Add the following to Sub-Clause 5.1.4:

"Steps will have to be taken by the Contractor to ensure that flexible pipes do not deform excessively in cross-section during and after construction and backfilling operations. The maximum deflection which will be acceptable at any stage during or after construction is 2% of the pipe diameter horizontally or vertically. The Contractor will be required to provide the necessary apparatus and to monitor deflection during construction.

Pipe deformations will only be maintained within the specified tolerances by correct backfilling practice. No heavy compaction equipment will be permitted for compaction of any pipe bedding, only pneumatic or hand rammers being acceptable. To this end, and to achieve the 93% compaction specified it is required that the bedding material be brought up evenly on either side of the pipe. The use of complete saturation of the material as a method of achieving the specified compaction may, subject to the Engineer's approval, be used. However, in this regard, Tenderers are advised that the presence of excessive quantities of water in the pipe trench could lead to flotation of the pipe.

Prior to the commencement of pipe laying the Contractor will be required to submit, to the Engineer, for his approval, his proposed methods of placing, and compacting methods which he proposes to implement in order to ensure compliance with the specification."

Add the following new sub-clause PSLB 5.1.5

***PSLB 5.1.5 Testing**

"Flexible and flanged joints shall be left exposed with a minimum of 300 mm clearance around the bottom of the pipe during hydraulic pressure testing of the pipe to facilitate inspection."

PSLB 5.2 Placing and Compacting of Rigid Pipes

Add the following new sub-clause PSLB 5.2.5:

***PSLB 5.2.5 Stone Bedding**

"In areas where waterlogged conditions exist or where ordered by the Engineer, special drains consisting of a 200 mm thickness (See PSLB 5.2.1.1) of single sized stone with a geofabric filter surround ("Bidim" Grade A4 or similar approved) extending the full width of the trench shall be provided below the bedding to the pipes. The excavation for these drains will be measured in cubic metres at the contract rate applying to unsuitable excavation below the bottom of the trench. The stone filling will be paid for per cubic metre and the geofabric filter will be paid for per square metre. All measurements in this connection will be to a width equal to the base widths and depths ordered."

PSLB 5.3 Placing and Compacting Flexible Pipes

PSLB 5.3 (a) Bedding Cradle

Delete the sub-clause and substitute the following:

"The pipes shall be bedded on a minimum 100mm thick layer of compacted granular bedding material on which a 50 mm thick layer of uncompacted granular bedding material has been placed and spread. Loose granular bedding material lying next to the pipe shall be placed into the haunch area and compacted with suitable hand tools (covered with rubber to prevent damage to the pipe coating), and additional selected granular material shall be added and compacted in 150 mm thick layers up to the mid point of the pipe diameter in the vertical plane. The remainder of the bedding i.e. the selected fill blanket, shall be placed in layers up the sides of the pipe, each layer being compacted until a level of 300 mm above the crown of the pipe is reached."

PSLB 5.3(b) Selected Fill Blanket

Delete "200 mm" from title.

PSLB 6 TOLERANCES

PSLB 6.1 Moisture Content and Density

Add the following to the Sub-Clause:

"The permissible deviations applicable are to be those for Degree of Accuracy II class of work."

PSLB 8 MEASUREMENT AND PAYMENT

PSLB 8.1.3 Volume of Bedding Materials

Add the following to the Sub-Clause:

"(c) The volume of bedding material shall be measured net i.e. the volume of the pipe is to be deducted.
(d) No additional payment will be made for bedding material placed in bell (fox) holes."

PSLB 8.1.6 Freehaul

Delete the Sub-Clause and substitute the following:

"All haul will be regarded as free haul. No overhaul will be paid for under this Contract."

PSLB 8.2.1 Provision of Bedding from Trench Excavation

Delete the Sub-Clause and substitute the following:

"Without the need for screening:

a) Selected granular material Unit : m³

The rates shall cover the cost of acquiring, from any point along the trench excavation as may be selected by the Engineer, bedding that complies with the relevant requirements of the specification, of delivering it to points alongside the trench spaced to suit the Contractor's methods of working, of making good any backfill deficiency from points where backfill has been acquired, and of disposing of displaced material.

Including for screening:

- b) Selected granular material Unit : m³

The rates shall cover the cost of screening or otherwise treating excavated material, at any point along the trench excavation as may be selected by the Engineer, in order to produce bedding that complies with the relevant specification, delivering it to points alongside the trench, spaced to suit the Contractor's methods of working, of making good any backfill deficiency there may be from points where screened backfill material has been acquired, and of disposing of displaced material."

PSLB 8.2.2 Provision of Bedding by Importation

Delete the sub-clause and substitute the following:

"Including for screening and/or other treatment:

- a) Selected granular material Unit : m³
b) Bedding sand to specified bedding dimensions Unit : m³

The rates shall cover the cost of acquiring, loading, transporting, offloading, screening or otherwise treating excavated material in order to produce bedding that complies with the relevant specification, delivering it to points alongside the trench spaced to suit the Contractor's methods of working and of disposing of displaced material.

NOTE: The rate for the supply and laying of pipelines covers the cost of handling the bedding material from alongside the trench, placing it under the pipeline, forming joint holes and completing the bedding around and over the pipeline."

PSLB 8.2.4 Encasing of Pipes in Concrete

Delete the fifth and sixth lines and substitute the following:

"encasing the pipe in concrete 150mm thick each side of the pipe and to 150mm above the crown of the pipe including the cost of formwork, (if any), etc. and the cost of formwork to form stop ends on either side of collars, couplings, joints etc if instructed by the Engineer.

The rate for concrete encasing shall include for the supply, installation and stripping of all formwork."

PSLB 8.2.5 Overhaul of Material for Bedding Cradle and Selected Fill Blanket

Delete the sub-clause.

Add the following new sub-clause PSLB 8.2.6:

***PSLB 8.2.6 Drainage Layer**

"Supply and place beneath pipe, 200mm crushed stone layer as ground water drainage layer. The excavation for these drains will be measured in cubic metres at the tendered rate applying to unsuitable excavation below the bottom of the trench (SABS 1200 DB 8.3.2 c).

The rate for stone filling shall be per cubic metre of stone fill, measured according to a width equal to the base widths and depths ordered. Unit : m³

Supply and installation of geofabric filter material (BIDIM Grade A4 or similar) around stone. The rate shall be per square metre of geofabric to enclose the stone material, measured net according to a width equal to the base widths and depths ordered. Unit : m²"

PSLD SEWERS (SANS 1200 LD)

PSLD 3 MATERIALS

PSLD 3.1 Pipes, fittings and pipe joints

***PSLD 3.1.2 Reinforced concrete pipes**

Add the following to SANS 1200 LD, sub-clause 3.1.2:

“Concrete pipes shall be the spigot / socket type manufactured by means of **vertical casting** and be supplied with a 3mm thick light green anchor knob sheet (AKS) (integral suitable anchors) high density polyethylene (HDPE) liner, cast into the pipe internally along the full length, and the full circumference of the internal diameter of the pipe. Factories manufacturing these pipes must have an ISO 9001:2009 Certification.

The joints between the concrete pipes are to be covered internally with 3mm thick HDPE capping strips. The capping strips are to be standard light green HDPE lining, manufactured using matching resin to that of the 3mm thick AKS lining cast into the inner walls of the pipes. Capping strips are to be at least 200mm wide and are to be heat tacked to the HDPE lining of the pipes, after which they are to be welded by the extrusion welding technique on both edges, to ensure a proper joint of the HDPE capping strip to the HDPE/AKS lining of the pipes. For each joint the welding of the capping strips are to be continuous for 360 degrees (full circumference) on both sides of the capping strip. HDPE welding rods of the same colour and matching resin are to be used for the extrusion welding. The fitting of the capping strips, extrusion welding and testing procedures shall comply with SANS 10409. Each joint is to be marked with a unique number/mark. Welder is to have a certificate of competence.”

PSLD 3.1.5 uPVC Pipes

Add the following paragraph to the Sub-Clause:

“Sewer pipes and specials shall be heavy duty uPVC Class 34 solid wall pipes with socketed joints all in accordance with SANS 791. Flexible connections shall be used at manholes as per SANS 1200 LD Drawing LD-2.”

PSLD 3.5.2 Precast Concrete Sections

Add the following paragraph to the Sub-Clause:

“Precast concrete manholes shall be acceptable provided that dolomitic aggregate be used and joints between rings are watertight. Chimneys in manholes will not be allowed.”

PSLD 3.5.6 Mortar

Add the following paragraph to the Sub-Clause:

“Sulphate resisting cement shall be used for all mortar and concrete work.”

PSLD 3.5.7 Step Irons

Add the following paragraph to the Sub-Clause:

“Step irons shall be manufactured from a polypropylene copolymer of the “Calcamite” type or approved equivalent.”

PSLD 3.5.8 Manhole Covers and Frames

Replace the Sub-Clause with the following:

“Manholes and covers and frames shall comply with the applicable requirements of SANS 558 and shall be of Type 1A Heavy Duty polypropylene lockable manhole cover and frames.”

PSLD 7 TESTING

PSLD 7.2 Tests and acceptance/rejections criteria

PSLD 7.2.1 Air Test

Add the following paragraphs to the Sub-Clause:

"All acceptance tests shall be carried out in the presence of the Engineer in accordance with the air test.

The Contractor shall make due allowance in the construction programme and in the tendered rates for the entire testing operation including for the provision of temporary stop ends and any other costs incurred as a result of testing the pipeline in intermediate sections.

All relevant check lists to be completed by the Contractor and available for verification during or after the completion of the testing."

PSLD 7.2.6 Watertightness of Manholes

Add the following paragraphs to the Sub-Clause:

"All acceptance tests shall be carried out in the presence of the Engineer.

The following test is to be carried out on the completed manhole before it is backfilled in the case of brick manhole and after backfilling in the case of a precast manhole.

The manhole shall be completely filled with water and allowed to stand for 24 hours. At the end of this period enough water shall be added to refill the manhole and in the subsequent period of 24 hours the water level shall not drop more than 75 mm per meter of depth of the manhole measured from the channel invert level to the underside of the concrete cover slab.

The Contractor shall make due allowance in the construction programme and in the tendered rates for the entire testing operation including for the provision of temporary stop ends and any other costs incurred as a result of testing the pipeline in intermediate sections.

All relevant check lists to be completed by the Contractor and available for verification during or after the completion of the testing."

***PSLD 7.2.7 CCTV Survey of Sewer Lines**

***PSLD 7.2.7.1 Closed-Circuit Television Camera Inspection of Outfall Pipeline**

a) Scope of Work

The scope of work requires CCTV inspections on existing sewer pipes ranging in size from 500 mm to 1 200 mm.

b) Specifications for Mainline CCTV Inspections

i) Inspection equipment

The Contractor must give full details on their equipment, and their compliance or otherwise with all relevant specifications.

ii) Camera on Tractor

1. The camera must be transported through the pipe on a tractor system, to allow for smooth transportation of the camera through the pipe. The tractor must be controllable at various speeds in forward and reverse and must be able to operate in pipes from 100mm diameter upwards. The tractor speed must be displayed on the video at all times and should never exceed speeds as specified in *PSLD 7.2.7.3.
2. Camera mounted on the tractor must be mounted in such a manner as to transport the camera within 10% of the centre of the pipe.
3. All inspections must be done with a pan-and-rotate camera. The pan-and-rotate camera must have the ability to execute "pre-programmed" commands for effective and efficient scanning of joints. The

system must have the capability to down load to the database, the cameras relevant viewing angles. This camera must be fully remote control including remote focus, iris and light control. The camera must pan and rotate to view all critical incidents and laterals.

c) Camera Vehicles

1. All CCTV inspection equipment shall be neatly compartmentalised and transported in a suitable vehicles.
2. All vehicles must have the ability to determine their current location (X & Y GPS position of the vehicle on site) in order to prepare as-built plans.

d) Inspection Range

The Contractor shall ensure that the equipment used has a minimum range of inspection of 180 m allowing for two manhole lengths.

e) Flow control equipment

The Contractor shall have a range of flow control equipment to be able to block pipe diameter from 100 mm to 1 200 mm diameter.

f) Recordings

1. As a minimum requirement, recordings on DVD medium shall be accepted.
2. The format of the DVD video file format must be approved by the Engineer.
3. Correct adjustment of the recording apparatus and its associated electronic equipment shall be demonstrated by a recording, at the commencement of each new DVD, of a colour test pattern showing colour definition and picture resolution for a minimum period of 30 seconds.
4. DVD's are to be labelled with the following information:
 - Council name
 - Contract number
 - DVD number
 - Contractor's name
 - Date

Ownership of and copyright on the data will vest in the Employer.

***PSLD 7.2.7.2 Equipment Characteristics**

a) Camera Equipment

The Contractor shall make use of a push-pull type camera (ELS) with distancing device (sleigh, brushes, packing). The camera alone will have maximum dimensions of 70 mm x 100 mm long. The camera must be colour and can be fixed-focus forward looking. The flexible rod spool will have 100 m capacity and the system should be able to negotiate 90 degree bends in 100 mm private drains. On average the system should be able to negotiate at least 50 m in a 100 mm house drain.

The camera control unit must be portable and equipped with an integrated video unit. Video recordings must be made.

b) Flow control equipment

This will not normally be necessary provided the Contractor can make suitable arrangements with house owners but the equipment should be at hand to ensure a dry inspection.

c) Linear Measurement

1. The CCTV monitor display shall incorporate an automatically updated record in metres and tenths of metres of the camera location within the pipelines accurate to + 1% or 0.3 m whichever is the greater.
2. The metre reading entered onto the display at the start of the survey must represent the actual distance from the accepted start of the length of sewer or pipeline. This then requires that the meter reading can be zeroed

from the control console as well as the ability to enter any distance that may be required. The meter-age shall start to register immediately the camera starts to move.

3. The Contractor shall ensure that precise location of defects or missing manholes can be made from the surface to a depth of at least 6 m.

The Contractor will be held liable for any inaccuracies in linear measurement beyond the allowed tolerances resulting in extra excavation, delays etc.

4. The accuracy of linear measurement shall be checked by plotting laterals (as inspected) and laterals (as-built) on a thematic map. In addition the Contractor shall be required from time to time to double inspect at random if the Employer is not satisfied as to linear accuracy by comparison between inspections before cleaning with inspections after cleaning and inspections after rehabilitation.
5. In addition, if on any specific section of pipe to be rehabilitated, laterals marked out according to CCTV reports are not found within the tolerances specified, then the CCTV contractor will be asked to re-inspect at their cost, with radiosonar attached to the camera, and to mark the position of laterals on the surface.
6. A calibrated flexible rod system will be accepted.

d) Slope Measurement

1. The camera system must be capable of measuring the slope of the pipe being inspected. The instantaneous angle must be filtered and is to be displayed on the screen and recorded on DVD. Raw inclinometer data is also to be stored for downloading to the database for the purpose of pipe profiling. The camera system must be capable of down loading to the database, no less than three readings per meter of pipe inspected.
2. Where available as-built slopes on all sewerage pipes to be inspected will be provided to the contractor. The "as-built" slopes must be installed into the database by the contractor in order to enhance the accuracy of the resultant pipeline profile.
3. The as-built line on the display must be surrounded by buffer zones in different colours or shades representing at least where critical backfalls would start (where a critical backfall represents an invert level deviation of more than 50% of the internal diameter).
4. In addition, start and end backfall incidents must be displayed on the pipeline profile and the "depth" of backfall (fall in invert level) must be computed and displayed.
5. The start and end of a critical backfall as determined by inclinometer must be fed to the database and logged as an incident.
6. The system must be able to import and display manhole cover reduced levels (when available). This together with design/as-built slopes manhole depths determined at manhole inspections can then be used to control the accuracy of inclinometer readings displayed as pipeline profiles/control the value of as-built slopes etc. The measured manhole depths, design/as-built slope, manhole cover reduced levels or difference in reduced levels must all be displayed.

e) Data Display (Viewed on the Monitor Screen and DVD)

1. A data generator shall electronically generate and clearly display on the viewing monitor and video recording a continuous record of data in an alpha numeric form containing the following minimum information:
 - i) Automatic update of the camera's meter-age position in the pipeline from adjusted zero to relevant point.
 - ii) Pipe dimensions
 - iii) Pipeline, location, road name and manhole reference numbers.
 - iv) Instantaneous angle and upstream/downstream direction of inspections.
2. The size and position of all text including meterage must be such that it can be adjusted or moved anywhere on the screen, so as not to interfere with the main subject of the picture.
3. The text generator must have a function that will remove and replace all data on screen so as to allow an unobstructed view of the entire screen when required.
4. The text generator shall have a real time clock and calendar on screen to indicate the progress on the survey.

f) Picture Quality Control (Minimum Standards)

1. The electronic systems, television camera and monitor, shall provide a live picture of not less than 400 lines definition in real full colour and with no interference. The pictures shall be sufficiently sharp so that any fault can be seen clearly.
2. Pan-and-rotate cameras must have adjustable focus. The adjustment of focus and iris shall provide a focal range from 3 mm to infinity with at least 62° angle of view lens. The distance along the pipe in focus from the initial point of observation shall be a minimum of twice the vertical height of the pipe.
3. The combination of object illumination and light sensitivity of the camera shall be adequate to obtain an effective picture of the structure of the sewers or pipelines to be surveyed without loss of contrast or flare out of picture or shadowing.
4. The camera system must provide lighting to illuminate the pipe sufficiently to allow for the detection of cracks and other structural defects in the pipe. The lighting must be of such a nature that the natural colour of the pipe is recorded (No black & white CCTV will be acceptable).
5. Suitable test devices shall be provided and be available throughout the contract, to enable practical demonstration of the systems abilities.
6. For colour tube type cameras, the test card shall be the Marconi Regulation Chart No 1 or equivalent with a colour bar, clearly defined with no tinting to show the following:
 - (i) Black
 - (ii) Blue
 - (iii) Cyan
 - (iv) Green
 - (v) Magenta
 - (vi) Red
 - (vii) White
 - (viii) Yellow
7. The camera shall be positioned centrally and parallel to the test card at a distance where the full test card just fills the monitor screen. The card shall be illuminated evenly and uniformly without any reflection.
8. The electronic systems, television camera and monitor shall be of such quality as to enable the following to be achieved:
 - a. Shades of Grey

The grey scale shall show equal changes in brightness ranging from black to white with a minimum of five stages.
 - b. Linearity

A background grid shall show squares of equal size, without convergence/ divergence over the whole of the picture. The centre circle should appear round and have the correct height/width relationship.
 - c. Resolution

For colour tube type cameras, the live picture shall be capable of registering a minimum of 250 lines and can be clearly visible with no interference. The resolution shall be checked with the monitor colour turned down.
 - d. Colour

For colour CCTV, with the monitor control adjusted for correct saturation, the six colours plus black and white shall be clearly resolved with the primary and complementary colours in order of decreasing luminance. The grey scale shall appear in contrasting shades of grey with no tint.
 - e. Colour Contrasting

For colour CCTV, to ensure the camera shall provide similar results when used with its' own illumination source, the lighting shall be fixed in intensity prior to commencing the survey and the white balance set to the colour temperature emitted. In order to ensure colour constancy, ideally no variation in illumination shall take place during the survey.

g) Sample of DVD Medium

The Contractor shall include with their tenders submission, a DVD medium of at least 100 m of sewer filmed with equipment intended for use on this contract. If the tender is accepted, these shall define the required standard of picture quality for the contract. Where the Engineer rejects any survey pictures, the Contractor shall take remedial action to provide that survey file of an acceptable standard.

***PSLD 7.2.7.3 Reporting and Quality Assurance Plan**

a) Reporting

All reporting shall be done according to the latest version of the Sewer Classification Manual as published by Sight Lines or concept Standardized Specifications for CCTV inspections, when available. An abridged version with photographs shall be within the operator's sight within all times.

All CCTV operators must be able to present certification on request that they have within the last year completed successfully a CCTV Operator Training/Revision Course.

The Contractor shall maintain the following accuracies:

- Header accuracy: 100%
- Incident and grading accuracy: 90%

The maximum camera speeds wherefrom reporting is done shall be:

- 0.2 m/s for inspections on newly laid or newly replaced/rehabilitated pipe.

***PSLD 7.2.7.4 Report Specifications**

All inspections to be done according to the Pipe Inspection and Sewer Classification Manual as supplied by Sight Lines (Pty) Ltd or South African Standardized CCTV inspections (when available).
CCTV inspection report consisting of:

- Pipe Number (referenced to adjacent manholes)
- Pipe diameter
- Inclinator data
- Defects reported and graded
- Lateral identification (including orientation)
- End inspection data
- Digitised photographs representative of all major and critical faults in a section of pipeline.

PSLD 8 MEASUREMENT AND PAYMENT

PSLD 8.2.1 Supply, lay, joint, bed and test pipeline

- PSLD 3.1 Pipes, fittings and pipe joints
- *PSLD 3.1.2 Concrete pipes
- *PSLD 3.1.8 Polyethylene pipes
- *PSLD 3.1.8.1 Flanges
- *PSLD 3.1.8.2 Flange gaskets, bolts, nuts and washers
- *PSLD 3.1.8.3 Couplings
- *PSLD 5.9.4 As-built information
- *PSLD 5.11.1 HDPE jointing
- *PSLD 5.11.1.1 Equipment
- *PSLD 5.11.1.2 Pre-welding Checks
- *PSLD 5.11.1.3 Dummy Welds
- *PSLD 5.11.1.4 Post-welding Checks
- *PSLD 5.11.1.5 Health and Safety
- PSLD 7.2 Test and acceptance / rejection criteria

PSLD 8.2.3 Manholes

Add the following paragraphs to the Sub-Clause:

"The rate tendered for manholes shall include for the cover and frame.

Depth of manholes shall be defined as the distance from the top of the manhole cover (slab and cover & frame included) to the lowest channel invert level of the manhole. The top of the sewer manhole cover must be raised 150 mm above natural ground level or as per drawings where otherwise indicated."

PSLD 8.2.11 Connection to Existing Sewers

Add the following paragraphs to the Sub-Clause:

"The sewer will connect to the existing outfall sewer pipe at the Head of Works (300mm diameter and 400mm diameter), BNR splitter box (1200mm diameter), SST to splitter box 600mm diameter), existing manholes (100mm to 200mm diameter), Raw Water Pump Station (160mm diameter), sub-soil at Manhole No. 1 (100mm to 200mm diameter) and existing manhole at SDB-02 (160mm diameter) as indicated on the drawings. The rate for this item will include for excavation, backfilling, breaking into the existing manhole/service, dealing with the existing flow, connecting and modifying of benching, ensuring no foreign matter enters the existing sewer and making good to the Engineer's satisfaction. Rate will include all work, material etc. to complete the connections."

