



PROJECT SPECIFICATIONS

The Project Specifications, consisting of four parts, form an integral part of the contract and supplement the Standardised Specifications.

Part 1 contains Project Specifications and the requirements to be met.

Part 2 contains reference to the Standardised Specifications.

Part 3 contains variations, amendments and additions to the Standardised Specifications.

Part 4 contains Particular Specifications for aspects of the works for which there are no Standardised Specifications per se.

In the event of any discrepancy between a part or parts of the Standardised Specifications and the Project or Particular Specifications, the Project and Particular Specifications shall take precedence.

In the event of a discrepancy between the Specifications (including the Project Specifications), the Bill of Quantities and the Drawings, the Specifications take precedence, thereafter the Bill of Quantities and thereafter the Drawings.

In all events, any discrepancies whatsoever shall be brought to the attention of the Engineer before the execution of the work under the relevant items.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Part 1: Project Specifications

PS 1 DRAWINGS

PS 1.1 Drawings Prepared by Engineer

The drawings issued to tenderers during the tender period must be regarded as provisional and preliminary in order to enable the tenderers to generally assess the scope of work. These drawings are of A2 size and are to be found under **Annexure A** (see separate tender book of drawings).

At the commencement of the contract, the Engineer shall deliver to the Contractor copies of the construction drawings and any instructions required for the commencement of the works. From time to time thereafter during the progress of the works, the Engineer may issue further drawings for construction purposes as may be necessary for adequate construction, completion and defects correction of the works. The work shall be carried out in accordance with the latest available revision of the drawings.

All drawings and specifications and copies thereof remain the property of the Employer, and the Contractor shall return all drawings and copies thereof to the Employer at the completion of the contract.

PS 2 CONSTRUCTION AND MANAGEMENT REQUIREMENTS

PS 2.1 General

The Contractor is referred to SANS 1200A: General for Construction and Management Requirements for Works Contracts. Certain aspects however require further attention as described hereafter.

PS 2.2 Management and disposal of water (Read with SANS 1200A sub-clause 5.5)

The Contractor shall pay special attention to the management and disposal of water and storm water on the site. It is essential that all completed works or parts thereof are kept dry and properly drained. Claims for delay and for repair of damage caused to the works as a result of the Contractor's failure to properly manage rain and surface water, will not be considered.

PS 2.3 Disposal of spoil or surplus material (Read with SANS 1200A sub-clause 5.6)

The Contractor shall dispose all surplus and unsuitable material in designated spoil areas as directed by the Engineer.

PS 2.4 Testing (Read with SANS 1200A clause 7)


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The Contractor shall arrange for all tests required for process control to be done by a laboratory acceptable to and approved by the Engineer. The Contractor must submit the results of tests carried out on materials and workmanship when submitting work for acceptance by the Engineer. The costs for these tests shall be deemed to be included in the relevant rates and no additional payment will be made for testing as required.

PS 2.5 Management of the Environment

An Environmental Management Programme (EMPr) is currently being compiled as part of the process of obtaining environmental authorisation for this project but will be in place before commencement of construction. It is noted that the requirements of the EMPr must therefore be borne in mind when tendering and pricing for this contract. A copy of the EMPr can be made available to the Tenderers should they wish to peruse it during the tender period. The appointed Contractor will be provided with a copy of the environmental authorisation and the EMPr before the commencement of construction.

The Contractor's initial costs for complying with the EMPr as well as all costs to maintain compliance with the EMPr and the environmental authorisation, for the duration of the construction period, are to be included in the Sums tendered.

PS 2.6 Security

The Contractor must ensure that all his/her employees as well as the employees of his/her subcontractors are able to identify themselves as members of the construction team.

PS 3 CONSTRUCTION PROGRAMME

PS 3.1 Preliminary programme

The Tenderer shall include with his tender a preliminary programme to be completed by all Tenderers. The programme shall be in the form of a simplified bar chart with sufficient details to show clearly how the works will be performed within the time for completion as stated in the Contract Data.

Tenderers may submit tenders for an alternative Time for Completion in addition to a tender based on the specified Time for Completion. Each such alternative tender shall include a preliminary programme similar to the programme above for the execution of the works and shall motivate his/her proposal clearly by stating all the financial implications of the alternative completion time.

The Contractor shall be deemed to have allowed fully in his/her tendered rates and prices as well as in his/her programme for all possible delays due to normal adverse weather conditions and special non-working days as specified in the Special Conditions of Contract, in the Project Specifications and in the Contract Data.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PS 3.2 Programme in terms of Clause 5.6 of General Conditions of Contract (2015)**

It is essential that the construction programme, which shall conform in all respects to Clause 5.6 of the General Conditions of Contract (2015), be furnished within the time stated in the Contract Data. The preliminary programme to be submitted with the tender shall be used as basis for this programme. The Contractor's attention is also drawn to clause 5.7 of the General Conditions of Contract (2015).

The Contractor shall indicate on the programme all critical path activities. In this regard, the Contractor's attention is drawn to Clause 5.12.1 of the General Conditions of Contract (2015), where consideration will only be given to claims for extension of time associated with critical path activities.

Activities must be broken down into sufficient detail so that it is possible to make an accurate assessment of the actual progress of work in relation to programme at any time.

The Contractor must submit a written progress report together with a copy of the approved construction programme (Gantt Chart) marked up with the current status line for the Engineer's approval at least 48 hours in advance of each formal site meeting. Such meetings will be held at no longer than monthly intervals.

PS 4 SITE FACILITIES AVAILABLE

At the commencement of the contract, the Employer shall make a portion of land available to the Contractor for the purposes of setting up his site camp and storage area. The site camp shall be located as close as is practically possible to the Western Highveld WTW.

The Contractor shall make his own arrangements for the provision of drinking water for his staff. Any costs associated with this will be deemed to have been allowed for in the Contractors rates and no additional payment for the provision of drinking water on site will therefore be entertained by the Employer.

The Contractor shall make his own arrangements for the provision of water for construction purposes. Any costs associated with this will be deemed to have been allowed for in the Contractors rates and no additional payment for the provision of drinking water on site will therefore be entertained by the Employer. No wastage of water by the Contractor will be tolerated.

There are no sanitation facilities present at the site of the Works. The Contractor shall therefore provide sufficient on-site ablution facilities for his staff as well as visitors to the site, in the form of portable chemical latrines. The Contractor will be responsible for the maintenance and servicing of these facilities for the duration of the contract and will ensure that all latrines are maintained in a


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



clean and sanitary working condition. The Contractor shall also be responsible for removing the latrines on completion of the Contract.

There is no electricity supply currently available at the site of the Works. The Contractor shall therefore make his own arrangements for the provision of electricity for construction purposes. Any costs associated with the provision of power on site for construction purposes as well as for the provision of power to any office buildings on site shall be for the Contractor's account.

PS 5 OCCUPATIONAL HEALTH AND SAFETY

PS 5.1 General Statement

It is a requirement of this contract that the Contractor shall provide a safe and healthy working environment and direct all his activities in such a manner that his employees and any other persons, who may be directly affected by his activities, are not exposed to hazards to their health and safety. To this end the Contractor shall assume full responsibility to conform to all the provisions of the Occupational Health and Safety Act No. 85 of 1993 (OHS Act) and the Construction Regulations 2014 issued on 17 February 2014 as amended by the Department of Labour.

The Contractor will implement an integrated Safety Health and Environment system (SHE). The environmental management unit and staff will however function separately from the SHE staff and functional area. SHE staff will act as environmental inspectors as part of their health and safety inspections and safety representatives appointed as per the OHS act will also act as environmental representatives.

For the purpose of this contract, the Contractor is referred to **Particular Specification PA – Health and Safety**. The purpose of this Specification is to ensure that Principal Contractors entering into a contract with the Employer maintain a level of performance with regard to health and safety issues during the performance of the contract that is in complete compliance with the relevant Health and Safety Regulations. In this regard the OHS Specifications form an integral part of the Contract and the Principal Contractor shall ensure that their contractors and/or suppliers comply with the requirements of this Specification.

PS 5.2 Health and Safety Plan

The Contractor shall, on receipt of notification that he has been awarded the contract, submit his own detailed Health and Safety Plan for the execution of the work under the contract. This Health and Safety Plan must at least cover the following:

- (i) a proper risk assessment of the works, risk items, work methods and procedures in terms of Regulations 7 to 28;
- (ii) pro-active identification of potential hazards and unsafe working conditions;
- (iii) provision of a safe working environment and equipment;


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (iv) statements of methods to ensure the health and safety of subcontractors, employees and visitors to the site, including safety training in hazards and risk areas (Regulation 5);
- (v) monitoring health and safety on the site of works on a regular basis, and keeping of records and registers as provided for in the Construction Regulations. During the monitoring, a record of any environmental matters requiring attention will also be recorded.
- (vi) details of the Construction Supervisor, the Construction Safety Officers and other competent persons he intends to appoint for the construction works in terms of Regulation 6 and other applicable regulations; and
- (vii) details of methods to ensure that his Health and Safety Plan is carried out effectively in accordance with the Construction Regulations 2014.

The Contractor's Health and Safety Plan will be subject to approval by the Employer before commencement of construction work. The Contractor will not be allowed to commence work, or his work will be suspended if he had already commenced work, before he has obtained the Employer's written approval of his Health and Safety Plan.

Time lost due to delayed commencement or suspension of the work as a result of the Contractor's failure to obtain approval for his safety plan, shall not be used as a reason to claim for extension of time or standing time and related costs.

PS 5.3 Cost of Compliance with the OHS Construction Regulations

The rates and prices tendered by the Contractor shall be deemed to include all costs for conforming to the requirements of the Act, the Construction Regulations and any specific Health and Safety requirements of the Employer, as applicable to this contract. Should the Contractor fail to comply with the provisions of the Construction Regulations, he will be liable for penalties as provided for in the Construction Regulations.

PS 6 WORKS INSPECTION REQUIREMENTS

The works should be inspected on a monthly basis by an environmental specialist to ensure compliance with the Environmental Management Programme. The works should also be inspected on a monthly basis by a Health and Safety specialist to ensure that workers and working conditions comply with the relevant safety requirements.

The works will also be inspected on a regular basis by the Engineer to ensure compliance with the standards, specifications, drawings and details, safety and security etc. all in accordance with the contract.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Part 2: Standardised Specifications

The standardised specifications on which this contract is based are **Standards South Africa's Standardised Specifications for Civil Engineering Construction SANS 1200**.

(Note: "SABS" has been changed to "SANS", without change to the contents of the specifications).

Although not bound in nor issued with this Document, the following Sections of the Standardised Specifications of SANS 1200 shall form part of this Contract:

SANS 1200 A	:	General
SANS 1200 AA	:	General (Small Works)
SANS 1200 AB	:	Engineer's office
SANS 1200 C	:	Site clearance
SANS 1200 D	:	Earthworks
SANS 1200 DA	:	Earthworks (Small Works)
SANS 1200 DB	:	Earthworks (Pipe Trenches)
SANS 1200 DK	:	Gabions and pitching
SANS 1200 DM	:	Earthworks (Roads, Subgrade)
SANS 1200 G	:	Concrete (Structural)
SANS 1200 GA	:	Concrete (Small Works)
SANS 1200 HA	:	Structural steelwork (Small Works)
SANS 1200 HB	:	Cladding and sheeting
SANS 1200 L	:	Medium-pressure pipelines
SANS 1200 LB	:	Bedding (Pipes)
SANS 1200 LC	:	Cable ducts
SANS 1200 LD	:	Sewers
SANS 1200 LE	:	Stormwater drainage
SANS 1200 ME	:	Subbase
SANS 1200 MF	:	Base
SANS 1200 MJ	:	Segmented Paving
SANS 1200 MK	:	Kerbing and Channelling
SANS 1200 MM	:	Ancillary Roadworks



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2

**PSA GENERAL (SABS 1200 A)****PSA 1 STANDARDISATION MARK (CLAUSE 3.1)**

Add the following to the Clause:

All material delivered to the site shall bear the Official Standardization Mark.

PSA 2 CONTRACTOR'S CAMP (CLAUSE 4.2)**PSA 2.1 Restrictions on employee accommodation (Sub-clause 4.2)**

No housing is available for the Contractor's employees. The Contractor shall make his own arrangements to house his employees.

The Employer shall place an area at the disposal of the Contractor to enable him to erect his site offices, workshops and stores. Any temporary housing and facilities shall comply with the requirements of the local authority. The Contractor shall provide his own fencing and site security.

PSA 3 DEALING WITH WATER (SUBCLAUSE 5.5)

In addition to the items as set out in Subclause 5.5 the contractor shall also provide pumping equipment, pipes and other equipment as may be necessary.

PSA 4 MEASUREMENT AND PAYMENT**PSA 4.1 Fixed charge and Value Related Items (Sub-clause 8.2.1)**

Replace the sub-clause with the following:

Payment shall be a lump sum to provide for the Contractor's expenses in connection with:

- (a) setting up and maintaining his organisation, camps and plant on the site;
- (b) effecting the insurances and indemnities required in terms of the General Conditions of Contract
- (c) meeting all other general obligations and liabilities which are not specifically measured for payment in these contract documents.

The lump sum total of items (a), (b) and (c) as measured and Fixed Charge Items and time Related Items shall not exceed 15% of the nett total Tender Amount. If the


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Tenderer should tender a higher amount for this item it shall be reduced to the amount allowed above and all other tendered prices increased in the proportion required to retain the same Nett Total Tender Amount.

The tendered lump sum shall not be subject to any variation if the actual value of work done under the Contract exceeds, or falls short of, the Tender Amount, or as a result of an extension of time for completion in terms of Clause 5.12 of the General Conditions of Contract.

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

Before any payment is made under this item the Contractor shall satisfy the Engineer that he has provided on site an establishment and plant of good quality and in value exceeding that of the first instalment. The Contractor may be asked to furnish documented proof that he owns the offices and plant on site, the value of which should exceed the amount claimed in the first certificate. In the event that the Contractor cannot satisfy the Engineer as to the value or ownership, the Engineer shall have the right to withhold part of any payments to be made under this item, until the Works have been completed.

Payment of the lump sum shall be made in three separate instalments as follows:

- (a) The first installment, 50% of the lump sum, will be paid in the first payment certificate after the Contractor has met all his obligations under this sub-clause and has made a substantial start on construction in accordance with the approved programme.
- (b) The second installment, 35% of the lump sum, will be paid when the value of the work done reaches one half of the Nett Total Tender Amount.
- (c) The third and final installment, 15% of the lump sum, will be paid when the works have been completed and the Contractor has fulfilled all requirements of this sub-clause. No payment for the scheduled Fixed Charge Items for this contract will not be made until the requirements regarding and the erection of name boards have been met.

PSA 4.2 Time-Related Items (Sub clause 8.2.2)

Replace this sub clause with the following:

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Subject to the provisions of 8.2.3 and 8.2.4, payment of item 8.4.1 (time-related item) will take place in equal monthly amounts, calculated on the tendered amount for the item, divided by the contract period in months, with the understanding that the total of the monthly payments which was paid for this specific item does not exceed the proportion that the progress of the works to date bears in relation to the works as a whole.

Should the Engineer grant an extension of time, the Contractor is entitled to an increase in the amount tendered for time related items, and this increase must be kept in the same proportion to the original tender amount as the extension of time is to the original time of the completion of the works.

Payment for such increased amounts will be considered as full compensation for all time related, provisional and general costs which arise as a result of the extension of time.

PSA 4.3 Facilities for Engineer (Sub clause 8.3.2.1)

Change the item descriptions of the following items as follow:

PSA 4.3.1 Item:

a) Engineer's office

Unit:

Month

The specifications for the items listed below should be provided in accordance with the "Facilities provided by the Contractor" in C3.1 Scope of Works:

The tendered sum shall provide for the following:

Provide the following units:

- 2 x Airconditioned Offices (minimum 10 m²)
- 1 x Airconditioned Boardroom (accommodating 25 people)
- 1 x Kitchen (7 m²)
- 2 x WC units (male and female)
- 6 x carports with crushed stone floor

Note that the areas surrounding the units in the Engineer's camp must be covers with gravel as specified in Section C3.1 Scope of Works

The Boardroom shall each be furnished with the following:

- Air conditioner


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- 1 x conference table to seat 25 people
- 25 x new chairs
- White board mounted to wall (Minimum 1.2 x 2m)
- 1 x 10 kg Fire Extinguisher

The office shall be furnished with:

- Air conditioner
- 2 x office desks and 2 x chairs
- 1 x drawing table
- 2 x steel cabinets
- 1 x A1 drawing rack
- 1 A4/A3 Colour laser printer/Scanner/Copier
- 1 x 10 kg Fire extinguisher

The kitchen shall be furnished with:

- 2 Min 300 l fridge/freezer combination fridge
- Microwave of min 36 l and 1 000 W
- Cordless kettle
- 2 x 1.8 m steel folding table
- A set of 12 x each of knives, forks, spoons and teaspoons
- A set of 12 x each of white ceramic crockery including dinner plates, side plates, bowls, coffee mugs, tea cups and saucers
- A set of 24 x beer glasses
- 1 x large wooden cutting board
- 1 x kitchen knife set in knife block which includes at least a large carving knife, bread knife, medium knife, pairing knife and kitchen scissors
- 1 x meat casserole with lid
- 1 x 10 kg Fire extinguisher

The contractor must supply the following equipment:

- New Dumpy Level and Staff
- New Dynamic Cone Penetrometer (DCP)
- Measuring wheel with electronic display
- Rain gauge
- 2 x 1m spirit level
- 2 x First Aid Kit

The contractor will provide the following additional services

- Uncapped WIFI coverage for the offices and boardroom (min 6 MBs speed)


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSA 4.3.2 Item:**

c) Name board

Unit: month

The tendered sum shall provide for two contract nameboards as specified by the detail drawings.

PSA 4.4 Exposing of existing services

Add the following new pay item:

PSA 4.4.1 Item:

Excavation by hand in all materials to expose existing services Unit: cubic meter (m³)

The tendered sum must include full compensation for all hand excavation as per the dimension approved by the Engineer for the locating, exposing and moving of existing services. Excavation outside of approved dimensions will not be paid. The rate must also include for backfill and compaction to 90% of mod AASHTO density and, if applicable, the removal of excess material not used for backfill, the securing of excavations, for handling surface and subsurface water, for protection of existing services and for any other activity necessary to complete the work. Free haul of 1,0 km will be applicable on the transport of excess material.

No distinction will be made between classes of material or types of services.

Note: The Contractor must provide sufficient supervision over labourers when services are exposed."

PSA 4.5 Occupational Health and Safety

Add the following new pay items:

Provision for the cost related to the Occupational Health and Safety Act, 85 of 1993, and the relevant Regulations:

- | | | |
|----|---|-----------|
| a) | Preparation of a Health & Safety Plan. | Unit: Sum |
| b) | Compilation of a Risk Assessment prior to Construction. | Unit: Sum |
| c) | Health & Safety induction Training of employees. | Unit: Sum |

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



- d) Compilation and keeping up to date the Health & Safety file which shall include all documentation required in terms of the act. Unit: Sum
- e) Implementation of the Health and Safety Plan over the entire construction period. Unit: Sum
- f) Appointment of Safety Officer Unit: Month

The tendered sum shall include full compensation for providing the above services as required from the Occupational Health & Safety Act. The rate shall include all related costs incurred by the Act, remuneration of personnel, trainers, etc. and equipment required for the execution of the required services as depicted by the Act. The tendered amount for items a, b, c, d and e shall only be paid on the successful completion of the task as approved by the client. The tendered amount for item shall be paid on a monthly basis.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSA 4.6 SUMS STATED PROVISIONALLY BY THE ENGINEER**

Add the following new pay items:

PSA 4.6.1 Item:

Project Liaison Officer
Sum Unit: Prov

The total cost is for the duration of the project.

PSA 4.6.2 Item:

Project Liaison Committee
Sum Unit: Prov

The total cost is for the duration of the project.

PSA 4.6.3 Item:

Additional laboratory testing
Sum Unit: Prov

PSA 4.6.4 Item:

As-Built Survey
Sum Unit: Prov

The rate shall cover the cost for a surveyor to conduct an AS BUILT survey of the works as required by the Clients Agent

PSA 4.6.5 Item:

Provision of Accredited Training
(a) Generic skills Unit: Prov
Sum
(b) Entrepreneurial skills Unit:
Prov Sum
(c) Engineering skills Unit: Prov
Sum


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSA 4.6.6 Item:**

Remuneration of a trainee student x 3
Prov Sum

Unit:

PSA 4.7 Security Services

The Contractor shall provide adequate security services for the protection of the Works, construction sites, temporary facilities, plant, equipment, materials and other property under the Contractor's control for the duration of the Contract.

The Contractor shall be responsible for the provision, management and supervision of suitably trained and competent security personnel at all locations where security is required, including construction sites, storage areas, site establishments, access points, temporary facilities and other areas designated by the Employer/Engineer.

The security services shall include, but not be limited to, the following:

- (a) Provide and maintain adequate security for the Site, Works, construction plant, equipment, materials, temporary facilities and personnel for the full duration of the Contract.
- (b) Undertake a site-specific security risk assessment prior to commencement of construction.
- (c) Provide 24-hour security coverage, seven (7) days per week.
- (d) Provide appropriately PSiRA-registered security personnel.
- (e) Provide a minimum of Grade D security officers for routine guarding and access-control duties.
- (f) Provide a suitably experienced Grade B Security Supervisor responsible for supervision and coordination of security personnel.
- (g) Provide Grade C security officers where required for higher-risk or more specialised security duties.
- (h) Control and monitor access to the construction Site and other secured areas.
- (i) Prevent unauthorised persons from entering the Site or accessing construction plant, equipment, materials and facilities.
- (j) Monitor the movement of personnel, vehicles, plant and materials into and out of the Site.
- (k) Maintain accurate registers of visitors, personnel, vehicles and deliveries.
- (l) Verify access credentials and ensure that only authorised persons and vehicles enter the Site.
- (m) Undertake regular day and night patrols and inspections of the Site and secured areas, with a minimum of two (2) security officers deployed per shift, ensuring that not less than two (2) security officers are on duty at any given time, 24 hours per day, seven (7) days per week.
- (n) Protect construction materials, plant, equipment, tools, fuel, temporary works and facilities against theft, damage, vandalism and unauthorised removal.
- (o) Monitor high-risk areas including plant yards, material storage areas, fuel storage areas, site offices and other areas identified through the security risk assessment.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



The Contractor shall ensure that all security personnel are suitably trained, appropriately identifiable and competent to perform the duties assigned to them. Security personnel shall conduct themselves professionally and shall comply with all applicable legislation and site rules.

Where security services are provided by a subcontracted security service provider, such service provider shall comply with all applicable legal and regulatory requirements relating to the provision of security services.

The Contractor shall submit details of the proposed security arrangements to the Employer/Engineer for information prior to commencement of the Works. The security arrangements shall include the proposed number and deployment of security personnel, access-control arrangements, patrol arrangements and emergency contact details.

The Contractor shall remain fully responsible for the security of the Works notwithstanding the appointment of a specialist security service provider.

The Employer shall not be liable for any loss of or damage to the Contractor's plant, equipment, materials, temporary works or other property arising from theft, vandalism or other security-related incidents, except where such loss or damage is attributable to the Employer's proven negligence or default.

The cost of providing security services, including security personnel, supervision, transport, communication, registers, equipment and all other resources necessary for the proper execution of the security services, shall be deemed to be included in the Contractor's rates and prices, unless a separate item is provided in the Bill of Quantities.

The Contractor shall ensure that the security services are maintained continuously for the period during which the Works or the Contractor's property require protection, including outside normal working hours, weekends and public holidays where necessary.

PSA 4.8. Permanent Information Description Board

The Contractor shall make provision for the supply, manufacture, delivery and erection of a permanent description board at each completed reservoir and elevated tank, at locations designated by the Employer/Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The description board shall provide permanent identification of the completed infrastructure and shall include, as a minimum, the following information:

- (a) name of the Municipality/Employer;
- (b) name of the project;
- (c) name and description of the reservoir/elevated tank;
- (d) capacity of the reservoir/elevated tank;
- (e) project completion year; and
- (f) any other information required by the Employer/Engineer.

The final wording, layout, dimensions, colours, logos and general appearance of the description board shall be submitted by the Contractor to the Employer/Engineer for approval prior to manufacture.

The description board shall be manufactured from durable, weather-resistant and corrosion-resistant materials suitable for permanent outdoor installation and shall be capable of withstanding the prevailing environmental conditions at the site.

The board shall be securely mounted on suitable permanent supports and foundations. The Contractor shall ensure that the supports, fixings and foundations are structurally adequate and resistant to corrosion, vandalism and deterioration.

The Contractor shall be responsible for all associated works necessary for the satisfactory completion of the description board, including:

- preparation of the site;
- setting out;
- excavation;
- concrete foundations;
- supply and installation of support posts;
- supply and fixing of the board;
- lettering, graphics and approved municipal/project logos;
- protective coatings and finishes;
- backfilling and reinstatement; and
- removal of all surplus material and construction debris.

The completed description board shall be positioned in a prominent and accessible location as directed by the Employer/Engineer, without obstructing access to, or operation and maintenance of, the reservoir/elevated tank.

The Contractor shall submit shop drawings and/or artwork showing the proposed dimensions, materials, support arrangement, foundation details, wording and graphical layout for approval prior to fabrication.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The Contractor shall rectify, at his own cost, any defects, damage, poor workmanship, incorrect information or deterioration attributable to inadequate materials or installation during the Defects Liability Period.