Add the following new payment item to SANS 1200 LD, sub-clause 8.2:

***PSLD 8.2.13 CCTV camera surveys..... Unit : m**

"The unit of measurement shall be the metre of each pipe inspected, measured centre to centre of adjacent manholes or to stopping point whichever is applicable.

The tendered rate shall include full compensation for, inter alia, the Closed-circuit television inspection lengths of sewer lines and any other related activity such as manhole inspections, reporting, etc. The tendered rate shall include for PSLD 7.2.7."

PSLE STORMWATER DRAINAGE (SANS 1200 LE)

PSLE 3 MATERIALS

PSLE 3.1(a) Precast Concrete Pipes

Delete the sub-clause and substitute:

"Concrete pipes shall be of reinforced concrete and shall comply with SABS 677 and be of the class as indicated on the drawings or scheduled in the Bill of Quantities."

PSLE 3.1 (d) Skewed Ends

Add to the Sub-Clause:

"Wherever required skew ends may be cut on site."

PSLE 3.1 (f) Pipes for Subsoil Drains (new Sub-clause)

Add new Sub-Clause:

"Pipes for subsoil drains shall have the specified internal diameter, which shall not be less than 100 mm, and shall be slotted uPVC or HDPE pipes with a wall thickness in accordance with Class 4 pressure pipes to SABS 966 or SABS ISO 4427."

The size of the perforations in perforated pipes shall in all cases be 8 mm \pm 1,5mm diameter and the number of perforations per metre shall not be less than 26 for 100 mm pipe and 52 for 150 mm pipe. Perforations shall be spaced in two rows for 100 mm pipes and four rows for 150 mm pipes.

Slotted uPVC or HDPE pipes shall have a slot width of 8 mm with a tolerance of 1,5mm in width. The arrangement of slots shall be to the Engineer's approval but the total slot area shall not be less than specified for the perforations."

PSLE 3.4.1 Bricks

Add to the Sub-Clause:

"Cement bricks complying with the relevant requirements of SABS 1215 bricks shall be considered as being acceptable."

Add the new Sub-Clauses:

***PSLE 3.6 Concrete**

"Concrete shall comply with the relevant requirements of SABS 1200 G or SABS 1200 GA, whichever is included in the project specification."

***PSLE 3.7 Permeable Material for Groundwater Drains**

"Permeable filter materials for groundwater drains shall consist of crushed stone of suitable gradings."

Permeable materials shall conform to the following requirements:

Crushed stone shall be clean, hard single sized stone and shall be free from shale, clay and other deleterious substances."

The aggregate crushing value of the stone shall not exceed 30 when tested in accordance with TMH 1 Test Method B1."

PSLE 5 CONSTRUCTION

PSLE 5.1.4 Culvert Construction After Earthfill

Add to the Sub-Clause:

"Wherever possible pipes and rectangular culverts shall be laid under trench conditions."

The compacted fill shall first be constructed to a height of 300 mm above the culvert before excavating for the culvert.

The trench width shall not exceed the outside diameter of the pipe plus 600 mm. A working width of 600 mm each side shall be allowed for rectangular culverts."

PSLE 5.2.2 Pipe Culverts

Add to the sub-clause:

"The bedding for stormwater pipes shall be to the requirements for Class C bedding of SABS 1200 LB, unless otherwise specified or shown on the drawings.

The ogee joints shall be fitted with 200 mm x 6 mm rubber sealing collars conforming to the latest SABS 974 Specification and with a shore hardness of approximately 40 degrees, or alternatively, the ogee joints shall be primed and double wrapped in accordance with the manufacturer's recommendations with 200 mm wide wrapping tape type CDP or similar approved."

PSLE 5.2.3 Concrete Casing of Pipelines

In second line of the Sub-Clause substitute "Grade 15/19" for "mix 15".

Add the following new sub-clauses:

***PSLE 5.2.6 Construction of Groundwater Drains**

"On completion of excavation the trench shall be lined with geotextile as specified or shown of the drawings.

A layer of permeable material of the class and thickness as shown on the drawings shall be placed on the bottom of the trench and lightly tamped and finished to the required gradient.

Pipes of the type and size required shall then be firmly bedded on the permeable material true to level and grades coupled where required and the trench backfilled in layers not exceeding 100mm with further permeable material to such height above the pipes as shown on the drawing or directed by the Engineer. The permeable material shall be lightly compacted and finished to the required level. The trench shall be specially protected against the ingress of water before completing the impermeable layer.

When placing successive layers the lower layer shall not be walked on or disturbed more than can be avoided. Care shall be taken to prevent the contamination of permeable material during construction of the groundwater drains and all permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his own expense.

Where plain butt joint pipes are used they shall be laid firmly together to prevent infiltration of backfill material. Perforated and slotted pipes shall be joined by couplers. Perforated pipes shall be laid with the perforations at the bottom, as instructed.

The higher end of groundwater pipe drains shall be sealed off with a cap or loose concrete cap of Class 20/19 concrete, as shown on the drawings, and at the lower end the pipe drain shall be built into a concrete headwall providing a positive outlet or connected to stormwater pipes or culverts."

***PSLE 5.8 Open Drains**

"Open drains are to be constructed to the details shown on the drawings, or as directed by the Engineer, to the correct line, levels and cross-sections. The material excavated from open drains is to be stockpiled for future use.

Measurement of open drain excavation shall be calculated from natural ground level or, in the case of drains within a road reserve, from the reduced level in the road excavation, and payment will be made on a rate per m3 basis irrespective of depth. The rate is to include for all work required to trim the drain(s) to the correct lines and levels."

***PSLE 5.9 Stone pitching**

"Where ordered by the Engineer, open drains, stormwater outlets, etc, shall be pitched with stone. Stone for pitching shall be of good, sound, durable rock of good shape and face, with a minimum size of 100

x 100 x 75 mm deep. Before pitching is commenced, all slopes and surfaces to receive pitching shall be carefully trimmed and dressed to the correct lines and grades. The pitching stones are to be laid with joints broken as much as possible and are to be hammered solidly into position to present a regular and uniform surface. All joints are to be grouted to their full depth in 4:1 cement:sand mortar."

***PSLE 5.10 Cutting of Pipes**

"As far as is possible culvert lengths shall be such that pipe units need not be cut. Should any straight or skew cuts be necessary, such cutting will not be measured and paid for separately in terms of Sub-Clause 8.2.4 since all additional work required in cutting the pipes as well as the wasted pipe ends shall be regarded as being included in the payment for the supply, lay, joint, bed and test of the relevant pipe culverts, as per Sub-Clause 8.2.1."

PSLE 8 MEASUREMENT AND PAYMENT

PSLE 8.2.1 Supply and Lay Concrete Pipe Culverts

Delete the title of the sub-clause and substitute:

"Supply, Lay, Joint, Bed and Test Pipelines"

Add to the Sub-Clause:

"The bedding shall be Class C, unless otherwise specified or shown on the drawings.

The rates shall cover the cost of providing the pipes as well as the cost of laying, bedding, jointing and making connections into manholes, including dealing with stormwater flow and testing the pipeline."

PSLE 8.2.4 Extra over Items 8.2.1 and 8.2.2 for Cutting End Units for Culverts on Site

Delete this Sub-Clause as no extra payment will be made for cutting end units for culverts.

Add the following new sub-clauses:

***PSLE 8.2.14 Minor Drainage Structures**

"Catchpits, manholes, drop inlets and headwalls constructed will be measured and paid for as complete units.

Item : Supply, construct and install drainage unit of the type, size category and depth stated in the Bill of Quantities Unit : No

The unit of measurement shall be the number of the particular type, size and category of drainage units supplied, constructed and installed in accordance with the drawings.

The tendered rate shall include for all materials, plant labour, supervision and incidentals for the construction of the drainage units complete and in accordance with the drawings.

The tendered rate shall further include for all necessary excavation in all materials, backfilling and disposal of surplus materials, formwork, concrete, benching, concrete finish, reinforcement, precast elements, steel channels and grids, step irons and all other items not specifically measured elsewhere, necessary for completion of the unit in accordance with the drawings.

The tendered rate shall include for all costs involved in complying with the requirements of the relevant specifications in respect of the individual types of work involved in completion of the units.

The tendered rates shall exclude for excavation in intermediate and hard material, payment for which shall be made as an extra over in the Schedule of Quantities."

***PSLE 8.2.15 Stone Pitching**

"Payment for stone pitching (PSLE 5.9) will be made at a rate per unit finished area and the rate is to include for all trimming and dressing of the excavation, laying of the stones and grouting of the joints.
Unit : m²"

***PSLE 8.2.16 Demolishing of Minor Drainage Structures (new Sub-Clause) - Provisional**

"The demolishing of manholes, catchpits, headwalls and any other minor drainage structures (PSLE 5.11) will be measured and paid for as complete units demolished and all rubble removed to approved spoil sites and the excavation backfilled and compacted to 90% mod AASHTO and the ground surface made good. The rate for demolishing minor drainage structures shall include the cost of dealing with stormwater flow during the procedure and the testing and re-instatement of normal flow upon completion.

The reinstatement of road surfaces or paving shall be paid separately.

Item : Demolish drainage unit of the type, size category and depth stated in the Bill of Quantities,
including dealing with stormwater flows (Provisional) Unit : No (Prov)"

PSLF ERF CONNECTIONS (WATER) (SANS 1200 LF)

PSLF 3 MATERIALS

PSLF 3.1.4 Polyethylene Pipes

Add the following paragraphs to Sub-Clause:

“High density polyethylene (HDPE) pipes to SABS 533 PE 100, Class 12 jointed with compression fittings or “Polycop” pipes with copper fittings shall be required as indicated on the relevant drawings.

House leadings shall be laid perpendicular to the water main and in a straight line without any coupling between the water main and 0,5 m before the edge of the road reserve. At the connection to the main, the pipe must be curved with a radius on not less than 1 000 mm. The outlet shall be in the direction of the water main so that the flow in the curved section of the connection is anti-clockwise. Connections crossing roads shall be at a depth of not less than 500 mm below final pass level.”

PSLF 3.1.6 Ferrules

Add the following paragraph to Sub-Clause:

“Screw-in type ferrules shall be used throughout and all ferrules shall be left in the open position.”

PSLF 3.1.7 Saddles

Add the following paragraph to Sub-Clause:

“Cast iron saddles shall be used. The saddle must be wrapped with denso tape. No separate payment will be made for the wrapping of saddles.”

PSM ROADS (GENERAL) (SANS 1200 M)

PSM 5 CONSTRUCTION

PSM 5.1 Traffic Control/Safety measures

Add the following Sub-Clause:

"When roads to be constructed under this contract join onto existing surfaced trafficked roads, the Contractor shall take all the necessary precautions to ensure the safety of the traveling public. To this end, signs warning through traffic of vehicles encroaching into the travelled way shall be erected by the Contractor prior to such work being undertaken. In addition flagmen shall be installed along the through road. These control measures shall be checked and recorded on a daily basis.

Under no circumstances shall drums be permitted to be used as traffic demarcation devices.

All signs must comply with the latest edition of the South African Road Traffic Sign Manual."

PSM 6 TOLERANCES

PSM 6.4 Level Control of road layers

Add the following sub-clause:

"The Contractor shall submit to the Engineer, at the time of requesting acceptance of a road layer, a record of the surface levels of that section, taken at metre intervals to coincide with the level pegs. A sample form will be obtainable from the Engineer."

PSM 7 TESTING

PSM 7.1 General

Add the following to this Sub-Clause:

"The random sampling method of TMH 5, for the location of positions, for field density testing will not necessarily be applied by the Engineer's Representative. Density testing shall be carried out where, in his opinion, the density of the compacted layer is suspect. The Contractor shall present the full width of the layer, between the stated linear stake values, for acceptance. Only in exceptional cases will partial widths of a layer be accepted for testing."

PSM 7.3 Routine Inspection and Testing

Add the following to this Sub-Clause:

"The request for acceptance of a layer shall be submitted in writing, specifying the exact location of the section and type of layer. On receipt of all these details the Engineer's Representative will arrange for the necessary inspections and tests to satisfy himself that the road layer complies. Testing will be carried out as expeditiously as possible, and the results will be available within 24 hours of receipt of test request. The Contractor shall backfill the test holes left in the layer with a similar material to that of the layer tested and compact the material to a similar density. Concrete shall not be used."

PSM 7.4 Compaction Control

Add the following to this Sub-Clause:

"Density test shall be carried out by the Contractor on each layer of the selected subgrade, subbase, base-course and shoulders/layers as soon as possible but not later than twenty-four hours (24) after compaction of that layer has been completed, and the results of the test shall be submitted to the Engineer without delays and in any case not later than twelve hours (12 hours) after they become available.

The Contractor shall locate and test any soft or wet areas evident in any layer and shall, if these tests fail, re-compact and retest such areas for density before requesting the Engineer to carry out check tests.

The Contractor shall provide adequate equipment and facilities for carrying out the tests required to be performed by him. Should the Engineer at any time consider that the equipment and facilities are inadequate for this purpose, he may instruct the Contractor to cease work on the completion of subgrade, sub-base and base course until such time as the Contractor has remedied the deficiency of equipment, labour and facilities.

The results of the test carried out by the Engineer shall be regarded as final."

PSM 7.5 Engineer's Discretion

Add the following to this Sub-Clause:

"Notwithstanding the provision of clause 7 of SABS 1200 M, testing of a section of completed work shall be at the sole discretion of the Engineer who may refuse to check test and consequently not approve a section of work which contains obvious defects such as loose patches, over-wet material etc."

PSM 8 MEASUREMENT AND PAYMENT

PSM 8.1 Inspection and Testing of a road layer

Add the following Sub-Clause:

"The cost of refilling and compacting the density test holes shall be included in the rate tendered for the construction of that layer."

PSME SUBBASE (SANS 1200 ME)

PSDME 3 MATERIALS

PSME 3.2.1 Subbase Material

Replace the following in this Sub-clause with:

“With reference Sub-clauses 3.2.1.d (ii) and 3.2.1.d (iii), the regional factor shall be taken as 0,6.”

PSME 5 CONSTRUCTION

PSME 5.4.1 Placing

Add the following to this Sub-clause:

“The subbase layer shall be 150mm thick unless shown otherwise on the drawings.”

PSME 6 TOLERANCES

PSME 6.1.1 General

Add the following to this Sub-clause:

“For layers, constructed of subbase quality material, on which the bituminous surface will be placed, the tolerance for dimensions and level shall be as set out in SABS 1200 MF, Sub-clauses 6.1.2 to 6.1.6 inclusive, as amended.”

PSMF BASE (SANS 1200 MF)

PSMF 3 MATERIALS

PSMF 3.3.2 Graded Crushed Stone

Add the following to Sub-clause 3.3.2, in the first sentence after the words:

SABS 1083 “for 37,5mm stone”.

PSMF 5 CONSTRUCTION

PSMF 5.4.4 Compaction

Amend Sub-clause 5.4.4.2 (a) by deleting “98%” and replace with “100%”.

PSMF 6 TOLERANCES

PSMF 6.1.2 Grade

Delete the contents of Sub-clauses 6.1.2 (a) and (b) and replace with:

“The height of the edge of the channel above the top of the completed base shall be not higher than the final asphalt level less 5mm. (Refer to SABS 1200 MH 6.3.4)”

PSMF 6.1.5 Cross-section

Amend the Sub-clause as follows:

Delete “25mm” and replace by “15mm”.

PSMF 7 TESTING

PSMF 7.3 Routine Inspection and Testing

Delete Clause 7.3 and replace with the following:

“The Density measured at all test holes shall be a minimum of 100% Mod. AASHTO density for the section of layer works to be acceptable.”

PSMJ SEGMENTED PAVING (SANS 1200 MJ)

PSMJ 3 MATERIALS

PSMJ 3.1.2 Class, strength and type

Add the following to Sub-clause 3.1.2:

“Blocks shall be 60 mm or 80 mm thick pavers, S-A type, Class 35 to the colour and type specified by the Engineer. Blocks are to be 80mm thick for roads and 60mm thick for walkways and other non-vehicular areas.”

PSMJ 3.3 Sand for bedding and jointing

Add the following to Sub-clause 3.3:

“The sand used for the bedding layer shall not contain proportions of silt and clay materials smaller than 0.075 mm that exceed 15%.”

PSMJ 5 CONSTRUCTION

PSMJ 5.3 Placing and compacting of sand bed.

Replace the first sentence of Sub-clause 5.3 with:

“The bedding sand shall have a compacted thickness of 20mm.”

Add the following to Sub-clause 5.3:

“The Contractor must make allowance for the penetration of the bedding sand layer into the compacted subbase layer. Only the 20 mm homogenous bedding sand layer will be measured for payment purposes.”

PSMJ 5.4 Laying of units

Replace the first paragraph of Sub-clause 5.4 with:

“Blocks shall be laid in the herringbone pattern.”

PSMJ 5.6.2 Paving subject to wheel loads exceeding 30 kN.

Add the following to Sub-clause 5.6.2:

“The paving proposed will be subjected to wheel loads exceeding 30kN.”

PSMK KERBING AND CHANNELLING (SANS 1200 MK)

PSMK 3 MATERIALS

PSMK 3.2.1 General

Replace the last sentence of Sub-clause 3.2.1 with the following:

“Precast units as indicated on the drawings shall be required in 1m lengths.

300 mm lengths shall be used in bellmouths and for radii less than 20 m. These kerbs shall be cast and not saw cut.”

PSMK 3.9 Bedding Material

Delete this clause and replace with the following:

“The material on which precast kerbs and channels are bedded shall consist of Grade 15/9 concrete to SABS 1200 GA and to the dimensions indicated on the drawings.”

PSMJ 5 CONSTRUCTION

PSMK 5.2 Precast Concrete Kerbing and Channeling

Replace the second paragraph of Sub-clause 5.2 with the following:

“Provision shall be made for expansion joints of width 10 mm at intervals not exceeding 10 m for kerbing, channelling and edging. The joints shall be filled with a suitable silicone or polysulphide sealant.

Notwithstanding the fact that vertical curves have not been specified where changes to grade of up to 2% occur, the kerbs and channels shall be laid to levels based on a minimum vertical curve length of 20 m.

No change in grade shall be applied on kerbs in bellmouths unless specific levels are indicated.”

PSMK 8 MEASUREMENT AND PAYMENT

PSMK 8.1 Basic Principles

Add the following new Sub-clause 8.1.4:

“Measurement and payment for bedding as well as the backing of kerbs as specified in SABS 1200 MK 5.2 shall be included in the separate items scheduled in terms of Sub-clause 8.2.1 and 8.2.2 of SABS 1200 MK. The rates shall cover the cost of supplying and installing the bedding as specified in Sub-clause PSMK3.9, as amended.”

Contract No: RW10404061/23

Description: TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS BY 15 ML/DAY
AT MEYERTON
PROJECT SPECIFICATIONS

PSMM ANCILLIARY ROADWORKS (SANS 1200 MM)

PSMM 8 MEASUREMENT AND PAYMENT

PSMM 8.3.4 Excavation and Backfilling and Concreting (if any) for sign supports Unit: No.

“The unit of measurement shall be the number of sign post foundations excavated backfilled and concreted as specified. The rate shall include for all plant, labour and materials needed to cast concrete surrounds and backfilling with soil for each sign post base.”

6. DETAILED MECHANICAL PERFORMANCE SPECIFICATIONS

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M1 SCOPE

The Mechanical Works consists of the design, manufacture, supply, delivery, installation, testing and commissioning and upholding during the Trial Operational Period and Defects Notification Period of mechanical equipment for the Completion of the 15Mℓ/day Extension to the Meyerton Wastewater Treatment Works (WWTW).

This Detailed Mechanical Performance Specification is supplemented by the requirements of the Standard Specification for Mechanical works. Where these specifications may conflict with other specifications, conditions and requirements that are of a general nature, this specification shall have precedence. Should the Contractor note an inconsistency between the specifications and the drawings, he is required to immediately notify the Engineer and obtain clarification or instructions prior to tendering and prior to ordering or installing equipment.

The additional scope of works is supplemental to the existing Mechanical Contract for the Extension to the Meyerton WWTW and is to be undertaken by the existing appointed Mechanical Contractor.

The existing Mechanical Contract for the Extension to the Meyerton WWTW consisted of the supply, delivery, installation, testing and commissioning of the following components:

- Mechanical screens at the Head of Works
- Screenings conveyor and disposal equipment at the Head of Works
- Mechanical components for the vortex degritters at the Head of Works
- Grit classifiers and grit disposal equipment at the Head of Works
- Blowers at the Head of Works
- Various submersible and dry-well pumps:
 - End-suction centrifugal pump at the Raw Water Pump Station
 - Submersible centrifugal pumps at the Irrigation Pump Station
 - Submersible pumps for wash water at the Head of Works
 - Propeller-type pumps for activated sludge recycle in the Biological Reactor
- Aeration equipment for the biological reactor
- Mixers for the biological reactor
- Weirs, sluice gates, groundwater relief valves, flap gates, sludge valves
- Rotating half-bridge and associated equipment for the secondary sedimentation tank

The additional Scope of Works for the Completion of the Extension of Meyerton WWTW, includes, but is not limited to, the following complying with the specifications:

Biological Nutrient Removal (BNR) Reactor

- Refurbishment/servicing of the installed eight (8) 11 kW top-mounted vertical shaft type mixing units
- Refurbishment/servicing of the installed six (6) 45 kW and four (4) 55 kW vertical shaft mechanical surface aerators

Return Activated Sludge (RAS) Pump Station

- Telescopic valves and associated pipework
- Sluice gates

Waste Activated Sludge (RAS) Pump Station

- Telescopic valves and associated pipework for WAS withdrawal from the reactor
- Two (2) self-priming solids handling centrifugal pumps complete with all pipework, valves and fittings and any other ancillaries required to make the pump sets complete and operational
- Lifting equipment

This description of the Works is not necessarily complete and shall not limit the work to be carried out by the Contractor under this Contract.

M2 SLUICE GATES

M2.1 GENERAL

This Specification shall apply to the sluice gates at the addition to the existing RAS Pump Station at the Meyerton WWTW.

The following Standard Specifications are to be read in conjunction with this section:

- MGA: General Mechanical
- MCP: Corrosion Protection
- MFC: Sluice Gates, Hand Stops, Stop Logs and Fixed Weirs

M2.2 DESIGN REQUIREMENTS

M2.2.1 Wall-mounted Sluice Gates

Two sluice gates are required at the addition to the existing RAS Pump Station, refer to drawing J30231E/010-230/A. The Contractor shall supply wall-mounted sluice gates as follows:

Location	Opening/ sluice gate size (mm)	Quantity	Invert to platform (mm)	Type of invert	Max head when closed (m)	Seating/ Unseating Head
RAS Pump Station	1000 W x 800 H	2	1408	standard	0.850	Seating

M2.3 MEASUREMENT AND PAYMENT

The measurement and payment of the sluice gates shall be measured under the Standard Mechanical Specifications Section MFC 10.

M3 MIXERS AND AERATORS

M3.1 GENERAL

This Specification shall apply to the vertical shaft mixers and surface mounted vertical shaft aerators installed at the biological reactor at the Meyerton WWTW. The mixers and aerators were installed in the biological reactor in 2018, however have not been under operation.

M3.2 MIXERS

Eight (8) 11 kW top-mounted vertical shaft type mixing units are installed, details as follows:

- Motor Mixtec
- Impeller type AS700
-

M3.2.1 Scope of Refurbishment Works

The refurbishment scope of works for the mixing equipment will typically entail the following;

- Isolate, drain and clean the civil structure where the mixing equipment are installed, if required.
- Completely disconnect the mixing equipment from the existing infrastructure where it is installed.
- Remove the mixing equipment from the installed position, onto proper transportation and transport to the Contractor's (or sub-contractor's) workshop.
- Dismantle and strip the mixing equipment completely. Properly clean all parts to enable inspection and measurement of wear and damaged parts.
- From inspection and measurement compile a comprehensive quote to refurbish the mixing equipment to the specified requirements herein.
- The quote will be evaluated, together with the dismantled and stripped equipment. On acceptance and approval of the quote by the Engineer and the Employer, the contractor may proceed with the refurbishment as per the approved quotation.
- The Engineer and the Employer will be notified timeously of the completion of the refurbishment and repair work on the mixing equipment, to arrange for a factory acceptance test. On acceptance of the refurbished equipment, the Contractor can deliver the mixing equipment to site.
- The refurbished mixing equipment may now be installed.
- The mixing equipment must undergo a full dry and wet commissioning procedure.
- The contractor must maintain the mixing equipment for the 12 month defect liability period.

M3.2.2 Refurbishment Works Requirements

Requirements during the refurbishment process and the final performance of the mixing equipment, entails the following;

- The Contractor will at all times ensure, to the best of his ability, that there is not additional damage to the mixing equipment during the refurbishment process.
- The Contractor will ensure minimum repair time to ensure the approved completion target date are met.
- The mixing equipment will be refurbished to its as-new condition. If the existing equipment and parts cannot ensure the maximum expected operational life, the equipment must be replaced with new improved technology equipment.
- Material used to refurbish the mixing equipment must be similar or better than the original design.
- The materials and parts used for the refurbishment of the mixing equipment shall at all times be original manufactured material and parts. No second grade, no-name branded replacement material or parts will be acceptable. The contractor and the supplier of the material and parts must provide proof of the material quality and origin.
- During the inspection stage, the Contractor will confirm with the Engineer the mixing energy per volume of each mixer, to ensure the efficient mixing capacity of the equipment.
- During the inspection stage, the contractor will confirm with the Engineer whether the existing installation configuration and layout is sufficient for the application.
- The mixing equipment refurbishment must ensure that it is robust and ensure maximum handling performance and minimal operation and maintenance requirements.
- The mixing equipment must ideally suit the existing civil structural housing.
- The mixing equipment must properly and efficiently interact with the adjacent and accompanying equipment.
- The mixing equipment, as the complete system and as the individual equipment and assemblies must comply with the relevant Particular Specifications, SABS and OHS Act regulations.

M3.3 AERATORS & MIXERS

Six (6) 45 kW and four (4) 55 kW vertical shaft mechanical surface aerators are installed, details as follows:

45kw aerators:

- | | |
|--|---------------|
| • Gearbox | SEW MC3PVSF06 |
| • Motor | SEW DRN225M4 |
| • Impeller, shaft, base frame and coupling | S.A.M.E Std. |

55kw aerators:

- | | |
|--|---------------|
| • Gearbox | SEW MC3PVCF07 |
| • Motor | SEW DRN250M4 |
| • Impeller, shaft, base frame and coupling | S.A.M.E Std. |

M3.3.1 Scope of Refurbishment Works

The refurbishment scope of works for the aeration & mixing equipment will typically entail the following;

- Isolate, drain and clean the civil structure where the aeration & mixing equipment are installed, if required.
- Completely disconnect the aeration & mixing equipment from the existing infrastructure where it is installed.
- Remove the aeration & mixing equipment from the installed position, onto proper transportation and transport to the Contractor's (or sub-contractor's) workshop.
- Dismantle and strip the aeration & mixing equipment completely. Properly clean all parts to enable inspection and measurement of wear and damaged parts.
- From inspection and measurement compile a comprehensive quote to refurbish the aeration & mixing equipment to the specified requirements herein.
- The quote will be evaluated, together with the dismantled and stripped equipment. On acceptance and approval of the quote by the Engineer and the Employer, the Contractor may proceed with the refurbishment as per the approved quotation.
- The Engineer and the Employer will be notified timeously of the completion of the refurbishment and repair work on the aeration equipment, to arrange for a factory acceptance test. On acceptance of the refurbished equipment, the Contractor can deliver the aeration & mixing equipment to site.
- The refurbished aeration & mixing equipment may now be installed.
- The aeration & mixing equipment must undergo a full dry and wet commissioning procedure.
- The Contractor must maintain the aeration & mixing equipment for the 12 month defect liability period.

M3.3.2 Refurbishment Works Requirements

Requirements during the refurbishment process and the final performance of the aeration equipment, entails the following;

- The Contractor will at all times ensure, to the best of his ability, that there is not additional damage to the aeration or mixing equipment during the refurbishment process.
- The Contractor will ensure minimum repair time to ensure the approved completion target date are met.
- The aeration & mixing equipment will be refurbished to its as-new condition. If the existing equipment and parts cannot ensure the maximum expected operational life, the equipment must be replaced with new improved technology equipment.
- Material used to refurbish the aeration & mixing equipment must be similar or better than the original design.
- The materials and parts used for the refurbishment of the aeration & mixing equipment shall at all times be original manufactured material and parts. No second grade, no-name branded replacement material or parts will be acceptable. The Contractor and the supplier of the material and parts must provide proof of the material quality and origin.
- The aeration & mixing equipment include the motor-gearbox drive unit, the platform base plate, the shaft and the aerator/ mixing impeller.
- During the inspection stage, the contractor will confirm with the Engineer the aeration/ mixing capacity of each aerator/ mixer, to ensure the efficient aeration and mixing capacity of the equipment.
- During the inspection stage, the contractor will confirm with the Engineer whether the existing installation configuration and layout is sufficient for the application.
- The aeration & mixing equipment refurbishment must ensure that it is robust and ensure maximum handling performance and minimal operation and maintenance requirements.
- The aeration & mixing equipment must ideally suit the existing civil structural housing.
- The aeration & mixing equipment must properly and efficiently interact with the adjacent and accompanying equipment.

- The aeration & mixing equipment, as the complete system and as the individual equipment and assemblies must comply with the relevant Particular Specifications, SABS and OHS Act regulations.

M3.4 TESTING AND COMMISSIONING

M3.4.1 Mixers

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.

Once the mixing system has been installed, the tank will be filled and the operation of the equipment shall be tested. When the mixing system has been operated for a sufficient period, samples shall be collected over a period of less than 5 minutes. A test run shall consist of samples being taken from five points within a 5 minute period. Each sample shall be tested individually for total solids. Composite samples will not be allowed.

The Contractor shall obtain the critical speed for the impeller/shaft structure on Site and shall confirm to the Engineer that this is at least 20 % away from the operating speed.

The power demand for the motor shall be measured in order to confirm that the specified power margin has been obtained.

M3.4.2 Aerators

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.

In-situ testing of aeration equipment shall be carried out by the Contractor in the presence of a representative of the Engineer, to verify the oxygenation capacity and efficiency of the equipment.

The steady state method shall be used.

The aerator shall be capable of operating without damage or deterioration when the tank's contents have fallen to one half of the working capacity of the tank.

The ability to reverse rotational direction shall be provided.

The Contractor shall provide an analysis of the dynamic system in order to confirm that the unit will not operate near its critical speed.

All results, readings and other information regarding the tests shall be freely available to the Engineer at the time of the tests, and copies of the Contractor's calculations shall be submitted to the Engineer. The power demand for the motor shall be measured in order to confirm that the specified power margin has been obtained.

Steady State Test Method:

The steady state test in activated sludge carried out on the equipment. An outline of this test method is given below:

- (a) Aerators are to be running at correct/normal operating conditions, in an already established activated sludge aeration basin, for the duration of this test.
- (b) Dissolved oxygen (DO) concentration readings are taken at 6 points (at least) in the tank. An average value (Cv) is calculated for these readings.
- (c) Measurements of power consumption (kW) of the aerators are taken during the test.)
- (d) A sample from the aeration basin is taken and sealed in a container (1 litre) with a DO probe. The drop in DO concentration is measured with time, and a plot is made. A linear section should be apparent on the graph.
- (e) The slope of linear section of the graph shall be measured and taken to equal -OUR, (Oxygen Utilisation Rate).

- (f) The saturation value of dissolved oxygen under test conditions is calculated as follows:

$$C'_{s(T)} = \frac{468}{(31,6 + T)} \times \frac{(P - p_w)}{(760 - p_w)}$$

- where $C'_{s(T)}$ (mg/l) = saturation concentration of oxygen in mixed liquor solution at T °C and P mmHg pressure
 - T = temperature of mixed liquor in aeration basin (°C)
 - P = barometric pressure (mm Hg)
 - p_w = saturation vapour pressure of water at T°C (mm Hg)
- (g) The value of K'_{La} is calculated as follows:
- (h) The value of K'_{La} is adjusted to the standard temperature of 20°C and no impurities level as follows:

$$K'_{La} = \frac{OUR}{(C'_{s(T)} - C_v)}$$

$$K_{La(20)} = K'_{La} \times \frac{1,012^{(20-T)}}{\alpha}$$

$$\text{where } \alpha = \frac{(K_{La} \text{ wastewater})}{(K_{La} \text{ clean tap water})}$$

- (i) The oxygenation capacity (O.C.) of the aerators under standard conditions is calculated as follows:

$$O.C. = K_{La(20)} \times C_{s(20)} \times V \times 10^{-3} \text{ kg/h}$$

where $C_{s(20)}$ = saturation concentration of oxygen in tap water containing 1000 mg/l dissolved solids at 20°C and 760 mm pressure (mg/l)

$$= 9,02 \text{ mg/l}$$

$$V = \text{volume of test unit under consideration (m}^3\text{)}$$

- (j) The oxygen transfer rate is calculated as follows:

$$R = O.C./kW \text{ kg/kWh}$$

M3.5 MEASUREMENT AND PAYMENT

M3.5.1 Refurbishment Works for Mixers

Unit: Sum

The tendered Sum shall include full compensation for all actions and costs involved in the refurbishment of the eight (8) 11 kW top-mounted vertical shaft type mixing units as described in Section M3.2.1 and M3.2.2 of this Specification

M3.5.2 Refurbishment Works for 45 kW Aerators

Unit: Sum

The tendered Sum shall include full compensation for all actions and costs involved in the refurbishment of the six (6) 45 kW vertical shaft mechanical surface aerators as described in Section M3.3.1 and M3.3.2 of this Specification

M3.5.3 Refurbishment Works for 55 kW Aerators

Unit: Sum

Contract No: RW10404061/23

**Description: TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS BY 15 ML/DAY
AT MEYERTON
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The tendered Sum shall include full compensation for all actions and costs involved in the refurbishment of the four (4) 55 kW vertical shaft mechanical surface aerators as described in Section M3.3.1 and M3.3.2 of this Specification

M4 WASTEWATER PUMPS

M4.1 GENERAL

This specification shall apply to all wastewater pumps at the Meyerton WWTW.

The Contractor shall provide pump sets complete with all ancillaries required to make the pump sets complete and operational.

The following Standard Specifications are to be read in conjunction with this section:

- MGA: General Mechanical
- MCP: Corrosion Protection
- MPW: Pipework, Valves and Fittings
- MWP: Water and Wastewater Pumps

M4.2 PERFORMANCE REQUIREMENTS

M4.2.1 Waste Activated Sludge (WAS) Pump Station

Pumps are required to pump the WAS from the WAS pump station sump to the sludge drying beds. The WAS pump station is shown in Drawing No. J30231E/010-227.

The Contractor shall provide the pump sets complete with all pipework, valves and fittings as shown in the drawings, and any other ancillaries to make the pump sets complete and operational.

The pump station is a dry/wet well configuration and the following pumps shall be provided:

Type of pump:	Self-priming, 76 mm solids handling, centrifugal type pump with wedge belt drive
Configuration:	1 x duty + 1 x standby
Duty flow:	51 l/s
Duty head:	3.8 m
NPSH required:	1.52 m
Material pumped:	Waste activated sludge (0.35 – 0.8%)

M4.3 OPERATION AND CONTROL

M4.3.1 Waste Activated Sludge (WAS) Pump Station

The sump shall be supplied with an ultrasonic level sensor to stop the pump when the level in the sump is below the safe operating conditions for the pump.

M4.4 MEASUREMENT AND PAYMENT

The pumps shall be measured as per the Standard Mechanical Specifications MWP 21.

The pipework, valves and fittings shall be measured as per the Standard Mechanical Specifications MPW 15.

M5 LIFTING EQUIPMENT

M5.1 GENERAL

Specifications for the lifting equipment for the WAS Pump Station (as detailed below) are provided in this section. For additional details, also refer to the drawings as detailed.

The following Standard Specifications are to be read in conjunction with this section:

- MGA: General Mechanical
- MCP: Corrosion Protection
- MLE: Lifting Equipment

M5.2 DESIGN REQUIREMENTS

M5.2.1 Waste Activated Sludge (WAS) Pump Station

A gantry beam with an electrically operated crab and hoist is required at the WAS Pump Station. The purpose of the gantry is for the removal/repair of the WAS pump equipment such as motors. The following dimensions and duties are required:

—	Length of travel :	8.0 m
—	Height (floor to bottom of beam) :	4.25 m
—	Minimum lift height :	0,5 m
—	Working load :	min 1 000 kg (or the maximum weight of the complete motor to be lifted should it exceed 1 000 kg)
—	Hoist speeds :	Refer Spec MLE: Lifting Equipment
—	Longitudinal travel speeds :	Refer Spec MLE: Lifting Equipment
—	Crawl beam :	203 x 133 x 30kg I-Beam

M5.3 INSPECTION AND TESTING REQUIREMENTS

The Contractor shall make all arrangements and carry all costs for the Engineer to inspect, or witness the testing (if applicable), the fully assembled equipment, including lifting equipment, in the manufacturer's workshop, prior to being delivered to site.

M5.4 MEASUREMENT AND PAYMENT

The measurement and payment of the lifting equipment shall be measured under the Standard Mechanical Specifications Section MLE 14.

7. STANDARD MECHANICAL SPECIFICATIONS

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SECTION MGA

STANDARD SPECIFICATION: GENERAL MECHANICAL ADMINISTRATIVE ASPECTS

MGA 1 Testing

MGA 1.1 Testing During Manufacture And / Or Construction

Plant and materials shall be tested at the manufacturer's works. The following minimum requirements shall apply:

Steel pipes

The welding of each steel pipe length shall be examined ultrasonically and radiographically. Each pipe length shall be subject to a hydrostatic pressure test to 90% of the guaranteed minimum yield stress for the grade of steel used.

The thickness, integrity and adhesion of pipe coatings and linings shall be tested.

Pumps

Each pump shall be tested individually with its own motor over its full working range. Testing shall be done in accordance with BS EN ISO 9906:2012 "Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1 and 2." The tests shall be to grade 2 accuracy and carried out on a test stand at the manufacturer's works.

NPSH3 tests shall be carried out at the guaranteed duty point, at the maximum run out condition and at three points in between.

Valves

Valves shall be tested as follows:

- i. body test - 1.5 times the PN rating of the valve;
- ii. seat test - 1.0 times the PN rating of the valve.

Double air valves shall be factory-tested to demonstrate drop tight sealing at pressures from 0.5 bar to twice the nominal pressure rating.

Cranes

The crane, and all slings, ropes, shackles and other lifting plant supplied shall be tested by the manufacturer at his works. The tests shall be carried out at 125% of Safe Working Load, and Test Certificates shall be supplied.

Electric motors

Detailed load tests shall be carried out on all motors with a rating greater than 37 kW to determine temperature rise, efficiency, speed and power factor, at different loads ranging from no-load to 110% of the continuous maximum rating of the motor.

The following tests shall be carried out:

- i. open-circuit test;
- ii. short-circuit or locked-rotor test;
- iii. losses and efficiency;

- iv. voltage or pressure tests;
- v. over-speed test;
- vi. noise tests;
- vii. vibration tests;
- viii. Measurement of stator and rotor resistances (where possible).

The procedures stated in the relevant parts of BS4999 and BSEN 60034 shall apply to the above tests.

The motors shall be tested in accordance with BS4999 for temperature rise, efficiency and power factor.

High voltage and insulation resistance tests shall be made when the apparatus is hot.

The power and power factor measuring instruments shall be connected in such a position as to allow for all losses in the complete system and not for the motor alone.

Electrical switchgear and motor control gear

The electrical plant supplied under this contract shall be tested to prove compliance with these Employer's Requirements and with the relevant BS specification where applicable.

High voltage and insulation resistance tests shall be made when the apparatus is hot.

Tests shall include, but shall not be limited to, the following:

- i. HV pressure tests and insulation resistance check;
- ii. LV pressure tests and insulation resistance check;
- iii. injection test;
- iv. shunt trip test;
- v. operation of all interlocks and protection devices.

Diesel generating sets

Each set shall be tested for output and performance in accordance with the requirements of BS649 and BS5000 Part99. Tests shall include all function tests, operation of all safety devices, load tests and temperature tests.

Cables

All electrical cables and wiring shall be fully factory tested.

MGA 1.2 a) Tests on Completion: Pre-Commissioning Tests

b) Pumping plant

The Contractor shall demonstrate that:

- vi. the pumps are correctly levelled and bolted down;
- vii. the suction and delivery pipework is watertight;
- viii. pump/motor couplings are correctly aligned;
- ix. the bearings are clean;
- x. any anti-vibration mountings are fitted correctly;
- xi. the pumps are lubricated;

- xii. the motors are lubricated;
- xiii. the pump glands are packed;
- xiv. there is no pipe stress on connections;
- xv. gland bowl drains are fitted and clean;
- xvi. the power cabling is complete;
- xvii. the control cabling is complete;
- xviii. the rotating assemblies turn freely;
- xix. any coupling guards are correctly fitted;
- xx. the suction and delivery valves are open;
- xxi. the pumps are primed and vented.

Each machine shall then be manually started to demonstrate:

- i. the correct rotation of the machine;
- ii. vibration is within acceptable limits;
- iii. gland leakage is not excessive.

c) Valves and penstocks

The Contractor shall demonstrate that valves and penstocks:

- i. have the specified direction of closing;
- ii. seal leak-tight;
- iii. where appropriate, have properly packed glands that do not leak excessively

MGA 1.3 d) (b) Cranes

The Contractor shall carry out site tests at the safe working load of each crane. The Contractor shall supply the necessary materials for the test load and shall remove the test load from the Site after successful tests have been carried out.

e) (c) Electrical installations

The entire installation shall be tested and commissioned in accordance with BS 7671:2001 "Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition." Prospective Fault Currents (Ipsc) and Earth Fault Loop Impedance (EFLI) shall be measured and recorded at different locations on each installation including at each LV switchboard, distribution board and at the furthest socket outlet from the source on each socket outlet circuit, and at each item of fixed Plant.

Testing and commissioning procedures shall be such as to effectively prove the correct operation of all components and their integration into the systems. The testing shall also prove that the systems function in accordance with the appropriate design criteria.

No plant other than 400/240 V lighting supplies shall be energised without the permission of the Engineer. The Contractor shall be responsible for the safety of both plant and personnel from the initial energisation of all plant and until handover.

The results of all tests shall be recorded and inserted into the operating and maintenance manuals.

MGA 1.4 Tests On Completion: Commissioning And Trial Operation

Before commissioning of the works the Contractor shall ensure the security of mountings, true, cool running of equipment, attend to adjustment and tuning, and ensure correct lubrication of all items. Sources of vibration and noise shall be located and the problem rectified.

Once the plant is running smoothly, each item shall be checked by the Engineer, together with the Contractor. Commissioning shall take place over a continuous period of four weeks, during which time the Contractor shall demonstrate the proper working of the equipment provided. All equipment shall operate trouble-free during the full four week period, failing which the equipment shall be repaired or replaced and commissioning shall be repeated, again over a four week period.

The Plant shall be operated on completion to the satisfaction of the Engineer over a continuous period of 28 days. The Plant shall at the discretion of the Engineer be divided into sections for the purpose of these tests but each and every section shall be tested for the full period of 28 days continuous operation.

During this period, the Contractor shall monitor:

- i. the performance of the raw water pumps;
- ii. the performance of the treatment plant in terms of raw water and treated water quality;
- iii. the performance of the filters in terms of washing frequency and washwater volumes;
- iv. the performance of the clear water pumps;
- v. the performance of the booster pumps.

MGA 1.5 Tests After Completion

The Employer will carry out tests after completion for a period of 28 days during the first rainy season following the taking over of the Works. During this period, the Employer will monitor:

- i. the performance of the raw water pumps;
- ii. the performance of the treatment plant in terms of raw water and treated water quality;
- iii. the performance of the filters in terms of washing frequency and washwater volumes;
- iv. the performance of the clear water pumps;
- v. the performance of the booster pumps.