PSA 5.1 Survey

The Contractor shall verify survey control and benchmarks before construction, undertake setting out and carry out regular checks of alignment, levels and dimensions.

Survey control points shall be protected. Disturbed control shall be reported immediately and re-established using an approved procedure before affected work continues.

The Contractor shall record the positions and levels of completed works, including buried services before covering, and submit as-built survey information in the coordinate system and formats specified in the Contract.

PSA 5.4 Protection of Overhead and Underground Services

Before excavation, the Contractor shall obtain available service information, consult relevant service owners and verify service positions using appropriate detection methods and authorised trial excavations.

Existing services shall be identified, marked, supported and protected during construction. Relocation, interruption or disconnection shall require prior authorisation from the service owner and Employer's Agent.

Damage shall be reported immediately. Responsibility for repairs and associated costs shall be determined in accordance with the Contract.

PSA 6.2.1 Accredited Training (New sub-clause 8.4.6)

New sub-clause 8.4.6:

"The sum tendered under this item shall allow for the Contractor's cost involved in paying for accredited off site training of local employees including transport to the training venue and accommodation of trainees and shall be paid in monthly instalments."

PS 8.3.5.2: Occupational Health and Safety Act Obligations

The Contractor shall comply with the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as amended, all applicable regulations issued thereunder, and the Employer's project health and safety specification.

The tendered sum shall cover the initial establishment of the Contractor's health and safety arrangements, including preparation and submission of the site-specific health and safety plan; initial risk assessments and safe work procedures; statutory appointments; establishment of the health and safety file; initial induction and training; and provision of the initial protective equipment, safety notices and emergency arrangements required for the Works.

Measurement and payment


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**Unit: Sum**

Payment shall be made upon completion of the initial health and safety establishment, submission of the required documentation and acceptance of the health and safety plan by the Employer or its authorised health and safety agent.

The sum shall include all labour, professional services, equipment, materials and incidental costs necessary for these initial obligations. Continuing supervision, inspections, training, replacement equipment and maintenance of health and safety arrangements shall be measured under the separately scheduled time-related OHS item

PSA 8.4.6.1 Continuing Occupational Health And Safety Obligations

The Contractor shall implement the accepted Health and Safety Plan throughout construction, maintain the Health and Safety File, update activity-specific risk assessments and provide the required competent safety personnel.

The Contractor shall conduct continuing inductions, toolbox talks, inspections and audits, maintain incident and corrective-action records and submit monthly compliance reports.

Unit: Month

The rate shall include continuing safety personnel, administration, training, inspections, records and measures allocated to this item by the Contract.

Payment shall be based on the period for which the specified services are provided, supported by monthly records. Part-month valuation and adjustments for extensions of time shall follow the Contract. Initial obligations paid under PSA 4.5 shall be excluded.

PSA 8.4.6.4 Environmental Management Plan Compliance

The Contractor shall implement the applicable Environmental Management Plan and environmental authorisation conditions throughout construction.

The work shall include the required environmental supervision, inspections, reporting, waste management, spill prevention and response, erosion control, dust suppression and protection of designated sensitive areas.

Unit: Month

The rate shall include continuing personnel, administration, routine monitoring and environmental measures allocated to this item. Payment shall be supported by monthly compliance records.

Specialist monitoring, independent Environmental Control Officer services and permanent rehabilitation shall be excluded where separately scheduled. Part-month valuation and extensions of time shall be governed by the Contract.

”
.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSAB ENGINEER'S OFFICE****PSAB 1 SCOPE (1)****PSAB 1.1 Sub-clause 1.1**

Replace the clause with:

"This specification covers the requirements for offices, be it prefabricated, semi prefabricated, mobile or semi-mobile and associated facilities for the Engineer's supervisory staff on Site, including the provision of the necessary structures, services and all arrangements in connection with the land on which the facilities are to be provided.

PSAB 2 MATERIALS (3)**PSAB 2.1 Name boards (3.1)**

Add the following to this clause:

"The Contractor will be required to supply 2 name boards for construction purposes under this contract. The name boards shall be erected at the commencement of construction at locations indicated by the Employer. The tendered rate shall include for the supply and erection of the nameboards at the positions indicated by the Employer, maintenance of the name boards for the duration of the construction period as well as for the removal of the name boards from site upon completion.

In addition, the Contractor is to also supply a permanent signboard for the Western Highveld WTW as well as permanent signage around the Western Highveld Water Treatment Works to ensure compliance with the OHS Act, for erection upon completion of construction. Separate provisional sums have been included within the BOQ for these items."

PSAB 2.2 Office Buildings (3.2)

Replace the contents of sub-clause 3.2 with:

"All buildings provided by the Contractor shall be considered as temporary by nature and may be of fully or partially prefabricated construction. The Contractor shall supply and furnish one air-conditioned "Kwikjack" or similar approved (6m x 3m) office for the use of the Engineer and his/her staff, and one air-conditioned "Kwikjack" or similar approved (9m x 3.4m) conference facility for conducting meetings with kitchen space provided.

In addition, a shelter, at least 12 m long x 5 m deep and 2.1 m high, constructed of timber frame with 80% shade cloth fixed to the top and to 3 sides, adequately sized to house four motor vehicles, shall be provided. The shade cloth at the sides shall extend to no more than 1.5 m above the finished ground level. The floor of the shelter shall be finished with a gravel layer or crushed stone.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSAB 2.3 Engineer's Accommodation (New clause 3.3)**

"Accommodation for the Engineer and his assistant shall be required under this Contract.

Accommodation for the Engineer and his assistant shall consist of the following: An accommodation unit of two separate single bedrooms, a toilet, a shower and an open plan lounge/dining room/kitchen area. All windows to have curtaining and mosquito netting. Each bedroom shall be furnished with a single bed, a bedside cabinet with lamp, a cupboard with hanging space and shelves, a small table, an air conditioning unit and a refuse bin. The lounge/dining room area shall be furnished with at least four lounge chairs, a coffee table, two side tables, a dining room table with six chairs, a bookcase, a rubbish bin, an air conditioning unit, a colour television set and DSTV system.

The kitchen area shall be furnished with at least two square metres of counter top with cupboards under, at least two wall mounted cupboards, a cooker, a microwave, a refrigerator, an electric kettle, a toaster, a vacuum cleaner, a broom, a dustpan & brush, all necessary crockery, cutlery, pots and pans for at least two people, a washing machine, an outside clothes line and a refuse bin. The unit shall also have a double car port covered with 80% shade cloth."

PSAB 3 PLANT (4)**PSAB 3.1 Telephone (4.1)**

Replace the contents of the sub-clause with:

"The Contractor shall be required to provide internet access at the Engineer's office. In addition, the Contractor shall provide a cellphone for sole use by the Engineer for the duration of the construction period with a minimum monthly allowance of R1000 per month."

PSAB 4 CONSTRUCTION (5)**PSAB 4.1 Survey Assistants (5.5)**

Delete the first sentence and substitute the following:

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


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSAB 4.2 Survey Equipment (New sub-clause 5.6)**

Add new sub-clause:

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

One automatic levelling Engineer's level plus tripod;
One levelling staff (4m long, 1cm gradations);
Two tachometric staffs (5 m long, 1cm chess-board pattern);
One spirit level (one metre long);
One hammer (2kg);
Two canvas carry-bags;
One 100 m steel tape;
One 30 m steel tape;
One 5 m steel tape;

The survey 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."

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PSD EARTHWORKS

PSD 1 INTERPRETATIONS (2)

PSD 1.1 Definitions (2.3)

Replace the definition "Borrow" with the following:

"Borrow material: Material, other than material obtained from excavations required for the Works, obtained from sources such as borrow pits or the authorized widening of excavations. 'Borrow' shall have a corresponding meaning."

Replace the definition "Specified density" with the following:

"Specified density: The specified dry density expressed as a percentage of modified AASHTO dry density."

Replace the definition "Stockpile" with the following:

"Stockpile (Verb): The process of selecting and, as may be necessary, loading, transporting and off-loading material in a designated area for later use and specific purpose."

Add the following definitions:

"Fill: An embankment or terrace constructed from material obtained from excavations or borrow."

Fill (material): Material used for the construction of an embankment or terrace."

PSD 2 MATERIALS (3)

PSD 2.1 Classification for Excavation Purposes (3.1)

PSD 2.1.1 Method of classifying (3.1.1)

Add the following:

"Classification of material other than 'soft excavation' shall be agreed upon before excavation may be commenced.

The Contractor shall immediately inform the Engineer when the nature of the material being excavated changes to such an extent that a new classification is warranted for further excavation. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to reclassify, at his discretion, such excavated material."

PSD 2.1.2 Classes of Excavation (3.1.2)

Delete sub-clause 3.1.2 b) as no separate classification for intermediate materials will be permitted.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSD 3 CONSTRUCTION (5)****PSD 3.1 Safeguarding of Excavations (5.1.1.2)**

Delete the first paragraph of this and replace with the following:

"a) The Contractor or his agent or representative appointed in writing by the Contractor shall be deemed to be the 'competent person' as defined in Clause 13(1) of the Construction Regulations, 2014.

PSD 3.2 Soil Erosion Measures (New sub-clause 5.1.1.4)

"Care shall be taken during construction to ensure that free flow paths are maintained in all drains, gutters and waterways. Special precautions shall be taken by the Contractor not to change existing conditions by leaving spoil in waterways. The Contractor shall be responsible throughout the duration of the Contract for the construction and maintenance of all soil erosion preventative measures necessary to protect the land utilised by the Contractor during the Contract from any adverse effects of soil erosion, settlement, scour etc., resulting from the construction activities."

PSD 3.3 Methods and Procedures (5.2)***PSD 3.3.1 Excavation (5.2.2)***

Add to b):

"Where outside shuttering is ordered by the Engineer, excavation of not more than 600 mm over the outside dimensions of the structure shall be deemed necessary for the fixing of outside formwork. This extra excavation and refilling, up to 600 mm wide, where necessary is to be measured and paid for under quantities allowed for this purpose in the Bill of Quantities. Outside shuttering shall be used for the construction of all major structures unless ordered otherwise by the Engineer."

Delete the first sentence of c) and replace with:

"Each excavated surface on which or against which a permanent concrete structure will be placed shall be trimmed to ensure that there is no projection greater than 20 mm into the excavated profile."

PSD 4 MEASUREMENT AND PAYMENT (8)**PSD 4.1 Scheduled Items (8.3)*****PSD 4.1.1 Bulk Excavation (8.3.2)***

Remove all references to "intermediate excavation" or "intermediate material" from sub-clause b).


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSD 4.1.2 Restricted Excavation (8.3.3)**

Remove all references to “intermediate excavation” or “intermediate material” from sub-clause b).

PSD 4.1.3 Grassing (8.3.11)

Delete sub-clause 8.3.11 and replace with:

“Approved grass shall be planted after topsoiling has been completed, with the tufts being spread at not more than 150 mm centres. The planted areas shall be kept neatly trimmed, fertilised and watered. The Contractor shall ensure that the planted areas are kept moist and do not dry out. Any grass that fails to grow shall be replaced by the Contractor, at his expense, with fresh grass until such time as the Engineer is satisfied that sufficient coverage of the area has been achieved or the Completion Certificate for the Contract has been issued, whichever is achieved first. The rate shall cover the cost of supplying and watering the grass and the labour for planting, watering and maintaining the grass in accordance with this Specification.”

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PSDB EARTHWORKS (PIPE TRENCHES)

PSDB 1 MATERIALS (3)

PSDB 1.1 Backfill Material (3.5)

In the third line of a) substitute "100 mm" for "150 mm".

PSDB 1.2 Selection (3.7)

Delete the second sentence and substitute the following:

"The Contractor is not required to use selective methods of excavating but may do so at his own cost. The Contractor shall however, if so instructed by the Engineer, screen or otherwise treat excavated material in order to produce material suitable for bedding or covering or both bedding and covering for the pipeline."

PSDB 2 CONSTRUCTION (5)

PSDB 2.1 Soil Erosion Measures (New sub-clause 5.1.2.4)

"Care shall be taken during construction to ensure that free flow paths are maintained in all drains, gutters and waterways. Special precautions shall be taken by the Contractor not to change existing conditions by leaving spoil in waterways. The Contractor shall be responsible throughout the duration of the Contract for the construction and maintenance of all soil erosion preventative measures necessary to protect the pipelines 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 pipelines."

PSDB 2.2 Barricading, Signage, Watching and Lighting (New sub-clause 5.1.5)

"While the responsibility for the efficient barricading, signage, lighting and watching of all trenches and stacks of materials shall rest upon the Contractor, he shall be required to make the following minimum provisions.

Barricading shall be done by means of at least two pieces of horizontal double sided 'red/white' chevron tape, or equivalent as approved by the Engineer. The tape shall be stretched tightly between suitable supports along both sides and ends of the excavation at approximately 0,45 m and 1,25 m above the ground. The supports shall consist of poles or steel fencing standards securely planted in solid ground so as to enclose the spoil material and the excavations and shall be at not more than 10 m centres, unless directed otherwise by the Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The Contractor shall make available on Site at all times a sufficient number of steel plates at least 2 m x 1,2 m x 8 mm thick which may be laid across open excavated trenches to provide bridges for vehicles along the route of the work as and where considered necessary by the Engineer."

PSDB 2.3 Backfilling (5.6)

PSDB 2.3.1 General (5.6.1)

Add to this sub-clause:

"Notwithstanding the requirements of sub-clauses 5.6.1 and 5.6.6 of SANS 1200 DB, no pipe joint or pipe fitting shall be covered by either the blanket fill or the main fill prior to the successful completion of the visual inspection and the pressure testing of the relevant section of the pipeline."

PSDB 2.3.2 Disposal of Soft Excavation Material (5.6.3)

Replace the sub-clause with:

"Soft excavation material from the trench, which is unsuitable or has become surplus because of bulking, displacement by the pipe and importation, shall be disposed of along the trench servitude, at designated spoil areas or approved spoil areas furnished by the Contractor, as applicable. The requirements of SANS 1200D shall apply to overhaul and to free haul for the disposal of surplus excavated material."

PSDB GABIONS AND PITCHING

DK 8.2.1

Trimming of batter faces to correct angle and preparation of embankment

PSDK 8.2.2

TERRACE BLOK TB500, minimum constructed mass 480 kg/m², including 300 mm drainage layer

PSDK 8.2.3

TERRACE BLOK TB300, minimum constructed mass 320 kg/m², including 500 mm drainage layer to top 5 courses

PSDK 8.2.4

Perforated drainage collection pipe + 19 mm stone


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



PSDK 8.2.5

Bidim A4 wrapping to drainage pipe and aggregate

PSDK 8.2.6

Findrain/Wickdrain 200 mm wide at 45° and 2 m centres

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSG CONCRETE (STRUCTURAL)****PSG 1 MATERIALS (3)****PSG 1.1 Cement (3.2)*****PSG 1.1.1 Applicable Specifications (3.2.1)***

Unless agreed to otherwise by the Engineer, the cement used on the Works shall be CEM 1, grade 42.5 complying with the requirements of SANS EN 197-1) 50197-1:2000/EN 197-1:2000.

PSG 1.1.2 Storage of Cement (3.2.3)

Add to the sub-clause:

“Cement shall not be kept in storage for longer than three weeks without the Engineer's permission. The cement store shall be run on a first in, first out basis.”

PSG 1.2 Aggregates***PSG 1.2.1 Use of Plums (3.4.2)***

The use of plums will not be permitted, unless agreed to by the Engineer.

PSG 1.3 Admixtures (3.5)

Unless approved by the Engineer, neither admixtures nor air-entraining agents shall be used in any concrete.

PSG 2 PLANT (4)**PSG 2.1 Formwork (4.5)*****PSG 2.1.1 Ties (4.5.3)***

Add to the sub-clause:

“The water tightness requirement of the structure shall be taken into account when deciding upon the type of tie to be used. The cover requirement will apply to ties left permanently in place.

No plugs, bolts, ties or clamps of any description used to hold the formwork will be allowed to project into or through the concrete unless expressly approved by the Engineer.

Only approved ferrules consisting of solid rods (that remain embedded in the concrete) and with removable ends shall be used to hold the formwork of the walls. The removable tie-rod ends shall


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



facilitate removal without damage to the concrete, and no permanently embedded parts of such tie-rods shall have less than 50 mm of cover to the finished concrete surface.

The cavities left in the concrete when the tie-rod end cones are removed shall be soundly caulked with a cement mortar to which an approved non-shrink grout has been added strictly in accordance with the manufacturer's specifications and shall be neatly finished to a smooth surface uniform with that of the surrounding concrete.

The cost of supplying special tie-rods as well as the filling of cavities left by the tie-rod cones shall be included in the rates tendered for formwork under the appropriate payment items.

On no account shall formwork be secured to reinforcing bars."

PSG 3 CONSTRUCTION (5)

PSG 3.1 Reinforcement (5.1)

PSG 3.1.1 Bending (5.1.1)

Add to the sub-clause:

"Reinforcement shall be cut with cropping or shearing equipment only. Cutting torches shall not be used."

PSG 3.1.2 Fixing (5.1.2)

Add to the sub-clause:

"No welding of reinforcement will be permitted."

PSG 3.2 Formwork (5.2)

PSG 3.2.1 Classification of Finishes (5.2.1)

Delete Clause 5.2.1(b) and replace with:

"This finish shall be obtained by the use of steel-faced forms arranged in a regular pattern to fit the appearance of the structure. After stripping, all small fins, bulges and other projections shall be removed, surface honeycombing, surface discolorations and other irregularities repaired and the surface rubbed to form a smooth finish of uniform texture and colour. The finish shall be to Degree of Accuracy 1 tolerances defined in Clause 6.2.2 and 6.2.3."

Add to the sub-clause 5.2.1 (c):

"The quality of the formwork to the external surfaces shall fall within the "Special" category and shall be such that no after-treatment e.g. rubbing down, other than the sealing of ferrule holes (which themselves shall be placed with precision in a regular pattern) will be necessary. The


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



formwork used shall be unblemished and erected in a regular pattern so that the joints shall be a feature of the finished surface which shall be to Degree of Accuracy 1 tolerances as defined in Clauses 6.2.2 and 6.2.3.”

PSG 3.2.1.1 Removal of Formwork (5.2.5.2)

Rephrase the first two lines to read:

“For this purpose and except as allowed in 5.2.5.3, the formwork shall remain in place, after all the concrete has been placed in the relevant lift, for the appropriate minimum period of time given in Table 2.”

PSG 3.3 Holes, Chases and Fixing Blocks (5.3)

Add to this sub-clause:

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

PSG 3.4 Chamfers (New sub-clause 5.5)

“Unless otherwise noted on the drawings, all exposed corners and arises shall be chamfered 25 x 25 mm.”

PSG 3.5 Concrete (5.5)

PSG 3.5.1 Quality (5.5.1)

PSG 3.5.1.1 Consistency (5.5.1.2 (b))

Delete the paragraph (b) and substitute the following:

“(b) by the Engineer in respect of prescribed mix and strength concrete, or”

PSG 3.5.1.2 Durability (5.5.1.5)

Add to the sub-clause:

“The exposure conditions at the site of the works are to be considered as being severe.”

PSG 3.5.1.3 Prescribed Mix Concrete (5.5.1.6)

Delete the fourth to tenth lines inclusive from the sub-clause and substitute the following:

“The grades of prescribed mix concrete are designated Grades 20, 15 and 10 and are composed of cement, sand and stone, as specified herein before, proportioned as listed in the accompanying table.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Grade (MPa)	Size of stone (mm)	Cement (kg)	Sand (m³)	Stone (m³)
20	19	50	0.11	0.14
15	19	50	0.13	0.16
10	37.5	50	0.16	0.22

While the proportion of cement to the combined quantity of sand and stone must remain constant for each grade of concrete, as set out in the table, the relative proportions of sand and stone are to be adjusted if required by the Engineer, so as to attain the most suitable consistency of concrete, due allowance being made for the bulking of sand due to moisture.

The addition of water shall be regulated by the use of properly calibrated containers, only sufficient water being added as will in the opinion of the Engineer, afford a workable mix.

The fine and coarse aggregate approved for use in strength concrete Grades 30 and 25 are to be used for prescribed concrete mixed Grades 20 and 15.

PSG 3.5.1.4 Strength Concrete (5.5.1.7)

Replace the contents of the sub-clause with:

“The grades of strength concrete are designated Grades 30 and 25 and are composed of cement, sand and stone, as specified herein before, proportioned as listed in the accompanying table.

Grade (MPa)	Size of stone (mm)	Cement (kg)	Sand (m³)	Stone (m³)
30	19	50	0.080	0.110
25	19	50	0.095	0.125

The concrete mixes for Grade 30 and 25 concrete shall be designed by the Portland Cement Institute's laboratory nearest to the site of the Works, or another competent laboratory approved by the Engineer. At least three weeks before placing any strength concrete on the Works, the Contractor shall supply and deliver to a laboratory at his own cost, samples of the aggregates he proposes to use in the strength grade concrete. While the proportion of cement to the combined quantity of sand and stone must remain constant for each grade of concrete, as set out in the table, the relative proportions of sand and stone may be adjusted to achieve the requirements of this Specification.

PSG 3.5.2 Mixing (5.5.3)

PSG 3.5.2.1 Ready Mixed Concrete (5.5.3.2)

Delete the first sentence and substitute the following:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



“Concrete produced at a central concrete production facility other than at the site of the Works shall only be accepted for use in the Works with the prior and express approval of the Engineer. When such approval has been given, the Engineer shall then decide whether or not to accept the test results obtained by the facility concerned.”

PSG 3.5.3 Placing (5.5.5)

PSG 3.5.3.1 Dropping Concrete Freely (5.5.5.5)

Replace the contents with:

“Dropping concrete freely will only be permitted if the Engineer is satisfied that this is the only practical method of placing.”

PSG 3.5.3.2 Pumping of Concrete (5.5.5.9)

Delete the sub-clause 5.5.5.9 and substitute the following:

“The placing of concrete by pumping will not be permitted.”

PSG 3.5.3.3 Blinding Layer (New sub-clause 5.5.5.10)

“Beneath all structural grades of concrete or elsewhere, if so ordered by the Engineer, or shown on drawings, the bottom of the excavation is to be covered by a blinding layer (screed) in Grade 15/19 concrete to a depth of 50 mm to prevent disturbance of the ground and to serve as an even and accurate positioned working floor for setting steel and placing foundation concrete. This blinding layer shall be laid immediately after excavations have been taken out and trimmed to the required depths and have been inspected and approved by the Engineer.”

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.

PSG 3.5.4 Construction Joints (5.5.7)

PSG 3.5.4.1 General Preparation of Construction Joints (5.5.7.3)

Delete sub sub-clauses (a), (b), (c), and (d) and substitute the following:

- “a) All horizontal and vertical construction joints shall be cleaned of all dirt and loose particles and shall be prepared to the satisfaction of the Engineer. All intersections of construction joints with concrete surfaces which will be exposed to view, shall be made straight and level or plumb and shall be constructed to the details shown on the drawings.
- b) The Contractor shall provide a compressor on site for the whole period during which concreting is in progress, and this must be available for cleaning concrete faces prior to placing fresh concrete or pouring joints.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- c) “Blowing off” may generally be carried out on horizontal surfaces but under special circumstances approved by the Engineer, it may also be carried out on vertical surfaces. The surface concrete to be prepared shall be between 4 and 8 hours old after completion of placing and shall be blown off using a mixture of air and water under a pressure of at least 500 kPa or by using a high-pressure water jet until all dirt, laitance, etc. is removed and particles of clean coarse aggregate are exposed sufficiently to produce a rough surface. Any loose particles of coarse aggregate shall also be removed. The success of this method of preparation depends on selecting the correct time (dependent on the type of cement) so that the concrete has set to just the necessary degree of hardness. The operation may therefore have to be undertaken outside normal working hours and at night. When the surfaces are at least 12 hours old, any remaining loose fine aggregate particles shall be washed off.
- d) “Scabbling”, which refers to removal of all surface laitance plus roughening the concrete surface with pneumatic picks in order to expose the coarse aggregate in a uniform pattern, may be carried out on both horizontal and vertical surfaces. The surfaces to be prepared in this manner shall be at least 12 hours old after mixing the concrete. At least 35% of the roughened surface area shall consist of exposed coarse aggregate.
- e) All surfaces either prepared, by “blowing-off” or by “scabbling”, shall be kept continuously wet until the next lift of fresh concrete is to be placed against them; the minimum time being 12 hours.
- f) The use of approved wet-to-dry epoxy resin concrete adhesive, strictly in accordance with the manufacturer's instructions, will be permitted in the formation of concrete joints at surfaces where the concrete is older than 7 days.”

PSG 3.5.4.2 *Placing Fresh Concrete at Joints (New sub-clause 5.5.7.4)*

- a) Vertical construction joint surfaces shall be, as instructed by the Engineer, either smooth, clean and kept damp for at least 24 hours before placing fresh concrete against them, or scabbled, cleaned and dampened as specified above.
- b) Horizontal construction joint surfaces shall have been “scabbled” or “blown off”, cleaned and kept continuously wet as specified above before fresh concrete is placed over them. Immediately before placing the fresh concrete, the damp surface of the set concrete shall be evenly coated (by brushing or brooming) with a layer of cement mortar between 10 mm and 15 mm thick. The water/cement ratio and the cement/sand ratio of this mortar shall be the same as that of the fresh concrete to be placed and the mortar shall be produced by leaving the coarse aggregate fraction out of a batch of the fresh concrete. Coating with


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



mortar is to be done in stages immediately before areas of set concrete are covered with fresh concrete, so that no mortar is exposed for longer than one hour after mixing, or less if the mortar has become dry or has started to set before being covered with fresh concrete. Any dried out mortar shall be removed and, after cleaning the surface, shall be replaced with fresh mortar.