SECTION MGD

STANDARD SPECIFICATION: GENERAL MECHANICAL DESIGN ASPECTS

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MGD 1 Scope

This section covers workmanship, materials of construction and other miscellaneous items applicable to all items of Plant, together with general requirements for particular items of mechanical Plant. All component parts of the Works shall, unless otherwise specified, comply with the provisions of this section or be subject to the approval of the Engineer. Deviation from this Specification will only be considered if the Engineer considers such deviation an improvement.

MGD 2 Safety

Equipment which is potentially dangerous shall be designed in accordance with a relevant South African or International Standard.

Hazards must be avoided or guarded. Nip points shall be guarded; sharp corners shall be rounded off; operating handles, supports and protrusions shall be kept clear of access ways.

Moving parts shall be properly guarded to the satisfaction of the Engineer.

An emergency stop button shall be installed in a convenient position next to each machine. The installation shall be designed to provide immediate access without the danger of accidental operation. In addition, trip wires which will stop the driving motor when pulled shall be provided along the accessible side/s of moving conveyor belts, chains and the like irrespective of operating speed and irrespective of guards provided.

Where, in the opinion of the Engineer, an installation is not safe, the Contractor shall remedy such defect at his own cost to the satisfaction of the Engineer.

MGD 3 Design factors

A high quality standard is demanded and reliability, long life, trouble free operation, efficiency, ease of maintenance and operation, and neatness are essential.

All plant and equipment shall be of robust construction and the design shall, as applicable, be based on:

- the full range of duties which can be reasonably anticipated;
- the power and torque transmitted by the driver system under full load and stalled conditions;
- the maximum pressure or vacuum which can be produced by pumps, blowers and compressors under all conditions including blocked or closed inlet and outlet circuits;
- conservative service and safety factors based on approved standards or laid down in the printed specifications of reputable and approved manufacturers;
- a safety margin of at least 20% in addition to any service or safety factors which apply;
- twenty four hour per day operation;
- a minimum life of 100 000 hours before repair or major part replacement; and
- Prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and as far as practical, mal-operation; if these occurrences cannot be avoided by good design.

Machines with non-overloading characteristics shall be selected wherever possible; e.g.:

motors shall be sized so that they cannot be overloaded by the driven machine.

MGD 4 Design Life

Unless otherwise specified, all items of Plant shall be rated for continuous service at the specified duties under the prevailing atmospheric and operational conditions on site. All materials and Plant shall be designed for long life with a minimum of maintenance and the Contractor may be called upon to demonstrate this for any component either by the service record of similar Plant elsewhere or by records of extensive type tests.

Routine maintenance and repair shall, as far as possible, not require the services of highly skilled personnel.

Except for consumable items such as gland packings, carbon brushes, etc., which normally require replacement more frequently, no part subject to wear shall have a life from new to replacement or repair of less than three years of continuous normal operation and where major dismantling is required to replace a part, such life shall be not less than ten years.

MGD 5 Moving parts

The following general requirements apply not only to machines but to all equipment with moving parts such as headstocks, extension spindles, swivelling davits, heavy duty hinges, pivots and the like:

All rotating or swivelling shafts, pins and the like, shall be adequately supported, guided and restrained by lubricated or self-lubricating bearings, collars and/or bushes.

Swivelling joints on linkages and the like shall be of the "universal" or fork and rod type with bearings or bushes fitted to the eyes or forks.

On abrasive applications abrasion resistant materials and slow speed operation shall be utilised.

Susceptibility to fatigue failure shall be minimised by proper design and manufacturing procedures. In particular, changes in section shall be radiused and care must be taken to avoid the use of welded components in areas of fluctuating stress.

The locking of nuts and pins in position shall be done to the approval of the Engineer.

Wearing parts shall be designed for inter changeability and ease of removal and replacement.

MGD 6 Arrangement and mounting

The arrangement and general design shall take the following requirements into consideration:

Lifting eyes, lugs, hooks, etc., shall be provided on heavy or large items to facilitate handling.

Castings or fabrications shall have machined pads for seating and be mounted on either soleplates or baseplates as appropriate.

Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.

The needs of operation and maintenance including neatness, access, working, space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.

With plant and equipment to be mounted on or against concrete or brick structures, provision shall be made for adjustment in the mechanical design. Any special accuracy requirements must be specified on the Contractor's Drawings.

MGD 7 Lifting equipment

All lifting equipment shall comply with the following requirements unless otherwise stated:

All aspects of lifting equipment, including design, fabrication and installation work shall be full in accordance with the relevant aspects of the Occupational Health and Safety Act and Regulations.

Lifting equipment shall be designed and constructed in accordance with a generally accepted technical standard.

The safe working load (SWL) shall be marked clearly on all items.

The complete installation shall be inspected and shall be tested over its complete lifting range using a load which is at least 125 % of the safe working load.

High-tensile or alloy steel chains shall have a factor of safety of at least four.

Chains shall have a factor of safety of at least five.

Steel-wire ropes shall have a factor of safety of at least six.

Man-made fibre ropes or woven webbing shall have a factor of safety of at least six.

Natural fibre ropes shall have a factor of safety of at least ten.

MGD 8 Materials and Workmanship

Materials - general

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.

All submerged moving parts of the Plant, or the pins and spindles, etc., of the submerged moving parts or the faces, etc., in contact with them shall be of corrosion-resistant metals. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall also maintain their properties without ageing due to the passage of time, exposure to light or any other cause.

Where "stainless steel" is specified or used it shall have resistance to atmospheric corrosion not less than that provided by BS EN 10088, Grade 304S11. Particular attention shall be made to the prevention of seizure by fretting where two corrosion-resistant metals are in contact, by the selection of materials of suitable relative hardness and surface finish and the application of lubricants. Where bronze is specified or used it shall be zinc-free.

Particular attention shall be paid to the prevention of corrosion due to the close proximity of dissimilar metals. Where it is necessary to use dissimilar metals in contact, they shall be selected so that the bimetallic corrosion is as low as possible.

Workmanship and general finish shall be of first class commercial quality and in accordance with best workshop practice. When erected and installed, the plant and equipment shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order.

The requirements of Sub-clause "Arrangement and Mounting" must be noted.

The Contractor shall provide all foundation bolts, supports, hangers, brackets, etc. required for the support and fixing of equipment.

The Contractor is not responsible for grouting puddle pipes which pass through liquid retaining walls or slabs but shall be responsible for all other grouting necessary for all plant and equipment.

The use of more than three shims in the alignment of equipment will not be permitted. Machined spacers shall be prepared where necessary. Shims and spacers shall be of a corrosion resistant material such as stainless steel.

Corrosion protection requirements shall be carefully attended to and the relevant paragraphs of Sub-clause "Paint Application" (see Clause "Corrosion Protection: Paint Coatings") must be noted. All mating faces must be coated before and sealed after assembly.

Fastener threads must be coated with a nickel-based, anti-seize compound before assembly.

Crevices which are formed between two surfaces shall be filled, prior to final fastening, with a suitable formable packing. This applies particularly to stainless steel.

All similar items of Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items of Plant. Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements made to manufacturer's drawings may be readily installed.

All Plant shall operate without excessive vibration and with the minimum of noise. All revolving parts shall be dynamically balanced so that when running at all operating speeds and any load up to the maximum there shall be no vibration due to lack of balance.

All parts that can be worn or damaged by dust shall be totally enclosed in dustproof housings.

Steel

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

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.

MGD 9 Structural Steel

Structural steel shall be in accordance with the requirements of SANS 1431. Mild steel shall be Grade 300W and high tensile steel shall be Grade 350W as set out in this specification.

The dimensions and properties of rolled steel sections shall be in accordance with the tables issued by the South African Institute of Steel Construction.

MGD 10 Workshop Details

The Contractor shall prepare his own workshop details where these are not provided on the drawings. On receipt of the design drawings and calculations, the Contractor shall satisfy himself that the design drawings contain all the information required for the preparation of the workshop details, supporting calculations, and any other necessary drawings. The workshop details and other drawings shall be submitted in duplicate to the Engineer for approval before the commencement of fabrication.

The Contractor's drawings shall be complete in every respect (including welding details, which shall be fully described) and shall be checked by the Contractor prior to submission. The Engineer will retain one copy of each drawing and the other copy will be returned to the Contractor with the Engineer's comments or written approval.

Contract No: RW10404061/23

**Description: TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS BY 15 ML/DAY
AT MEYERTON
PROJECT SPECIFICATIONS**

Fabrication shall not commence unless and until the Contractor has obtained the Engineer's approval, in writing, of the workshop details. The approval given by the Engineer does not absolve the Contractor from the responsibility for dimensional accuracy and structural adequacy.

MGD 11 Fabrication And Assembly

All structural steel shall be within the tolerances specified in the relevant clause and shall be flat, straight (unless required to be formed to another shape) and free from twists. At all stages of fabrication, any structural metal other than grade 300W steel shall be positively identified by grade by means of a suitable approved marking system.

Cutting may be done by sawing, shearing, cropping or flame cutting provided that the method used will not adversely affect the properties of the material. Edges shall be free from any defects or distortions, and all burrs, notches and similar defects shall be removed.

The abutting surfaces of joints which depend on contact for the transmission of load shall be accurately prepared so that the full area of surfaces intended for bearing is in contact.

Unless protection against corrosion is provided by other means approved by the Engineer, the interior of any hollow section shall be sealed to prevent the ingress of water into the interior of the member. Vent holes for galvanizing shall be sealed by means of a plastic plug after galvanizing has been completed.

Holes for fasteners shall not be formed by flame cutting. Holes in light members not thicker than 12 mm or the diameter of the hole, whichever is the smaller, may be punched. Holes for fasteners up to 25 mm in diameter shall not be more than 2 mm bigger than the fastener diameter, and for larger fasteners not more than 3 mm bigger than the fastener diameter. All burrs shall be removed from holes before assembly.

All matching holes for fasteners or pins shall be accurately aligned so that the fasteners can be inserted freely through the assembled members in a direction at right angles to the faces in contact. Drifting to align the holes shall not distort the metal or enlarge the holes.

The parts to be joined shall be firmly drawn together. Where necessary, washers shall be tapered to give the bolt heads and nuts a full bearing. Where bolt holes have clearances greater than those specified and are acceptable to the Engineer, washers shall be used under the bolt heads and nuts.

The length of each bolt shall be such that, after tightening, at least two full thread revolutions, but not more than five, will project beyond the outer face of the nut and at least one full thread (in addition to the thread run-out) will remain clear between the nut and the unthreaded shank.

Wherever possible, riveting shall be done with pneumatic equipment. Riveted members shall have all parts firmly drawn together and aligned before riveting is done. Each rivet shall, when driven, completely fill the hole and have a well-formed head or, if countersunk, shall completely fill the countersink. All loose, eccentric-headed, badly formed, burnt or otherwise defective rivets shall be cut out and replaced at the Contractor's expense.

MGD 12 Staircases

Staircases shall be provided in accordance with the details and positions as shown on the drawings and in accordance with the requirements of this section.

The staircases shall be fabricated from the materials specified in the detail specifications, shall be of an approved design and shall comply with all the requirements of the Occupational Health And Safety Act.

All mild steel staircases shall be galvanized in accordance with the requirements of the Standard Specification on Corrosion Protection. All galvanising shall be done in accordance with SANS 763 for heavy duty applications. Under no circumstances shall any cutting, drilling, welding, etc. be allowed after galvanizing.

Each staircase shall be fastened with at least four bolts at its top to a structure, wall or beam. The bottom of each staircase shall be founded on a concrete base to which it shall be fastened with at least four anchor bolts. The minimum width of all staircases measured between the handrails shall be 900 mm, unless otherwise shown on the drawings.

MGD 13 Hand-railings

Hand-railing shall be provided on the sides of all staircases and edges of walkways as required by the Occupational Health And Safety Act.

All hand-railing shall be of the material specified in the detail specifications, and shall be manufactured and positioned in accordance with the details shown on the drawings and in accordance with the detail specifications.

Galvanizing shall be applied to all mild steel hand-railing, and shall be of the heavy-duty class in accordance with the requirements of the Standard Specification on Corrosion Protection, and under no circumstances shall any cutting, drilling, welding, etc. on any part be allowed after galvanizing.

All hand-railing shall be erected strictly in accordance with the manufacturer's requirements and shall be standard "Wecrolok" or approved equivalent types.

The painting of hand-railing shall mean the application of a final coat of paint, as specified in the Standard Specification on Corrosion Protection. Unless otherwise instructed by the Engineer the colour of the final coat shall be as indicated in the Standard Specification on Colour Coding.

MGD 14 Welding

Welded parts consisting of steel to BS EN 10113, BS EN 10028 or similar steel shall be welded in accordance with BS EN 1011. Circumferential welds, etc., shall be fabricated and tested in accordance with PD 5500, BS 2633 or equivalent standards where applicable.

All joints shall have the plate edges accurately prepared to the appropriate profile for welding. The parts shall then be assembled and accurately checked before welding proceeds. The welding and fabricating procedure shall be such that residual stresses are a minimum and distortion is avoided. Special attention shall be given to ensure that distortion does not occur after machining to affect the alignment and operation of the part concerned. All fabricated items shall be stress relieved after welding.

Welding procedures shall be in accordance with BS EN 288-3:1992. Each unit shall be fabricated and welding completed before final machining or other fitting work is carried out. All fillet welds shall be continuous. Intermittent welding and incomplete penetration butt welding shall not be used. All welds

shall be sound, full strength and free from undercut and slag inclusions. Crater effects at the ends of weld runs shall be eliminated. All slag shall be removed.

Welding electrodes shall be of the low hydrogen type and shall comply with requirements not less than BS EN 499 or equivalent standard for carbon steels, and BS EN 1600 or equivalent standard for stainless steels. Only stainless steel electrodes shall be used for welding stainless steel. Stainless steel to be welded shall be suitably stabilised.

Only skilled, qualified and tested welders shall be employed. The welders shall be tested in accordance with BS EN 287-1:1992, or other equivalent standard. Detailed records of welding shall be kept, showing the name of each welder against each run in a weld and any welder found to be producing an unacceptable amount of defects shall be removed until he has passed the test again.

All welds shall be 100% ultrasonically tested. Ultrasonic testing shall be carried out in accordance with BS EN 1714:1998 and the Contractor shall propose a standard of acceptance. All fillet welds shall be tested by ultrasonic crack detection, or other approved means. For all other items of Plant the Contractor shall allow for adequate radiographic examination of the welds. The positions to be examined will be indicated by the Engineer. The "International Institute of Welding Collection of Reference Radiographs of Welds" shall be used as a guide for the interpretation of radiographs and as a basis for comparison regarding the nature and extent of weld defects. The minimum grade for acceptance shall be blue.

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

MGD 15 Castings

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

Grey Cast Iron Castings	SANS 1034	BS.1452
S.G. Iron Castings	SANS 936/7	BS.2789
Steel Castings (General Purpose)	SANS 1465	BS.3100
Aluminium Castings	SANS 989/992	BS.1490
Copper and Copper Alloy Castings	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 and sand and slag inclusions 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 cast iron shall be of standard grey close-grained quality to BS EN 1561:1997. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings that are not machined shall be smooth and shall be carefully fettled to remove all foundry irregularities.

Minor defects not exceeding 12½% of total metal thickness and that will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer shall be notified of larger defects and no repair welding of such defects shall be carried out without prior approval. If the removal of metal for repair will reduce the stress-resisting cross-section of the casting by more than 25%, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25%, then that casting may be rejected. Castings repaired by welding for

major defects shall be stress-relieved after such welding.

Non-destructive tests will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine that repair welds have been properly made.

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.

MGD 16 Fabrication of carbon steels

Standards

Steelwork shall be constructed, fabricated and erected in accordance with SANS 1200H where applicable.

Finish

Weld spatter and other protrusions shall be removed. Sharp edges shall be rounded to a radius of at least 2mm.

Requirements for corrosion protection

In addition to finishing requirements, the requirements of corrosion protection application shall be taken into consideration. All surfaces must be accessible for surface preparation and coating. Inaccessible pockets, open hollow sections or the like shall not be permitted except where hot-dip galvanizing (without painting) is called for. Surfaces which cannot be properly prepared after fabrication must be abrasive blasted and coated with a two-pack epoxy pre-weld primer before fabrication.

MGD 17 Fabrication of stainless steels

The requirements regarding the fabrication of carbon steels apply to the fabrication of stainless steels as well. In addition, the following requirements apply to the fabrication of stainless steels.

Surfaces which become contaminated with steel or otherwise stained or otherwise marked so as to be of uneven colour, shall be cleaned by pickling or electro-cleaning rather than by grinding.

The Contractor shall arrange for the Engineer to inspect fabrications, including fabricated pipework in the fabrication workshop.

MGD 18 Forgings

All major, stress-bearing forgings shall be made to a standard specification that shall be submitted to the Engineer for approval before work is commenced. They shall be subject to internal examination and non-destructive tests for the detection of flaws, and shall be heat treated for the relief of residual

stresses. The name of the maker and particulars of the heat treatment proposed for each such forging shall be submitted to the Engineer. The Engineer may arrange for such forgings to be inspected at the place of manufacture with a representative of the Contractor.

MGD 19 Fixings

Nuts, bolts, studs and washers for incorporation in the Plant shall conform to the requirements of the appropriate approved standard. Nuts and bolts for pressure parts shall be of the best quality bright steel, machined on the shank and under the head and nut. Bolts shall be of sufficient length such that two thread revolutions shall show through the nut when in the fully tightened condition.

Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of a diameter such that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.

Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Engineer.

Where bolts pass through structural members, taper washers shall be fitted where necessary to ensure that no bending stress is caused in the bolt.

Where there is a risk of corrosion, bolts and studs shall be designed so that the maximum stress in the bolt and nut does not exceed half the yield stress of the material under all conditions.

All bolts, nuts and screws which are submerged in water shall be made of nickel-bearing stainless steel.

MGD20 Allowance for Wastage

The Contractor shall supply as specified and to the satisfaction of the Engineer reasonable excess quantities to cover wastage of those materials which will normally be subject to waste during erection, commissioning and setting to work.

MGD 21 Lubrication

Provision shall be made for suitable lubrication to ensure smooth operation, heat removal and freedom from undue wear. Plant selected shall require minimum lubrication attendance and down time for lubricant change.

The Contractor shall furnish a complete schedule of recommended oils and other lubricants. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Engineer for approval before incorporation in the instruction manuals. In the case of grease lubricated roller type bearings for electric motors a lithium base grease is preferred.

The Contractor shall supply the first fill of oil and grease from approved lubricant suppliers.

All grease nipples, oil cups and dip sticks shall be readily accessible, being piped to a point as near as practicable to the lubrication point.

MGD 21.1 Grease Lubrication

Where lubrication is effected by means of grease, preference shall be given to a pressure system that does not require frequent adjustment or recharging. Frequent, for this purpose means more than once weekly and grease systems having shorter periods between greasing should be avoided. Where

necessary for accessibility grease nipples shall be placed at the end of the extension piping and, when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position with spacing in accordance with the recommendations of BS 1486 Part 1. Button head type nipples shall be used for normal grease lubrication. Anti-friction bearings requiring infrequent charging shall be fitted with hydraulic type nipples. Where more than one special grease is required a grease gun for each special type shall be supplied and permanently labelled. Pipework for grease distribution shall be of stainless steel or non-ferrous metal.

MGD 21.2 Oil Lubrication

Oil sumps shall be fitted with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The normal, maximum and minimum levels at 30° C shall be clearly visible in the sight glass type as viewed from the normal access floor to the particular item of Plant, and they shall be easily dismantled for cleaning.

All sight glasses shall be firmly held and enclosed in metal protection in such manner that they cannot be accidentally damaged.

All lubrication systems shall be designed so as not to present a fire hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into contact with any electrical Plant, heated surfaces or any other potential source of fire.

Gear boxes and oil baths shall be provided with adequately sized filling and draining plugs and suitable means of oil level indication.

Roller chain drives shall have oil bath lubrication.

Drain points shall be located or piped to a position such that an adequately sized container can be placed beneath them. Where a large quantity of oil is involved or drainage to a container difficult, a drain valve and plug shall be provided at the point of discharge.

Bearings equipped with force fed oil lubrication shall be automatically charged prior to machinery starting up and pressure monitored during operation with automatic shutdown of machinery and alarm on low oil pressure.

Access, without the use of portable ladders, to lubrication systems shall be such as to permit maintenance, drainage and re-filling, without contamination of the charged lubricant.

The design of breathers shall take into account the humidity and atmospheric contamination at the vent point and measures shall be incorporated to prevent contamination of the lubricant.

The Contractor shall supply flushing oil for each lubrication system when an item of Plant is ready for preliminary running and a sufficient quantity of the approved lubricants for setting to work and for the commercial operation of the Plant for two years after the Taking-Over Certificate has been issued.

MGD 22 Alignment

Machinery bedplate design, packing and fixing shall be such as to minimise distortion and vibration. Aligned machinery shall be mounted on either bed or sole plates permitting removal and reinstatement without a requirement to re-grout. Bedplates shall incorporate fine adjustment of the vertical and horizontal alignment between driver and driven members.

Final alignment shall be done after installation and before commissioning, shall be checked in the presence of the Engineer and shall be to his approval. Alignment shall be sufficiently accurate to ensure that no initial pre-load is placed on the shaft coupling.

Each motor shall be aligned to its pump using laser aligning equipment.

The use of pourable epoxy resin chocks shall be acceptable. If pourable chocks are used, the baseplate feet do not have to be machined but each machine foot shall be provided with a screw for vertical alignment. The chock thickness shall not be less than 20 mm.

MGD 23 f) Machinery Dismantling

- g) Tapped holes or other provisions must be made in all main castings, for the insertion of jacking screws or the fixing of drawing gear to facilitate dismantling. On items of machinery subject to frequent dismantling, bolts or studs shall be employed in preference to set screws.

MGD 24 h) Guards

- i) Guards shall comply in all respects with the Occupational Health and Safety Regulations and the following points shall also be noted: -
- j) Guards are required to cover all moving or revolving components of machinery. They shall be designed to be secure but removable without disturbing other parts of the Plant. Guards which do not adequately cover moving protrusions such as keys, lock-nuts, lock-washers, setscrews, etc., or irregularities such as keyways, will under no circumstances be accepted. The Contractor shall ensure that stationery points, requiring access, are located safely, outside the guards. Large guards shall be equipped with small removable panels for the inspection and checking of enclosed components.
- k) Guards shall be neatly and rigidly constructed and fixed and shall not vibrate or cause noise during operation.
- l) Where expanded metal or similar mesh is used, the mesh opening shall not permit a circular object 10mm or larger to penetrate.
- m) Mesh shall not be used for chain guards but on belt drives the side of the guard most conveniently sited for inspection shall be constructed of expanded metal or similar. Mesh should similarly be used in other situations where inspection or ventilation is required.
- n) Guards shall completely enclose drives and shall entirely prevent a person from touching any moving protrusion.
- o) Allowance must be made for adjustment on belt guards or where adjustment will be required.
- p) It shall be possible to remove the guard easily for maintenance purposes.
- q) Guards shall preferably be fabricated of 316 stainless steel (uncoated) but may also be hot-dip galvanized, zinc-sprayed or aluminium-sprayed carbon steel, coated to specification in all these cases. Fasteners shall be M10 or larger and shall be of 316 stainless steel.
- r) Guards shall be provided to prevent access to electrical apparatus and moving parts of machinery.

s) Noise and Vibration

All Plant must be capable of being operated without excessive vibration and the minimum amount of noise.

A maximum noise level at the Site boundaries not exceeding an equivalent continuous sound level of 55dB(A) when all equipment installed is being operated; and

Where the Contractor is unable to restrict the noise level of the machines to the maximum specified, by the appropriate selection of suitable equipment; e.g. by selecting slow speed or silent type machines, quiet type cooling fans, suitable silencers, etc. then sound attenuation by means of an acoustic hood or similar shall be offered.

The Contractor shall provide and fix all material for the prevention of transmission of noise and vibration through the structure. All fans, motors, A/C package units, compressors, diesel engines and other motive Plant shall be mounted on resilient mountings in such a manner that the Plant foundations are isolated from the floor or structure. In addition, all rotating Plant shall be statically and dynamically balanced.

Mechanical vibration shall be isolated by the use of anti-vibration mountings and flexible connections to ensure an isolation efficiency of 95% from the building structure. Vibration in plant, equipment, pipework, valves, etc. under all conditions, including when one, two or more units are in operation, shall be limited so that have the instantaneous acceleration due to vibration in any axis is limited to 0.2g (where g is the gravitational constant).

Gearboxes

Gearboxes that must be angle mounted shall have a rating, choice of bearings, seals and lubrication system suitable for such mounting. Splash lubrication alone is not acceptable but may be used in conjunction with a forced feed method to reach all bearings and gears. Calibration of the oil dipstick and its position together with that of the sump drain plug will require special consideration.

MGD 27 Bearings

The Contractor shall select the most appropriate type of bearing for the Plant supplied. Plant with vertical shafts shall have thrust and guide bearings. All bearings shall be designed to prevent the ingress of water except where the bearings are water lubricated.

Single journal plain bearings shall have phosphor bronze or synthetic lubrication impregnated bushes and carbon or stainless steel journals respectively. Synthetic bearings shall only be used where bearing condition can readily be inspected.

Plain type bearings shall be self-lubricating by grease, forced oil or impregnation. Ball and roller type bearings shall be adequately lubricated by oil or grease and sealed to prevent leakage of lubricant along the shaft. Attention shall be given to ensure that dismantling of bearings is simple and free from risk of damage.

Sealed for life units are acceptable subject to a minimum design life of 50 000 hours operation at maximum loading. Plant that may be subject to vibration whilst stationary shall be provided with bearings designed to withstand damage from such a cause. Bearings fitted to gearboxes shall have a minimum design life of 100 000 hours at maximum loading.

Below-water bearings shall be of the journal type, of ferrobestos, rubber, gunmetal or equal with journals of stainless steel.

Bearing systems shall be designed to provide safe shut down without damage under normal stoppages as well as electrical supply failure.

MGD 28 Payment Items

Payment for actions to be taken in accordance with this specification shall be deemed included in the tendered rates and prices for the items to which such actions relate.

SECTION MCP

STANDARD SPECIFICATION: CORROSION PROTECTION

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MCP 1 **Scope**

All metal items forming part of the works shall be coated with a protective system to inhibit corrosion. The specifications for surface preparation, selection of materials and application of the protective system are covered in this section.

Due to the corrosive nature of the fluids and hence the atmosphere in and around the plant, particular attention is to be paid to corrosion protection.

Surface preparation and coating application shall be carried out by experienced industrial painting contractors who are fully equipped and staffed to do such work in their own covered premises strictly in accordance with the paint manufacturer's recommendations. Before proceeding with the corrosion protection coatings, the Contractor shall submit the name of the painting sub-contractor for approval by the Engineer.

Any material or equipment that forms part of the works and which shows signs of corrosion during the Defects Notification Period shall be replaced by the Contractor at his own cost with a similar item providing superior corrosion resistance.

MCP 2 **General**

The Contractor shall ensure that he has available the latest edition of all the relevant National Specifications and Codes of Practice and the manufacturer's data sheets for materials to be used.

Surface preparation and coating application shall not be done on Site except for minor repairs and for application of the final aesthetic coat, where specifically called for or where permitted by the Engineer in writing.

All paints in a paint system shall be purchased from the same manufacturer.

The Contractor shall submit in the Appendices to the document, details of the paints he intends using and shall only proceed with purchase of the paints upon receipt of written approval from the Engineer.

Manufacturer's data sheet or legible copies thereof for each product shall be attached to the Appendices.

Materials and procedures shall comply with the appropriate SABS Specifications and Codes of Practice when relevant.

Strict attention shall be paid to fettling of surfaces by the Fabricator (see Clause MCP 5) prior to coating. Surface preparation requirements, the need for strict cleanliness and adherence to specification requirements especially with regards to over coating times are emphasized.

Areas which are 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 of 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.

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 organization.

The Contractor shall provide a Quality Plan to show the stages at which Quality Control will be carried out. The Quality Plan is subjected to approval by the Engineer, who may require it to be revised if considered inadequate.

The Engineer will require a Program of Work so that Quality Surveillance inspection can be planned and executed at the appropriate time according to the Contractor's program .

The Contractor shall provide the material suppliers descriptions of materials to be used and shall receive from them a written assurance that the materials to be supplied will meet the requirements specified.

MCP 3

Design

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

Water Retention Areas

Avoid water retention areas wherever possible. For example, angle or U section steel should be used with the toes pointing downwards. The concrete base of steel columns should be sloped away from the steel and the sloping edge should be painted to avoid water ingress at the steel/concrete interface.

Crevices

Crevices give rise to accelerated corrosion by forming an oxygen concentration cell. Crevices may be avoided by using;

- continuous welding, not space welding
- mastics or sealants to seal unavoidable crevices such as bolted connections
- Insertion of rubber or suitable plastic between mating surfaces.

Bimetallic Couples

Electrical contact between dissimilar metals gives rise to a corrosion cell when an electrolyte such as water is present. Junctions between dissimilar metals shall be insulated.

Accessibility

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

Differential Aeration

Posts buried in soil are subjected to accelerated corrosion to differential aeration. Additional protection shall be given to that part which is buried and up to at least 100 mm above ground.

Sharp Edges, Weld Spatter and Weld Slag

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

Hot Dip Galvanizing

The design of articles to be galvanized shall be referred to the galvanizer .

MCP 4

Materials

No variation in materials tendered and approved by the Engineer shall be permitted without the approval of the Engineer in writing.

Correct material selection shall be confirmed by the material supplier.

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

Manufacturer's name.

Product Brand and Reference Number.

Batch Number which may incorporate the date of manufacture.

Date of manufacture, unless already incorporated in the batch number.

Abbreviated instructions for storage and use of the material, which shall include mixing ratios of components of multi-component materials, minimum temperature of application and method of application.

The SABS mark where applicable.

All coating materials shall be kept in an approved store, which shall be dry, enclosed and where the temperature is unlikely to exceed 40C 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.

Materials used in the preparation and application of corrosion protection systems shall comply with the following requirements:

a) Blast cleaning

Grit for blast cleaning shall be in accordance with SABS 064.

b) Hot dip galvanising and zinc spraying

The quality of zinc shall conform to the requirements of SABS 763.

c) Paint

Paints shall be used in accordance with manufacturer's requirements. Shelf life and pot life times shall not be exceeded. Only thinning as recommended by the manufacturer will be permitted.

Particular care shall be taken in ensuring compatibility of the various layers of a paint system.

Paint shall comply with the relevant SABS specification.

Alternate layers in a paint system shall be contrasting colours to facilitate uniform coverage.

Particular care shall be taken in correct materials selection and usage for touch up of damaged areas.

MCP 5 Fettling or Dressing by the Fabricator

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

Remove all weld flux and weld spatter. 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.

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

Articles for hot dip galvanizing shall not contain overlap joints. Closed sections shall be suitably vented.

MCP 6 Surface Preparation

Mild Steel

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

Mild steel shall be blast cleaned in accordance with Section 4.3 of SABS 064 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 value given in Table 1. 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.

Property	Above Water	Immersed Surface	Tape Wrapping
Cleanliness to SIS	Sa2½	Sa3	Sa2
06 5900 (min)			
Residual dust and debris	0,5%	0,3%	1%
Oil grease and perspiration	Nil	Nil	Nil
Surface Profile min (micrometers)	25	50	50
	50	10	100
Water soluble iron salts maximum at any point	500 mg/m ²	100 mg/m ²	500 mg/m ²

Average of any 250 cm	100 mg/m ²	100 mg/m ²	100 mg/m ²
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TABLE 1 – REQUIRED STANDARDS FOR BLAST CLEANING

Cast Iron and Cast Alloys

All cast surfaces shall be blast cleaned with new 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 burst on sand and casting skin have been completely removed. This blast cleaning shall be carried out by the Foundry prior to cleaning of castings is inadequate for galvanizing.

Galvanized Steel Surfaces

Galvanized steel surfaces shall be thoroughly degreased prior to painting, using either a water risible solvent degreaser used in accordance with the manufacturer's instructions, 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 and 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 which, when wetted all over with potable water, maintains a continuously wet surface and the water does not break up into islands of un-wetted surface.

After degreasing, the surface shall be lightly abraded by one of the following methods:

- On small areas by the use of abrasive paper not coarser than 120 grade, or by using non-metallic abrasive pads.
- On large areas by "sweep blast cleaning", using a nozzle pressure not greater than 300 kPa and a very fine abrasive. Cracking, flaking, or any form of de-lamination of the zinc coating due to excessive blast cleaning shall not be permitted. Removal of zinc by blast cleaning shall not exceed 10 micrometers.

Finally, all dust and debris shall be removed by vacuum cleaning, or by washing, and the surface shall be allowed to dry before coating.

Aluminum

Generally, aluminum surfaces will be anodized or powder coated and will require no further treatment. Where painting is required, the aluminum 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, and then apply a thin coat (8 to 13 micrometers dry film thickness) of wash primer complying with SABS 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.

Stainless Steel

Components fabricated from stainless steel shall not be contaminated with iron or mild steel. Sheared edges, welds or surfaces subjected to any form of heat treatment shall be pickled and passivity. Stainless steel surfaces shall not be scratched or stressed.

When it is required to paint stainless steel, the surface shall be blast cleaned with non-metallic abrasive

such as iron slag, copper slag or platinum slag. The use of steel shot, steel grit or cast iron is strictly prohibited. Any contamination with iron or mild steel is prohibited.

Where blasting is impractical, the surface shall be cleaned with detergent solution and roughened manually by using 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.

Painted Surfaces

i. Fully painted surfaces to be repaired

Bare areas shall be cleaned with abrasive paper not coarser than 220 mesh to bright metal surface. The surrounding paint, which must be intact, shall be feathered for a distance of 20 mm beyond the damaged areas. 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. The damaged area shall be allowed to dry, after which spot repair 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.

When additional coats are required over the whole surface, the whole surface shall be abraded to a uniform matt finish, dust and debris removed, and the surface allowed to dry. All further coats shall then be applied as specified to give a uniform finish. Note that abrasion of the coating is not required for vinyl systems.

ii. Fully painted surfaces to be over coated

Where additional coats are required over the whole surface, the surface shall be degreased and abraded to a uniform matt finish. The surface shall be washed to remove all contamination and then allowed to dry. Further coats shall then be applied as specified to give the required coating thickness and specified finish.

iii. Primed surfaces

Shop applied 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.

Plastic Surface such as u-PVC and Polyester GRP

Sand the surface thoroughly with fine abrasive paper to achieve a uniform matt finish. Remove all debris, oil and grease by scrubbing with a solution of a suitable water based detergent such as Shell Teepol Lensex. Allow to react for 15 to 30 minutes, and then rinse off very thoroughly with clean potable water to remove all residues. Allow to dry completely before painting.

General Requirements

Surface preparation prior to application of corrosion protection systems shall comply with the following requirements:

a) Blast cleaning

Blast cleaning of the base metal shall be in accordance with the requirements of SABS 064.

For hot dip galvanised items the surface preparation shall be in accordance with the requirements of SABS 763.

b) Surface cleanliness

The contractor shall ensure that all surfaces are free of rust, grease (finger marks) and moisture immediately prior to coating. Not more than 4 hours shall pass before coating of blast cleaned

surfaces.

c) Control of environment

Wherever possible painting shall be done under factory conditions, before the items are transported to site. Only decorative final coats shall be applied on site after erection. Paints shall be applied in a dust-free environment, within the temperature and humidity limits set by the manufacturer.

d) Overcoating and repair of damaged areas

Where maximum times exceed overcoating times as specified by the manufacturer, the surface shall be prepared by rubbing down with emery paper and the surface cleaned of all dust.

Areas of damaged paintwork shall be prepared by rubbing down to base metal, or sandblasting if the area affected is extensive, to a distance of 25 mm from the damaged area. Care shall be taken to ensure a neat feathering of the edges. The exposed metal area so prepared shall be re-coated within 4 hours.

Galvanised items

Where galvanised items are to be painted the item shall not be passivated. The surface shall be degreased, clean to a water break-free surface, and dry prior to painting.

Damaged areas of galvanising shall be thoroughly rubbed down and two coats of "cold galvanising" applied.

MCP 7

Application of Paints

Environmental Conditions

Paint shall not be applied in dusty conditions, nor when the steel surface temperature is less than 3 C above dew point, or higher than the advised by the paint manufacturer, or 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.

Mixing

All coating materials shall be very thoroughly mixed until 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.

Method of Application

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

NOTE: Zinc silicate primers shall be applied by conventional spray, using a continuously agitated pressure pot, unless otherwise recommended in writing by the manufacturer.

Over-Coating

Over-coating 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 over-coating times is particularly important for coatings which are subsequently immersed.

The contractor shall be held responsible for blistering of paint coatings on immersion, when shown to be caused by solvent retention.

All coats shall be clean and free from dust, oil, moisture, perspiration before over-coating. Operators handling blast cleaned or partially painted surface shall wear clean gloves to avoid contamination of the surface.

Manufacturer's Instructions

Recommendations supplied by the manufacturer in the form of the latest edition of printed data sheets, or given in writing on the manufacturer's letterhead, shall be followed. Verbal information by the manufacturer's representative will not be accepted unless confirmed in writing by the company.

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 minimize damage to the coating. All damage caused in handling, transportation and erection shall be repaired to the satisfaction of the Engineer at no extra cost.

MCP 8

Metal Coating and Corrosion Resistant Metals

Hot Dip Galvanizing

Design and Fabrication

Components for hot dip galvanizing shall be designed and fabricated in accordance with the recommendations of SABS Code of Practice Project No. 341/50490 (not published at the time of preparation of his specification), except that the use of lead plugs is not permitted.

It is recommended that the manufacturer consults the galvanizer before design and fabrication to ensure that the fabrication will be suitable of galvanizing.

The main requirements are as follows:

- (i) Overlap joints shall be avoided wherever possible. If essential, such overlap joints shall be thoroughly degreased before assembly and shall be vented by drilling holes through one or both overlapping materials.
- (ii) Closed sections shall be suitably vented. If the inside of a closed section is not to be galvanized, a snorkel vent tube of suitable length and bore shall be attached.
- (iii) Gussets and internal baffles in tanks shall be cropped to allow free flow of zinc and air.
- (iv) Joints shall be continuously welded, using balanced welding techniques to avoid stresses. Welds shall be free from cavities, undercutting, weld slag and spatter.
- (v) Symmetrical design shall be used whenever possible and the use of thin gauge steel adjacent to heavy sections shall be avoided.
- (vi) Openings and flanges of manholes and bosses shall finish flush on the inside to ensure complete drainage.
- (vii) Castings shall be designed to be of as uniform section as possible and shall be blast cleaned as specified before dispatch to the galvanizer.

The Hot Dip Galvanizing Process

- (i) Hot dip galvanizing shall comply with SABS 763 for fabricated articles, SABS 934 for

pre-galvanized sheet or SABS 935 for wire.

- (ii) Mating surface on fabricated or cast iron components shall be wiped or centrifuged on removal from the galvanizing bath to remove blobs, runs or excess metal that may impair the air/gas/water tightness of the joint.
- (iii) Bolts, nuts and washers used for fixing shall be hot dip galvanized to SABS 763. Electroplated fasteners will not be accepted unless otherwise agreed by the Engineer in writing.

Repair of Galvanized Articles

Welding, flame cutting, or other heat processes shall not be carried out on galvanized articles unless permission is granted by the Engineer in writing.

If such permission is given, or if mechanical damage has occurred, repair shall be carried out as follows:

- (i) 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.
- (ii) The preferred repair process is to blast clean the bare steel and apply zinc by the thermal spray process in accordance with SABS 1391 Part 1, Grade Zn 150. On completion of metal spraying, burnish the surface by means of a mechanical wire brush to give a uniform appearance. Such burnishing shall remove not more than 10 micrometers of zinc.
- (iii) Where small areas are to be repaired, clean the surface thoroughly with fine abrasive paper, remove all debris with a damp cloth and allow to dry. Apply an approved one pack epoxy ester based zinc rich primer containing not less than 90% by mass of zinc in the dry film. A sufficient number of coats (usually 3 or 4) shall be applied such that the repair coating thickness is not less than the average zinc thickness specified in SABS 763, 934 or 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 primer is completely dry, one coat of alkyd resin aluminum paint may be applied to obtain a uniform appearance.

NOTE: Repair of galvanized surfaces by application of aluminum paint alone IS NOT PERMITTED.

Storage of Galvanized Components

Galvanized components shall be stored 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 to avoid "ponding" by rainwater.

If storage staining does occur, remove the stains by scrubbing with detergent solution and bristle brush or nylon pad. The use of steel wool or other metallic abrasive is not permitted. Rinse thoroughly and allow to dry. If the residual zinc thickness complies with the requirements of the appropriate grade in the relevant specification, no further action is required unless instructed by the Engineer.

If the zinc thickness is below specification, the article shall be re-galvanized or repaired as instructed by the Engineer.

Stainless Steel Fabrications

Grade and Welding Techniques

The grade of stainless steel to be used shall be as specified in the appropriate section of the mechanical specification or drawing. Where welding is necessary, the appropriate "L" (low carbon content) shall be used. Plate shall be supplied as No 1 Finish in accordance with BS 1449 Part 4.

Welding procedures shall be only those recommended by the stainless steel manufacturer or by the South African Stainless Steel Development Association. Only welders coded to BS 4870 Part 1 or to ASME IX, 1983 shall be employed.

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

Fabrication of stainless steel components shall be carried out in clean work places where there is no contamination by mild steel. Grinding and polishing equipment shall be dedicated and shall not be contaminated with iron or mild steel.

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

Pickling and Passivation

Cut edges, welds and heat treated surfaces shall be pickled and passivated to remove all discoloration. Proprietary pickling and passivating pastes (as supplied by an approved supplier) shall be used in accordance with the manufacturer's recommendations. Care shall be taken not to exceed the maximum contact time recommended.

All safety precautions shall be strictly observed.

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 stainless steel manufacturer or the South African Stainless Steel Development Association. SAFETY PRECAUTIONS shall be strictly observed.

Corrosion Resistant Steel 3CR12

Welding Techniques

- (i) Welds shall be full penetration welds, using 309 austenitic electrodes or filler wire, or as recommended by the manufacturers.
- (ii) Welders shall be suitably coded for welding similar thickness of austenitic stainless steel, in accordance with BS 4870 Part 1 or ASME IX, 1983.
- (iii) Welding procedures shall comply with the recommendations of the manufacturers of 3CR12.
- (iv) Welds shall be smooth and free from blow holes, undercuts, sharp projections and similar visual defects.

Pickling and Passivation

- (i) After completion of welding, both weld and heat affected zones shall be cleaned, pickled and passivated. Any heat scale on the steel shall be pickled and passivated.
 - (ii) The procedure shall be as follows:
 - a) Not to painted surfaces
- Grind or wire brush, using dedicated grinders or stainless steel wire brushes to achieve the required smooth profile or remove scale.

- b) Pickle with a thixotropic paste containing 15-20% nitric acid and 1-2% hydrofluoric acid, with a contact time of 15 to 10 minutes.
- c) Rinse thoroughly with clean water until the pH of the washings is the same as that of the wash water.
- d) Repeat the above process, if necessary to remove all discoloration.
- e) 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.
- f) Rinse thoroughly with clean potable water until washings are the same pH as the wash water.
- g) Operatives shall wear protective aprons, gloves and safety glasses during pickling and passivating operations.
- h) Splashes on the skin shall be thoroughly washed with clean water immediately after contact. A weak solution of sodium bicarbonate shall be kept available for neutralization. Seek medical attention if in doubt.
- i) 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).

Aluminium

Anodizing

Aluminum components where specified as anodized shall be natural anodized and sealed in accordance with SABS 999 Grade 25. The corrosion resistance of the coating shall be not less than 8 when tested in accordance with 3.6 of specification SABS 999. Anodising shall be carried out after completion of all welding.

Powder Coating

When specified by the Engineer, aluminum handrails 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 power coat aluminum effectively. The coating shall comply with BS6496, 1984.

Fixing

Whenever aluminum components, such as stop log frames, come into contact with concrete or grout, the surface of the aluminum in contact with concrete shall be coated with two coats of an approved epoxy tar composition.