- c) No fresh concrete shall be placed on the top surface of concrete, which is laterally restrained (e.g. by formwork or by in-situ earth) while the top layer of concrete is between 3 hours and 12 hours old after mixing. No fresh concrete shall be placed on top of the concrete with an unrestrained lateral surface while the top layer of concrete is between 2 and 12 hours old after mixing."

PSG 3.5.5 Curing and Protection (5.5.8)

Add to the sub-clause:

"Notwithstanding the acceptable methods of curing itemised under (a) to (c) of the sub-clause, the walls of thin-wall reservoirs or other structures shall be subjected to continuous spray curing for a minimum period of 7 days."

Delete from the sub-clause all references to the curing periods relating to concrete made with Portland Blast Furnace Cement since the use of the latter is not permitted in terms of the Contract.

PSG 3.5.6 Adverse Weather Conditions (5.5.9)

PSG 3.5.6.1 Hot Weather Concreting (5.5.9.2)

Add to the sub-clause:

"When concrete operations are being carried out at ambient temperatures in excess of 32°C, the Contractor shall apply the relevant recommendations for hot weather concreting set out in PCI 305 "Recommended practice for hot weather concreting."

PSG 3.5.7 Concrete Surfaces (5.5.10)

PSG 3.5.7.1 Unformed Concrete Surfaces (5.5.10.2)

Add to the sub-clause:

"All unformed concrete surfaces shall be finished to one or more of the following classes of finishes:

- a) Class 1: Screeded Finish

Immediately after being poured the concrete shall be screeded with a straight edge working between templates set accurately to line and level. No mortar shall be added to overcome surface irregularities. These shall be made good by re-screeding or by the addition of concrete.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



b) Class 2: Wood Floated Finish

After screeding to line and level and when the water sheen has disappeared, the concrete surface shall be trowelled by hand with a wood float to a uniform consolidated surface free from any trowel marks and uniform in texture and appearance.

c) Class 3: Steel Trowelled Finish

Commence as for Class 2 and finish with a steel trowel. The final finish shall be done at the correct time, for example, while the concrete is still sufficiently plastic to take polish but when it has hardened sufficiently to prevent drawing water and fine materials to the surface. Any adherence of mortar to the steel trowel indicates that the correct stage has not yet been reached."

PSG 3.5.7.2 Tolerances (New sub-clause 5.5.10.4)

- "a) Surface Class 1 shall not vary by more than 6 mm measured from a 3 m straight edge placed anywhere on the surface.
- b) Surface Class 2 and 3 shall not vary by more than 3 mm measured from a 3 m straight edge placed anywhere on the surface.
- c) Special surfaces such as bearing seats shall be finished to a higher degree of accuracy, as shown on the drawings."

PSG 3.5.8 Watertight concrete (5.5.11)

Add the following:

"All water retaining structures are to be subjected to a water tightness test. No vertical or inclined construction joints of any kind will be permitted in the perimeter walls of water retaining structures unless these have been specially ordered or authorised by the Engineer.

All water retaining structures shall be subjected to a watertightness test prior to backfilling around the structures. After the structures have reached their design strength, they shall be slowly filled with clean water at a rate not exceeding 2 metres depth per 24 hours to their normal maximum water level. After allowing a further 24 hours for takeup by the concrete surfaces, the rate of leakage shall be measured by a hookgauge to be provided by the Contractor. If the rate of leakage exceeds 2 litres per square metre of water surface area per 24 hours and there is no prospect, in the opinion of the Engineer, of the rate of leakage improving, the Contractor shall take remedial steps as specified by the Engineer. The cost of any remedial steps required will be for the Contractor's account."


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 3.5.8.1 Concrete for Watertight concrete (New sub-clause 5.5.11.1)**

Add new sub-clause:

"Grade 35 MPa /19 mm concrete shall be used for the construction of all water retaining structures."

PSG 3.5.8.2 Pipes and Conduits Embedded in Concrete for Watertight Retaining Structures (New sub-clause 5.5.11.2)

Add new sub-clause:

"Except with the approval of the Engineer, no pipes other than those shown on the drawings shall be embedded in the concrete."

PSG 3.5.8.3 Disinfection of Water Retaining Structures (New sub-clause 5.5.11.3)

Add new sub-clause:

"Before filling each water retaining structure for the first time with water, it shall be swept thoroughly clean. While the structure is being filled with water, a sodium hypochlorite solution shall be dosed to achieve a theoretical total chlorine concentration of 25ppm.

Once the structure has been filled with water, it shall be left for a 24 hour period. Thereafter, total chlorine concentration shall be measured. A concentration of 20ppm total chlorine will be considered acceptable. Should such concentration not be achieved, the Contractor shall carry out, at his own cost, all steps deemed necessary by the Engineer to achieve satisfactory disinfection.

Once satisfactory disinfection is achieved, the structure shall be drained and sufficient sodium thiosulphate (typically 1 part/part of total chlorine) shall be dosed into the system to fully neutralise the chlorine before discharging.

The structure shall then be filled and after 24 hours, samples will be taken by the Engineer for analysis (the Contractor shall allow for the cost of these tests within his tendered rate). Should the following limits not be achieved, the Contractor shall carry out, at his own cost, all steps deemed necessary by the Engineer to confirm satisfactory disinfection:

PARAMETERS	COUNT
E Coli	0
Coliforms	0
Faecal Streptococci	0


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 3.5.9 Grouting (5.5.13)**

Add to the sub-clause:

“Grouting shall be done to the instruction of the Engineer using materials of suitable consistency as follows. Unless otherwise directed, grouting mixtures shall consist of one part cement to two parts concrete sand by volume, well mixed and with sufficient water added to obtain the required consistency. Where recesses to be filled are of appreciable dimensions, the Engineer may direct the Contractor to replace a proportion of sand with fine stone to reduce shrinkage.”

PSG 3.5.10 Liquid Grout (New sub-clause 5.5.13.1)

Add new sub-clause:

Where liquid grout is required for bolt holes etc., water shall be added in such quantity that, when the material is thoroughly mixed and stirred, it shall flow readily so as to fill all recesses and air spaces in the work to be grouted. Before grouting any section of the work with liquid grout, the surfaces to receive grout shall first be thoroughly cleaned and flushed with water. The grout shall then be introduced in such a manner as to fill effectively all recesses. When the grout has set the surface of the work shall be finished off flush and smooth with cement mortar.

PSG 3.5.11 Grouting of Pipes/Specials through Walls (New sub-clause 5.5.13.2)

“Where entry holes for pipes / specials have been left in the walls, the Contractor shall be responsible for the grouting in of such pipes / specials regardless of whether or not these have been supplied by himself.

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

- (a) Remove all shuttering and boxing remaining in the holes;
- (b) Make any alterations required to the position and shape of the holes;
- (c) Thoroughly clean the sides of the holes so as to obtain satisfactory bond surface for the new concrete; and
- (d) Free all surfaces of the pipes / specials of all coatings and thoroughly scrape and clean the pipes / specials.

After accurately positioning the pipes / specials in the respective holes, the Contractor shall fix the pipes / specials in the holes.

Immediately prior to grouting being carried out by 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 consisting of three parts concrete sand and one part cement.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The concrete ingredients shall be mixed and placed as dry as possible to obtain a dense, waterproof concrete. Where a watertight seal is required, the concrete shall be carefully worked around the puddle flange, if any, and the pipe barrel or body of the special, shall be vibrated in layers so as to obviate any failing away from pipe / special surfaces of the concrete already placed. The whole shall, when set, form a dense, homogeneous, and waterproof mass. A spare vibrator with an independent power source shall be kept in readiness to ensure continuity of placing in the event of the breakdown of the duty vibrator.

Smooth formwork that has been suitably strengthened for use with a vibrator shall be provided for facing the concrete around each pipe / special.”

PSG 3.5.12 Dry-Packed Grout (New sub-clause 5.5.13.3)

“When dry-packed grout is specified, under base plates etc., only sufficient water shall be added to make the mixture ball when squeezed in the hand. Before any grouting is done with dry caulking, the surfaces between which the caulking is to be placed shall first be thoroughly cleaned and flushed with water. All surplus visible water shall be wiped or blown away and the dry caulking shall be forcefully rammed or hammered into place using suitable tools. Exposed surfaces shall be finished off neatly with a trowel and extensive exposed areas shall be covered with wet sacking and kept damp for at least 24 hours.

Where additives are required for grouting operations, these shall be brought onto site in the manufacturer’s unopened containers and used strictly in accordance with the manufacturer’s instructions, which the Contractor shall not fail to obtain. If necessary, the Engineer may require the Contractor to undertake preliminary tests to check the behaviour of proprietary additives under the conditions prevalent on the site.”

PSG 3.5.13 Epoxy Grout (Epoxy mortar type only) (New sub-clause 5.5.13.4)

Add new sub-clause:

“The manufacturer’s instructions shall be observed when an epoxy grout is used.”

PSG 3.5.14 Cement Mortar (New sub-clause 5.5.16)

Add new sub-clause:

“Where cement mortar is specified for filling around pipes etc. water shall be added to obtain a firm paste, which can be worked with a trowel but is not fluid. Surfaces to receive mortar shall be well wetted and excess water allowed to drain, or be removed. The mortar shall be worked into place with a trowel or tamping rod, exposed surfaces floated off, covered with wet hessian for 24 hours, and allowed to harden without disturbance.”


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 3.5.15 Joints (New sub-clause 5.5.17)****PSG 3.5.15.1 Fibreboard (New sub-clause 5.5.17.1)**

"Fibreboard shall be provided between concrete sections wherever shown on the drawings. Fibreboard shall be impregnated and treated with a special bituminous compound to protect it from weathering, e.g. "Flexcell", as manufactured by Expandite (Pty) Ltd or a similar approved board of comparable composition, which shall be securely fixed in position to avoid distortion or displacement while concreting operations are in progress."

PSG 3.5.15.2 Expansion Joints (New sub-clause 5.5.17.2)

"Joint recesses to receive sealing compound are to be formed to the dimensions and shapes indicated on the drawings. These recesses are to be formed with rough sides and so shuttered that the shuttering can be removed without any timber having to be left in the recesses. Shuttering shall be left in the joints until the joints are ready for priming and filling with sealant. After the removal of the shutters, joints shall be cleaned by mechanically operated wire brushes and shall be hacked and scabbled and all dust removed."

PSG 3.5.15.3 Sealing Joints (New sub-clause 5.5.17.3)

"The sealing of the joints (contraction / movement) is to be carried out by the Contractor under the supervision of a representative of the specialist firm supplying the sealing compounds. The Contractor is to be responsible for supplying these approved materials, transporting them to site, storing and using them, as required, and providing all labour, tools, equipment and everything necessary to prime and fill the joints."

Before priming and pouring, the joint recesses are to be thoroughly cleaned and dried out, in which connection, the use of compressed air is stipulated, to the approval of the Engineer.

No sealing of joint recesses is to be carried out until at least 21 days after the adjacent concrete has been cast.

Every care shall be exercised by the Contractor to ensure that the work shall be carried out in accordance with the requirements of this specification and in strict conformity with any special instructions given by the manufacturers for the proper use and treatment of the sealing materials provided by them."

PSG 3.5.16 Bituminous Coatings to Earth Faces (New sub-clause 5.5.18)

"All earth covered concrete surfaces shall receive two applications of an approved bituminous coating such as Ebsco E55 Bituminous Waterproofing Compound or similar approved."


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The coatings shall be applied strictly in accordance with the manufacturer's instructions and shall be repaired to the satisfaction of the Engineer if damaged during backfill operations."

PSG 3.5.17 Screeding (New sub-clause 5.5.19)

"Where special/proprietary screeding or granolithic screeding is specified or scheduled, the surface shall be treated as specified in SANS Subclause 5.5.10.1 before application of the 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 be 0,5 or less.

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 the 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:-

- a) First - as soon as the granolithic screed has been compacted and screeded.
- b) Second - after 2 hours to close the surface and remove laitance.
- c) Third - after a further 4 hours.

The above 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 SANS Subclause 5-5.8(b) but shall additionally be protected from direct sunlight and drying winds as it is being placed.

All screeding necessary to accommodate equipment provided by the Mechanical and Electrical Contractor shall be done under that contractor's supervision and in strict accordance with his instructions. It shall be commenced as soon as the equipment supplier gives notice on completion


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



of erection and shall be finished expeditiously. The Contractor shall make good any damage to the equipment resulting from his personnel not following the Mechanical and Electrical Contractor's instructions. Any spillage on the equipment shall be cleaned off immediately."

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 cement/water ratio of the mix shall be at least 2,0.

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 slab in the case of the clarifier, aeration tank, anaerobic ponds and chlorine contact tank shall be either a double coat of a spray grade bitumen emulsion complying with SANS 309 applied at a rate of 1,0 ℓ/m² of net bitumen or a 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.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



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 1200. 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 prepared by mitring and welding/vulcanising intersection pieces 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. "Rearguard"-type waterstops shall have flanges or cleats that grip effectively.

PSG 3.11.3 Fillers

Closed cell expanded polyethylene fillers shall comply with the following:

Property	Unit	Value Test Method
Density	kg/m ³ 110	DIN 53420
Compression Stress at compression strains of 10% 25% 50%	kPa 175 kPa 210 kPa 340	DIN 53577 DIN 53577 DIN 53577
Compression set after 24 hours recovery	% 14	
Tensile Strength	kPa 680	DIN 53571
Elongation at Break	% 49	DIN 53571


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Max. water absorption after 24 hours by volume	% 0,1	ASTM C-177
--	-------	------------

Fillers shall be pre-cut to suit the application with a tear-out strip for forming the specified recess for the sealant. If so required, the filler shall be glued into position with approved epoxy glue.

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 either a two-component polysulphide liquid polymer base complying with the requirements of SANS 110 or a polyethylene-based polyurethane "pouring grade" for horizontal or near horizontal joints or "gun grade" for vertical/overhead joints and joints steeper than 1 in 10 to the horizontal. All elastomeric sealants shall comply with BS 4254 Type A1 and shall have a movement tolerance of 25%.

PSG 3.12 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 TESTS (7)

PSG 4.1 Testing (7.2.)

PSG 4.1.1 Laboratory Testing (7.2.3)

Add to the sub-clause:

"The Contractor will be liable for all costs incurred in designing the concrete mixes and making structural concrete cubes and having these tested."


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 4.4 Vibrators****Add the following to this 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 4.5.3 Ties****Add the following to this 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.

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

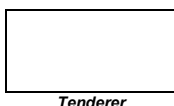
Add the following Clause:**PSG 4.6 Water-bath**

A temperature-controlled water-bath with a capacity to cure two hundred cubes shall be provided on site. The water-bath shall be located under cover.

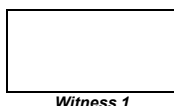
PSG 5 MEASUREMENT AND PAYMENT (8)**PSG 5.1 Measurement and Rates (8.1)*****PSG 5.1.1 Reinforcement (8.1.2)***

Delete sub-clause 8.1.2.1 b).

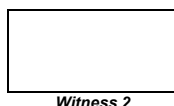
Delete sub-clause 8.1.2.2 a) and replace with:



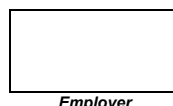
Tenderer



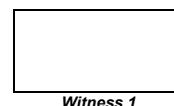
Witness 1



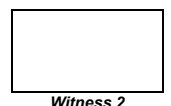
Witness 2



Employer



Witness 1



Witness 2



- "a) Each reinforcement bar size and type will be separately scheduled. Additional splice lengths or swage type connections introduced at the Contractor's request shall not be measured and will be to the Contractor's account."

Delete from the first line of sub-clause 8.1.2.3 a) "of nominal size 25 mm".

PSG 5.1.2 Concrete (8.1.3)

Delete sub-clause 8.1.3.1(b) and replace with:

- "(b) No allowance will be made for concrete required to make up over-break in soft, boulder or hard rock excavation. No payment will therefore be made for additional concrete or formwork, ordered in writing by the Engineer to replace over-break."

Add to sub-clause 8.1.3.3 a):

"Any additional precautions required for adverse weather conditions shall be covered in the unit rate."

Delete from the first line of sub-clause 8.1.3.3 (a) the words:

"the cost of the design of the mix in the case of strength concrete,"

Add the following new sub-clause after sub-clause 8.1.3.3. (d):

- "(e) Separate items have been included in the Bill of Quantities for concrete complete with formwork for each particular grade of concrete or for structural units of similar size and shape, or for both. The unit rates shall cover the cost of the provision of concrete (made with ordinary Portland Cement unless otherwise so scheduled); mixing, testing, placing, compacting, the forming of stop-ends and unforeseen construction joints, striking where necessary, together with the cost of all parts of formwork in contact with the concrete and the necessary bearers, struts, and other supports, plus the layout and plant necessary to erect and strike such formwork."

Fixing

Add the following to this Sub-clause:

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

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.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



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 5.1.3 Scheduled Reinforcement Items (8.3)

PSG 5.1.3.1 Steel Bars (8.3.1)

Delete "Unit: t" and replace with "Unit: kg"

PSG 5.1.4 Bituminous Coating to Earth Faces (New sub-clause 8.9)

"Bituminous CoatingUnit: m²

The unit of measurement of bituminous coating to concrete surfaces shall be the square meter of surface coated. The rate tendered shall provide for all materials, plant, tools, labour, etc., necessary for the satisfactory installation of the coating in accordance with the manufacturer's specifications."

PSG 5.1.5 Screeding (New sub-clause 8.10)

"Granolithic screedUnit: m²

Screeding (both special/proprietary floor finish screeding and granolithic screeding) will be measured by area. The rate shall cover the cost of the supply and application of the specified material, complete as specified, and in accordance with the manufacturer's instructions for proprietary screeds, all to the approval of the Engineer. Repairs to unsatisfactory work will not be paid for. The unit rate or lump sum shall cover the cost of all materials, labour and equipment required to provide the screed as specified in Clause 5.3.8 above. The rate shall include the steel float finish."


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 5.2 Formwork****PSG 5.2.1 Classification of finishes****Add the following to this Sub-clause:**

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.

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 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 this 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.

PSG 5.5 Concrete (Watertight)**PSG 5.5.1 Concrete (Quality)****Add the following to this clause:**

35 MPa concrete with the minimum and maximum cement contents of 325 kg/m³ and 450 kg/m³ respectively shall be used. For concrete containing extenders the maximum cement 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.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



All Water Retaining structures and all manholes shall be constructed using watertight concrete. The Contractor shall abide by all conditions set out in sub-clause 5.5.11 as amended 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 on the specification.

PSG 5.5.1.1 Crystalline Waterproofing Additive

Furnishing of 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's representative, 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 obtain approval to install the crystalline waterproofing additive in writing from the product manufacturer, which written approval shall be given to the Engineer's representative. This requirement shall not


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



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.

Procedures for mixing shall be as follows:

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSL MEDIUM-PRESSURE PIPELINES****PSL 1 INTERPRETATIONS (2)****PSL 1.1 Abbreviations (2.4)**

"HDPe : High Density Polyethylene"

PSL 2 MATERIALS (3)**PSL 2.1 Steel Pipes, Fittings and Specials (3.4)*****PSL 2.1.1 Pipes of nominal bore up to 150 mm (3.4.2)***

Delete "shall be screwed" in the second and third lines and replace with "shall be flanged to SANS 1123 Table 1600/3".

Add the following to this sub-clause:

"The pipes shall be 'normalized' or seamless steel pipes and shall be used with malleable cast iron fittings complying with the requirements of SANS 509 14:1994/ISO 49:1994."

PSL 2.1.2 Pipes of nominal bore over 150 mm (3.4.3)

Delete bullet point b) and replace with:

"b) the pipes shall be flanged to SANS 1123 Table 1600/3 and of 6 m length; and"

Add the following to this sub-clause:

"The pipes shall be 'normalized' or seamless steel pipes and shall be used with malleable cast iron fittings complying with the requirements of SANS 509 14:1994/ISO 49:1994."

PSL 2.2 Other Types of Pipe (3.7)***PSL 2.2.1 uPVC pipes (3.7.1)***

Only Unplasticised Polyvinyl Chloride (uPVC) pipes shall be used. Unplasticised Polyvinyl Chloride (uPVC) pipes shall be in accordance with SANS 966-1:2013. Minimum working pressure to be Class 9.

PSL 2.2.2 High Density Polyethylene Pipes (HDPe) (New sub-clause 3.7.3)

High Density Polyethylene (HDPe) pipes shall be in accordance with SANS ISO 4427 in material grade PE 100. Minimum working pressure to be PN 10, Standard Diameter Ratio (SDR) 17 (equivalent to material grade PE 100, PN 10).


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSL 2.3 Jointing material (3.8)*****PSL 2.3.1 Flanges and Accessories (3.8.3)***

Delete "SABS 1123 or BS 4504 : Part 1" in the fourth line, and replace with "SANS 1123, Table 1600/3".

Add to the sub-clause:

- "c) Each bolt and nut set is to be supplied with two appropriately sized washers. When fitting the bolts and nuts, one washer is to be placed against each bolt and nut."

PSL 2.3.2 Loose Flanges (3.8.4)

Add to the sub-clause:

"Bolts and nuts are to comply with SANS 136."

PSL 2.3.3 HDPE pipe couplings (New sub-clause 3.8.8)

"All couplings to HDPE pipes to be a minimum of PN10 rated compression fittings. Only compression fittings of the following brand names, or similar approved, will be acceptable: Philmac, Magnum, Plasson, Astore, Unidelta and Elprene."

PSL 2.4 Corrosion protection (3.9)***PSL 2.4.1 Steel Pipes (3.9.2)******PSL 2.4.1.1 Steel Pipes of Nominal Bore up to 150 mm (3.9.2.1)***

Delete the contents of this clause and substitute the following:

Corrosion protection of steel pipes of nominal bore up to 150mm shall conform to the requirements of **Particular Specification PC: Mild Steel Pipes and Fittings**.

PSL 2.4.1.2 Steel Pipes of Nominal Bore over 150 mm (3.9.2.2)

Delete the contents of this clause and substitute the following:

Corrosion protection of steel pipes of nominal bore over 150mm shall conform to the requirements of **Particular Specification PC: Mild Steel Pipes and Fittings**.

PSL 2.4.2 Protection Against Electrolytic Corrosion (3.9.3)

Delete the third line and substitute the following:

"tape or tape impregnated with a petroleum based material, or other approved insulating material, shall be applied in"


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSL 2.4.3 Flexible Couplings (3.9.4)**

Delete the contents of this clause and substitute the following:

"All flexible couplings shall be thoroughly wrapped with tape impregnated with a petroleum-based material."

PSL 2.4.4 Joints, Bolts, Nuts and Washers (3.9.5)

Delete "hot-dipped bitumen coated" and replace with "hot-dipped galvanised".

PSL 2.4.5 Valves (3.10)

Delete the contents of this clause and substitute the following:

Valves shall comply with the requirements of **Particular Specification PB: Valves (Medium-Pressure)**.

PSL 2.5 Manholes and surface boxes (3.11)**PSL 2.5.1 Bricks (3.11.1)**

Delete the first sentence and substitute the following:

"Bricks shall be obtained from an approved manufacturer and shall be either engineering bricks of minimum compressive strength 7MPa that comply with the applicable requirements of SANS 227:2007 or concrete masonry blocks (390 x 190 x 190) of minimum compressive strength 3,5 MPa that comply with the applicable requirements of SANS 0400 10400:1990 and SANS 1215:2008."

PSL 2.5.2 Sand (New sub-clause 3.12)

"Sand used for mortar (general purpose) and for plaster (external) shall comply with the applicable requirements of SANS 1090:2009."

PSL 2.5.3 Cement (New sub-clause 3.13)

"The cement used on the Works shall be CEM 1, grade 42.5 complying with the requirements of SANS EN 197-1 50197-1:2000/EN 197-1:2000."

PSL 3 CONSTRUCTION (5)**PSL 3.1 Laying (5.1)****PSL 3.1.1 Depths and cover (5.1.4)****PSL 3.1.1.1 General (5.1.4.1)**

Add to this sub-clause:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



"Unless otherwise directed, all uPVC and HDPE pipes to be laid with their pipe markings facing upwards for ease of pipe type, size and class identification if/when exposed in the future."

PSL 3.2 Valve and hydrant chambers (5.6)

PSL 3.2.1 General (5.6.1)

Replace "Drawing L-1" with "Typical Drawings".

PSL 3.2.2 Construction of Chambers (5.6.2)

Replace "Drawings L-1, L-2 and L-3" with "Typical Drawings".

PSL 3.3 Brickwork in Chambers and Manholes (5.8)

Delete the eleventh line and substitute the following:

"Mortar for brickwork and plasterwork shall be composed of one part of cement to four parts of sand."

Twelfth and thirteenth lines to be deleted.

Add to the sub-clause:

"Plaster is to be applied in one coat not less than 12 mm in thickness."

PSL 3.4 Flanges and Accessories (New sub-clause 5.11)

PSL 3.4.1 Bolted Connections (New sub-clause 5.11.1)

"Bolted connections shall comply with the following:

- a) All steel pipes in diameter shall be flanged to SANS 1123:2011, unless otherwise indicated on the drawings.
- b) All flanges shall be Type 3, plate flanges for welding and blank flanges shall be Type 8. Matched flanges shall correspond in construction and dimensions to flanges on equipment. Matched flanges shall be provided with the correct bolts, nuts and packing rings. All piping shall be thoroughly cleaned before connections are made.
- c) Bolts, tie-bolts and nuts shall be galvanised to SANS 763) 10684:2011/ISO 10684:2011 and shall comply with the relevant requirements of SANS 135:1985 and SANS 136:1985.
- d) The length of each bolt shall be such that after the bolt has been tightened, the end of the bolt shall not project beyond the nut by more than two threads. Tie-bolts on restrained couplings shall be fitted with "backing nuts".