Quality Assurance Requirements

Contractor Qualification

The Tenderer shall state in the Appendix to his document the name of the painting sub-contractor that he proposes to use to carry out the painting or coating. The Engineer may, at his discretion, require a Quality Audit of the painting sub-contractor to ensure that he has the management, facilities, skilled staff, and quality control 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.

The contractor shall obtain confirmation from the material supplier that materials to be used comply with the specification and are suitable for the intended purpose by having the appropriate Appendix completed by the material supplier.

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, all as required by the specification. Quality control shall be inclusive in the contractor's tender price.

Quality Surveillance

Independent surveillance – The Engineer may employ an independent technically of the work on his behalf.

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

- (i) Completion of fettling or dressing prior to leaving the fabricator's works.
- (ii) Blast cleaning and application of the first or prime coat.
- (iii) After completion of all coats to be applied at the contractor's works.
- (iv) At the commencement of repairs to be carried out on site.

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

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.

Samples

The Engineer or his representative 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 material of the same batch number and may lead to rejection of all that batch of material and the reworking of any components that have already been coated with rejected material.

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.

Cost of Quality Surveillance

Cost of Quality Surveillance shall be borne by the Employer, except when surveillance results in rejection of the lot or when notice by the Contractor results in a fruitless strip, in which cases the cost shall be debited against the contractor's account.

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-compliance with the specification, and the cost of surveillance will be back charged to the contractor.

Data Sheets, Specifications, and Codes of Practice

The contractor shall have available the latest issues of manufacturer's data sheets materials to be used, National specifications and Codes of Practice relevant to the work to be carried out, as well as a copy of his specification, all of which shall be available to the Contractor's Quality Control Manager.

MCP 9

Paint Systems

Paint systems shall comply with the following requirements:

a) Items above water

After the surface has been prepared as specified the following paint system shall be applied:

- i) A vinyl co-polymer primer shall be applied to a thickness of 75 micron.
- ii) In accordance with the manufacturer's specified overcoating time the second coat, vinyl co-polymer intermediate coat, shall be applied to a thickness of 75 micron.
- iii) The specified curing time shall elapse before the item is handled and transported to site for erection.
- iv) All areas damaged in transport and during erection shall be repaired
- v) Immediately prior to the application of final coat, the surface shall be prepared by cleaning and rubbing down as specified. The final decorative coat, to colour as required, of vinyl co-polymer shall be applied to a thickness of 50 micron (in two passes if required to achieve thickness).
- vi) Care of the finished article must be taken during the drying and curing period.

b) Pipe linings and items immersed in water

After the surface has been prepared as specified, two pack polyamide-cured high build epoxy(Copon 2300 or Epidermix 330 or similar) shall be applied strictly in accordance with the manufacturer's requirements, to a thickness of 250 micron.

c) Items supplied with factory applied system

The contractor shall ensure that a system equal to or better than the above is applied to those items "bought in". All variations or alterations shall be subject to the Engineers approval. Wherever practical or desirable allowance shall be made for a decorative final coat to be applied on site.

d) Galvanised items

After preparation of the surface the following system shall be applied:

- i) A vinyl co-polymer primer shall be applied to a thickness of 75 micron
- ii) Vinyl co-polymer intermediate coat applied to a thickness of 75 micron
- iii) Vinyl co-polymer final decorative coat to a thickness of 50 micron (in two passes if required to achieve thickness)

MCP 10

Galvanising

Unless otherwise specified in the Detail Specification all galvanising shall be done in accordance with SANS 763 for heavy duty applications.

MCP 11 Payment Items

Unless scheduled separately, payment for corrosion protection shall be included in the rates for supply, delivery and commissioning of equipment.

SECTION MMM

STANDARD SPECIFICATION: MACHINE MOUNTINGS

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MMM 1	Scope
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MMM 2	General Requirements
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MMM 3	Payment Items
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MMM 1	Scope
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This specification covers the requirements for machine mountings which shall be included with all equipment supplied and not as separate items.

MMM 2	General Requirements
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Common baseplates

Both direct-coupled and belt-driven machines shall be mounted with their drivers on common cast iron or fabricated steel baseplates of rigid construction.

Corrosion protection

Steel baseplates shall be hot-dip galvanized unless specified otherwise.

Machined mounting pads

Baseplate shall incorporate machined mounting pads at the support and fixing positions of each item of plant and equipment to be mounted on the baseplate. On fabricated baseplates this machining shall be done after fabrication, stress relieving (if applicable) and hot-dip galvanizing are complete. The thickness of the solid pads shall be not less than 1,25 times the diameter of the holding down bolts. The pads shall not be provided with threaded holes for machine screws but shall be drilled for inserting through-bolts and adequate provision shall be made for reaching the nut with a suitable spanner. In the period between machining and installation of the equipment, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening compound, Tectyl or equivalent, shall be applied to exposed machined surfaces and to the crevice formed at the foot of the equipment.

The above design may be suitably modified if the Contractor uses a pourable resin based chocking system. Such chocks shall be at least 15 mm thick.

Fasteners

Anchor fasteners shall be of grade 316 stainless steel with threads coated with a nickel-based, anti-seize compound before assembly.

Alignment

Preliminary alignment shall be done at the factory to ensure that the baseplate has been correctly manufactured, but final alignment shall always be done on site after installation and grouting has been completed. Alignment shall be accurate and to the approval of the Engineer and a final alignment check witnessed by the Engineer must be carried out by the Contractor prior to start up.

Shimming

Not more than three shims may be used at any point and these must be made of a corrosion resistant material.

Jacking Screws

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt-driven units. Direct-coupled motors above 10kW shall be provided with jacking screws for horizontal and side way alignment and direct-coupled motors above 150 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be of grade 316 stainless steel.

Grouting

Baseplates shall be designed and grouted as to eliminate collection points for water or dirt. Except where otherwise approved in writing by the Engineer, all baseplates on concrete plinths shall be fully grouted in. Grouting holes must be provided on baseplates having a continuous top plate. Tapped holes and fixing setscrew protrusions shall be suitably protected.

The material used for grouting shall be a non-shrink, cementitious grout. The initial grouting shall be overseen by the supplier's technical representative.

Soleplates

In applications where baseplates are not practical, machined soleplates, suitably fixed and grouted to the concrete plinths, shall be provided. No machine may be mounted directly onto a concrete base without the use of either a baseplate or soleplate.

MMM 3

Measurement and Payment

All mountings are to be included in the price for the item of equipment offered. Mountings are to be included as ancillary equipment where reference is made to "ancillary equipment".

SECTION MNB

STANDARD SPECIFICATION: NUTS, BOLTS AND FASTENING SETS

SECTION	CONTENTS
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MNB 1	Scope
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MNB 2	General Requirements
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MNB 3	Payment Items
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MNB 1	Scope
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This specification covers the requirements for fasteners and fastening sets which are to be included with all equipment offered and not as separate items.

MNB 2	General Requirements
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Fasteners General

Standards

Bolts and nuts shall be hexagon head type complying with SANS 1700 with threads of the coarse pitch series. Allen head screws of any type shall not be used without the Engineer's written consent.

Fasteners M12 and smaller

All fasteners M12 and smaller shall be manufactured of grade 316 stainless steel.

Fasteners larger than M12 - in corrosive areas

All fasteners in corrosive areas shall be manufactured of 316 SS. Corrosive areas shall be taken to include any moist or wet area such as in and above settling tanks, in or in the vicinity of open channels, where a continuous spray can be expected and all internal and external areas in the vicinity of the inlet works of a wastewater treatment works. All fasteners embedded in brick, concrete or soil shall also be of 316 SS.

Fasteners larger than M12- Non-corrosive areas

Fasteners larger than M12 which are in non-corrosive areas shall, except when specified otherwise, be hot-dip galvanized.

High tensile bolts

Where high tensile bolts are required by the design, they shall be hot-dip galvanized and painted. The bolt holes and crevices shall be filled and sealed prior to painting.

Material compatibility

Fastener material shall always be of equal or better corrosion resistance than the items being fastened, e.g. 316 stainless steel bolts must be used to fasten together 316 stainless steel fabrications or flanges.

Washers

Washers of similar material to the bolts shall be provided under each nut and setscrew head. Multiple washers or shims shall not be used. Spring washers or other approved locking arrangement shall be used on all fasteners subject to vibration.

Anti-seize compound

Before assembly, threads shall be treated with a nickel based, anti-seize/corrosion protection compound; Chesterton 725: Nickel Anti-Seize Compound, or equivalent. The thread shall be treated in the area under the final position of the nut. Compound on the exposed thread shall be cleaned off after installation. If it is found during inspection that compound has not been applied, the Contractor shall disassemble all fasteners and comply with this requirement.

Thread projection

Bolt threads shall project between 1 and 6 mm from the head of the nuts when fixed. Longer projections will only be allowed if the Contractor can show that bolts of a more suitable length are not manufactured.

Corrosion protection

After installation the exposed surfaces of bolts not made of 316 stainless steel shall be coated as for the items being fastened. If the use of Allen head or similar fasteners has been approved by the Engineer, the recessed heads shall be filled with a suitable non-hardening sealing compound.

Anchor fasteners

Type and material

All anchor fasteners shall be of grade 316 stainless steel.

Anchor fasteners for water retaining structures and for brickwork shall be of the chemical anchor fastening type. Anchor fasteners for other applications may be of the expanding type or chemical anchor type.

Hook bolts

Grade 316 stainless steel hook bolts shall be supplied and grouted by the Contractor into pockets which will be provided in the concrete structure in accordance with the information to be supplied by the Contractor. The grouting products shall be used strictly in accordance with the manufacturer's instructions.

Alternative anchor bolts

The use of 316 stainless steel "Hilti Kwik Bolt" stud bolts or similar may be used as an alternative where approved by the Engineer. If steel reinforcing bars are encountered while the holes are being drilled, the Contractor shall knock a hole in the concrete around the steel and grout in a stainless steel hook bolt as described above.

Through-bolt anchors

Where machinery is anchored by studs or bolts which extend through the supporting structure and is therefore fastened down with the use of nuts from both sides, these, together with associated washers and brackets, shall also be of grade 316 stainless steel.

MNB 3

Measurement and Payment

All fasteners and fastening sets are to be included in the price for the item of equipment offered. The unit item offered will include the price of the fastener and fastening sets. Fasteners are to be included as ancillary equipment where reference is made to "ancillary equipment."

SECTION MGF

STANDARD SPECIFICATION: GRID FLOORS, GUARDRAILS AND LADDERS

SECTION	CONTENTS
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MGF 1	Scope
MGF 2	General Requirements
MGF 3	Materials Of Construction
MGF 4	Testing And Commissioning
MGF 5	Measurement And Payment

MGF 1 Scope

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 all grid floors, guard rails and ladders.

MGF 2 General Requirements

Grid flooring

All grid flooring shall be Mentis type RS40 or equal approved with bearer bars across the shorter span. The depth of bearer bars shall not be less than 30 mm with a bearer bar pitch of not greater than 40 mm. Panels are to be set level and fixed down in angle frames so as to prevent rocking. All cut-outs in grid flooring for pipes, valve spindles and the like are to be banded and made before any corrosion protection is done. The edges of removable grid access covers must also be banded.

Guard railing

Guard railing shall be provided in accordance with legislated requirements and shall be provided generally in positions where the vertical change in level is 1 000 mm or greater.

Guard railing shall comply with SANS 0104.

All guard railing shall be of GRP and shall comprise hand and knee rails not less than 32 mm diameter and stanchions spaced at not more than 1,8 m except where specifically directed otherwise in writing by the Engineer.

On platforms, walkways, landings or around dangerous areas the vertical height, measured from the top of the hand rail to the floor or surface, shall be at least 1 000 mm.

On stairways and fixed ladders the rails shall be parallel to the stringers, and the vertical height, measured from the top of the hand rail to the nosing of the tread, shall be at least 900 mm.

For applications covered by this Specification, the rails and stanchion shall withstand, without permanent deflection, a proof force of 890 N and 1780 N respectively, applied at any point and in any direction. Contractors shall provide proof that their guard railing has been tested and withstands these loads. The loads specified in SANS 10160 for guard railing and stanchions are to be adhered to.

Stanchions and rails shall be smoothly finished and free from sharp corners, edges and projections which may injure persons or damage clothing. Stanchion bases shall have the corners rounded or sheared off.

Railing, if tubular, shall be joined using the slip-jointing method with separate and neatly fitting tubular inserts fitted into the railing bore. If used, pins shall have their ends peened over and smoothed or, if taper pins are used, shall be filed off flush with the rail. The joint shall withstand the loads specified above when situated in any position including centrally between two stanchions. Joints shall preferably be located inside the stanchion balls. All joints shall be sealed.

Railings shall be ended off with positively fixed (pinned) closure bends. At corners, short radius bends with stanchions on both ends shall be employed or, alternatively, stanchions specifically designed for such a position shall be employed. No sharp endings will be permitted.

Stanchions shall generally be base-mounted to suit the arrangement requirements and shall be of solid or welded construction. Welding shall be compatible with the material, shall not impair the strength or corrosion resistance of the material, shall be continuous and shall be smoothly finished and then passivated.

Stanchions shall be self-draining to suit the mounting arrangement.

Holes for the rails to go through the stanchions shall have a diametral clearance not exceeding 1mm but preferably 0,5 mm. On stairways with stanchions vertically mounted, the hole shall be angled to suit and shall accurately fit the angled rail with the abovementioned clearances. The crevices caused by rails passing through the stanchions shall be sealed.

Stanchion feet which are attached to metallic surfaces shall have minimum dimensions of 150 mm X 60 mm. Two fasteners, of minimum size M16, shall be used to attach the foot. Foot material thickness shall be not less than 8 mm. Neatly fitting packing shall be fitted under stanchion feet to prevent the formation of crevices.

Stanchion feet which are attached to non-metallic surfaces shall have minimum dimensions of 150 mm X 150 mm. In instances where the horizontal surface to which the foot is to be fastened is less than 150 mm wide, the foot shall be designed to be seated on at least two surfaces. Four fasteners, of minimum size M16, shall be used to attach the foot to the concrete. Foot material thickness shall be not less than 10 mm. Non-shrink, cementitious grout shall be applied under the foot just prior to final tightening of nuts.

Guard railing in public places

The requirements for guard railing at equipment installations shall also apply for guard railing for public places. The following specific requirements must also be complied with:

The structural design shall be done in accordance with the requirements of SANS 0104.

No opening in guard railing installed in public places shall allow the passage of a ball of 100 mm diameter.

Permanent ladders and stairs

General

Permanent ladders shall comply, primarily, with the requirements of the OSH Act and, secondarily, with SANS 10400.

Permanent ladders

Ladders shall comply with the following detail design aspects:

Access points to the head of ladders from platforms and walkways shall be protected by self-closing gates or by chains.

No part of the ladders shall project into the passageway.

The clear width between stringers shall be between 450 mm and 550 mm.

A minimum clear space of 230 mm must be allowed behind the rungs.

The diameter of the rungs shall be between 20 mm and 50 mm.

Additional rungs shall be provided in the same horizontal plane as the top rung in order to close the gap between the platform and the ladder. Sufficient rungs shall be provided to ensure a maximum gap of 75 mm. These top rungs shall be at the same level as the floor or platform to which access is being provided.

Stringers shall be formed from flat bar. The vertical distance between the ladder support brackets shall not exceed 1 800 mm.

The stringers shall extend to 1 100 mm above the floor or platform and shall be matched with any guard rail protections at this level. Connections between hot-dip galvanized steel ladders and stainless steel guard railing shall be bolted. Unless laterally supported by the guard rails, these stringers shall be supported by vertical structural sections (not flat bar) whose footings shall comply with this Specification for guard rail stanchion feet.

All rises in a flight shall be uniform and the surface of the top rung shall be level with the top platform or landing. The height chosen for the rise shall be between 225 mm and 255 mm.

Except on chimneys, the height of a ladder should not exceed 6 000 mm. Greater heights shall be provided with intermediate landings between each 6 000 mm ladder section.

If the height between start and end levels is over 4 000 mm, the ladder shall be fitted with a safety cage. The safety cage shall extend at least 1 000 mm above the higher landing. The cage shall be no more than 700 mm away from the plane of the rungs. The cage shall comprise no fewer than seven vertical elements.

Anchor bolts shall be of grade 316 stainless steel and shall be no smaller than M16.

Stringers, rungs and anchor brackets shall be of solid structural sections (e.g. flat bar, round bar, square bar, angles, etc.) and no hollow sections will be accepted for any part of the ladder.

Stairs

Stairs shall comply with BS 5395

MGF 3

Materials Of Construction

Grid flooring

Grid flooring and frames shall be GRP Materials. Painting shall be done to suit the relevant safety codes.

Where grid flooring bears onto painted surfaces, strips of rubber insertion material shall be secured under the grid flooring to protect the paint.

The fixing clip set (saddle clamp and locking plate) and all fasteners shall be of grade 316 stainless steel.

Guard railing

All guard railing shall be of GRP materials Stanchion feet shall be epoxy-coated.

A nickel-based, anti-seize compound shall be applied to all threads before fastening.

All components shall be supplied in the pickled and passivated condition which may also be polished. All surfaces must be uncontaminated and unmarked to ensure maximum corrosion resistance. A manufacturer's test certificate shall be provided for each batch of stainless steel giving the chemical analysis of the material.

Inserts for internal slip joints may be of non-corrosive material using steel reinforcing provided the steel is completely enclosed.

Where kickplates are required by legislation, these shall extend to 150 mm above the walkway level.

Permanent ladders and stairs

Unless other materials are specified, ladders and stairs shall be of carbon steel and hot-dip galvanized after all fabrication has been completed.

MGF 4 Testing And Commissioning

Works testing

Where applicable an inspection of the assembled units will be conducted at the manufacturer's premises to check material integrity, corrosion protection and fabrication soundness. Material certificates are to be issued to the engineer before deliver to site of the equipment.

Tests on completion

Performance testing will be carried out on the equipment after commissioning and adjustment. All tests are to be witnessed by the Engineer, and contractors must give the Engineer 14 days notice prior to any test. The contractor must cover the cost of any tests that need to be repeated as a result of the equipment not being able to meet the requirements outlined below.

The tests will be performed on the equipment over a single 8 hour shift. They shall consist of the following:

An inspection will be carried out to ascertain that the equipment has been installed correctly and with due diligence.

Any load testing required.

The equipment will be considered acceptable when:

1. Equipment has been correctly installed and satisfies the engineer.
2. The equipment passes any load tests called for.

During the Defects Liability Period

Checks on all equipment will be conducted for correct operation and functioning at 1 month, 6 months and 12 months after plant take-over.

MGF 5 Measurement and Payment

MGF 5.1 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.

MGF 5.2 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.

Contract No: RW10404061/23

**Description: TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS BY 15 ML/DAY
AT MEYERTON
PROJECT SPECIFICATIONS**

Payment will only be transferred once the engineer has received full Operation and Maintenance Manuals along with the relevant plant drawings.

SECTION MWP

STANDARD SPECIFICATION: WATER AND WASTEWATER PUMPS

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MWP 1 Scope

This specification covers the supply, delivery, installation, testing and commissioning of pumps used for pumping of water and wastewater.

MWP 2 General Requirements

Pumps shall be supplied complete with motor, drives, couplings and baseplate or frame. Electrical switchgear, cabling, etc. shall be supplied as stated in the Detail Specification. The design of the pump/motor set shall be of the non-overloading type in order to prevent failure of the motor should the delivery pipeline fail.

The duty required of the pump is described in terms of the system curves in this document and pumps supplied shall be capable of successfully performing under all conditions so indicated. Pumps shall run at a preferred speed of 1 450 rpm.

As far as possible, standard component parts shall be used. No pump shall be considered for approval unless it has a proven record of successful use in Southern Africa, under circumstances similar to those that will be encountered during the normal operation of the pumps as specified. A list of relevant references in this respect may be requested from the tenderer during the evaluation of tenders.

Performance curves giving detail of flow, head, efficiency, rotational speed, power requirements and NPSH requirements shall be submitted with the tender.

MWP 3 Design And Materials

The pump shall be part of the manufacturer's current product range and shall be of the manufacturer's standard proven design. The material of manufacture shall be chosen with due consideration of the conditions under which the pump will operate, including the properties of the liquid to be pumped.

MWP 4 Casings

Pump casings shall be of high-grade cast iron designed to be capable of pressures 40% greater than the shut off head of the pump.

MWP 5 Bearings

All bearings shall have a minimum B10 design life rating of 100 000 hrs.

Adequate attention to choice of bearings shall be made with respect to loading, thrust, mounting, thermal expansion and contraction, lubrication and the conditions under which the bearings will be operating. Bearings shall be adequately sealed to prevent ingress of water.

MWP 6 Impellers

Impellers shall be made of cast iron, cast steel, zinc-free bronze or stainless steel. For fractional kW pumps other materials may be considered but used only with the Engineer's written approval. The impeller shall be securely fixed to the shaft with a key and keyway and blind nut.

MWP 7 Wearing Rings

Where pumps are fitted with wearing rings to limit re-circulation losses they shall be machined to tolerances compatible with the solids content of the water to be pumped. Wearing rings shall be easily replaceable.

MWP 8 Seals

Pumps shall be fitted with stuffing boxes rather than mechanical seals under most conditions for ease and simplicity of maintenance.

Seals shall be effective over the normal working range ie no flow static head to shut off head of pump. Leakage from glands shall be openly collected and suitably piped out of the pump station. All such drainage pipework shall form part of the scope of work associated with the supply, delivery, installation, testing and commissioning of the pump.

a) Stuffing Boxes

Stuffing boxes shall be sized to accommodate not less than four rings of packing plus the lantern ring and a portion of the gland. The lantern ring shall be served by both inlet and outlet connections. A renewable sleeve shall be fitted to the shaft where it passes through the stuffing box. A slinger shall be incorporated between the stuffing box and the bearings. The stuffing box shall be easily tightened, and shall be easily removable for repacking.

b) Mechanical Seals

Particular attention shall be paid to the selection of materials and design of the seal in relation to the conditions under which the pump is to operate. Where mechanical seals are offered full technical detail of such seals shall accompany the tender.

MWP 9

Lubrication

The pump shall have a dipstick to allow the oil level to be checked, and grease nipples shall be provided where necessary to allow application of grease.

Oil and grease specifications and lubrication intervals shall be included on the nameplate to be provided on the pump, and full detail on lubricant types and lubrication intervals and procedures shall be given in the Operation and Maintenance manuals.