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- e) All bolt threads shall be liberally coated with “Copper slip” or similar approved prior to assembly. Upon completion, bolt heads and nuts shall be wrapped with the “Denso Mastic Blanket System” comprising of a priming solution, mastic blanket, petrolatum tape and lay-flat sheeting.
- f) Satisfactory temporary end covers shall be provided by the Contractor for protection of flanges, prepared ends of open-ended pipes and fittings and screwed ends, to prevent damage to internal lining and external coating during transportation and during handling on site.”

PSL 4 TESTING (7)

PSL 4.1 Standard hydraulic pipe test (7.3)

PSL 4.1.1 Water for Testing (New sub-clause 7.3.4)

“The Contractor shall make his own arrangements for providing water for testing.”

PSL 5 MEASUREMENT AND PAYMENT (8)

PSL 5.1 Scheduled Items (8.2)

PSL 5.1.1 Anchor/Thrust Blocks and Pedestals (8.2.11)

Delete the last line and substitute the following:

"formwork, concrete, reinforcement (if any), and screeding of top surfaces".

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSLB BEDDING (PIPES)****PSLB 1 MATERIALS (3)****PSLB 1.1 Bedding (3.3)**

Add to the sub-clause:

"The bedding for all flexible pipes laid under this Contract shall be as per Drawing LB-2 with joint holes (pockets) being provided in the bedding as shown on the drawing, at each pipe joint and coupling. No sharp-edged stones shall come into contact with either the pipes or the couplings (joints). No extra payment will be made for forming joint holes (pockets)."

PSLB 1.2 Selection (3.4)***PSLB 1.2.1 Suitable Material available from Trench Excavation (3.4.1)***

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 SANS 1200 DB, and the provisions of sub-clause 3.7 of SANS 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 if so ordered by the Engineer, shall screen or otherwise treat the excavated material in order to produce material suitable for bedding."

PSLB 2 PLANT (4)**PSLB 3 CONSTRUCTION (5)****PSLB 3.1 Concrete Casing to Pipes (5.4)**

Add to the sub-clause:

"Where concrete casing is ordered by the Engineer it is to be of 20/19 grade concrete with a minimum thickness of 150 mm above the top of the pipe".

PSLB 4 MEASUREMENT AND PAYMENT (8)**PSLB 4.1 Principles (8.1)*****PSLB 4.1.1 Volume of Bedding Materials (8.1.3)***

Replace the sub-clause with:

"The volume of bedding materials will be computed from:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- a) The outside dimensions of the pipe and the side allowance determined in accordance with sub-clause 8.2.3 of SANS 1200DB and as shown on Drawing LB-2, and
- b) The depth of each bedding section as shown on Drawing LB-2. No allowance will be made for bulking of material i.e. computed volumes are **compacted** bedding volumes to the above dimensions.
- c) The volume of the pipe will be deducted from bedding volume calculations."

PSLB 4.1.2 Disposal of displaced material (8.1.5)

Replace the contents of this sub clause with the following:

"Material displaced by the pipeline and by importation of material from sources other than trench excavation, shall be disposed of as specified in SANS 1200 DB - sub-clause 5.6.3."



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



Part 4: Particular Project Specifications

PA HEALTH AND SAFETY

PA 1 SCOPE

This specification covers general Health and Safety requirements specific to this project. The purpose of this specification is to assist the Contractor in preparing his Health and Safety Plan for the construction of the Works. As such, this specification must not be considered as a comprehensive Health and Safety manual covering all construction activities that could be expected to occur on the Works, but must rather be seen as a minimum requirement.

PA 2 REFERENCES

PA 2.1 Legal Requirements

The approach to Health and Safety on the Works shall be in accordance with the Occupational Health and Safety Act No. 85 of 1993, subject to the Construction Regulations 2014, hereinafter referred to as the Regulations.

These specifications shall be read in conjunction with the Supporting Specifications listed in PA 2.2 and contain revisions that will be deemed to satisfy this project.

PA 2.2 Supporting Specifications

References made to Health and Safety in the documentation that comprise the Tender and Contract documentation for this project shall be read as part of this specification.

PA 2.3 Definitions

Reference made in the Construction Regulations to the “Client” shall refer to the same representation as referred to in the project Tender or Contract documentation as the “Employer”. Reference made in the Construction Regulations to “Principal Contractor” shall refer to the same representation as referred to in the project Tender or Contract documentation as “Contractor”. Reference made in the Construction Regulations to “Contractor” shall refer to the same representation as referred to in the project Tender or Contract documentation as “Sub-Contractor”.

PA 3 CONTRACTOR

The Contractor accepted by the Employer for the construction of the Works under this contract, shall take on the responsibilities of the Principal Contractor as described above.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PA 4 SUB-CONTRACTORS**

The Contractor shall take on the responsibility to ensure that the Sub-Contractors comply with the Regulations.

PA 5 CONTRACTOR'S HEALTH AND SAFETY PLAN

The Contractor shall submit his Health and Safety Plan, required in accordance with Regulation 5(1), within 14 days after receiving a written appointment from the Employer for the Contract.

PA 6 SUB-CONTRACTORS' HEALTH AND SAFETY PLANS

No Sub-Contractor will be allowed to perform any work under this Contract until the Sub-Contractor's Health and Safety Plan has been approved by the Employer.

PA 7 SUPERVISION OF CONSTRUCTION WORK

Before any work commences on site, the Contractor shall submit to the Employer the name of the person or Contractor's employee, who will be the designated Construction Supervisor, as defined under Regulation 6(1). That person may assume the role of Construction Supervisor, in terms of the Regulations, for work performed by the Contractor's sub-contractors, subject to complying with the other sub-regulations under Regulation 6.

PA 8 RISK ASSESSMENT**PA 8.1 General**

It will not be required for every Contractor to perform a risk assessment as required in Regulation 7(1). Where Sub-Contractors are appointed to perform work of a similar nature, trenching and pipe laying for instance, it will be deemed sufficient if a blanket risk assessment is performed for typical activities. The Contractor shall be responsible however, to make each Sub-Contractor aware of the blanket risk assessment before the Sub-Contractor commences working on site. The Contractor remains responsible to comply with Regulation 7

PA 8.2 Health and Safety Committee/Representative

The Contractor shall actively pursue the formation of a Health and Safety Committee representing all the people to be employed on site and the Labour Desk that will be established by the Employer to facilitate the employ of local labour, shall be invited to participate in the activities of the Health and Safety Committee.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



PA 9 FALL PROTECTION

The necessary fall protection plan, training, medicals, appointments and equipment shall be compiled and implemented by the Contractor if any construction activities falling under this project could pose a potential “fall risk” as defined in the Regulations.

PA 10 EXCAVATION WORK

PA 10.1 Excavation

Excavation to depths exceeding 1.5 metres are a possibility on this project. If excavations of deeper than 1.5m are required, the Contractor will be required to implement all necessary precautions such as sloping the sides of the excavation or erecting shoring / bracing, all in accordance with the requirements of the Regulations.

PA 11 WATER ENVIRONMENTS

No work is expected to be executed in water environments under this contract.

PA 12 HOUSE KEEPING AT CONSTRUCTION SITES

The Contractor shall make adequate precautions to prevent diesel spillage at the Contractor’s diesel storage and dispensing points, from contaminating the surrounding area.

PA 13 CONSTRUCTION WELFARE FACILITIES

PA 13.1 General

The requirement for sanitary facilities as required under Regulation 28 throughout the project shall apply.

PA 13.2 Ergonomic Considerations

The Employer’s general requirements are that the design of the project and components thereof where possible, must take into account the ergonomics of the required task.

The Works requires the installation of heavy equipment, such as valves, steel pipe specials and the like, into underground chambers that are considered as confined spaces. All chambers where access is intended should be sized so that a person of average height and size can work inside with reasonable ease. To this end, the finished floor to soffit height in all accessible chambers should be not less than 1.7 meters, while the minimum size of accessible chambers should be 1.5 x 1.5 metres.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Accesses to chambers should be placed and sized for ease of access and for ease of installing the fittings required for the chamber.

The Contractor is required to scrutinise the designs presented to him for construction, for features that compromise the Ergonomic aspects of Health and Safety and bring potential problem areas to the attention of the Employer or the Engineer at least four weeks before construction of the particular feature. The problem area will then be attended to or, if the design cannot be altered, special precaution will be required or special steps taken to circumvent the problem.

If the Contractor fails to identify and/or notify the Engineer or Employer of any aspects that could affect Health and Safety ergonomically, in the required time beforehand, delays caused in rectifying these will be the Contractor's responsibility.

PA 13.3 Confined Spaces

Workers will not be required to work in confined spaces other than that created through trench excavation, and chamber construction as per PA13.2. The Contractor shall comply with all the requirements of General Safety Regulation 5.

PA 14 GENERAL HEALTH AND SAFETY REGULATIONS

This specification contains regulations of a general nature that contribute to Health and Safety on site and are aspects of Health and Safety that the Contractor must note. The Employer or Engineer shall have the right to instruct the Contractor to comply with a Regulation, or any other Health and Safety related aspect not included in these General Regulations, if the Employer or the Engineer considers that a relevant action or situation could endanger the Health and Safety of a worker or workers.

PA 14.1 Definitions

"building work" means building work as defined in the General Administrative Regulations published under Government Notice R2206 of 5 October 1984;

"confined space" means an enclosed, restricted or limited space in which, because of its construction, location or contents, or any work activity carried on therein, a hazardous substance may accumulate or an oxygen-deficient atmosphere may occur, and includes any chamber, tunnel, pipe, pit, sewer, container, valve, pump, sump, or similar construction, equipment, machinery or object in which a dangerous liquid or a dangerous concentration of gas, vapour, dust or fumes may be present;


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



"fire-resistance" means the minimum period for which a building element or component will comply with the requirements for stability, integrity and insulation when tested in accordance with SANS 10177-2:2005;

"flammable liquid" means any liquid, which produces a vapour that forms an explosive mixture with air, and includes any liquid with a closed-cup flash point of less than 55°C;

"high-risk substance" means a substance listed in the Schedule to the General Administrative Regulations published under Government Notice R2206 of 5 October 1984, as amended from time to time;

"putlog scaffold" means a scaffold supported by a single row of standards and the structure in connection with which it is being used;

[Definition of "putlog scaffold" added by GN R1791 of 1988.]

"scaffold" means any temporary elevated platform and supporting structure used for supporting workers or materials or both;

[Definition of "scaffold" added by GN R1791 of 1988.]

"SANS 10177-2:2005: Part II" means the South African Bureau of Standards' code of practice entitled Fire Resistance Test for Building Elements, SANS 10177-2:2005;

"suspended scaffold" means a working platform suspended from supports by means of one or more separate suspensions from each support;

[Definition of "suspended scaffold" added by GN R1791 of 1988.]

"trestle scaffold" means a working platform supported on trestles, stepladders, tripods and the like.

[Definition of "trestle scaffold" added by GN R1791 of 1988.]

PA 14.2 Personal Safety Equipment and Facilities

- (1) Subject to the provisions of paragraphs (f), (g), (h) and (i) of regulation 5 of the General Administrative Regulations published under Government Notice R2206 of 5 October 1984, the Contractor and user of machinery shall make an evaluation of the risk attached to any condition or situation which may arise from the activities of the Contractor or user, as the case may be, and to which persons at a workplace or in the course of their employment or in connection with the use of machinery are exposed, and he shall take such steps as may under the circumstances be necessary to make such condition or situation safe.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (2) Where it is not practicable to safeguard the condition or situation contemplated in sub-regulation (1), the Contractor or user of machinery, as the case may be, shall take steps to reduce the risk as much as is practicable, and shall provide free of charge and maintain in a good and clean condition such safety equipment and facilities as may be necessary to ensure that any person exposed to any such condition or a situation at a workplace or in the course of his employment or on premises where machinery is used is rendered safe.
- (3) Taking into account the nature of the hazard that is to be countered, and without derogating from the general duties imposed on Contractors and users of machinery by sub-regulations (1) and (2), the safety equipment and facilities contemplated in sub-regulation (2) shall include, as may be necessary-
- a) suitable goggles, spectacles, face shields, welding shields, visors, hard hats, protective helmets, caps, gloves, gauntlets, aprons, jackets, capes, sleeves, leggings, spats, gaiters, protective footwear, protective overalls, or any similar safety equipment or facility of a type that will effectively prevent bodily injury;
 - b) waterproof clothing, high-visibility clothing, chemical-resistant clothing, low temperature clothing, chain mail garments, waders, fire retardant or flame-proof clothing, ice-jackets, or any similar safety equipment of a type that will effectively protect the wearer thereof against harm;
 - c) belts, harnesses, nets, fall arresters, life lines, safety hooks, or any similar equipment of a type that will effectively protect persons against falls;
 - d) mats, barriers, locking-out devices, safety signs, or any similar facility that will effectively prevent slipping, unsafe entry or unsafe conditions;
 - e) protective ointments, ear-muffs, ear-plugs, respirators, breathing apparatus, masks, air lines, hoods, helmets, or any similar safety equipment or facility of a type that will effectively protect against harm;
 - f) suitable insulating material underfoot where persons work on a floor made of metal, stone, concrete or other similar material; and
 - g) generally, such safety equipment or facilities as may be necessary to render the persons concerned safe.
- (4) The Contractor or the user of machinery, as the case may be, shall take steps to ensure that no safety equipment or facility provided as required by this or any other regulation is removed from a workplace or from premises where machinery is used, except for purposes of cleaning, repair, maintenance, modification, mending or replacement, and no person shall remove any such safety equipment or facility from a workplace or premises where machinery is used, except for the aforesaid purposes.
- (5) The Contractor shall instruct his employees in the proper use, maintenance and limitations of the safety equipment and facilities provided.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (6) The Contractor shall not require or permit any employee to work unless such an employee uses the required safety equipment or facility provided in terms of this or any other regulation.
- (7) The provisions of this regulation shall not be construed as derogating from the provisions of any specific regulation prescribing specific safety equipment or facilities.

PA 14.3 First Aid, Emergency Equipment and Procedures

- (1) The Contractor shall take all reasonable steps that are necessary under the circumstances, to ensure that persons at work receive prompt first aid treatment in case of injury or emergency.
- (2) Where more than five employees are employed at a workplace, the Contractor of such employees shall provide a first aid box or boxes at or near the workplace which shall be available and accessible for the treatment of injured persons at that workplace.
- (3) Taking into account the type of injuries that are likely to occur at a workplace, the nature of the activities performed and the number of employees employed at such workplace, the Contractor shall make sure that the first aid box or boxes contemplated in sub regulation (2) contain suitable first aid equipment which include at least the equipment listed in the Annexure hereto. The Contractor shall further make sure that only articles and equipment contemplated here or other similar equipment or medicine is kept in the first aid box or boxes.
- (4) Where more than 10 employees are employed at a workplace, the Contractor of such employees shall take steps to ensure that for every group of up to 50 employees at that workplace, or in the case of a shop or an office as contemplated in the Basic Conditions of Employment Act, 1983 (Act No. 3 of 1983), for every group of up to 100 employees, at least one person is readily available during normal working hours, who is in possession of a valid certificate of competency in first aid, issued by-
- a) the SA Red Cross Society;
 - b) the St John's Ambulance;
 - c) the SA First Aid League; or
 - d) a person or organisation approved by the chief inspector for this purpose.
- (5) The Contractor shall at a workplace where a high-risk substance or toxic, corrosive or similar hazardous substances are used, handled, processed or manufactured, ensure that the first aid worker contemplated in sub regulation (4) is trained in the first aid procedures that are necessary for the treatment of injuries that may result from such activities,


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



including the acute detrimental effects of exposure to such substances, and in the emergency procedures which are necessary in the case of accidental leakage or dumping of such substances.

- (6) The Contractor shall affix a prominent notice or sign in a conspicuous place at a workplace, indicating where the first aid box or boxes are kept as well as the name of the person in charge of such first aid box or boxes.
- (7) An employee with an open wound, cut, sore or any similar injury, who works in a workplace where a substance contemplated in sub regulation 5 is used, handled, processed or manufactured, shall report such injury to his Contractor forthwith. The Contractor may not permit such employee to continue working before the injury has been cleaned with soap and water or with a diluted disinfectant.
- (8) Where any employee is exposed or can be exposed to a potential hazard of injury to the eye through contact with a biological or chemical substance, the Contractor concerned shall make sure that there is an eye-wash fountain in the immediate vicinity of the workplace of such employee and that the employee is trained in the use thereof.
- (9) Where an employee at a workplace is exposed or can be exposed to a potential hazard of injury to or absorption through the skin as a result of sudden contact with a large amount of toxic, corrosive, high risk or similar hazardous substance, the Contractor concerned shall make sure that there is a fast-reacting deluge-shower with clean water or a similar facility in the immediate vicinity of the workplace of such employee and that the employee is trained in the use thereof.

PA 14.4 Use and Storage of Flammable Liquids

- (1) The Contractor shall not require or permit any person to work in a place where the vapour of any flammable liquid is generated to such an extent that it constitutes an actual or potential fire or explosion hazard or endangers the safety of any person, unless the provisions of sub-regulation (2) to (12) of this regulation are complied with.
- (2) The Contractor shall not require or permit a flammable liquid to be used or applied other than in a room, cabinet or other enclosure specially constructed for this purpose of fire-resisting material, or in a place which, owing to its situation or construction or any other feature or circumstance, is of such a nature that-
 - a) no fire or explosion hazard is, can or may be created thereat;
 - b) any vapour resulting from such use or application is efficiently dispersed and diluted into the atmosphere subject to the provisions of the Air Pollution Prevention Act, 1965 (Act No. 45 of 1965); and


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- c) no other workplace can or may be contaminated by such vapour.
- (3) The Contractor shall cause every room, cabinet or enclosure contemplated in sub-regulation (2) to be fitted with an efficient intake and exhaust ventilation system to remove any vapour there from and to prevent its re-circulation in a manner which may lead to the contamination of any other workplace or the creation of a fire or explosion hazard: Provided that, notwithstanding any other provision of this regulation, the Contractor shall provide every employee doing spraying with a respirator, mask or breathing apparatus of a type approved by the chief inspector, and that any such employee shall while spraying use such apparatus provided to him.
- (4) Where spraying is done in any room, the Contractor concerned shall ensure that the ventilation system contemplated in sub-regulation (3) complies to the following requirements:
- a) If the air supply and extraction is horizontal, the average air speed measured at a level of 1.5 metres above the floor, or at the level of the platform on which persons stand to work, shall not be less than 0.5 metres per second;
 - b) if the air supply is vertical and the extraction thereof is done through slits or a grill along the side walls at floor level, the average air speed measured at a level of 1.5 metres above the floor, or at the level of the platform on which persons stand to work, shall not be less than 0.4 metres per second; or
 - c) if the air supply is vertical and the extraction thereof is done through a grill over the whole of the floor area, the average air speed measured at a level of 1.5 metres above the floor, or at the level of the platform on which persons stand to work, shall not be less than 0.3 metres per second.
- (5) Where spraying is done into any cabinet or enclosure as contemplated in sub-regulation (2), the Contractor concerned shall ensure that the ventilation system contemplated in sub-regulation (3) complies with the following requirements:
- a) Where the area of the open face of the cabinet is not more than one square metre, the average speed of air movement through the said face shall not be less than one metre per second;
 - b) where the area of the open face is more than one square metre but less than two square metres, the average speed of air movement through the said face shall not be less than 0.75 metres per second; or
 - c) where the area of the open face is equal to or exceeds two square metres, the average speed of air movement through the said face shall not be less than 0.5 metres per second.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (6) With regard to the ventilation system contemplated in sub-regulation (3) the Contractor shall cause-
- a) all ducts, trunks and enclosures of the system to be of fire-resistant material with a smooth interior finish and to be constructed in such a manner as to facilitate the cleaning thereof;
 - b) the system to be kept in operation during working hours as well as for at least the period of time thereafter that may be necessary to clear the vapour from the atmosphere of the room, cabinet or enclosure to below 25 per cent of the lower explosive limit of that vapour; and
 - c) the work to be so organised that the flow of air towards the intake of such ventilation system is not obstructed and draws the spray or vapour of the flammable liquid away from any employee operating the equipment.
- (7) With regard to any room contemplated in sub-regulation (2), the Contractor shall cause every such room-
- a) with a floor area exceeding 20 square metres to have at least two separate entrances at opposite ends of the room, which shall be fitted with doors opening outwards that cannot be locked; and
 - b) to be fitted with an inspection window of strengthened and shatterproof glass that cannot be opened.
- (8) The Contractor shall not permit-
- a) any fire, flame or naked light or anything which may generate static electricity or any other thing which may ignite a flammable liquid or its vapour, to be used in or taken into any room, cabinet or enclosure contemplated in sub-regulation (2) in which any such flammable liquid is used, sprayed or stored, and shall affix a suitable and conspicuous sign prohibiting any such act at all the entrances to any such room, cabinet or enclosure;
 - b) any person to, and no person shall, smoke in any place in which flammable liquid is used or stored, and the Contractor shall affix a suitable and conspicuous notice prohibiting such smoking at all the entrances to any such place; and
 - c) any process capable of causing sparks or fire, or the application of any heat for the drying of sprayed or treated articles, to take place in any room, cabinet or enclosure used for spraying, before the space or atmosphere has been cleared of all vapour.
- (9) With respect to any room, cabinet, or enclosure contemplated in sub-regulation (2), the Contractor concerned shall cause-
- a) discarded cotton waste, cleaning rags or similar material to be removed daily and safely disposed of;

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



- b) only that quantity of flammable liquid needed for work on one day to be taken into or kept in such room, cabinet or enclosure: Provided that partially consumed stock may be stored in a properly marked, fireproof wall cabinet inside the workplace;
 - c) all drums, cans, canisters or similar containers holding flammable liquids to be kept tightly closed when not in actual use and, after their contents have been used up, to be removed from the workplace and safely disposed of daily; and
 - d) every such room, cabinet or enclosure to be kept clean and all fans, ducts, trunks and enclosures of the ventilation system contemplated in sub-regulation (3) to be kept clean and in good working order: Provided that any cleaning, scraping or scouring shall be done with implements that cannot cause sparking if the concentration of the vapour exceeds 25 per cent of the lower explosive limit of that vapour.
- (10) The Contractor shall cause every flammable liquid store to be-
- a) separated by means of fire-resisting material with a fire-resistance of two hours from any room, cabinet or enclosure contemplated in sub-regulation (2);
 - b) constructed of fire-resisting material with a fire-resistance of two hours;
 - c) constructed in such a way that, in case of spillage, a volume of the flammable liquid in question equal to the quantity of flammable liquid ordinarily kept in store plus 10 per cent of that quantity, can be contained;
 - d) ventilated to the open air in such a manner that vapour cannot accumulate inside the store; and
 - e) clearly marked with a sign indicating that it is such a store and also indicating the amount of flammable liquid which may be stored therein.
- (11) Taking into account the construction and location of the premises in question and the quantity and types of flammable liquids involved, the Contractor shall install an adequate amount of efficient fire-fighting equipment in suitable locations in and around every building in which such substances are used, handled or stored, or as may be recommended by the fire chief of the local authority concerned.
- (12) The provisions of this regulation shall not be construed as applying to the use of flammable liquids in the course of or in connection with building work: Provided that every Contractor engaged in building work shall ensure that, where flammable liquids are used or applied at the workplace concerned, this is done in such a manner that no fire or explosion hazard is created, and that the workplace is effectively ventilated: Provided further that where the workplace cannot be ventilated effectively the Contractor shall provide every employee involved with a respirator, mask or breathing apparatus of a type approved by the chief inspector, and shall take steps to ensure that every such employee, while using or applying flammable liquid, uses the apparatus supplied to him.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PA 14.5 Work in Confined Spaces**

- (1) The Contractor or user of machinery shall take steps to ensure that a confined space is entered by an employee or other person only after the air therein has been tested and evaluated by a person who is competent to pronounce on the safety thereof, and who has certified in writing that the confined space is safe and will remain safe while any person is in the confined space, taking into account the nature and duration of the work to be performed therein.
- (2) Where the provisions of sub-regulation (1) cannot be complied with, the Contractor or user of machinery, as the case may be, shall take steps to ensure that any confined space in which there exists or is likely to exist a hazardous gas, vapour, dust or fumes, or which has or is likely to have, an oxygen content of less than 20 per cent by volume, is entered by an employee or other person only when-
 - a) subject to the provisions of sub-regulation (3), the confined space is purged and ventilated to provide a safe atmosphere therein and measures necessary to maintain a safe atmosphere therein have been taken; and
 - b) the confined space has been isolated from all pipes, ducts and other communicating openings by means of effective blanking other than the shutting or locking of a valve or a cock, or, if this is not practicable, only when all valves and cocks which are a potential source of danger have been locked and securely fastened by means of chains and padlocks.
- (3) Where the provisions of sub-regulation (2) (a) cannot be complied with, the Contractor or user of machinery shall take steps to ensure that the confined space in question is entered only when the employee or person entering is using breathing apparatus of a type approved by the chief inspector and, further, that-
 - a) the provisions of sub-regulation (2) (b) are complied with;
 - b) any employee or person entering the confined space is using a safety harness or other similar equipment, to which a rope is securely attached which reaches beyond the access to the confined space, and the free end of which is attended to by a person referred to in paragraph (c).
 - c) at least one other person trained in resuscitation is and remains in attendance immediately outside the entrance of the confined space in order to assist or remove any person or persons from the confined space, if necessary; and
 - d) effective apparatus for breathing and resuscitation of a type approved by the chief inspector is available immediately outside the confined space.
- (4) The Contractor or user of machinery shall take steps to ensure that all persons vacate a confined space on completion of any work therein.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (5) Where the hazardous gas, vapour, dust or fumes contemplated in sub regulation (2) are of an explosive or flammable nature, the Contractor or user of machinery shall further take steps to ensure that such a confined space is entered only if-
- a) the concentration of the gas, vapour, dust or fumes does not exceed 25 per cent of the lower explosive limit of the gas, vapour, dust or fumes concerned where the work to be performed is of such a nature that it does not create a source of ignition; or
 - b) such concentration does not exceed 10 per cent of the lower explosive limit of the gas, vapour, dust or fumes where other work is performed.
- (6) The provisions of this regulation shall mutatis mutandis also apply, in so far as they can be so applied, to any work which is performed in any place or space on the outside of and bordering on or in the immediate vicinity of, any confined space, and in which place or space, owing to its proximity to the confined space, any hazardous article, oxygen-deficient atmosphere or dangerous concentration of gas, vapour, dust or fumes may occur or be present.

PA 14.6 Work in Elevated Positions

The Contractor shall not permit any person to work in an elevated position, and no person shall work in an elevated position, unless such work is performed safely from a ladder or scaffolding, or from a position where such person has been made as safe as if he were working from scaffolding.

PA 14.7 Working in Danger of Engulfment

- 1) The Contractor shall not require or permit any person to, and no person shall, enter any place from or into which solid or particulate material is being discharged where a danger exists of a person being engulfed by such solid or particulate material, unless-
- a) such a person is provided with and properly uses a safety belt and rope;
 - b) at least one other person who has been properly instructed, is and remains in attendance outside such place to keep the persons therein under continuous observation in order to render assistance in case of emergency; and
 - c) the precautions prescribed by regulation 5 of these regulations are taken if dangerous gas, fumes, dust or vapour may be present in such a place.

PA 14.8 Stacking of Articles

- (1) The Contractor shall not permit the building of stacks, which consist of successive tiers, one on top of another, unless-
- a) the stacking operation is executed by or under the personal supervision of a person with specific knowledge and experience of this type of work;
 - b) the base is level and capable of sustaining the weight exerted on it by the stack;


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- c) the articles in the lower tiers are capable of sustaining the weight exerted on them by the articles stacked above them;
 - d) all the articles which make up any single tier are consistently of the same size, shape and mass;
 - e) pallets and containers are in good condition; and
 - f) any support structure used for the stacking of articles is structurally sound and can support the articles to be stacked on it.
- (2) The Contractor shall not permit-
- a) articles to be removed from a stack except from the topmost tier or part of that tier; and
 - b) anybody to climb onto or from a stack, except if the stack is stable and the climbing is done with the aid of a ladder or other safe facility or means.
- (3) The Contractor shall take steps to ensure that-
- a) persons engaged in stacking operations do not come within reach of machinery which may endanger their safety;
 - b) stacks that are in danger of collapsing are dismantled immediately in a safe manner; and
 - c) the stability of stacks is not endangered by vehicles or other machinery or persons moving past them.
- (4) Unless a stack is otherwise supported, the Contractor shall take steps to ensure that tiers of stacked material consisting of sacks, cases, cartons, tins or similar containers-
- a) are secured by laying up articles in a header and stretcher fashion and that corners are securely bonded; and
 - b) are stepped back half the depth of a single container at least every fifth tier or that, alternatively, successive tiers are stepped back by a lesser amount: Provided that at least the same average angle of inclination to the vertical is achieved: Provided further that where the containers are of a regular shape and their nature and size are such that the stack will be stable, they may be stacked with the sides of the stack vertical if the total height of the stack does not exceed three times the smaller dimension of the underlying base of the stack.
- (5) Notwithstanding the provisions of sub-regulation (4), free standing stacks that are built with the aid of machinery may, with the approval of an inspector, be built to a height and in a manner permitted by the nature of the containers being stacked: Provided that-
- a) the stacks are stable and do not overhang; and
 - b) the operator of the stacking machinery is rendered safe as regards falling articles.

PA 14.9 Welding, Flame Cutting, Soldering and Similar Operations

- (1) The Contractor shall not permit welding or flame cutting operations to be undertaken unless-


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- a) the person operating the equipment has been fully instructed in the safe operation and use of such equipment and in the hazards which may arise from its use;
 - b) effective protection is provided and used for the eyes and respiratory system and, where necessary, for the face, hands, feet, legs, body and clothing of persons performing such operations, as well as against heat, incandescent or flying particles or dangerous radiation;
 - c) leads and electrode holders are effectively insulated; and
 - d) the workplace is effectively partitioned off where practicable and where not practicable all other persons exposed to the hazards contemplated in paragraph (b) are warned and provided with suitable protective equipment.
- (2) The Contractor shall not permit welding or flame cutting operations to be undertaken in a confined space, unless-
- a) effective ventilation is provided and maintained; or
 - b) masks or hoods maintaining a supply of safe air for breathing are provided and used by the persons performing such operations.
- (3) The Contractor shall not permit electric welding to be undertaken in wet or damp places, inside metal vessels or in contact with large masses of metal, unless-
- a) the insulation of the electrical leads is in a sound condition;
 - b) the electrode holder is completely insulated to prevent accidental contact with current-carrying parts;
 - c) the welder is completely insulated by means of boots, gloves or rubber mats; and
 - d) at least one other person who has been properly instructed to assist the welder in case of an emergency is and remains in attendance during operations,
- provided that the provisions of this sub-regulation shall not apply to a welding process where the maximum voltage to earth does not exceed 50 volts.
- (4) The Contractor shall not permit welding, flame cutting, grinding, soldering or similar work to be undertaken in respect of any tube, tank, drum, vessel or similar object or container where such object or container-
- a) is completely closed, unless a rise in internal pressure cannot render it dangerous; or
 - b) contains any substance which, under the action of heat, may-
 - i. ignite or explode; or
 - ii. react to form dangerous or poisonous substances,
- unless a person who is competent to pronounce on the safety thereof has, after examination, certified in writing that any such danger has been removed by opening, ventilating or purging with water or steam, or by any other effective means.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (5) Where hot work involving welding, cutting, brazing or soldering operations is carried out at places, other than workplaces which have been specifically designated and equipped for such work, the Contractor shall take steps to ensure that proper and adequate fire precautions are taken.

PA 14.10 Ladders

- (1) The Contractor shall ensure that every ladder is constructed of sound material and is suitable for the purpose for which it is used, and-
- a) is fitted with non-skid devices at the bottom ends and hooks or similar devices at the upper ends of the stiles which shall ensure the stability of the ladder during normal use; or
 - b) is so lashed, held or secured whilst being used as to ensure the stability of the ladder under all conditions and at all times.
- (2) The Contractor shall not permit a ladder to be used if it-
- a) has rungs fastened to the stiles only by means of nails, screws, spikes or in like manner; or
 - b) has rungs which have not been properly let into the stiles: Provided that in the case of welded ladders or ladders of which the rungs are bolted or riveted to the stiles, the rungs need not be let into the stiles; or
 - c) has damaged stiles, or damaged or missing rungs.
- (3) The Contractor may not permit that-
- a) a ladder which is required to be leaned against an object for support be used which is longer than 9 m; and
 - b) except with the approval of an inspector, the reach of a ladder be extended by fastening together two or more ladders: Provided that the provisions of this sub regulation shall not apply to extension or freestanding ladders.
- (4) In the case of wooden ladders the Contractor shall ensure that-
- a) the ladders are constructed of straight grained wood, free from defects, and with the grain running in the length of the stiles and rungs; and
 - b) the ladders are not painted or covered in any manner, unless it has been established that there are no cracks or other inherent weaknesses: Provided that ladders may be treated with oil or covered with clear varnish or wood preservative.
- (5) When work is done from a ladder, the Contractor shall-
- a) take special precautionary measures to prevent articles from falling off; and
 - b) provide suitable sheaths or receptacles in which hand tools shall be kept when not being used.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (6) The Contractor shall ensure that a fixed ladder which exceeds 5 m in length and is attached to a vertical structure with an inclination to the horizontal level of 75° or more-
- a) has its rungs at least 150 mm away from the structure to which the ladder is attached; and
 - b) is provided with a cage which-
 - i. extends from a point not exceeding 2,5 m from the lower level to a height of at least 900 mm above the top level served by the ladder; and
 - ii. shall afford firm support along its whole length for the back of the person climbing the ladder, and for which purpose no part of the cage shall be more than 700 mm away from the level of the rungs: Provided that the foregoing provisions of paragraph (b) shall not apply if platforms, which are spaced not more than 8 m apart and suitable for persons to rest on, are provided.

PA 14.11 Ramps

- (1) The Contractor shall ensure that every ramp-
- a) is constructed in accordance with accepted technical standards;
 - b) has a safety factor of at least two with respect to the load it is expected to carry: Provided that the design makes sufficient provision for the load on the ramp as a result of the turning, braking and acceleration of vehicles, if the ramp is used for vehicles; and
 - c) has an inclination to the horizontal level of not more than 34° or one vertical to one and one half horizontal.
- (2) The Contractor shall ensure that every ramp-
- a) the inclination of which renders additional foothold necessary, but in every case where the inclination is more than 14° or one vertical to four horizontal, is provided with stepping laths which-
 - i. are placed at suitable intervals; and
 - ii. extend the full width of the ramp: Provided that the stepping laths may be interrupted over a width not exceeding 230 mm to facilitate the movement of barrows; and
 - b) which is higher than 2 m and is provided on both sides with-
 - i. substantial guard rails which are at least 900 mm and not exceeding 1000 mm in height, and
 - ii. toe-boards that are at least 150 mm high and so affixed that no open space exists between the toe-board and the ramp.

PA 14.12 Scaffold framework

- (1) The Contractor shall ensure that-


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- a) scaffold standards are properly propped against displacement and are secured vertically on firm foundations: Provided that putlog scaffolds shall incline slightly towards the structure;
 - b) steel scaffold standards with "heavy", "medium", "light" or "very light" platform loadings which shall not exceed 320, 240, 160 and 80 kg/m², respectively, are spaced not more than 1.8 m, 2 m, 2.5 m and 3 m apart, respectively; and
 - c) wooden scaffold standards are spaced not more than 3m apart;
 - d) ledgers are spaced vertically not more than 2.1 m apart;
 - e) putlogs or transoms-
 - i. which do not support a platform, are spaced at the same distances as the distances prescribed in paragraph (b) in respect of scaffold standards;
 - ii. which support a platform, are spaced not more than 1,25 m apart if the platform is constructed of solid timber boards; and
 - f) every part of a wooden scaffold frame has a diameter of at least 75 mm or a section of similar strength.
- (2) The Contractor shall not permit a scaffold to be used unless it-
- a) is securely and effectively braced to ensure stability in all directions;
 - b) is secured at suitable vertical and horizontal distances to the structure to which work is being done, unless it is designed to be completely free-standing;
 - c) is so constructed that it has a throughout factor of safety of at least two; and
 - d) is inspected at least once a week and every time after bad weather by a person who has adequate experience in the erection and maintenance of scaffolds, and all findings are recorded in a register or report book.
- (3) The Contractor shall not permit that-
- a) a scaffold with a supporting wooden framework exceeds a height of 10 m; and
 - b) a scaffold is erected, altered or dismantled by or under the supervision of a person other than a person who has had the necessary training and experience of such work and who has been appointed by the Contractor in writing for this purpose.

PA 14.13 Scaffold platforms

- (1) The Contractor shall ensure that-
- a) every plank of a solid wooden scaffold platform is at least 275 mm wide and 38 mm thick;
 - b) every plank which forms part of a scaffold platform is supported at distances not exceeding 1.25 m, and its ends are projected not less than 70 mm and not more than 200 mm beyond the last prop;
 - c) every plank of a scaffold platform is firmly secured to prevent its displacement; and
 - d) every platform is so constructed as to prevent materials and tools from falling through.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (2) The Contractor shall ensure that every scaffold platform-
- a) with “heavy”, “medium”, “light” or “very light” platform loadings is not less than 1 125 mm and not more than 1 380 mm, not less than 1 125 mm and not more than 1 150 mm, not less than 900 mm and not more than 1 150 mm, and not less than 675 mm and not more than 1 150 mm, respectively, wide: Provided that where a platform is used only as a gangway, a platform width of 450 mm shall be sufficient;
 - b) which is more than 2m above the ground is on all sides, except the side facing the structure, provided with-
 - i. substantial guard rails of at least 900 mm and not exceeding 1 000 mm in height; and
 - ii. toe-boards which are at least 150 mm high from the level of the scaffold platform and so affixed that no open space exists between the toe-boards and the scaffold platform: Provided that if the toe-boards are constructed of timber, they shall be at least 25 mm thick;
 - c) is not more than 75 mm from the structure: Provided that where workmen must sit to work, this distance may be increased to not more than 300 mm; and
 - d) is kept free of waste, projecting nails or any other obstructions, and is kept in a non-slip state.
- (3) The Contractor shall not permit that a working platform which is higher than 600 mm be supported on a scaffold platform and shall provide an additional guard rail of at least 900 mm and not exceeding 1 000 mm in height above every such working platform.
- (4) The Contractor shall ensure that convenient and safe access is provided to every scaffold platform, and where the access is a ladder; the ladder shall project at least 900 mm beyond the top of the platform.

PA 14.14 Suspended scaffolds

- (1) The Contractor shall ensure that the outriggers of each suspended scaffold-
- a) are constructed of steel or any other material of similar strength and have a factor of safety of at least four with respect to the load it is to carry;
 - b) have an overhang of not more than 1,8m beyond the edge of the structure and are of such length that the counteracting length can be anchored securely;
 - c) are, otherwise than by means of weights at the inner-ends, properly propped, suitably spaced and firmly anchored: Provided that an inspector may grant permission that outriggers may be anchored by means of weights; and
 - d) are provided with stop or other effective devices at the outer-ends to prevent the displacement of ropes.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (2) The Contractor shall ensure that the working platform of every suspended scaffold is suspended by-
- a) pulley-blocks, sheaves, winches or hoists of the correct size for the ropes being used;
 - b) at least two independent steel wire ropes in the case of a working platform which is not wider than 912 mm, and at least four independent steel wire ropes in the case of a working platform which is 912 mm and wider; and
 - c) steel wire ropes of which the factor of safety is at least ten with respect to the maximum load which each rope is to carry.
- (3) The Contractor shall ensure that-
- a) the hand or power-driven machinery used for the lifting or lowering of the working platform of a suspended scaffold is so constructed and maintained that an uncontrolled movement of the working platform cannot occur;
 - b) the machinery referred to in paragraph (a) is so situated that it is easily accessible for inspection;
 - c) the rope connections to the outriggers are vertically above the connections to the working platform; and
 - d) in the case of a working platform suspended by two ropes only, the connections of the ropes to the working platform are of such height above the level of the working platform as to ensure the stability of the working platform.
- (4) The Contractor shall ensure that the working platform of every suspended scaffold-
- a) is at least 456 mm and not exceeding 1.8 m in width;
 - b) is suspended as near as possible to the structure to which work is being done and, except when light work is being done, is secured at every working position to prevent horizontal movement between the working platform and the structure;
 - c) is on all sides, except the side facing the structure, provided with substantial guard rails of at least 900 mm and not exceeding 1 000 mm in height above the level of the working platform: Provided that in the case of a working platform suspended by two ropes only, the guard rails shall be on all sides; and
 - d) is on all sides provided with toe-boards which are at least 150 mm high from the level of the working platform and so affixed that no open space exists between the toe-boards and the working platform: Provided that if the toe-boards are constructed of timber, they shall be at least 25 mm thick.

PA 14.15 Trestle scaffolds

- (1) The Contractor shall not use a trestle scaffold, or permit it to be used, unless-
- a) it is soundly constructed of solid material; and
 - b) all reasonable precautionary measures have been taken to prevent the unexpected spreading of its supporting legs when it is in use.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- (2) The Contractor shall not use a trestle scaffold or permit it to be used, if it-
- a) is higher than 3 m; or
 - b) consists of more than two tiers.

PA 14.16 Minimum Contents of a First-Aid Box

- Item 1: Wound cleaner/antiseptic (100 ml).
- Item 2: Swabs for cleaning wounds.
- Item 3: Cotton wool for padding (100 g).
- Item 4: Sterile gauze (minimum quantity 10).
- Item 5: 1 Pair of forceps (for splinters).
- Item 6: 1 Pair of scissors (minimum size 100 mm).
- Item 7: 1 Set of safety pins.
- Item 8: 4 Triangular bandages.
- Item 9: 4 Roller bandages (75 mm × 5 m).
- Item 10: 4 Roller bandages (100 mm × 5 m).
- Item 11: 1 Roll of elastic adhesive (25 mm × 3 m).
- Item 12: 1 Non-allergenic adhesive strip (25 mm × 3 m).
- Item 13: 1 Packet of adhesive dressing strips (minimum quantity, 10 assorted sizes).
- Item 14: 4 First aid dressings (75 mm × 100 mm).
- Item 15: 4 First aid dressings (150 mm × 200 mm).
- Item 16: 2 Straight splints.
- Item 17: 2 Pairs large and 2 pairs medium disposable latex gloves.
- Item 18: 2 CPR mouth pieces or similar devices.



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



PB VALVES (MEDIUM-PRESSURE)

PB 1 SCOPE

This specification covers the supply and installation of gate valves up to 600 mm diameter, air valves up to 150 mm diameter and reflux valves for use on pipelines transporting potable water.

PB 2 INTERPRETATIONS

PB 2.1 References

PB 2.1.1 Code of Practice

The recommendations of SANS 0120 10120-5 L have been incorporated into this specification as far as they are applicable.

PB 3 MATERIALS

PB 3.1 General

Valves 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 shall be capable of withstanding the applicable test pressures specified in Clause PB 7. All valves shall be supplied complete with coupling and jointing material.

Unless otherwise stated in the Bill of Quantities or otherwise not applicable, all valves shall be supplied with operating caps.

Satisfactory temporary end covers shall be provided to protect threads, flanges and prepared ends of valves from damage during transportation and handling on site.

Valves shall be so transported, stored and handled as to prevent damage. Valves damaged in any way shall be removed from the site.

PB 3.2 Durability of Valves

The valves shall be suitable for use on water pipelines and all materials utilised in the construction of the valves shall be resistant against corrosion from the water in the area.

PB 3.3 Gate Valves for Waterworks

PB 3.3.1 General


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



All gate valves shall comply with the requirements of SANS 664:2011 and shall carry the SANS mark. The valves are to be cast iron fitted with non-rising spindles and all valves shall be of the resilient seal type except those that are fitted for scour purposes, unless otherwise stated.

PB 3.3.2 Direction of Rotation

Unless otherwise stated in the Bill of Quantities or project specification, the direction of spindle rotation for valve closing will be clockwise when viewed from above.

PB 3.3.3 Class of Valves

Gate valves shall be of a class commensurate with a maximum working pressure as defined by the Engineer or as shown on the drawings.

PB 3.3.4 Valve Trim

The valve trim shall be Type B, gunmetal trim, to SANS 664:2011 i.e. gunmetal seats (body and gate), bronze spindle, and gunmetal spindle nut.

PB 3.3.5 Seat Rings

The seating rings on valves up to and including 300 mm diameter shall be pressed into undercut recesses, machined into both the gate and valve body in such a manner that the permanent distortion of the seating ring prevents them from becoming loose.

For valves larger than 300 mm diameter, the gunmetal-seating ring shall be pinned into a rectangular recess machined in both the valve gate and body.

PB 3.3.6 Auxiliary Fittings

Unless otherwise stated in the Project Specification, valves of 300 mm diameter and larger shall be fitted with the following auxiliary fittings:

PB 3.3.6.1 Drain Plugs

300 mm diameter valves and larger shall be supplied with gunmetal drain plugs screwed into the lowest point of the valve and the valve body shall be suitably drilled and tapped to accept the drain plug. The plug must be in position when the test pressure is applied.

PB 3.3.6.2 Ball Bearing Thrust Collars

300 mm diameter valves and larger shall be fitted with a ball bearing race fitted on the top and bottom of the thrust collars. The ball bearing races shall be totally enclosed in a grease packed cover, which shall be sealed to prevent the egress of grease. Provision shall be included for lubricating the ball races and the lubrication arrangement shall allow for greasing while the valve is under pressure.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PB 3.3.6.3 Spur Gearing**

Where considered necessary by the supplier, gate valves of 300 mm diameter and larger, shall be fitted with spur gearing and an indicator, clearly visible from above, to show the position of the valve gate. The spur gearing must be fitted with a cast iron cap. The gear ratios shall comply with the valves given in the table below.

Size of valve (mm)	Spur gear ratio	Size of valve (mm)	Spur gear ratio
300	2:1	450	3:1
350	2:1	500	3:1
375	2:5:1	525	3:1
400	2:5:1	600	3:1

PB 3.3.6.4 By-Pass Unit

Valves of 300 mm diameter and larger shall be fitted with a by-pass valve, fitted either integral with the valve body or to suitable short double flanged tailpieces. All fittings used for the by-pass arrangement shall be capable of withstanding the test pressure of the main valve and shall comply with the conditions of this specification. By-pass sizes shall comply with the values given in the table below.

Size of valve (mm)	By-pass size (mm)	Size of valve (mm)	By-pass size (mm)
300	40	450	75
350	40	500	75
375	50	525	75
400	50	600	75

PB 3.4 Butterfly Valves**PB 3.4.1 General**

Buttery valves shall generally comply with the requirements of SANS 1849:2008 – Butterfly Valves for General Purposes except where a specific product is specified.

The butterfly valves required for this project shall be the AMRI-KSB ISORIA 16 series (or similar approved) flanged or wafer type as detailed on the drawings or as scheduled. The valves shall be provided with ductile iron bodies, 13% Cr stainless steel shafts, stainless steel discs and shall be lined with special formulation E.P.D.M. lining.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PB 3.5 Air Valves**

All air valves shall be either 16 or 25 bar rated 50 mm, 80 mm or 100 mm dia "Vent-O-Mat" RBX double acting anti-slam air valves as shown on the drawings.

PB 3.5.1 Isolating Valves for Air Valves

Air valves shall be provided and supplied complete with isolating valves of suitable pressure rating entirely reliable in operation for the shutting down of the air valve for its complete inspection and removal and replacement of the balls or other parts as required.

- a) The isolating valve shall either be 16 or 25 bar rated 50 mm dia lever operated ball valves to SANS 1056-3:2012 or 16 or 25 bar rated 80 or 100 mm dia AVK or similar approved lever operated butterfly valves incorporated in the inlet stem to the air valve and jointed as specified or shown on the drawings.
- b) The direction of rotation of the isolating valve, unless otherwise stated in the Project Specification or Bill of Quantities, shall be clockwise closing, when viewed from above.

PB 3.6 Flanges

Flanges shall be to the dimensions and drilled as for gate valves according to SANS 664:2011.

PB 3.7 Reflux Valves***PB 3.7.1 General***

Unless otherwise specified, reflux valves shall be flange ended and shall comply with the requirements of SANS 144, Cast Iron Single Door Reflux Valves or SANS 192 Cast Steel Single Door Reflux Valves as applicable and shall bear the SANS mark.

PB 3.7.2 Class of Valve and Body

The working pressure and class of valve shall be as stated in the Bill of Quantities or Project Specification and shall be according to the table below.

Class	Maximum working pressure	Body construction
10	1.0 MPa	Cast iron
16	1.6 MPa	Cast iron
25	2.5 MPa	Cast steel
40	4.0 MPa	Cast steel
100	10.0 MPa	Cast steel


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PB 3.7.3 Flange Drilling**

Flanges shall be drilled and bolted according to the requirements of SANS 144 and SANS 192 as applicable. Precision bolts and nuts unless otherwise stated in the Project Specification are not required.

PB 3.7.4 Valve Trim

The trim of reflux valves shall be as follows:

- a) Cast iron reflux valves shall have stainless steel trims;
- b) Cast steel reflux valves shall have stainless steel seats and stainless steel hinge pins.

PB 3.7.5 Finish

All cast iron parts, except flange faces shall be thoroughly cleaned and an epoxy primer applied, followed by one or more coats of high-build epoxy material to give a total dry film thickness of at least 250 µm applied in conformity with the manufacturer's recommendations.

PB 3.8 Knife Gate Valves**PB 3.8.1 General**

Knife gate valves shall be constructed according to SANS 664. All valves shall be "Wafer Type" Bi-Directional Cast Knife Gate Valves. Gate edges shall be machined, finished, and rounded. The gate faces shall be finish ground.

The valve shall be provided with a handwheel, unless otherwise specified. Handwheels for Classes 10 and 16 valves, shall be manufactured from cast iron and for Classes 24, 40 and 100, from cast steel.

Manually actuated valves 50-300mm diameter shall have handwheel actuators. Valves 350-900mm diameter shall be supplied with handwheel and bevel gear actuators.

Unless otherwise stated, the knife gate valves are to be the rising spindle type.

The valves shall be capable of being easily operated by one man, against the maximum, unbalanced pressure.