MWP 10

Mountings And Baseplate

The pump shall be suitably equipped with mounting points to facilitate location and fixing in level position the pump to a baseplate or flange mounting. In mounting to the baseplate or frame, which shall also serve the prime mover and gearbox, a facility shall be provided for setting up and alignment.

The baseplate shall be manufactured from steel and be of sufficient stiffness to ensure accurate location and alignment.

The baseplate shall be securely bolted to the floor or plinth with at least M20 bolts, before final alignment and setting up of the pump/drive/motor. Where a plinth is required the Contractor shall provide detail of the size of the plinth, as its construction could form part of the scope of work of others.

MWP 11

Pipework, Valves And Fittings

The pipework, valves and fittings associated with the pumps and pump station shall be supplied and installed by the Contractor to ensure the proper functioning of the installation.

All pipework, valves and fittings indicated as mechanical work on the drawings shall be deemed part of the scope of the supply, delivery, installation, testing and commissioning of the pump as specified.

All pipework designed by the Contractor shall comply with the provisions of SABS 1200 L. and Section PSL of the Employer's Requirements.

The scope of the pipework, valves and fittings associated with the pumps are denoted "mechanical" on the drawings. The required type and diameters of the pipework, valves and fittings are shown. The Contractor shall design the pipework in accordance with the specifications and to suit the characteristics of the pumps and pipework supplied. Unless otherwise specified, other pipework, valves and fittings are described separately in the Bill of Quantities.

The additional specifications on the drawings shall also apply.

All costs involved in the supply and installation of such pipework, valves and fittings shall be deemed part of the tendered rate for the supply, delivery, installation, testing and commissioning of the pump as specified.

MWP 11.1 Pipes

The class of pipe selected shall be such as to provide a working pressure equal to the greater of:

- t) The maximum shut off head of the pumps, or
- u) The pressure given in the Employer's Requirements which allows for working head and pressure surges.

MWP 11.2 Pipe Joints

Generally, flanged joints are required. Where required for movement or assembly and maintenance requirements flexible couplings may be used. Flanges shall be manufactured in accordance with SABS 1123 as amended, and the pressure requirements of the adjacent pipework. Each joint shall be completely watertight under test and working conditions.

MWP 11.3 Isolating Valves

Each pump shall be fitted with an isolating gate valve on both the suction and delivery pipes, and a non-return valve shall be installed adjacent to the pump on the delivery side. Unless otherwise specified such isolating valves shall be gate valves.

MWP 11.4 Butterfly Valves

Butterfly valves shall only be used on "clear water" ie water containing no particles or stringy matter that may affect the operation of the valves. Butterfly valves shall not be accepted for use in pump installations unless specified or indicated on drawings.

Butterfly valves shall comply with BS 5155.

MWP 11.5 Non-Return Valves

Non-return valves shall be designed and manufactured to provide satisfactory operation under the conditions of service envisaged and under zero flow conditions. Access to moving parts shall be possible without the need to remove the body from the line.

Non-return valves shall not be installed in vertical pipe sections.

MWP 12 Lifting Eyes

Where the weight of the pump is in excess of 30 kg the pump shall be equipped with lifting eyes to allow it to be lifted by a hoist or overhead crane.

MWP 13 Pressure Gauges

Each pump shall be fitted with suitable pressure gauges on both the suction side and the delivery side of the pump. The gauges shall be permanently mounted in position and provided with a gauge cock to allow isolation of the gauge, and also removal of the gauge for servicing or replacement purposes.

Gauges shall have a face diameter of not less than 100 mm and shall be selected such that the normal operating pressure of the pump is indicated at between 50 % and 75 % of the scale of the gauge.

MWP 14 Motor/Pump Couplings And Transmissions

Generally the pump shall run at the same speed as the prime mover and be directly coupled by means of a flexible coupling. Where such a layout is not desirable V-belt drives are preferred, and only under exceptional circumstances will the use of a gearbox be approved.

The flexible coupling or V-belt drive, where used, shall be designed to accept the full load torque at design speed, and also the start and stop loads, with due allowance being made for shock loading. Special care shall be taken in the selection of bearings for V-belt applications, in order to ensure that they can withstand the lateral forces that apply.

The couplings or drive shall also be designed to accommodate under all the above loading conditions, thermal expansion and contraction movements of the shafts, the effects of end float, vibrations and a practical amount of misalignment of the shafts.

All pump sets shall be equipped with suitable vibration sensors, which shall monitor vibration in both the horizontal and vertical planes. Vibration above a certain set maximum tolerance, determined by the pump manufacturer, shall give rise to an operator alert.

All rotating or moving parts shall be enclosed by moveable guards.

MWP 15 Motors

Unless otherwise specified the pump shall be driven by an electric motor. Electric motors shall comply with the requirements of the Standard Specification for Electric Motors, contained elsewhere in this document.

The motor shall be so sealed from the pump as to prevent the ingress of moisture and shall have a completely moisture proof terminal block into which the power supply cable is to be brought.

MWP 16 Pump Control

Where required a detailed description of the pump control requirements will be given in the Detail Specification, contained elsewhere in this document.

MWP 17 Painting and Corrosion Protection

Where possible, materials of manufacture shall be selected for corrosion resistant properties.

Detailed requirements for painting and corrosion protection are specified in a separate section.

MWP 18 Nameplates

A corrosion resistant metal nameplate shall be fixed to each pump with the following information punched or engraved thereon:

- a) Manufacturer's name
- b) Serial number of the pump
- c) Model number and type
- d) Impeller type/diameter installed
- e) Normal operating head and flow
- f) Rotational speed
- g) Bearing numbers
- h) Lubricant details
- i) Lubrication intervals

The nameplate shall have clearly legible punched or embossed lettering and shall be affixed to the pump in a position where it can be easily read.

MWP 19 Installation

The pump and motor set, mounted on common base plate or frame, shall be installed in accordance with the manufacturer's recommendations and instructions.

Erection of pipework and positioning of valves and fittings shall be done in such a way as to ensure the minimum of residual stress in the installation. Great care shall be taken both in the design and installation of the pipework to ensure that no undue forces are imposed on the pump itself. The Contractor shall be responsible for the design, positioning and installation of all pipe supports. Valves shall not be suspended from pipework but shall be supported on adequately sized concrete pedestals.

Flexibility in the installation shall be maintained until all pipe runs are complete, whereafter the pump baseplate shall be finally fixed to the plinth, pipes grouted in and pipe and valve support pedestals cast.

After the pumps have been in operation for seven days the foundation bolts shall be finally tested for tightness, the alignment checked, and dowel pins fitted in the pump and motor feet.

MWP 20 Testing

All pumps shall be subject to a site test, as installed, to confirm the performance of the equipment supplied against the data supplied at time of tender. At the discretion of the Engineer factory testing of pumps may also be required before installation.

All performance testing shall be carried out in accordance with BS EN ISO 9906:2000. Hydraulic performance acceptance tests. Grades 1 and 2., with all instrumentation and personnel being supplied by the Contractor.

The tests shall be carried out after initial installation checks and after at least 12 hours of test running. Should any aspects of performance not fall within 5% of the stated figures supplied at time of tender, the Contractor shall take all necessary steps to correct the performance and the tests shall be performed again.

On completion of each test the results shall be made available to the Engineer.

MWP 21 Payment Items

The following payment items shall apply, and different payment items will be included in the Bill of Quantities based on the type and size of equipment required.

MWP 21.1 Supply and delivery of pumping equipment Unit: No

Pumping equipment shall be measured and paid for based on the number of pumps, complete with electric motors, couplings, pipework, valves, fittings and pressure gauges supplied and delivered to site. The tendered rate shall be held to include the supply and delivery of all pumps including all appurtenances necessary to ensure satisfactory operation of the pumping installation.

MWP 21.2 Installation, testing and commissioning of pumping
equipment Unit: No. or Sum

Pumping equipment shall be measured and paid for based on the number of pumps, complete with electric motors, couplings, pipework, valves, fittings and pressure gauges installed, tested and commissioned on site. The tendered rate or Sum shall be held to include the installation, testing and commissioning of the complete pumping installation, including all appurtenances necessary to ensure satisfactory operation of the pumping installation.

SECTION MPG

STANDARD SPECIFICATION: PRESSURE GAUGES

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MPG 10	Testing And Commissioning
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MPG 1 Scope

This section covers the supply, delivery, installation, testing, and commissioning of pressure gauges.

MPG 2 General

The equipment shall be supplied and installed, complete with mountings, housings, tubing, fittings, etc. necessary for the display of pressure in pipes.

Pressure gauges shall comply with the requirements of BS 1780 where applicable.

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.

MPG 3 Materials Of Manufacture

The equipment provided shall be manufactured from corrosion-resistant materials. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze or other approved corrosion-resistant materials.

Where applicable, corrosion protection shall be provided as specified the Detail Specification.

MPG 4 Equipment Selection

Pressure gauges shall be analogue and of the bottom entry type.

The gauge shall have a face of not less than 60 mm in diameter, and all markings shall be clear and easily legible. Black markings on a white face are preferred.

Gauges shall be graduated in kilo-Pascal (kPa.)

The finish of all gauges shall be non-reflective.

MPG 5 Range And Accuracy

The gauge shall have a range of measurement not less than 1.25 times the operational range of the equipment to which it is connected. In cases where gauges are used to indicate pressures above and below atmospheric pressure, the gauge range shall be not less than 125% of the maximum positive and maximum negative pressure.

The normal working pressure shall be indicated at a point between 50 % and 75 % of the full-scale deflection of the gauge.

The instrument shall indicate accurately to within 3 % of the full-scale deflection.

MPG 6 Isolating Valve Or Gauge Cock

All pressure gauges shall be equipped with an isolating valve or a gauge cock to allow it to be isolated from the pipe. The cost of the valve or gauge cock shall be deemed included in the tendered rate for the equipment.

MPG 7 Gauge Protectors

Where a pressure gauge is to be installed on a pipe conveying corrosive liquids or slurries, or where there is a risk that the pressure ports of the gauge could become blocked as a result of the properties of the medium conveyed, such gauges shall be equipped with gauge protectors.

MPG 8 Damping

Glycerine-filled gauges shall be used for applications involving hydraulic pipelines, while vacuum-damped gauges shall be employed where they are to be installed on air or gas lines.

MPG 9 Labels And Marking

Labels shall be provided, especially on remote-mounted gauges, to indicate the locations where pressure is measured.

The operating set point of all meters and indicators shall be clearly marked in red. Where compensation of more than 2% of the instrument span is needed for the difference in level between the instrument and the tapping point, the reading shall be suitably adjusted and the amount of compensation shall be marked on the dial.

Pressure gauges shall have concentric scales.

MPG 10 Testing And Commissioning

After installation, pressure gauges shall be tested and commissioned together with the equipment to which they are connected, such as pumps or compressors and their associated pipework.

MPG 11 Payment Items

Unless otherwise specified in the Detail Specification, the cost of the supply, delivery, installation, testing and commissioning of pressure gauges shall be deemed included in the tendered rates for the equipment to which they are connected, and no separate payment items shall apply.

SECTION MPW

STANDARD SPECIFICATION: PIPEWORK, VALVES AND FITTINGS

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MPW 14	Cleaning And Disinfection
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MPW 1 Scope

This specification covers the manufacture, supply, delivery, installation, testing and commissioning of pipework, valves and fittings associated with mechanical equipment.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 2.13 Bonding

All flexible, flanged and similar discontinuous joints shall be bonded across the joint to provide electrical continuity throughout each buried pipeline.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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 on 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.

MPW 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.
- 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.

MPW 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.

SECTION MVA

STANDARD SPECIFICATION: VALVE ACTUATORS

SECTION	CONTENTS
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MVA 1	Scope
MVA 2	General Requirements
MVA 3	Materials Of Construction
MVA 4	Testing And Commissioning
MVA 5	Measurement And Payment

MVA 1 **Scope**

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 valve actuators.

MVA 2 **General Requirements**

General

Actuators shall be capable of transmitting sufficient torque or load to the shaft of the valve to unseat at the maximum working pressure for which the valve is rated and to operate the valve from the fully*open to fully closed state within a reasonable time. The speed of operation shall be such as to avoid any possibility of water hammer in pipelines.

MVA 3 **Materials Of Construction**

Electric actuators

Actuator enclosure

Actuators should be protected to IP67 in accordance with IEC 144. All joints shall be O-ring protected.

Gearing

All torque transmitting housing parts should be out of cast iron. Aluminium die cast is only allowed for covers. The gearing should be totally enclosed and grease-lubricated. Lubricant must be PCE and PCT fee. All cover screws which must be opened for commissioning or setting must be captive so that they cannot be lost.

Performance

The actuator gearing must be self-locking so that the actuator stays in its last position. The self- locking feature must stay active if the actuator is changed into handwheel mode. The actuator must be able to be fitted in all mounting orientations.

Motors

The motors shall be 3-phase squirrel cage motors EFF1 premium efficiency specially designed for valve application providing high torque and low inertia. The motors should be totally enclosed, housing being one casting, non-ventilated, the insulating class should be F. Motors should be thermally protected by

3 thermostats, embedded in the motor windings, one for each phase. The motors should be time rated 5215 min to IEC 34 at nominal motor load and at least 33% of maximum valve torque for 15 min. The motor wiring should be connected to the main actuator housing by a plug and socket for easy removal.

A geared side-mounted handwheel of suitable size shall be provided for safe and efficient manual operation. The manual control shall be independent of motor drive. The changeover from motor operation to handwheel operation shall be accomplished by a declutching device which must be without load during the change into the handwheel mode. The changing from handwheel operation into motor operation shall be automatic. The force of the handwheel shall be in accordance with DIN 3210 Sheet 2.

Torque switches

The actuators shall incorporate two, from each other independent, settable torque switches.

Limit switches

The actuators shall be supplied with one limit switch for open end position and one limit switch for close end positions. The limit switches shall be directly geared to the output shaft of the actuator without any slipping clutch device. The limit switches must function independently of the torque switches. Overtravel of the set point, e.g. by hand operation, shall not change the set position. Adding additional switches - for intermediate or end position - must be possible without opening the lubricated main gear case.

Switches

Switches must be encapsulated to IP66 to IEC 144, as a separate part to protect them against getting wet during setting work on the actuators and allow setting while power is on. They should be rated at 5 Amps at 250 V AD. Switches got to be bounce free. A minimum load of 20 mA at 24 V DC must be operated by a standard switch.

Position indicator

Actuators shall be fitted with an indicator showing valve or penstock opening position. The scale of the position indicator shall be marked open and close and show the actual degree of opening in mid-position of the valves. The installation of a feedback potentiometer or an electronic current feedback must be possible. They must be driven by a gearing selected in a way that at least 83% of the possible travel is used. The feedback drive must be fully assembled by the actuator manufacturer.

Heaters

Actuators shall have the possibility to incorporate a self-regulated anti-condensation heater of 015 W rating which shall be energised from the internal control transformer.

Output drive

Output drives should be in accordance to ISO 5210. In case of drive form A to ISO 5210 they should be separate from the main actuator housing in order to remove the complete actuator from the valve, while the valve stem is kept in position by the output drive of the actuator.

Control

The controls should be a part of the actuator design, suitably housed to prevent breathing and condensation build-up. All connections between the actuator and the control housing should be made by one plug and socket connection for easy removal of the complete control.

Contactors

The reversing contactors should be electrically and mechanically interlocked, rated appropriate to the motor size and suitable for 60 starts per hour.

Local control

As part of each control should be a local control station with a selector switch for local, off and remote, padlockable in any of these positions. Additional local switches for open, stop and close operations must be available.

Control signals

In remote control mode the actuator shall be controlled by open, close and stop contacts in the control panel. The contacts for this control in the control panel are voltage-free and are energised from the actuator. The inputs of these signals must be separated from the control by optocouplers in the actuator.

Indicating signals

The actuator shall provide for remote indication the following signals by voltage free contacts rated at 250 V 1 Amp.

- i.open end position;
- ii.close end position;
- iii.LOCAL/OFF/REMOTE switch in Local;
- iv.LOCAL./OFF/REMOTE switch in Remote; and
- v.Collective fault signal containing power failure, wrong phasing, motor thermostat tripped, control voltage failure and torque switch operation in intermediate position of the valve.

Within the control LED's should be provided for indicating of torque switch operation in intermediate position of the valve or any electrical malfunction.

Programming

Within the control it should be possible to program the function of the end position switching i.e. torque switch or limit switch dependent. It must also be programmable for both opening and closing direction independent of each other whether the actuator runs after getting a control signal by self-retaining contacts into the end position or runs only as long the control signal is coming.

Internal wiring

All internal connections within the integral control and between the different boards should be made by plug and socket connections except for motor power cables. All plug and sockets should have different sizes so that they cannot be mixed up.

External wiring connection

The external wiring connection should be done by one plug and socket for all control and motor wires. All terminations shall be clearly marked. Provisions should be made for three cable entries, one for the motor cable, one for the control cable and one for possible feedback signals.

Pneumatic actuators

Pneumatic actuators shall be diaphragm or piston operated single or double acting direct or yoke operated units as required in the Detailed Specification and designed to operate on wet air with traces of oil. Where stated in the Detailed Specification, a spring return shall be provided for closure under normal operation and in the event of air supply failure. Similarly hand operation using a handwheel shall be provided where specified to permit operation when the air supply has failed. The valves shall operate incrementally and maintain the position selected under all conditions and shall accommodate the maximum unseating torque or load of the valve plus provision for 100% overload. All components of the actuators shall be manufactured from robust non-corrodible materials. Pistons and tie rods shall be manufactured from stainless steel 316L. Pistons shall be manufactured from acetyl resin and be provided with nitrile rubber seals. Actuator bodies/barrels shall be manufactured from anodized aluminium or epoxy powder coated carbon steel. Air supply lines to each actuator shall be fitted with isolating valves, strainers, automatic condensate traps and flushing connections.

Solenoid, spool, poppet, pilot and other control valves shall be constructed from die cast aluminium glass filled polyamide or similar robust material with non-corrodible internal components, en- capsulated coils and IP65 electrical enclosures where applicable.

Hydraulic actuators

Hydraulic actuators shall be of the rotary or direct action piston type suitable for the mode of operation of the valve. In the event of failure of the actuator or hydraulic power pack the valve shall return to the closed position. Manual operation shall be provided as for the electric actuator above. All components shall be suitable for continuous operation under corrosive exposed conditions. Liners and other components in contact with the hydraulic fluid shall be hard chrome or other similar material suitable for the environment. The hydraulic pump and power pack shall be adequately rated for the specified altitude and temperature, and shall be designed to accommodate the maximum unseating torque or load of the valve plus 50%. Where actuators are required for positioning they shall be provided with robust hydraulic valves and components which will permit smooth operation and controlled location throughout the operating range.

MVA 4

Testing and Commissioning

Tests on completion

Performance testing will be carried out on the equipment after commissioning and adjustment. All tests are to be witnessed by the Engineer, and contractors must give the Engineer 14 days notice prior to any test. The contractor must cover the cost of any tests that need to be repeated as a result of the equipment not being able to meet the requirements outlined below.

The tests will be performed on the equipment over a single 8 hour shift. They shall consist of the following:

1. Smooth and efficient operation of the actuators.
2. Measurement of absorbed power using a calibrated kW/hour meter and calculation of efficiency of each actuator.

The equipment will be considered acceptable when:

1. The equipment meets the duty requirements as defined in this section of the Specification.
2. The tests defined above prove the acceptable operation of the equipment.
3. Where a power test is required, the power absorbed by each motor at duty point does not exceed the values stated in the Technical Data Sheets.

During the Defects Liability Period

Checks on all equipment will be conducted for correct operation and functioning at 1 month, 6 months and 12 months after plant take-ove

MVA 5

Measurement And Payment

MVA 5.1 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.

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**Description: TENDER FOR THE UPGRADE OF MEYERTON WASTEWATER TREATMENT WORKS BY 15 ML/DAY
AT MEYERTON
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MVA 5.2 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.

SECTION MFC

STANDARD SPECIFICATION: SLUICE GATES, HAND STOPS, STOP LOGS AND FIXED WEIRS

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MFC 4	Hand Stops And Stop Logs
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MFC 9	Leakage Testing
MFC 10	Payment Items

MFC 1 Scope

This specification covers the requirements relating to the supply and installation of sluice gates, hand stops, stop logs and weirs for fluid flow control purposes.

MFC 2 Definitions

The term "sluice gate" shall include wall-mounted gates (or penstocks), channel gates and downward opening weir gates.

Wall-mounted gates are used to close off an opening in a wall, and shall incorporate a seal on all four sides of the opening. Wall-mounted gates shall be specified in the Detail Specification to accommodate seating or unseating pressure.

Channel gates are used to control flow in open channels and require sealing on three sides, as a seal along the top edge is unnecessary.

Downward opening weir gates are designed to control flow over the top of the gate. Construction shall be similar to that of wall-mounted gates (other than for the direction of travel of the gate.)

Hand stops are similar to wall-mounted or channel gates, but are smaller and are manually operated.

Stop logs consist of a series of hand operated gates above each other in the same frame, which allows the height of the gate to be adjusted in fixed increments by adding or removing one or more sections.

Fixed weirs consist of metal plates, with a horizontal or notched edge, installed against the side of a channel or tank to control or measure the rate of flow over the weir. Notches may be v-shaped, trapezoidal or rectangular.

Tilting weirs are hinged at the bottom and are tilted by turning of the handwheel, which adjusts the height of the top edge of the weir, which controls flow over the weir.

MFC 3 Sluice Gates

Unless otherwise specified in the Detail Specification, all components other than handwheels, spindle guides and seals shall be manufactured from pickled and passivated stainless steel grade 304L.

Handwheels may be manufactured from cast iron or mild steel. Spindle guides shall be manufactured from bronze.

All sluice gates shall have replaceable pressure-activated music-note or lip-type seals of neoprene rubber.

Gates shall be of robust construction and ribbed horizontally or vertically as required to ensure that no undue deflection of the gate occurs.

Gates shall be suitably guided throughout their distance of travel, shall not jam and shall be held uniformly against the frame face. A system of adjustment shall be provided for ensuring that the gate is held against the seal correctly. Side wedge adjusters shall be provided. Top and bottom wedge adjusters shall be provided where required by the installation.

Frames shall be fabricated from angle or channel sections, and shall be provided with adequate anchors to allow firm fixing in position.