PB 3.8.2 Class of Valve and Body

Valves operating under working pressures up to PN10 and of diameter up to 350mm shall be constructed of cast iron unless otherwise specified.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Valves subject to working pressures up to PN16 and of diameter over 350mm, but not exceeding 600mm, shall be of cast iron and shall comply with the relevant requirements of SANS 664 unless otherwise specified.

Packing system shall fit a rounded machined packing chamber. The packing gland shall match the valve body. The fasteners shall be stainless steel.

Body shall be a one-piece casting of type 304 or 316 stainless steel.

Resilient seat shall be capable of bubble-tight bi-directional shutoff to the full pressure rating of the valve and provide shutoff on dead end service.

Valves shall be of a perimeter seat design and the seat shall provide guiding for the gate.

PB 3.8.3 Flange Drilling

Flange drilling shall be in accordance SANS 1123-1000 or SANS 1123-1600.

PB 3.8.4 Direction of Rotation

The direction of closing shall be clockwise.

PB 4 PLANT

In the assembly and coupling up of valves, correct tools and spanners of the correct size designed for the function they are to fulfil shall be used. The indiscriminate use of pipe wrenches will not be permitted and any fittings damaged by the use of incorrect tools shall be removed from the site.

PB 5 CONSTRUCTION

The applicable clause of SANS 1200 L: Medium Pressure Pipelines shall apply unless otherwise stated in the Project Specifications.

PB 6 TOLERANCES

The dimensional tolerances specified in the following standard specifications shall apply:

SANS 144	Cast Iron Single-Door Reflux Valves
SANS 664:2011	Cast Iron Gate Valves for Waterworks
SANS 192	Cast Steel Single-Door Reflux Valves


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



PB 7 TESTING

The testing of the various valves shall be according to the relevant SANS specifications 144, 664, 192 and 128 for the works test.

Once installed in pipelines, the valves shall be subject to the same hydraulic tests and pressures specified for the pipelines.

PB 8 MEASUREMENT AND PAYMENT

The applicable clauses of SANS 1200 L shall apply unless otherwise stated in the Project Specification.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PC MILD STEEL PIPES AND FITTINGS

PC 1 STEEL PIPES & FITTINGS OF NOMINAL DIAMETER UP TO 150 MM

PC 1.1 Scope

This specification applies to the fabrication, welding and galvanizing of mild steel pipes and fittings of nominal diameter up to 150 mm.

PC 1.2 Fabrication

- a) All fabricated steel pipe of nominal diameter up to 150 mm to be manufactured using ASTM A106 (Standard Schedule 40) Seamless Pipes in conjunction with ASTM A234 Grade WPB butt weld fittings to ANSI B16.9 and BS1640 and welded in accordance with SANS 15614-1: 2007 and/or ISO 15614-1: 2004.
- b) The supply and installation of all steel pipe work to be in accordance with SANS 1200L.
- c) All steel pipe to have a minimum wall thickness of 4.5mm.
- d) All steel pipe work and fittings for welded assemblies/specials to be sand blasted internally and externally prior to – and after - being welded together (refer to PC 1.4 item a)).
- e) All gaskets to be full-faced "Klinger" or similar approved.
- f) Allowances have been made in pipe and fitting assembly lengths for 2mm spaces between flange faces for gaskets and 10mm spaces between the pipe end and flange face for flange adaptors.
- g) All pipe work and fittings dimensions to be checked on site and any discrepancies reported to the Engineer, prior to any installation/assembly taking place.
- h) All pipework, including puddle flanges, passing through brickwork or concrete walls or buried underground to be "Denso" wrapped, unless otherwise directed in writing.

PC 1.3 Welding

The specification and qualification of welding procedures for metallic materials, including welding procedure tests, to be in accordance with **SANS 15614-1: 2007** and/or **ISO 15614-1: 2004**.

Apart from reference to the above, the following documentation is required prior to the evaluation of an offer to tender or prior to any welding taking place:

- a) A preliminary welding procedure specification.
- b) The qualification or appropriate range of qualifications of the welder or welding operator who undertakes the welding procedure.
- c) Documentation relating to the above, including a copy of a current certificate of competence and photograph of the welder or welding operator.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



After the award of the tender, but prior to installing the initial batch of pipe work, the following must be presented to the Engineer for approval:

- a) A signed and numbered radiographic report and visual copy of the x-rays of at least two butt welds carried out on the initial pipe work. (Items to be numbered).
- b) All remaining welds to be supported by documentation relating to a solvent dye penetration test of each weld. (Both document and item to be numbered accordingly).

NB: The Engineer reserves the right to call for further radiographic procedures if deemed necessary. All further batches of pipe work must be accompanied by written proof of dye penetration tests of all welds.

PC 1.4 Galvanizing

- a) All welded assemblies to be sand blasted internally and externally prior to hot dip galvanizing. NB: This is in addition to the sandblasting of steel work and fittings prior to the welding procedure (refer to PC 1.2 item d)).
- b) All welds to be inspected and approved by the Engineer prior to hot dip galvanizing, unless otherwise directed in writing.
- c) All pipe work and fittings including bolts, nuts and washers to be hot dip galvanized to **SANS 121 - ISO 1461**.
- d) All nuts to be oversized to allow for hot dip galvanizing.
- e) All damaged hot dip galvanized surfaces, or all ends of pipes cut to suit on site, to be treated with "Zincfix" or similar approved epoxy repair coating, to manufacturer's specification.

NB: Documentation relating to the above must accompany each batch of galvanized pipe work and fittings delivered to site (each item to be listed).

It is also a recommendation that the galvanizer should be a member of the Hot Dip Galvanizers Association of Southern Africa. This allows the Contractor some recourse in the case of delays or rejection of items.

PC 2 STEEL PIPES & FITTINGS OF NOMINAL DIAMETER GREATER THAN 150 MM

PC 2.1 Scope

This specification applies to the fabrication, welding and galvanizing of mild steel pipes and fittings of nominal diameter greater than 150 mm.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PC 2.2 Fabrication**

- a) All fabricated steel pipe work of greater than 150 mm ND to be Grade C carbon steel in accordance with SANS 719-2011.
- b) The supply and installation of all steel pipe work to be in accordance with SANS 1200L.
- c) Steel pipe wall thickness as specified in SANS 719, depending on pipe ND to be used. Minimum pipe wall thickness to be 4.5 mm.
- d) All steel pipe work and fittings for welded assemblies/specials to be sand blasted internally and externally prior to being welded together.
- e) All gaskets to be full-faced "Klinger" or similar approved.
- f) Allowances have been made in pipe and fitting assembly lengths for 3 mm spaces between flange faces for gaskets. For flange adaptors, spaces between the pipe end and flange face have been allowed in accordance with the manufacturer's specifications.
- g) All pipe work and fittings dimensions to be checked on site and any discrepancies reported to the Engineer, prior to any installation/assembly taking place.
- h) All pipework, including puddle flanges, passing through brickwork or concrete walls or buried below ground to be "Denso" wrapped, unless otherwise directed in writing.

PC 2.3 Welding

As per PC 1.3.

PC 2.4 Linings and Coatings***PC 2.4.1 Surface Preparation***

- a) Remove all weld splatter, sharp edges and protrusions;
- b) Pipes and fittings to be in rust condition A to C of Swedish Standard SIS 05 5900. Pipes and fittings in rust condition D will be rejected.

PC 2.4.2 Cleaning of Surface

- a) Surfaces to be degreased with water based solvent degreaser in accordance with SANS 1244;
- b) Surfaces to be thoroughly washed with clean potable water to remove all residues and allowed to dry.

PC 2.4.3 Blast Cleaning

- a) Surfaces to be sand-blasted in accordance with Swedish standard SIS 05 5900 (or ISO 8501-1);
- b) The pipe surface shall not be contaminated by oil, grease or any other contaminants harmful to the lining and coatings process.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PC 2.4.4 Pipe Lining**

- a) Pipe lining to be solvent-free epoxy in accordance with ANSI/AWWA C210-97 "Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water pipelines";
- b) The dry film thickness to be a minimum of 400 and a maximum of 600 microns and to be free from sags and runs.

PC 2.4.5 Pipe Coating

- a) Pipe coating to be solvent-free polyurethane in accordance with ANSI/AWWA C222-99 "Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings";
- b) The minimum dry film thickness of coating to be 2000 microns within a tolerance of -100 microns and + 1000 microns.

PC 2.4.6 Damage to Linings and Coatings

Internal lining - to be repaired with two-component solvent-free polyamide cured epoxy to same thickness as existing adjacent lining.

External coating – to be repaired with solvent-free polyurethane coating to same thickness as existing adjacent coating.

PD BUILDING WORKS**PD 1 GENERAL**

This specification covers the various construction activities associated with the erection of buildings which form part of this Contract. Building work shall be carried out in accordance with the National Building Regulations, SANS 0400, the applicable clauses of the SANS Standardized Specifications and the information contained in this specification. Work appurtenant to the erection of buildings such as earthworks, concrete work, structural steelwork etc. shall be carried out as specified in the appropriate standardized specifications and will be measured and paid for under those specifications.

PD 2 BRICKWORK, PLASTERWORK AND FLOOR SCREEDS**PD 2.1 Materials****PD 2.1.1 Bricks**

Burnt clay bricks shall comply with SANS 227 and shall be of the class scheduled or shown on the Drawings.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



All brickwork below ground shall be engineering bricks (ROK), 14 MPa in class 1 mortar (10 MPa) compressive strength. Brickwork in all superstructures shall be as specified on the drawings.

All load bearing bricks shall be 14 MPa bricks. Concrete bricks where approved by the Engineer, shall have a nominal compressive strength of 8 MPa. Satisfactory proof of the load-bearing capacity of the bricks offered shall be submitted before deliveries are made to the Site.

Air bricks shall be well-burnt terracotta and shall be free from cracks and blemishes and lined with copper mosquito gauze.

Three samples of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be of a standard equal to or better than that of the approved samples.

PD 2.1.2 Cement

Cement shall comply with the requirements of SANS 471 and shall be stored under cover. The use of Portland blast-furnace cement (PBFC) which complies with the requirements of SANS 626 will only be allowed if approved by the Engineer.

PD 2.1.3 Aggregate

Fine aggregate shall consist of natural sand, or crushed rock or gravel, and shall be hard, clean and free from adherent coatings or other deleterious matter. Sand for plaster and mortar shall comply with the requirements of SANS 1090, whereas the aggregates for normal and granolithic floor screeds shall comply with the requirements of BS 1199 and BS 1201 respectively.

PD 2.1.4 Water

Water shall be clean and free from clay, silt, oil, acid, alkali, organic or other matter which would impair the required strength and durability of the mortar, plaster or floor screed.

PD 2.1.5 Wall ties and brickwork reinforcement

Wire ties shall be of galvanized steel of the single wire type for solid walls and either the “Butterfly” or Modified PWD type for hollow walls. Ties shall be of sufficient length to allow not less than 75 mm of each end to be built into brickwork or embedded in concrete.

Brickwork reinforcement shall be manufactured from hard drawn steel wire conforming to BS 785 and shall consist of two 2,8 mm diameter main wires with 2,5 mm diameter cross wires at 300 mm centres welded at intersections.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Brickwork reinforcement shall be lapped not less than 300 mm at end joints and for a length equal to the width of the widest reinforcement at intersections.

PD 2.1.6 Damp-proof sheeting

Damp-proof sheeting shall comply with SANS 248, type FV for fibre felt, or SANS 952, type B for embossed polyethylene sheeting.

PD 2.2 Construction of Brickwork

PD 2.2.1 Cement mortar

Cement mortar shall, unless otherwise specified, consist of one part Portland cement to four parts sand (1:4) by volume for foundation brickwork and one part Portland cement to six parts sand (1:6) by volume for superstructure brickwork. The ingredients for cement mortar shall be measured in proper gauge boxes on a boarded platform and thoroughly mixed. Alternatively, mixing may be by means of an approved mechanical batch mixer. Only when the dry ingredients have been thoroughly mixed and a mixture of uniform colour has been obtained may the water be added in sufficient quantity to obtain mortar with the required consistency.

Cement mortar shall be used within two hours of adding water to the mix and shall not be used after two hours or if it has begun to set. Mortar shall be turned over frequently to prevent it from setting until it is used.

PD 2.2.2 Brickwork

Dimensions of all the brickwork shall be set out and built as shown on the Drawings. Bricks shall be kept wet before laying and the top of brickwork shall be wetted before any further bricks are laid. Bricks shall be well buttered with mortar before being laid and all joints shall be thoroughly flushed up as the work proceeds. All joints to face brickwork shall be neatly made and key-drawn with a 6 mm key.

Brickwork shall be carried up in a uniform manner with no portion being raised more than 1 m above an adjacent portion. All perpends, quoins, etc, shall be kept strictly true and square and the whole properly bonded together.

Brickwork shall be built in stretcher bond or English bond as shown on the Drawings, and bats shall not be used except where required for the bond. All joints shall be 10 mm wide and four courses shall measure 340 mm.

All brickwork shall be constructed with galvanized brickwork reinforcement build-in at every fourth course in superstructure brickwork and every second course in foundation brickwork.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Brickwork for cavity walls and solid walls built in stretcher bond shall be tied with wall ties at 255 mm vertical and 690 mm horizontal in foundations and at 340 mm vertical and 690 mm horizontal in superstructure, and shall be staggered vertically. At openings, the ties shall be positioned not more than 300 mm apart along the periphery of the opening and 150 mm from the opening.

Face brickwork shall be kept perfectly clean and rubbing down of the brickwork shall not be allowed. Scaffold boards shall be turned back during heavy rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

PD 2.2.3 Reinforced brickwork

Brickwork over door and window openings shall be reinforced with steel rods, welded or expanded mesh, etc. Reinforcement shall be placed in each course of brickwork for a minimum of four (4) courses or as shown on the Drawings. Reinforced brickwork shall continue at least 300 mm on each side of the openings.

Brick lintels shall be built upon rigid temporary supports left in position for not less than seven (7) days after brick-laying. Pre-stressed concrete lintels may be used where approved by the Engineer.

PD 2.2.4 Key for plaster

Joints of all brickwork receiving plaster shall be raked out, or the brick surfaces shall otherwise be prepared with an acrylic slurry or any other approved bonding agent.

PD 2.2.5 Damp-proofing

A damp-proof course shall be laid over the full width of all the walls at a minimum height of 150 mm above the final ground level or wherever else it may be required, and it shall be lapped for at least 150 mm at angles and joints. A damp-proof course shall also be laid and stepped up under all external sills.

PD 2.2.6 General

Rough and fair cutting shall be performed as required, and the brickwork shall be fitted around any steel work. Face brickwork shall be carefully cut and fitted to suit fittings.

Chases shall be left or formed for edges of concrete floors, staircases, etc. Chases shall also be provided wherever they may be required for pipes, conduits, switch boxes, distribution boards, and the like. Joints shall be raked out for flashings


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 2.3 Plasterwork*****PD 2.3.1 Plaster coats***

A plastered finish shall consist of a single coat, comprising one application of a 1:6 cement sand mixture with a wood or steel-float finish except where otherwise indicated.

PD 2.3.2 Thickness

The total thickness of the plaster finish shall be 13 mm minimum and 20 mm maximum.

PD 2.3.3 Workmanship

All plasterwork shall be finished smooth and ready to receive paint. Plaster shall be flush with the faces of all switch and plug boxes, the interiors of which shall be kept free from plaster. Plastered surfaces shall be plumb and jambs and reveals shall be formed square

The plasterer shall cut out and make good all cracks, blisters and other defects and leave the plasterwork, on completion, in a state which is acceptable to the Engineer

PD 2.4 Floor Screeds

Floor screeds shall have a mix proportion by mass consisting of one (1) part Portland cement and three (3) parts (1:3) fine aggregate. A minimum amount of water is to be used, but it shall be sufficient to allow adequate compaction.

Screeds shall be laid on clean hardened bases in panels not exceeding 14 m² and shall be steel-trowelled to a true and smooth finish. In monolithic construction, the panels shall not exceed 30 m². Joints in screeds shall coincide as nearly as possible with joints in the bases. The thickness of screeds shall be as shown on the drawings or as directed by the Engineer.

The entire screed surface shall be free from loose or raised particles of aggregate, trowel marks or any irregularities, humps or depressions exceeding 5 mm when measured from a 3 m long straight edge. Screeds shall be cured for three (3) to seven (7) days as may be directed by the Engineer, and shall be protected from damage. No moisture-sensitive floor finish shall be laid on screeds unless a reliable moisture test shows that the screed is sufficiently dry to receive the covering.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PD 3 DOORS AND WINDOWS

PD 3.1 Materials

PD 3.1.1 General

All steel and iron work shall be delivered clean and free from rust, pitting or other defects. Shop primers shall be applied before delivery and shall consist of a coat of red oxide paint, or any other approved antirust paint on all surfaces.

Unless otherwise specified, all materials shall conform at least to the appropriate SANS or BS standards where such standards apply to ironmongery, or steel, cast iron and any other related materials.

PD 3.1.2 Pressed-steel door frames

Pressed-steel door frames shall comply with SANS 1129 and shall be manufactured from 1,6 mm thick mild-steel sheeting, pressed to the required shapes, properly mitred, welded and reinforced, with all welding neatly cleaned off.

Frames shall be of the widths required to suit the thickness of the walls into which they are built and shall be fitted with suitable tie bars and braces at the bottom. Three lugs to be built into the brickwork shall be provided on each jamb.

Rebates in frames and transoms for doors shall be of the widths required to suit the thicknesses of the doors and shall be fitted with a pair of approved steel butt hinges set flush into recesses in the frames. 4,5 mm thick reinforcing plates shall be welded to the backs of the frames at hinge positions.

Heads of frames over double doors shall be drilled where required to form keeps for bolts and shall be fitted with one rubber buffer for each leaf of the door.

Frames for single doors shall be fitted with approved chromium striking plates and an adjustable striking plate keeper boxed in at the back of the frame by a welded-on sheet-metal box. The frames shall be fitted with a minimum of two rubber buffers.

Frames shall be protected against twisting and damage during transit and erection.

PD 3.1.3 Pressed-steel doors

Pressed-steel doors shall be manufactured from 1,6 mm thick steel plate. The doors shall be of standard design, pressed to shape with 40 mm reveals all round. The doors shall be strengthened


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



with full-length vertical V-shaped or other approved sectional strengthening ribs projecting to the outer face. Two horizontal stiffening rails shall also be welded to the inner face of the doors.

A door shall be hung on a pair of 100 mm long steel butt hinges with loose pins. The leaves of the hinges shall be welded to both the door and the door frame, and a 1,6 mm thick steel plate shall be welded to the inner face of the door to protect the lock.

One leaf of double doors shall be fitted at the top and bottom with approved 150 mm cast brass barrel bolts in an approved manner and the other leaf shall be fitted with a lock, the striking plate of which shall be fixed to the first leaf.

Where indicated on the drawings, doors shall be fitted with louvred ventilation grills of approved design, backed with insect and vermin-proof gauze screening.

PD 3.1.4 Steel window frames

All steel window frames shall comply with SANS 727 and shall be of the types and sizes shown on the Drawings.

Standard industrial types of steel window frame shall be constructed from rolled mild-steel industrial sections, 35 mm wide by 3 mm thick, with opening sections constructed from standard residential sections, 25 mm wide by 3 mm thick, welded at angles and properly jointed at intersections.

PD 3.1.5 Aluminium doors, windows etc.

The Contractor for the manufacturing and installations of the aluminium doors and windows is to submit proof of AAAMSA membership and doors and windows shall comply with AAAMSA design criteria.

The following certificates shall be provided prior to commencement of site work:

- A copy of the relevant AAAMSA Performance Test Certificate from the manufacturer/contractor supplying the architectural aluminium product.
- A Certificate of Conformance confirming that anodizing or powder coating has been processed in accordance with SANS 999 and SANS 1796 respectively.
- A Certificate of Conformance confirming that glazing has been installed in accordance with SANS 10137, ensuring that safety glazing materials have been installed in the mandatory areas and that each individual pane of safety glazing materials has been permanently marked.
- A warranty from the manufacturer of the laminated safety glass and/or hermetically sealed glazing units guaranteeing the products against delamination and colour degradation for a period of not less than five years.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The successful tenderer shall provide full shop drawings for the approval by the Engineer prior to the manufacturing of any work.

PD 3.1.6 Door locks and handles

All door locks shall comply with the requirements of SANS 4 and shall be of approved manufacture and pattern. All locks shall be supplied with two keys. Keys shall be distinctly numbered with consecutive numbers and each key shall be stamped with the same number as that of the lock which it controls. No two locks in any one building may have the same key.

External doors shall be fitted with master-keyed four-lever heavy duty mortice locks or cylinder locks as indicated.

All locks shall be properly installed and, after completion, striker plates shall be adjusted and the locks serviced.

Door handles shall be of cast zinc of approved manufacture and pattern.

PD 3.1.7 Miscellaneous fittings

All retaining devices for doors and windows as well as fittings such as coat hooks, retaining hooks, etc shall be of solid brass unless otherwise indicated. All fittings shall be secured by screws or set screws of the same material and finish as the fitting.

Fittings to be fixed to plastered walls, masonry or floors shall be fixed direct by means of patent plastic or fibre plugs fitted into drilled holes.

Door stops shall be provided at every door and shall be 40 mm diameter rubber stops.

Patented precast concrete window surrounds or blocks shall be as scheduled in the bill of quantities.

PD 3.2 Installation of Doors and Windows

All built-in door and window frames shall be set straight, plumb and level, and shall operate to the satisfaction of the Engineer after fixing has been completed.

Fittings shall be either removed, or wrapped and protected from damage, until all rough trades have been completed.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 4 GLAZING****PD 4.1 Materials*****PD 4.1.1 Glass***

Glass shall comply with the requirements of CKS 55. The quality of all window glass shall be such that surface deterioration will not develop after glazing.

All glass shall be free from bubbles, waviness, scratches, stains or other imperfections.

Unless otherwise specified, sheet glass for glazing shall be flat-drawn clear glass of ordinary glazing quality and of the thicknesses indicated below:

For panes not exceeding 1,5 m² in area: 4 mm.

PD 4.1.2 Putty

All putty shall comply with the requirements of SANS 680.

Putty shall not be too hard or soft or caked when used, and shall dry evenly without crazing or cracking. Defective putty shall be cut out and replaced by the Contractor at his own expense, and any broken glass shall also be so replaced and putty so repainted.

PD 4.2 Glazing

Glass shall be cut in panes to suit all glazed openings with sufficient clearance all round to prevent cracking by expansion, contraction or vibration. In all cases the glass shall be well bedded and back-puttied and installed as specified in SANS Code of Practice 0137. All putty shall be carefully trimmed, cleaned off and neatly finished off straight with smooth surfaces and sharp mitres. A paint primer shall be applied as soon as the putty has dried out sufficiently to prevent shrinkage cracks from forming. The entire glazing operation shall be cleaned before the premises are handed over for occupation.

PD 5 CARPENTRY AND JOINERY**PD 5.1 General*****PD 5.1.1 Materials***

All timber used for structural purposes shall be of merchantable grade and shall comply with the requirements of SANS 563 and SANS 1245. Structural timber shall be carefully selected and of the best quality, free from large or dead knots, shakes, waney edges or other defects. Purlins and bracing shall comply with the requirements of SANS 653. Finger-jointed structural timber shall comply with the requirements of SANS 096 and laminated timber with the requirements of SANS


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



1089. Hardwoods and softwoods for joinery shall comply with SANS 1099 and SANS 1359 respectively and suitable species shall be used for the various purposes.

Unless otherwise specified, all materials shall conform to the appropriate SANS or BS Specification where such standards exist for nails, screws, bolts, adhesives, etc.

PD 5.1.2 Preservative treatment

All structural timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SANS 05, and no untreated timber shall be used. The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

PD 5.1.3 Priming

The jointing surfaces of all joints exposed to the weather and built-in portions of frames shall be thickly primed except where adhesives are specified. Carpentry and joinery items which are prepared for painting by the manufacturer, shall be knotted and primed before being dispatched to the Site. Primed surfaces shall be touched up where necessary during the progress of the work or where site adjustments have been made.

PD 5.2 Carpentry Work

PD 5.2.1 Scope of work

Carpentry work shall be carried out in a manner consistent with good workmanship and in compliance with the Drawings.

The carpenter shall perform all cutting away and making good in attendance upon all other trades and he shall provide and maintain temporary coverings required for the protection of any finished work that might be damaged if left unprotected during the progress of the work.

PD 5.2.2 Dimensions

Unwrought timber shall be as sawn and shall be to the dimensions and within the tolerances specified in the relevant SANS Standard Specifications mentioned in subclause PD 5.1.1.

PD 5.2.3 Jointing

Unless otherwise specified, all joints shall be secured by means of a suitable type and a sufficient number of approved connectors. All joints shall be carefully made in such a way that they will not impair the strength and stiffness of the beams or members.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 5.2.4 Timber roof construction**

The plates, joists, rafters, purlins, brandering and other pieces used for the construction of the roof and trusses shall be of the dimensions, spacing and construction as shown on the Drawings. All the joints in the framework shall be of the most appropriate type, accurately formed and adequately secured with fasteners as specified.

PD 5.3 Joinery Work**PD 5.3.1 Scope of work**

Joinery work shall consist of the manufacture, delivery to the Site, and fixing in the buildings, of all joinery shown on the Drawings.

Except where a special finish is specified, the Contractor shall have all stairs, landings, doors, shelves and other joinery work cleaned and scrubbed down and shall leave all his work in a good order to the satisfaction of the Engineer.