Sluice gates shall have rising spindles with a screwed stop collar that can be locked in position to prevent excessive compression.

Spindles shall be adequately guided to prevent buckling under compression when the gate is closed.

Rising spindles shall be protected by spindle cover tubes. Unless otherwise specified in the Detail Specification, such cover tubes shall be stainless steel.

Manually operated sluice gates shall be equipped with handwheels of suitable size in order to limit rim pull effort to below 150 N. Where necessary, suitable reduction gearing shall be provided.

Unless otherwise specified in the Detail Specification, the height of the handwheel above the level of the operator platform shall be 900 mm.

Sluice gates shall be designed for operation under full design pressure for both manual and actuated operation. The gate shall be provided with low friction bearing strips to reduce friction between the gate and the frame.

Where sluice gates require electric actuators for operation, these actuators shall comply with the requirements as set out in the standard specification on valve actuators, which, if applicable, shall be included elsewhere in this document.

A manual override function shall be provided for all electrically actuated sluice gates to allow them to be operated manually if necessary.

MFC 4 Hand Stops And Stop Logs

Unless otherwise specified in the Detail Specification, hand stops and stop logs shall be manufactured from pickled and passivated stainless steel grade 304L.

Unless otherwise specified in the Detail Specification hand stops and stop logs shall not have seals.

Gates shall be of robust construction and ribbed horizontally or vertically as required to ensure that no undue deflection of the gate occurs.

Frames shall be fabricated from angle or channel sections, and shall be provided with adequate anchors to allow firm fixing in position.

MFC 5 Fixed Weirs

Unless otherwise specified in the Detail Specification, fixed weir plates shall be manufactured from stainless steel.

Weir plates shall be at least 300 mm high, and shall be plain or shall have notches as specified. Notches shall be 100 mm deep or as indicated on the drawings and the weir plate shall have a minimum thickness of 4 mm.

Weir plates shall be provided with slotted holes to allow at least a 50 mm height adjustment for leveling of the weir. These holes shall be provided at a maximum spacing of 500 mm. Watertight sealing shall be provided where weir plates are joined together, and the sealant shall be of a material resistant to the possible corrosive effect of the fluid flowing over the weir, and shall be UV-resistant.

A sealing strip shall be installed between the weir plate and the wall to which the plate is attached. This sealing strip shall be of a material resistant to the possible corrosive effect of the fluid flowing over the weir, and shall be UV-resistant.

MFC 6 Tilting Weirs

Unless otherwise specified in the Detail Specification tilting weirs shall be provided with end plates which shall prevent leakage along the sides of the weir. A seal to prevent leakage along the hinge shall be provided.

Each tilting weir shall incorporate an indicator plate, clearly visible from the operating position, to show the amount of travel of the gate. The indicator plate shall be clearly graduated in 10 mm increments, and shall be manufactured from stainless steel.

The edge of the tilting weir shall be level at all degrees of lowering. A tolerance of 1mm per meter length of the weir shall be allowed in this respect.

MFC 7 Fabrication

Fabrication of stainless steel shall comply with the fabrication requirements specified elsewhere in this document. In particular, welding shall be continuous and crevices shall be avoided.

Stainless steel shall be pickled and passivated prior to installation and again before commissioning.

MFC 8 Installation

Installation shall be done by the Contractor using staff skilled in such installations. The Contractor shall be responsible to ensure proper operation of the sluice gates, hand stops, stop logs and weirs, and shall make all necessary adjustments required to achieve this.

The Contractor shall advise the Engineer of the size and position of all openings to be left in civil structures to allow for the installation of the frames.

Grout shall be of the non-shrink type and shall be applied strictly in accordance with the manufacturer's instructions.

MFC 9 Leakage Testing

Leakage testing of sluice gates and tilting weirs shall be done under maximum expected pressure and after all installation work has been completed. No leakage between frames and the structure shall be acceptable.

The acceptable leakage rate shall be:

- a) 0,015 l/s/m of seating perimeter / 3 m pressure head (for off-seating conditions);
- b) 0,008 l/s/m of seating perimeter / 3 m pressure head (for on-seating conditions).

Fixed weirs shall be sealed droptight against structures and at joints between adjacent weir plates.

Hand stops and stop logs shall be installed such as to provide minimum leakage, unless seals are specified in the Detail Specification, in which case the same maximum leakage rates as in (a) and (b) above shall apply.

MFC 10

Payment Items

The following payment items shall apply to sluice gates, hand stops, stop logs and weirs:

MFC 10.1	Supply and delivery of wall-mounted sluice gate	Unit: No
MFC 10.2	Supply and delivery of channel gate	Unit: No
MFC 10.3	Supply and delivery of downward opening weir gate	Unit: No
MFC 10.4	Supply and delivery of hand stop	Unit: No
MFC 10.5	Supply and delivery of stop log	Unit: No
MFC 10.6	Supply and delivery of fixed weir	Unit: No
MFC 10.7	Supply and delivery of tilting weir	Unit: No

The tendered rate shall include full compensation for all actions and costs involved in the supply and delivery to site of the items as specified.

Different items will be scheduled for gates and weirs of different sizes and pressure head ratings.

MFC 10.8	Installation, testing and commissioning of wall-mounted sluice gate	Unit: No
MFC 10.9	Installation, testing and commissioning of channel gate	Unit: No
MFC 10.10	Installation, testing and commissioning of downward opening weir gate	Unit: No
MFC 10.11	Installation, testing and commissioning of hand stop	Unit: No
MFC 10.12	Installation, testing and commissioning of stop log	Unit: No
MFC 10.13	Installation, testing and commissioning of fixed weir	Unit: No
MFC 10.14	Installation, testing and commissioning of tilting weir	Unit: No

The tendered rate shall include full compensation for all actions and costs involved in the installation, testing and commissioning of the items as specified.

Different items will be scheduled for gates and weirs of different sizes and pressure head ratings.

SECTION MLE

STANDARD SPECIFICATION: LIFTING EQUIPMENT

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MLE 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.

MLE 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.

MLE 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.

MLE 4 Gearboxes

Gearboxes for crane duty shall be of the totally enclosed free-floating planetary type, life-lubricated with oil.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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.

MLE 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

MLE 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.

- MLE 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.
- MLE 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.
- MLE 9.3 Isolators**
The main isolator shall be rated as a motor start circuit breaker with thermal and magnetic short-circuit protection.
- MLE 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.
- MLE 9.5 Labels**
All isolating switches, contactors, relays etc. shall be labelled according to the wiring diagram.
- MLE 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.
- MLE 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.
- MLE 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.
- MLE 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.
- MLE 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".

MLE 11 Corrosion Protection

The equipment provided shall be manufactured from corrosion-resistant materials. Where applicable, corrosion protection shall be provided as specified the Detail Specification.

MLE 12 Painting And Colour-Coding

All plates used in the manufacture of the crane shall be abrasive blast cleaned at the preparation stage to remove mill scale and rust.

After manufacture, the structure shall be given one shop coat of protective primer followed by a finishing coat of matt enamel in the colour specified by the Engineer.

The hoist and travel units shall be provided with one shop coat of protective primer followed by a finishing coat of matt enamel in the colour specified by the Engineer.

MLE 13 Testing And Commissioning

The crane, and all slings, ropes, shackles and other lifting equipment supplied shall be tested by the manufacturer at his works. The tests shall be carried out at 125% of Safe Working Load, and Test Certificates shall be supplied.

Site tests shall be carried out by the Contractor who shall supply the necessary materials for the test load. The test load shall be removed from site by the Contractor after successful tests have been carried out.

Electric Payment Items

**overhead
crane 14**

MLE 14.1	Supply and delivery of electric overhead crane	Unit: No
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MLE 14.2	Installation, testing and commissioning of electric overhead crane	Unit: No
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The unit of measurement for the supply and delivery of electric overhead cranes and for the installation, testing and commissioning of electric overhead cranes shall be the number of units provided and installed. The tendered price shall include for all costs, fittings and actions required to provide a fully operational electric overhead crane as specified.

SECTION MIA

STANDARD SPECIFICATION: INSTRUMENTS AND ANCILLARIES

SECTION	CONTENTS
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MIA 2	Mechanical Flow Meters
MIA 3	Electromagnetic Flow Meters
MIA 4	Level Switches And Indicators
MIA 5	Pressure Gauges
MIA 6	Electrical Indicators And Integrators
MIA 7	Level Instrumentation

MIA 1 General

Unless otherwise specified in the Detail Specification the following requirements shall apply to all instruments and ancillary equipment installed on the Works.

All instruments, gauges and control gear that perform similar duties shall be of uniform type and manufacture throughout the Works in order to facilitate maintenance and the stocking of spare parts.

Panel mounted instruments shall have damp-protecting and dust-protecting cases. Instruments mounted outside instrument panels shall have weatherproof and dustproof cases. Instrument cases shall be of corrosion-resistant material or finish. Instrument screws (unless forming part of a magnetic circuit) shall be of brass or bronze. Access to terminal compartments of instruments mounted outside panels or other enclosures shall not expose any working part. Moving parts and contacts shall be adequately protected from the ingress of dust.

Unless otherwise specified instruments shall be finished in the manufacturer's standard colour. Instrument dials shall be of such material that no peeling or discoloration will take place with age.

Plant-mounted indicators and gauges shall be sized to give full legibility when viewed from a position with convenient and easy access or from the point at which any operation requiring observation of the gauge is performed. The minimum diameter for any gauge shall be 100 mm except where forming part of standard instruments and accessories such as air sets.

Dials and bezels shall be of bronze and internal components shall be of stainless steel, bronze or other corrosion-resistant material.

Plant mounted in enclosures shall be suitable for continuous operation at the maximum internal temperature possible in service, due account being taken of internally-generated heat and heat dissipated by other Plant. All components shall be rated adequately and circuits shall be designed so that changes of component characteristics within the manufacturers' tolerances shall not affect the performance of Plant. All Plant shall be designed to operate without artificial cooling. Instruments shall be easily withdrawable from cases without interrupting their circuits.

Plant provided with anti-condensation heaters shall be capable of operating without damage if the heaters are left on continuously.

Measuring instruments shall have zero and span adjustment.

Instruments not mounted in panels shall be supplied complete with all brackets, stands, supporting steelwork and weatherproof enclosures (separate from the instrument cases) necessary for securing them in their working positions and affording complete protection at all times including periods of

servicing, adjustment, calibration and maintenance. Instruments mounted in open areas that could be vandalised shall be mounted in lockable vandal proof boxes.

MIA 2 Mechanical Flow Meters

Mechanical flow meters shall be of the in-line helical vane type conforming to the Class B requirements of BS 5728.

Meters shall have flanged spheroidal graphite iron casings to BS EN 1563:1997 coated with two-pack epoxy enamel.

The rotors shall be manufactured from polypropylene with stainless steel shafts.

The counter housing shall be sealed and be provided with a seven figure straight reading digital counter and have a centre sweep hand calibrated to give 10% of the smallest unit on the counter per revolution. The units shall be cubic metres or litres, dependant on the application.

The counter covers shall be provided with a hinged polyacetal or brass cover to protect the counter face from dirt and damage.

Each meter shall be flanged to BS EN 1092: 1997 and be supplied complete with a low loss flanged in-line strainer to prevent any large particles in the water from clogging or damaging the meter. The strainers shall have removable components to allow access for cleaning and maintenance without removing the flanged strainer body.

Mechanical flow meters shall be able to provide a pulsed output for continuous flow rate monitoring suitable for telemetry link-up.

MIA 3 Electromagnetic Flow Meters

Electromagnetic flowmeters shall comply with the requirements of BS EN ISO 6817:1997. They shall operate on electromagnetic induction principles and give an output signal directly proportional to the liquid rate of flow. Each meter shall be capable of linking up to a telemetry system and shall have two 4 - 20mA outputs and two relays.

Each meter shall have a stainless steel metering tube (detector head) and a non-conductive liner suitable for potable water. End connections shall be steel flanged. The detector head shall be complete with corrosion resistant earthing rings and matching flange adapters of the self-locking type suitable for use on the pipes. One flange of the detector head shall be connected to a flanged pipe, while the other shall be connected with the flange adapter to facilitate removal.

The flow meter shall be carefully sited in the process pipework in accordance with BS 5792 and the flow meter supplier's instructions. Particular attention should be paid to the provision of the correct velocity range, earthing rings and the correct number of upstream and downstream clear diameters. A bypass and isolating valves shall be provided to allow the removal of the flow meter for maintenance.

The Contractor shall provide any taper pieces necessary to give the correct velocity range through the flowmeter.

The primary flowhead shall be suitable for continuous submersion in accordance with BS EN 60529:1992 IP68 or better. The maximum depth of submergence shall be three metres. The primary flowhead shall have electrodes that may be removed for cleaning or replacement without interrupting the flow.

Plant mounting enclosures for signal converters shall be to IEC 529, standard IP65 or better. Measuring ranges shall be continuously adjustable from 1 to 9.999 metres per second with facility to change to 0.5 to 5.5 m/s for high accuracy measurement of low flows.

For flows between 50-100% of the range, the accuracy shall be better than or equal to $\pm 0.5\%$ of the actual flow rate; for flows between 10-50% of the range accuracy shall be better than or equal to $\pm 0.3\%$

of the actual flow rate; and for flows between 1-10%, accuracy shall be better than or equal to $\pm 0.1\%$ full scale value.

The effects of ambient temperature on the output signals shall not exceed 0.15% per 10° C.

MIA 4 Pressure Gauges

The equipment shall be supplied and installed, complete with mountings, housings, tubing, fittings, etc. necessary for the display of pressure in pipes.

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.

Pressure gauges shall comply with BS EN 837-1:1998. Pressure gauges, transmitters and switches shall have over range protection. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze or approved corrosion-resistant material. Pressure gauges shall have concentric scales.

Where compensation of more than 2% of the instrument span is needed for the difference in level between the instrument and the tapping point, the reading shall be suitably adjusted and the amount of compensation shall be marked on the dial.

The gauge shall have a range of measurement not less than 1.25 times the operational range of the equipment to which it is connected. In cases where gauges are used to indicate pressures above and below atmospheric pressure, the gauge range shall be not less than 125% of the maximum positive and maximum negative pressure.

The normal working pressure shall be indicated at a point between 50% and 75% of the full-scale deflection of the gauge. The instrument shall indicate accurately to within 3% of the full-scale deflection.

All pressure gauges shall be equipped with an isolating valve or a gauge cock to allow it to be isolated from the pipe. The cost of the valve or gauge cock shall be deemed included in the tendered rate for the equipment.

Where a pressure gauge is to be installed on a pipe conveying corrosive liquids or slurries, or where there is a risk that the pressure ports of the gauge could become blocked as a result of the properties of the medium conveyed, such gauges shall be equipped with gauge protectors.

Glycerine-filled gauges shall be used for applications involving hydraulic pipelines, while vacuum-damped gauges shall be employed where they are to be installed on air or gas lines.

Labels shall be provided, especially on remote-mounted gauges, to indicate the locations where pressure is measured. The operating set point of all meters and indicators shall be clearly marked in red.

After installation, pressure gauges shall be tested and commissioned together with the equipment to which they are connected, such as pumps or compressors and their associated pipework.

MIA 5 Ultrasonic Level Measuring Instruments

Ultrasonic level measuring devices shall comply with the following minimum requirements:

(i) Level sensor

The sensor head shall be protected to IP68.

Sensing heads shall be mounted on stainless steel brackets and positioned with due regard given to an unhindered beam path and within easy reach of maintenance personnel.

(ii) Signal converter

The signal converter shall be supplied in an IP55 (indoors) or IP65 (outdoors) minimum polycarbonate enclosure and shall comprise a base unit and a programming device. Communication between the programmer and signal converter shall be in such a manner that the IP rating is not prejudiced.

A 90 mm (3.5 inch) or larger digit liquid crystal display shall be used to indicate key programming features, setting and output conditions. The display shall be in the English language. The unit shall also be provided with a keypad for calibration and configuration.

The unit shall be suitable for either 24 V DC or 240 V AC operation.

Accuracy of the signal converter shall be better than $\pm 0.5\%$ of reading.

The signal converter shall have the following programmable outputs:

- i.) 4-20 mA proportional to user definable engineering units;
- ii.) SPDT relay contact output closing upon failure of the signal converter or lost echo;
- iii.) 3 off SPDT contact outputs with independently set trip points. These outputs shall be programmed to energise upon high/low level, rate of change or to allow a number of pump sequencing operations.

MIA 6 Level Switches And Indicators

Level transmitters shall be of the float, pressure bulb, displacer, diaphragm or air-bubbler types. Float-operated transmitters shall have counterweights. Floats and displacers of transmitters and switches shall be of corrosion-resistant material or shall be coated with epoxy resin.

Level switches of the buoyancy type shall consist of a micro switch with changeover action enclosed in a non-corrosive material. A balance weight shall also be incorporated in the switch to counteract the buoyancy effect for the specific gravity of the particular fluid. The connecting cable shall be sealed into the switch.

Buoyancy switches shall be installed with a minimum of two metres of spare connecting cable neatly coiled at a supporting bracket. The connecting cable fixing shall facilitate any alteration in operating level within the limit of the spare cable.

Level switches operating on the conductivity principle shall have three electrodes per relay or control unit except where a differential between the "cut-in" and "cut-out" values is not required or where two or more relays are associated with the same vessel, when a common "earth" electrode shall be used.

Electrodes for the same vessel shall be mounted on a common plate that shall be made in sections if desirable to facilitate handling. Electrode heads shall permit an adjustment in operating levels of not less than 90mm without necessitating cutting or extending electrodes.

Electrodes shall be of a noble metal to resist corrosion, and shall be insulated for most of their lengths. The thickness of electrodes and points of intermediate support shall be chosen so that no bending of the electrodes occurs under Plant operation conditions. This includes temporary bending.

Relay units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall have conductivity discs.

MIA 7 Conductivity Electrodes And Level Relay Systems

Conductivity electrodes shall be formed from stainless steel tubes encapsulated in PVC sleeving down to 75 mm from the end of the electrode. The electrode shall be sealed.

Where necessary, intermediate insulated support brackets shall be installed to prevent the electrodes swaying. The intermediate supports shall be installed above normal top water level at the particular

location. An earth electrode shall be provided at each electrode installation. Pipework shall not be used for the earth.

The electrode holders shall comprise a moulded back phenolic body capable of accepting 20 mm BS pipe. Plated clamping collars complete with cable termination shall be provided to locate the electrode. The holder cap shall also be of moulded phenolic material. A gasket shall be placed between body and cap. The body shall be arranged to receive screwed conduit.

Electrode holders shall permit adjustment in operating levels of not less than 100 mm without necessitating cutting or extending electrodes.

Relay units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall have conductivity discs. Electrodes shall be energised with an alternating voltage not exceeding 25 V open circuit.

MIA 8 Pressure Transducers

Pressure transducer level measuring sensors shall be of the stainless steel submersible type operating on the piezo-resistive silicon strain gauge principle.

Compatible power supply and signal processing units shall be provided with protection against radio frequency interference and supply transients. The final output shall be a 4-20 mA signal proportional to level. Lightning protection shall be provided where applicable. Pressure transducers shall be IP68 rated.

The transducer/cable shall be suitably supported with stainless steel brackets. A bracketed stainless steel restraining tube shall be provided in deep sumps etc.

MIA 9 Electrical Indicators And Integrators

Indicators for use with analogue signal transmission systems shall comply with BS 89 and have an accuracy class index of 1.0. Indicator movements shall be critically damped (dead-beat). Indicators for use on more than one circuit shall have rotary switches to select the circuit, with engraved plates to show the circuit selected.

Indicators shall have circular scales or shall be of the vertical edgewise type and shall be designed to avoid parallax error. Scales shall be clearly marked in the specified units and shall comply with BS 3693. All instruments that are mounted on one panel or board, or are in adjacent groupings, shall have similar styles of figures and letters. Dials shall be white with black scales and lettering not subject to fading.

The material for scales shall be such that no peeling or discoloration will take place with age under all environmental conditions.

Major scale marks and numerals shall be of the same size and thickness and shall be separated by not more than twenty-five minor marks. Pointers shall taper to the width of the scale marks.

Integrators shall be of the multi-digit cyclometer type. Each integrator shall have an integral or separate current-to-pulse converter with sufficient adjustment of the pulse rate to avoid the use of any multiplying factor except in integer power of ten. Each integrator shall incorporate an adjustable limiter whereby any input below a preset value is inoperative. Unless otherwise specified, integrators shall have a minimum of eight digits with a decimal point where applicable.

MIA 10 Payment Items

The following payment items shall apply to instruments and ancillary equipment:

MIA 10.1	Supply and delivery of mechanical flow meter	Unit: No
MIA 10.2	Supply and delivery of electromagnetic flow meter	Unit: No

MIA 10.3	Supply and delivery of pressure gauge	Unit: No
MIA 10.4	Supply and delivery of ultrasonic level measuring instruments	Unit: No
MIA 10.5	Supply and delivery of level switches and indicators	Unit: No
MIA 10.6	Supply and delivery of conductivity electrodes and level relay systems	Unit: No
MIA 10.7	Supply and delivery of pressure transducers and integrators	Unit: No
MIA 10.8	Supply and delivery of electrical indicators and integrators	Unit: No

The tendered rate shall include full compensation for all actions and costs involved in the supply and delivery to site of all items required for the installation of fully functional instruments and ancillary equipment as specified. Different items will be specified in the Bill of Quantities depending on the type of equipment required.

MIA 10.9	Installation, testing and commissioning of mechanical flow meter	Unit: No
MIA 10.10	Installation, testing and commissioning of electromagnetic flow meter	Unit: No
MIA 10.11	Installation, testing and commissioning of pressure gauge	Unit: No
MIA 10.12	Installation, testing and commissioning of ultrasonic level measuring instruments	Unit: No
MIA 10.13	Installation, testing and commissioning of level switches and indicators	Unit: No
MIA 10.14	Installation, testing and commissioning of conductivity electrodes and level relay systems	Unit: No
MIA 10.15	Installation, testing and commissioning of pressure transducers and integrators	Unit: No
MIA 10.16	Installation, testing and commissioning of electrical indicators and integrators	Unit: No

The tendered rate shall include full compensation for all actions and costs involved in the installation, testing and commissioning of fully functional instruments and ancillary equipment as specified. Different items will be specified in the Bill of Quantities depending on the type of equipment required.