PD 5.3.2 Dimensions

All wrought timber shall be sawn, planed, drilled or otherwise machined or worked to the correct sizes and shapes shown on the Drawings. Reasonable tolerances shall be provided at all connections between joinery works and the building structure to compensate adequately for any irregularities, settlements or any other movements.

PD 5.3.3 Manufacture

The joiner shall perform all the necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all the other works necessary for correct jointing. He shall also provide all metal plates, screws, nails and other fixings that may be necessary for doing the specified joinery work properly.

PD 5.3.4 Joints

Where joints are not specifically indicated, they shall be the recognised forms of joints for each position. The joints shall be so made as to comply with Part 2 of BS 1186.

PD 5.3.5 Doors and frames

Door frames, linings, panel doors, framed, ledged and braced doors, flush doors, sliding doors, etc. shall be supplied or made by the joiner and shall be installed, fitted or hung as detailed on the Drawings. All timber shall be wrought and prepared for oiling, staining, varnishing or painting.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 5.3.6 Skirtings, cornices etc.**

Skirtings, cornices etc. shall not be installed until after the wall coverings have been applied, the flooring laid and ceilings installed, unless otherwise specified.

PD 5.3.7 In-situ joinery

In-situ joinery work shall not be executed until after all floor, wall and ceiling surfaces have been formed or constructed, unless otherwise instructed.

PD 5.3.8 Ceilings

Ceilings shall, unless otherwise specified or scheduled, consist of plaster board or fibre-cement panels as shown on the Drawings and shall be nailed to the bracing or suspended from the roof structure. The panels shall be separated by exposed tees and insulated with a 50 mm thick fibreglass wool blanket where shown on the Drawings.

PD 6 ROOF SHEETING AND ACCESSORIES

Roof sheeting and accessories shall comply with and shall be measured and paid for under SANS 1200 HB. All sheeted roofs shall be as specified on the drawings.

PD 7 PLUMBING**PD 7.1 Materials****PD 7.1.1 General**

All materials shall be of the best quality and shall be approved by the Engineer before installation. Cracked, chipped, dented or faulty items or materials shall be replaced at the Contractor's expense. Glazed ceramic sanitary ware shall comply with the requirements of SANS 497 and all other materials shall comply with the standards as specified, scheduled or shown on the Drawings.

PD 7.1.2 Water closet (WC) suites

WC suites shall unless otherwise specified or scheduled consist of a glazed vitreous china closet with an S or P trap and seat lugs, a 14 litre low-level matching flat-bottomed flushing cistern placed and fixed on the closet, or a suspended enamelled cast-iron cistern with the flush pipe connected to the flushing rim of the closet with rubber cone joints, and a solid heavy-duty plastic seat with cover, hinges and buffers.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 7.1.3 Urinals**

Urinals shall be of the type specified or scheduled, of glazed vitreous china, wall mounted, with an automatic or a manual flushing system, and chromium-plated fittings.

PD 7.1.4 Wash-hand basins

Wash-hand-basins shall unless otherwise specified or scheduled be of glazed vitreous china or enamelled cast iron, wall mounted on a pair of cast-iron brackets, and fitted with chromium-plated fittings consisting of two taps, outlet and chain, and supplied with a plug and an anti-siphon trap.

PD 7.1.5 Sinks

Sinks shall comply with the requirements of SANS 242 and shall be complete with cabinet, chromium-plated outlet, anti-siphon trap, plug, chain and two bib taps or one mixer tap, all as detailed or as scheduled.

PD 7.1.6 Pipes and tubing

Cast-iron and steel pipes used in plumbing work shall comply with the requirements of SANS 746 and SANS 62 respectively. Copper tubing shall comply with the requirements of SANS 460 and malleable cast-iron fittings with SANS 509.

PD 7.2 Construction

Plumbing shall be carried out strictly in accordance with the Drawings and with the National Building Regulations, with specific reference to Government Notice R1875 dated 31 August 1979. Steel pipes and their malleable cast-iron fittings shall be joined with red lead and hemp, lead pipes shall have wiped soldered joints, and cast-iron pipes shall be joined by caulking with hemp and metallic lead. Soil pipes from WC's shall have an internal diameter of at least 100 mm and shall be fitted with a pan connector and an access bend (or an access junction where a vent pipe is used), and carried through walls and into the ground for connection to the sewer. Vent pipes shall be fitted with approved balloon gratings. Waste pipes from basins and sinks shall have an internal diameter of at least 32 mm and shall discharge into gulleys. Bends for waste pipes shall incorporate cleaning eyes. Cisterns, basins and sinks shall be connected to the pipe system with 12 mm diameter copper service pipes, and chromium-plated stopcocks shall be installed for isolation and maintenance purposes.

PD 8 PAINTING**PD 8.1 General**

No paint shall be applied to any surface containing traces of dust, grit, grease, oil, loose rust, millscale or corrosion products of any kind or to any surface that is not free from moisture. Where necessary, surfaces shall be thoroughly washed to remove all traces of soluble salts and/or


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



corrosive air-borne contaminants prior to painting, and the surfaces shall be dried and painted immediately thereafter.

Welding shall be completed in so far as it is possible before painting commences, but in cases where welding can be done only at a later stage, no paint shall be applied to within 75 mm of the proposed weld position unless otherwise specified. Welds and adjacent parent metal shall be abrasive blasted and/or ground and all contaminants such as flux shall be removed prior to painting.

Surfaces of members which are to rest on concrete or other floors or which will be otherwise inaccessible after erection shall receive the full paint system prior to erection.

Damaged paint areas on metal surfaces shall be cleaned, rust spots removed where applicable and the surrounding paint which is still intact shall be feathered for a distance of 20 mm beyond the damaged area.

Spot priming and repair shall consist of all the coats previously applied and shall overlap the damaged area.

Damaged galvanised areas shall be cleaned and any rust spots and any flakes of the coating surrounding the damaged area removed. The coating shall then be restored by zinc spraying or soldering, or painting with a zinc-rich paint, as may be approved by the Engineer.

Where the shop coat is allowed to age for a few months before the final painting is done, light sanding or rubbing with steel wool or scrubbing with clean water using a bristle brush shall be carried out. Steel to be embedded in concrete shall not be painted below 50 mm from the final level of the concrete. Each priming coat and each undercoat of paint shall be inspected and approved by the Engineer before any subsequent undercoat or finishing coat is applied.

All finishing colours shall be as shown on the Drawings, or as directed by the Engineer.

PD 8.2 Materials

Paints shall comply with the requirements of the appropriate Specifications below:

PD 8.2.1 Primers

SANS 678: For wood

SANS 679: Zinc chromate for steel

SANS 723: Etch-wash primer for metals

SANS 912: Calcium plumbate for galvanized iron

SANS 926: Zinc-rich epoxy for steel


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 8.2.2 Undercoats**

SANS 681: For all undercoats

PD 8.2.3 Finishing coats

SANS 515: For interior use, flat and egg-shell finish

SANS 630: For interior and exterior use, high-gloss enamel

SANS 631: For interior and exterior use, oil gloss paint

SANS 633: For interior use, emulsion paint

SANS 634: For exterior use, emulsion paint

SANS 684: For exterior use on structural steel

SANS 801: For interior and exterior use, epoxy-tar paint

SANS 802: For interior and exterior use, bituminous aluminium paint

SANS 887: For interior use, glossy and egg-shell varnish

The Contractor shall furnish the Engineer with the following information and details regarding the paints and decorative materials for the painting system he proposes to use, for written approval:

- a) The name of the manufacturer and trade name.
- b) The brand, type or grade of paint and the appropriate SANS Specification.
- c) Manufacturer's data sheets, colour references, instructions for use, including surface preparation, sealers, primers, undercoats, finishing coats, coat thicknesses and curing periods, which shall all be considered as being part of these Specifications if approved by the Engineer.
- d) Safeguards to protect the applied paint from damage until the work is accepted by the Engineer.
- e) The shelf or pot life of materials, if applicable.
- f) An undertaking that the proposed paint system is suitable for its intended use and that the various coats of paint are compatible with one another

Where proprietary brands are used, the manufacturer's priming and all subsequent coats of paint suitable for that particular brand shall be employed in accordance with the manufacturer's instructions.

No other materials of a similar nature and quality or from another manufacturer may be used instead of those approved, unless written permission to do so has been obtained from the Engineer. All materials shall be brought onto the Site in containers sealed by the manufacturer. Paints of a different quality, type, brand or colour shall not be mixed, or thinned and shall not be adulterated in any way, but shall be used as supplied by the manufacturer. Any mixing or tinting required shall be carried out by the manufacturer. Tinting of paint on the Site by the Contractor will only be allowed with the written permission of the manufacturer and the Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 8.3 Inspection and Preliminary Work**

Before commencing paintwork, the Contractor shall carefully inspect the surfaces to be painted to satisfy himself that the surfaces are in a satisfactory or acceptable condition to receive the paint system specified. All metal fittings and fastenings shall be removed where applicable before the preparatory processes are commenced. On completion, the metal fittings and fastenings shall be cleaned and refitted in position.

PD 8.4 Workmanship and Finishes

Paint may be applied by spray, brush or roller depending on the materials used, the surface to be painted, and the manufacturer's instructions. Every coat of paint, irrespective of the method of application, shall be adequately and permanently keyed or bonded to the base material or previously applied coat, and shall be evenly distributed, continuous, free from sags, runs, brush marks, pin holes or other imperfections, and shall dry to a smooth finish. An approved water trap and air-regulating valve shall be furnished and installed on all equipment used in spray painting. Before painting the interiors of buildings they shall be cleaned and the floors shall be washed and kept free from dust during the progress of the interior work.

The Contractor shall protect all nearby surfaces against disfigurement by spatters, splashes and smirches of paint or paint materials. The Contractor shall be responsible for any damage by paint or dirt caused by his operations to vehicles or property or injury to persons and he will be required to provide protective measures to prevent any such damage or injury and make good, where required, at his own expense. If passing traffic creates dust which may harm or spoil the appearance of external painted surfaces, the Contractor shall sprinkle the adjacent areas with water, at his own cost, for a sufficient distance on each side of the location where painting is being done.

Undercoats shall be tinted by the manufacturer to distinguish between successive coats. The final coats or finishing coats of paint shall be applied after all the other work in the vicinity has been completed. The painter shall keep some of the final paint in reserve in the event of his having to make good any patching which may be required as a result of damage or unforeseen circumstances.

Upon completion, the Contractor shall, in the case of buildings, clean all glass, remove all paint spots from walls, floors and fittings, and leave the premises clean and fit for occupation. All inflammable materials, comprising solvents, thinners, wiping cloths, etc. shall be placed in tightly closed containers and properly disposed of.

PD 8.5 Painting of Plaster, Concrete or Brick Surfaces**PD 8.5.1 Surface preparation**


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Surfaces for painting shall be prepared by sandpapering, scraping or wire-brushing to remove loose material, dust, laitance, scum or other deleterious materials or high spots. Defective areas shall be cut out where necessary and made good with an approved non-shrink filler. Cracks shall be cut out, suitably keyed, and given a coat of an approved bonding agent before the filler is applied. All patches shall be rubbed down to an even surface. Surfaces shall be washed and allowed to dry. Surfaces shall be treated with neutralising liquid for walls, and if the surface is coarse or textured, either one full coat of pigmented wall sealer or one full filler coat shall be applied in addition to the neutralising liquid.

PD 8.5.2 Paint application

Prior to the emulsion paint being applied, the surface shall be sealed with an approved clear sealer and primed with an undercoat diluted to 50%. Emulsion paint (PVA or acrylic) shall then be applied in two finishing coats. Egg-shell finish (alkyd oil-based), oil gloss paint or enamel gloss paint shall be applied as follows: one coat of universal undercoat shall be applied and it shall be followed by one coat of a mixture comprising 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of semi-gloss eggshell, or oil gloss paint or enamel gloss paint shall then be applied.

PD 8.6 Painting of Woodwork

PD 8.6.1 Surface preparation

The surfaces shall be cleaned, sandpapered and rubbed down to a smooth, even face before painting. The moisture content of the timber shall not be more than 20% at the time when the first coat is applied. All cracks, shakes or scars shall be filled flush with a filler approved by the Engineer before painting. The surface shall then be washed with cleaner and allowed to dry.

PD 8.6.2 Primer application

One coat of an approved wood primer shall be applied. After open-grained timber has been prepared and primed, the grain shall be stopped and filled with synthetic filler and rubbed down with water paper. All new woodwork shall be properly primed on all surfaces and edges before being fixed in position. All woodwork not previously painted shall be given a prime coat, well brushed in.

PD 8.6.3 Paint application

One coat of universal undercoat shall be applied followed by one coat of a mixture of 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of oil gloss paint or enamel gloss paint or semi-gloss egg-shell (alkyd oil-based) paint shall then be applied.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PD 8.6.4 Varnish finish**

Two coats of gloss varnish or egg-shell varnish shall be prepared, stopped and applied.

PD 8.7 Painting of Metal Surfaces**PD 8.7.1 General**

Wherever possible, all painting shall be done at the manufacturer's works, but where this is not feasible, the Engineer may permit the application of the undercoat and finishing coats to be carried out on the Site, in which case a prime coat shall be applied at the manufacturer's works prior to the members being despatched to the Works.

PD 8.7.2 Surface preparation

The preparation of metal surfaces shall comply with SANS Code of Practice 064 and shall receive the greatest care to ensure rust-free conditions prior to the paint system being applied. All surfaces shall be prepared by removing loose paint, rust, plaster, scale, dust, dirt, grease etc. and by repairing or patching defective paint surfaces before painting or repainting. Damaged shop-primed surfaces shall be thoroughly cleaned of rust and patched with a prime coat.

PD 8.7.3 Paint application**PD 8.7.3.1 Iron and steel work**

All iron and steel work shall be properly primed with a red-lead-based primer where steel work is likely to be exposed to the elements for longer than 30 days. Zinc-chromate primer may be used where overpainting will be completed within 30 days of priming. Metal-etch wash primers may be used under dry conditions where overpainting will be completed within 24 hours of priming. The dry-film thickness of the prime coat shall not be less than 0,300 mm.

After priming, one coat of universal undercoat shall be applied. If necessary, the undercoat shall be tinted to a shade just lighter than the desired finish with approved liquid stainers. The dry-film thickness shall not be less than 0,250 mm.

The two finishing coats shall either be of alkyd resin-based synthetic enamel, gloss or matt oil paint, or as specified elsewhere. The dry-film thickness shall not be less than 0,250 mm per coat.

When mating surfaces are brought together, both surfaces shall have been given the full treatment specified, but where this cannot be done, each surface shall be given a copious coating of primer and the surfaces drawn together while the paint is still wet.

The portion of structural steel members to be buried in soil, and all bases to a height of 500 mm shall be given two coats of an epoxy-tar primer instead of the zinc-chromate primer specified for other surfaces.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The surfaces of steel and cast-iron articles, such as floor gratings, grids and manhole covers shall, after a thorough brushing to remove loose rust, be painted with two coats of epoxy-tar paint, each at least 0,230 mm thick.

PD 8.7.3.2 Galvanized iron and steel

All traces of protective coating shall be removed with galvanized iron cleaner, and two coats of calcium plumbate primer shall be applied. One coat of tinted universal undercoat and two finishing coats of alkyd resin-based synthetic enamel gloss paint shall be applied.

PD 8.7.3.3 Non-ferrous metals

Surfaces of aluminium, copper etc. shall be prepared and cleaned, and one coat of self-etch zinc-chromate wash primer shall be applied. One coat of universal tinted undercoat and two finishing coats of enamel gloss paint shall then be applied. Where non-ferrous metals are not to be painted, the surfaces shall be cleaned, polished and two coats of lacquer applied.

PD 8.8 Painting of Floor Screeds

Where chemicals could cause damage to floors, such floors shall be painted with an approved epoxy paint. The type of paint to be used will be shown on the Drawings and will depend on the types of chemical that are used. The preparation of such floor screeds for painting and the subsequent application of paints shall be carried out strictly in accordance with the manufacturer's instructions.

PD 8.9 Paint Thickness

Unless otherwise specified, all coats of paint, whether prime coat, undercoat or finishing coat, shall have a dry-film thickness of not less than 0,200 mm, irrespective of the method of application.

PD 8.10 Inspection

The Contractor shall provide the necessary equipment to establish whether the primers, undercoats and finishing coats have been applied to the correct thickness according to the correct applications. The Engineer may take samples of the paints during painting operations for testing and quality control.

PD 9 MEASUREMENT AND PAYMENT

PD 9.1 Brickwork

(Thickness, type and class indicated) Unit: m²

The unit of measurement shall be the square metre of each type of brickwork built, calculated from the leading dimensions of the brickwork. Areas of pipes etc. built into brickwork shall not be


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



included in the areas measured. At corners and intersections common to more than one brick wall, the areas shall be measured only once. The tendered rates shall include full compensation for the construction of the brickwork complete as specified, including pointing, the supply and building-in of conduits, beams, lintels, pipe sleeves, the raking-out of joints, weepholes, wall ties, brickforce reinforcement as specified, as well as the building in of plasterwork, facings, paintwork doors, windows, etc. where scheduled.

PD 9.2 Plasterwork

(Thickness of plaster and finish indicated) Unit: m²

The unit of measurement shall be the square metre of each type of coat completed as specified. The tendered rates shall include full compensation for the construction of the plasterwork, including supplying all materials, mixing, applying, finishing, forming reveals, joints, narrow widths, rounded angles, V-joints etc. complete as specified.

PD 9.3 Floor Screeds

(Description and thickness indicated) Unit: m²

The unit of measurement shall be the square metre of floor screed laid, as specified, on floors, steps or areas shown on the Drawings or as designated by the Engineer. The tendered rates shall include full compensation for constructing the floor screeds, including supplying all materials, mixing, laying, finishing, and forming nosings, reedings, skirtings etc.

PD 9.4 Doors and Windows

(Type and size indicated) Unit: No.

The unit of measurement shall be the number of doors and windows installed complete as specified. The tendered rates shall include full compensation for manufacturing and installing steel or aluminium doors, windows, and frames complete with hinges, handles, locks, barrel bolts, door closers, retaining devices, door stops, stays and any other work or ironmongery necessary to complete the work as specified or as shown on the Drawings. The tendered rate for doors and windows shall also include full compensation for glazing, window sills and thresholds as specified, including all necessary timber subframes for aluminium doors and windows, etc.

PD 9.5 Ceilings

(1) Plaster-board ceiling (type and thickness indicated):

a) Fixed ceiling Unit: m²


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The unit of measurement shall be the square metre of fixed or suspended ceiling or bulkheads installed complete as scheduled. The unit of measurement for cornices shall be the linear metre. The tendered rates shall also include full compensation for the construction of the ceilings, bulkheads and cornices including the exposed tees, grids, frameworks, hangers, trap doors, insulation blanket and brandering as specified, as well as the suspension system where applicable.

PD 9.6 Joinery

(1) Items measured by number:

a) Doors (type and size indicated)..... Unit: No.

b) Etc for other items measured by number

(2) Items measured by length:

a) Skirtings (type and size indicated) Unit: m

b) Etc for other items measured by length

The units of measurement shall be the number or metre of each type and/or size of joinery item specified. The tendered rates shall include full compensation for supplying all materials, and manufacturing, cutting, wasting, fixing and installing the joinery items. Tendered rates for doors shall also include for all ironmongery applicable to the specific doors as specified and indicated on the door and ironmongery schedule drawings, including fixing, installing, testing etc.

PD 9.7 Miscellaneous Work

(1) Paintwork Unit: m², m, Sum

(2) Plumbing Unit: m, No., Sum

The unit of measurement shall be as scheduled. The tendered sums or rates shall include full compensation for the supply of all materials, delivery to site, storage, all equipment and labour, preparation, application, installation, testing, all temporary work and safety precautions, replacement of defective work, protection of completed work and clean-up after completion.

PD 9.8 Miscellaneous Items

(1) Items measured by area:

a) (Description of item) Unit: m²

(2) Items measured by length:

a) (Description of item) Unit: m

b) Etc

(3) Items measured by number:

a) (Description of item) Unit: No.

b) Etc


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The unit of measurement shall be the number, linear metre and square metre as applicable to each item. The tendered rates shall include full compensation for all labour, plant, equipment, transport etc., manufacturing or providing and installing each item complete as scheduled and shown on the Drawings, and shall include all corrosion protection where applicable.

PE MECHANICAL EQUIPMENT SPECIFICATIONS

PE 1 COAGULANT DOSING

The coagulant selected for use in the treatment process is polyelectrolyte which is to be delivered to site by bulk tanker. The storage and dosing installation shall be installed in the flocculation room located adjacent to the raw water splitter box at the head of the works and shall comply with the following requirements:

- All uPVC pipework shall be in accordance with SANS 966-1:2013 with a class 16 pressure rating.
- 63mm Ø uPVC surface mounted transfer pipework complete with quick coupling and PVC isolating valve at the loading point and PVC isolating valves at all top entry points to the storage tank (Minimum of 2 No.).
- 63mm Ø uPVC scour valve at tank floor level.
- 63mm Ø uPVC vermin proofed vent pipe.
- 5 000 litre closed plastic storage tank with 600mm diameter lockable manhole access lid suitable for the storage of the reagent. All pipework connections to the tank shall be flanged. The tank shall be fitted with 20mm Ø clear level indicator complete with bottom isolating valve. The level indicator shall be supported in an epoxy-coated mild steel channel strapped to the side of the tank with stainless steel straps for protection.
- Minimum 20mm Ø uPVC surface mounted polymer transfer pipes from the two bulk storage tanks to 2 No. 500 litre dosing tanks and from the dosing tanks to the polymer transfer pumps and from the polymer transfer pumps to the dosing point.
- Duty and standby polymer transfer pumps to transfer polymer from storage tanks to dosing tanks.
- 2 No. 500 litre dosing tanks shall be provided with a potable water supply for dilution when required.
- Duty and standby digital reagent dosing pumps suitably rated (Alldos or similar approved) complete with flow dampeners to mitigate pulsating flow.
- Dosing shall be through a sparge pipe with potable carrier water to ensure even dosing at the raw water splitter box.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PE 1.1 Operation and Automation**

- The dosage rate shall be manually (locally) adjustable about a set point and automatically flow proportional to the raw water inflow.

PE 2 DOSING PUMPS

The scope of works includes the supply and installation of the three dosing pumps within the chemical dosing room complete with motors and controls and all necessary pipework, fittings and pipe supports to connect to the suction and delivery pipes in accordance with the drawings.

The pumps shall be similar in all respects and shall be selected to deliver a range of 1 to 60 l/h.

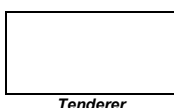
The dosing pumps shall be positive displacement pumps and shall comply with the following requirements:

- Chemical dosing pumps shall be fabricated from materials suitable for the intended purpose.
- The pumps shall be of the digital diaphragm dosing type with a turn down ratio of at least 100.
- The pumps shall be fitted with flow dampeners to ensure a smooth almost continuous flow rate.
- The pumps shall be equipped with a stepping motor to ensure precise and stable dosing.
- The pumps shall incorporate a low level probe and shall have internal protection to prevent over pressurization of the delivery line.
- The pumps shall have a 4-20mA input.
- The pumps shall have an integrated digital display with a pin code lockable touch pad showing:
 - Set maximum pressure.
 - Dosage rate.
 - Integrated flow.
- The pump shall have 220V power supply

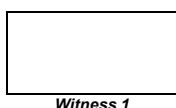
Parameter	Description/Value
Liquid to be pumped	Polyelectrolyte
Dosing rates	1-60 l/h
Power	220V

PE 3 POLYMER TRANSFER PUMPS

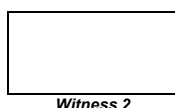
The scope of works includes the supply and installation of two polymer transfer pumps complete



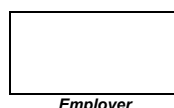
Tenderer



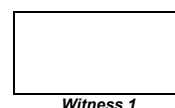
Witness 1



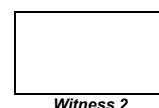
Witness 2



Employer



Witness 1



Witness 2



with motors and controls and all necessary pipework, fittings and pipe supports to connect to the suction and delivery pipes in accordance with the drawings.

The pumps shall be similar in all respects and shall be selected to deliver 1.0 l/s.

The polymer transfer pumps shall be positive displacement pumps and shall comply with the following requirements:

- Chemical dosing pumps shall be fabricated from materials suitable for the intended purpose.
- The pumps shall incorporate a low-level probe and shall have internal protection to prevent over pressurization of the delivery line.

Parameter	Description/Value
Liquid to be pumped	Polyelectrolyte
Temperature	14 to 25°C
Flow rates	1 l/s
System Head	10 m
Power	380V, 3 phase, 50Hz

PE 4 BACKWASH PUMPS

One duty and one standby pump are required to backwash the filters.

The tendered rate shall include the supply and installation of the two backwash pumps within the Pump Room complete with motors and controls. All necessary pipework, fittings and pipe supports to connect to the suction and delivery pipes are to be in accordance with the drawings and are itemised separately in the bill of quantities. The backwash pumps shall be controllable from the filter gallery.

The pumps shall be similar in all respects and shall be fitted with variable speed drives and selected to deliver a minimum of 73 l/s against a total system head of 5.3 m and a maximum of 146 l/s against a total system head of 6.4 m.

Bearings shall be selected with a B10 life in excess of 100 000 hours. Bearings shall be provided with easily accessible grease nipples for lubrication.

Motors shall be rated with a service factor of 1.2 on maximum power.

Submersible pumps will not be accepted.


Tenderer


Witness 1


Witness 2

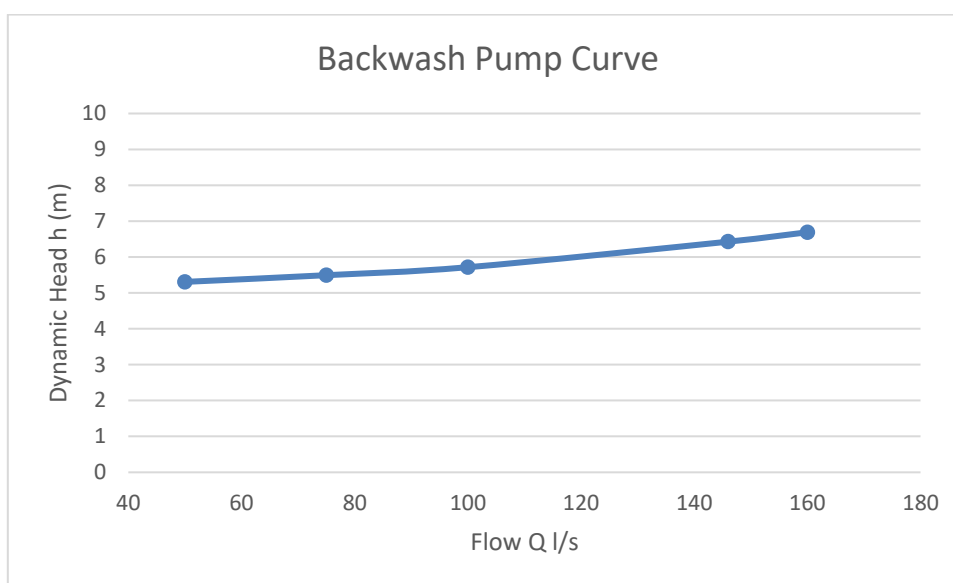

Employer


Witness 1


Witness 2



Parameter	Description/Value
Liquid to be pumped	Treated Potable Water
Temperature	14 to 25°C
Flow rates	73 - 146 l/s
System Head	5.3 – 6.4 m
Power	380V, 3 phase, 50Hz



PE 5 DOMESTIC WATER PUMPS

PE 5.1 Pumps for Supply to Treatment Works and Staff Accommodation Tanks

The scope of works includes the supply and installation of the following equipment:

- One (1 No.) duty and one (1 No.) standby pump, required to supply domestic water to the works and staff accommodation.

The tendered rate shall include the supply and installation of the two pumps within the Pump Room complete with motors, controls and all necessary pipework, fittings and pipe supports to connect to the suction and delivery pipes.

The pumps shall be similar in all respects and shall be selected to deliver a minimum of 5 l/s against a total system head of 12 m.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Bearings shall be selected with a B10 life in excess of 100 000 hours. Bearings shall be provided with easily accessible grease nipples for lubrication.

Motors shall be rated with a service factor of 1.2 on maximum power.

Submersible pumps will not be accepted.

Parameter	Description/Value
Liquid to be pumped	Treated Potable Water
Temperature	14 to 25°C
Flow rates	5 l/s
System Head	12 m
Power	380V, 3 phase, 50Hz

PE 5.2 Booster Pumps for Staff Accommodation

The scope of works includes the supply and installation of the following equipment:

- 1 No. duty pump to boost supply to staff accommodation from tank located alongside building. The pump will be installed alongside the tank.

The tendered rate shall include the construction of a 25MPa concrete plinth for the pump, supply and installation of the pump complete with motors, controls and all necessary pipework, fittings and pipe supports to connect to the delivery pipe to the water supply to the building, an appropriate pump cover and a three phase power supply from the staff accommodation building distribution board.

The pumps shall be similar in all respects and shall be selected to deliver a minimum of 2 l/s against a total system head of 3.2 bar.

Bearings shall be selected with a B10 life in excess of 100 000 hours. Bearings shall be provided with easily accessible grease nipples for lubrication.

Motors shall be rated with a service factor of 1.2 on maximum power.

Submersible pumps will not be accepted.

Parameter	Description/Value
Liquid to be pumped	Treated Potable Water
Temperature	14 to 25°C
Flow rates	2 l/s


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



System Head	3.2 bar
Power	380V, 3 phase, 50Hz

PE 6 AIR BLOWERS

One duty and one standby blower are required for the air scouring of the filters.

The tendered rate shall include the supply and installation of the two Rotary twin Lobe Blowers within the Pump Room complete with motors and controls. All necessary pipework, fittings and pipe supports to deliver air to the filter beds are to be in accordance with the drawings and are itemised separately in the bill of quantities. The air blowers shall be controllable from the filter gallery.

The blowers shall be similar in all respects and shall be mounted on a single galvanised baseplate and shall be V-belt driven. The maximum rotational speed of the blower shall be 1500 rpm. The intake end of the blower shall be fitted with an air filter and silencer. The air filter shall have a maintenance indicator.

The delivery pipework shall be fitted with:

- A silencer.
- Wafer type non-return valve.
- Pressure relief valve.
- Bourdon type glycerine dampened pressure gauge (100mm diameter with a range of 0 to 100 kPa).
- 100 DN flexible coupling to ensure that vibration transmission along the delivery pipeline is minimised.

Parameter	Description/Value
Liquid to be pumped	Air
Temperature	14 to 25°C
Volume of air	10m ³ /min
System Head	30 kPa
Power	380V, 3 phase, 50Hz

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PE 7 CHLORINE DOSING

The chlorine installation shall be based upon gaseous abstraction from 1 tonne cylinders. Chlorine will be stored in the Chlorine Storage Room and the dosing equipment shall be located in the Vacuum Room. The motive water pumps and MCC shall be located in the Pump Room.

PE 7.1 Chlorine Storage and Vacuum Room Equipment

The scope of works includes the supply and installation of the following equipment in the Chlorine Storage Room:

- Lifting beam, 2T electrical hoist with lift and crawl capability and spreader beam (priced separately – see Section 3 of the bill of quantities).
- Pipe manifold to accommodate 2 No. x 1000kg cylinders. The manifolds shall incorporate heated drip tubes to prevent condensation.
- The pipe manifolds shall terminate with an end plug to enable periodic purging of the line using nitrogen. (The provision of a nitrogen cylinder is not included in this contract).
- Each “pigtail” shall have an isolating valve on each end to prevent chlorine loss during cylinder change.
- The manifolds shall be plumbed into an auto-change-over unit which shall shut down on leak detection.
- Load cells with LOCAL LED digital mass (kg) indicators shall be provided for both 1 tonne cylinders.
- The room shall be equipped with a suitably rated fan with elevated (2m above roof) vermin and weather proofed duct. The fan switch shall be located in the Pump Room.

The scope of works also includes the supply and installation of the following equipment in the Vacuum Room:

- 3 No. (2 duty, 1 standby) chlorine flow regulators, each sized for 2 kg/h. The flow regulators shall be equipped with 4-20mA inputs to enable flow proportional dosing control. Connecting valves and pipework shall allow for the following operating permutations:
 - Pre-filter chlorination - Duty chlorinator
 - Post-filtration chlorination - Duty chlorinator
 - Pre or post chlorination - Standby chlorinator
- Duty, standby motive water pump system (380 V) with duty to suit.
- Motive water pipework shall be 50DN minimum.

PE 7.2 Chlorine Safety Equipment

The following minimum equipment shall be provided at the chlorine storage and dosing installation:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Chlorine detectors (2 No.) with one located in the Chlorine Storage Room and the other located in the Vacuum Room. The chlorine detector shall trigger an audible alarm and visual alarm located at the chlorine room.
- A foot activated safety shower complete with a water supply from the potable water supply.
- Eye bath.
- Two sets of breathing apparatus for emergency use.
- Ammonia torch.

PE 7.3 Operation and Automation

- The dosage rate shall be manually (locally) adjustable and automatically flow proportional about a set point.
- Alarms shall be visual and audible and relayed to the control room and or SCADA system.

PE 8 FILTRATION

PE 8.1 Filter Floor

The filter shall have a plenum (false floor) under drain system that shall be of the monolithic type to enable simultaneous backwash and air scour. The drainage system shall be comprised of vertical slot filter nozzles at a density of 39 nozzles per m² (spacing of 160 mm x 160 mm). The slot size shall be 0.25 mm x 22 mm with 30 slots per nozzle. The nozzles shall have an air metering orifice to ensure even air distribution during the air scrub cycle and shall also incorporate an air bleeding orifice to bleed air from the plenum cavity following the air scrub cycle. The stem of the nozzle shall protrude a minimum of 100mm below the soffit of the filter floor.

The nozzles shall be installed in sleeves to facilitate easy removal and replacement when required.

PE 8.2 Filter Testing

Upon completion, each filter will be tested by subjecting each chamber to a test pressure of 80kPa whilst the floor is covered with 100 mm of water. No perimeter joint leakage nor leakage at filter ferrules will be permitted.

Once the pressure test has been completed, each filter shall be subjected to a “bubble test” with 150mm of water covering the nozzles. The air distribution shall be equal and no “boiling” or “dead spots” shall be evident in the air pattern during the “bubble test”.

PE 8.3 Filter Media

Single size silica sand media shall be utilised in the filters and the media depth shall be 800mm. The filter media shall comply with the following specifications:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- The effective particle size (ES) shall be $0.9\text{mm} < \text{ES} < 1.2\text{mm}$.
- The uniformity coefficient (u_c) of the media shall be less than 1.4 where $u_c = d_{60}/d_{10}$.
- Particle specific gravity (SG) shall be $2.4 < \text{SG} < 2.7$.
- Silica content shall be $> 96\%$.

PF LABOUR INTENSIVE CONSTRUCTION

PF 1 CONSTRUCTION ACTIVITIES

PF 1.1 Excavation

Material, including topsoil may be excavated by hand only if practicable. Harder material may be loosened by mechanical means prior to excavation by hand, where practicable.

The excavation of any material which could represent danger or injury to workers shall not be excavated by hand.

PF 1.1.1 Trench Excavation

Materials classified as suitable for hand excavation may be excavated by hand in trenches having a depth of less than 1.5 metres.

Typical task rates for labour intensive constructive methods (for tendering purposes) are provided below.

Activity		Production Rate / Person / Day
1.	Trench Excavation 0 to 1m deep	
(i)	In Very Loose/Very Soft material	3.5m ³
(ii)	In Loose/Soft material	2.8m ³
(iii)	In Medium Dense/Firm material	1.7m ³
2.	Trench Excavation 1 to 1.5 m deep	
(i)	In Very Loose/Very Soft material	3.0m ³
(ii)	In Loose/Soft material	2.4m ³
(iii)	In Medium Dense/Firm material	1.5m ³
3.	Grubbing 1 metre wide strip	10.0m
4.	Earthworks (incl. load up to 1m lifting)	
(i)	In Very Loose/Very Soft material	4.5m ³
(ii)	In Loose/Soft material	4.0m ³
(iii)	In Medium Dense/Firm material	3.5m ³
(iv)	In Dense/Stiff material	3.0m ³
5.	Wheel barrow haul	

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



(i)	0 - 20 m		11,5m ³
(ii)	20 - 40 m		8,5m ³
(iii)	40 - 60 m		6,5m ³
(iv)	60 - 80 m		5m ³
(v)	80 - 100 m		4,5m ³
6.	Backfilling using sand 0 - 1,5 m	deep	3,5m ³
7.	Placing pipe bedding		2.5m ³
8.	Concrete		
(i)	Mixing		1,5m ³
(ii)	Placing		1m ³
9.	Laying blockwork/brickwork		
(i)	Per packer		50m ²
(ii)	Per team member		3,5m ²

PF 1.1.2 Backfilling to trenches in non-trafficable areas

Backfilling to trenches shall be placed in layers of thickness not exceeding 100 mm. Each layer may be compacted by hand stampers where practicable:

- To 90% Proctor density;
- Such that more than 5 blows of a Dynamic Cone Penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that the backfill does not comprise more than 10 percent gravel of size less than 10 mm and contains no isolated boulders, or
- Such that the density of the compacted trench backfill is not less than that of the surrounding undisturbed soil when tested comparatively with a DCP.

PF 1.1.3 Other Excavation

In all other excavations up to a depth of 1.5 meters, materials suitable for excavation by hand, including topsoil so classified, may be excavated by hand where practicable. Harder material may be loosened by mechanical means for removal by hand.

PF 1.2 Clearing and Grubbing

Grass, shrubs and small bushes may be cleared by hand where practicable.

PF 1.3 Shaping

All shaping may be done by hand where practicable.

PF 1.4 Loading

All loading of material excavated by hand, regardless of the method of haulage, may be undertaken by hand where practicable.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PF 1.5 Haulage**

Material excavated by hand may be hauled to its point of placement by means of wheelbarrows where practicable, where the haulage distance is not greater than 100 metres and the slope against which the haulage is done is less than 20 percent.

PF 1.6 Offloading

Material not hauled by tipper trucks, dumpers or wheelbarrow, may be off-loaded by hand where practicable.

PF 1.7 Spreading

Materials, except rock fill, may be spread by hand where practicable.

PF 1.8 Grassing

Grassing may be undertaken by hand where practicable.

PF 1.9 Stone pitching and rubble concrete masonry

Stone required for stone pitching and rubble concrete masonry, whether grouted or dry, may be collected, loaded and offloaded by hand where practicable, unless acquired from a commercial source. Stone placing may be by hand. Grout for stone pitching may be mixed by hand where practicable.

PF 1.10 Manufactured Elements

Individual elements designed and manufactured by the contractor, such as manhole rings, cover slabs, concrete planks and pipes, edge beams and the like, may not have a mass of more than 320kg. The elements should also be large enough so that four workers can comfortably and simultaneously acquire a proper handhold on them.

PF 2 EMPLOYMENT OF LOCAL LABOUR**PF 2.1 Labour Resourcing**

Unskilled and semi-skilled labour shall be resourced through the project's labour desk.

PF 2.2 Contract of Employment

A pro-forma Contract of Employment must be completed for each member of the labour force engaged. A copy of the Contract of Employment completed for each member of the labour force engaged shall be given to the Engineer prior to their commencing work on this Contract. The Contractor shall ensure that all labour employed under this Contract is remunerated at a minimum rate of R30.23 per hour, or at such higher rate as may be prescribed from time to time


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



in terms of the National Minimum Wage Act, 2018 (Act No. 9 of 2018), as amended, and any applicable sectoral determination or collective agreement.

PF 2.3 Construction Activity Tasks

PF 2.3.1 Production Rates for Tender Purposes

It will be assumed that the tendered rates, where applicable, have been based on the typical production rates given in the table under clause PF 1.1.1.

Notwithstanding the production rates shown in the table, tasks established by the Contractor shall be such that:

- i. the average worker completes 5 tasks per week in 40 hours or less and,
- ii. the weakest worker completes 5 tasks per week in not more than 55 hours.

When it is established that the production rates set by the Contractor do not comply with (i) and (ii) above, the Contractor shall, on instruction from the Engineer, revise the production rates to comply with the requirements of (i) and (ii).

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PG ELECTRICAL WORKS

PG 1 LV ELECTRICAL SCOPE OF WORKS

PG 1.1 Free Issue Material / Services

The Client nor the Main Contractor shall issue any free-issue materials nor render any labour, transport or machinery and tools assistance. The Electrical Contractor shall supply all materials, labour, transport, machinery and tools required for the complete LV works.

PG 1.2 Exclusions

Any mains supply reinforcements beyond the metering point, supply authority metering or MV supply.

PG 1.3 Low Voltage (400/231V) Electrical Works, Reticulation and Distribution:

This scope of works shall include the design (for the MCCs and DBs), procurement, supply, loading, delivery, off-loading, storage, installation and commissioning of new Motor Control Centre, PLC & Telemetry system, Earthing, Cable Reticulation, Building Distribution, Area Lighting and associated electrical works for the Water Treatment Works, which shall include but not be limited to the following scope of works and services:

- Cooperation and liaison with any or all Engineers, Client, Main Contractor, Sub-Contractors and Suppliers, which shall include planning and project programming,
- Supply of all materials and equipment,
- Delivery and all associated transport including crane hire and rigging where required,
- Loading and off-loading,
- Storage and security,
- Site clearing where required,
- Supply of all labour including professional, skilled and semi-skilled,
- Supply of all plant, vehicles, tools and machinery,
- Trenching, boring and barricading,
- Backfilling, compaction & landscaping,
- Site clearing,
- Testing & commissioning,
- The provision of acceptable "as-built" documentation including red-lined drawings.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 2 LV ELECTRICAL WORKS GENERAL****PG 2.1 Abbreviations**

A	Ampere(s)
AC	Alternating Current
al	Aluminium
BoQ	Bill of Quantities
cu	Copper
DB	Distribution Board
ECC	Earth Continuity Conductor
E/F	Earth Fault
FAT	Factory Acceptance Testing
IP	Ingress Protection
kV	kilo Volt (voltage)
kVA	kilo Volt-Ampere (unit of apparent power)
kVAr	Kilo Vars (unit of reactive power)
kW	kilo Watt (unit of real power)
kWh	kilo Watt Hours (unit of energy consumption)
LED	Light Emitting Diode
LV	Low Voltage (< 1000 V)
m	Metre (unit of length)
MCB	Miniature Circuit Breaker
MCC	Motor Control Centre
MCCB	Moulded Case Circuit Breaker
MD	Maximum Demand
MV	Medium Voltage (1000 – 36 000 V)
O/C	Over Current
OHS&E	Occupational Health, Safety & Environment
PLC	Programmable Logic Controller
PS	Pump Station
PVC	Polyvinyl Chloride
SCADA	Supervisory Control & Data Acquisition
SLD	Single Line Diagram
SWA	Steel Wire Armoured
TBD	To be Determined
TBP	To be Provided
TRF	Transformer
V	Volt(s)
W	Watt
WTW	Water Treatment Works

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PG 2.2 Drawings

Drawing No.	Title	Sheet Size	Revision
E-325WS-01	LV Site Reticulation & Lighting	A0	A
E-325WS-02	Lighting, Small Power & Lightning Protection	A0	A
E-325WS-02	Schematic Line Diagram	A0	A

- The Electrical Contractor shall ensure that the most recent revision for all drawings is used at all times.
- Revision 0 – 10 shall be used for construction purposes.
- Revisions A – E shall be used for tendering or quoting purposes only.
- Drawings shall be plotted to the correct size and in colour to ensure that the correct details are used.

PG 2.3 Site & System Conditions

PG 2.3.1 Site access and delivery details

Facility	Requirements/Comments
Site location	Masobe, Limpopo
Access to site	Mainly asphalt and gravel roads
Site Office	Site office facilities are not required
Offloading	The contractor is responsible for all offloading
Crane facilities	The contractor is responsible for the hire and operation of any crane facilities required. The contractor will personally supervise all crane operations and activity
Storage Facilities	None. The responsibility for storing of materials will be that of the Contractor. The client will accept no materials until they are installed in their final positions and commissioned
Electricity	The contractor shall provide a portable generator where supply is not readily available.
Water supply	Available for drinking purposes only
Toilet Facilities	None. The Contractor shall provide such facilities where required
Security	Limited. The onus rests with the Contractor to secure all materials, tools and equipment. The Client shall not be held responsible for any loss or damage resulting from theft, damage or vandalism. The Contractor shall make provision for his own security.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 2.3.2 Site Conditions**

No.	Description	Condition/Comments
1	Altitude	The altitude in the area varies between 1100 m and 1150 m above mean sea level.
2	Temperature	Ambient temperature between 10°C and 30°C Average daily maximum ambient: 17°C
3	Humidity	Summer: Mid 50% Winter: Low
4	Rainfall	Approximately 850 mm per annum. An average of 2 – 3 working days per month are lost due to inclement weather. No claims for delays as a result of adverse weather conditions shall be considered.
5	Lightning	The area is subject to severe lightning storms, approximately 6.3 flashes/km ² /year

PG 2.3.3 Electricity Supply System

- The nominal system voltages are 11kV, 400V three phase and 231V single phase.
- The system frequency is 50 Hertz and the phase rotation is R-W-B anti-clockwise.
- The maximum MV system voltage is 12.5kV.

PG 2.4 General Requirements**PG 2.4.1 General**

- All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and adequate working space for such activities.
- The plant shall incorporate all components and equipment necessary to achieve the functionality defined in the specification.
- All materials, components, and equipment used in the manufacture of the plant shall be new and unused, shall be of current manufacture, and shall be free from any defects or imperfections.
- The arrangement of all circuit components/functional units shall be to the approval of the Engineer.

The Electrical Contractor under this contract shall comply with the following requirements:

- SANS 10142-1 Low Voltage Installation.
- Act 85 of 1993: The occupational health and safety.
- SANS 10400 XA: The National Building Regulations for energy usage in buildings.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- SANS 10400-O: The National Building Regulations for Lighting.
- SANS 475: LED Luminaires for interior and exterior lighting: performance requirements.
- SANS 1777: Photoelectric control units for lighting.
- SANS 164-1: Plugs and sockets outlets for buildings.
- SANS 60598: Luminaires to bear safety mark.
- SANS 60529: Degrees of protection provided by enclosure (IP codes).
- SANS 10198-2: The selection of low voltage cables.
- SANS 10313: Protection against lightning.
- SANS 10292 (SABS 0292), Earthing of low voltage (LV).
- ISO 9001: Quality Systems.
- SANS 767-1: Earth Leakage Protection Units – Part 1: Fixed Earth Leakage Protection Circuit Breakers.
- SANS 61643:1-11: Low Voltage Surge Protective Devices.
- SANS 61439:1-5: Low Voltage Switchgear and Control Gear Assemblies.
- SANS 60947: 1-8: General rules and common safety requirements for low-voltage switchgear and control gear.
- SANS 1973-3:2008: Low-Voltage Switchgear and Control Gear Assemblies Part 3: Safety of assemblies with a Rated Prospective Short-Circuit Current of Up to and Including 10kA.
- SANS 0292: Earthing of Low Voltage (LV) Distribution Systems.
- SANS 556-1: Low-Voltage Switchgear Part 1: Circuit Breakers.
- SANS 1091: National Colour standard for paint.

PG 2.4.2 Safe Design

All equipment supplied under this contract shall be designed:

- To prevent any injury to personnel employed on the construction, operation and maintenance of the plant.
- To facilitate inspection, cleaning and repair of the equipment.
- To operate continuously and satisfactorily in the prevailing site conditions.
- To be able to withstand without damage such sudden variations of electrical load as may be met under normal working conditions, including short circuits and lightning strikes.
- To obviate risks of accidental short-circuits due to animals, birds and insects.
- To avoid pockets in which water can collect in outdoor equipment.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- To avoid condensation in closed compartments by the provision of adequate ventilation or where necessary, heaters.
- Such that conductors can carry normal load and fault currents without overheating or other damage.
- Such that moving parts can be readily lubricated. Grease nipples shall be provided in accessible positions for this purpose.
- To be vermin proof.
- To be corrosion resistant.

PG 2.4.3 Quality of Materials and Workmanship

- All materials and equipment for this Contract shall be new and undamaged. Corresponding parts shall be interchangeable.
- Where so directed by the specification or by the Engineer, the Contractor shall provide samples and test certificates of materials for approval.
- The labour used by the Contractor shall at all times be adequately qualified and experienced for the particular task.

PG 2.4.4 Tools and Test Devices

The Contractor shall provide a complete set of any special purpose tools, equipment or test devices necessary for the safe operation and maintenance of the equipment supplied on this Contract.

A list of this equipment shall be provided together at the time the Bid/Offer is submitted.

PG 2.4.5 Fixings and Connections

Nuts, Bolts and Washers:

Only metric size nuts, bolts and washers shall be used unless otherwise specified. Each bolt or stud shall project at least one thread but not more than 6 mm from the nut. Special spanners shall be provided where nuts and bolts are not easily accessible. The nuts on the moving plant or plant subject to vibration shall be fixed by means of locknuts, "Loctite" or other approved locking method. Bolts and studs shall be adequately sized to carry the loads, which may be imposed on them.

PG 2.4.6 Galvanising and Painting

- The area has a fairly corrosive atmosphere and special attention shall be given to all finishes.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- **NO** drilling, cutting, bending, punching, welding and forming of the steel or any surface damage shall be allowed after galvanising or painting.
- Should it be necessary to drill or cut any galvanised structure, the member/object in question shall be returned for sand blasting and re-galvanising. Cold galvanising shall not be accepted.
- All steel to be hot dip galvanised in accordance to SANS 121 with a minimum zinc deposit or 85 microns.
- All paint colours shall be approved by the Engineer.

PG 2.5 Occupational Health & Safety

- The attention of the Electrical Contractor is drawn to the requirements of this Act and in particular, the Construction Regulations.
- The Electrical Contractor shall also ensure that any sub-contractor employed by him shall also comply with the Act and the regulations.

PG 2.6 Regulations and Standards

- The design, construction, installation, inspection, testing and commissioning of the plant shall comply with all relevant statutory regulations, and the latest editions (current at the time of Tender) of all relevant South African National Standards.
- The manufacturer shall operate an approved, auditable quality assurance system covering the design, construction, inspection and testing of the plant.
- The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:
 - Occupational Health and Safety Act (Act 85 of 1993),
 - Construction Regulations 2003 issued in terms of Section 43 of the Act,
 - Local Fire Regulations, and
 - Regulations of the Local Supply Authority.

PG 2.6.1 Regulations, Specifications and Standards:

Standard Number	Description
SANS 152	Low-voltage air-break switches, air-break disconnectors, air-break switch disconnectors, and fuse-combination units
SANS 156	Moulded case circuit-breakers
SANS 1973	Low-voltage switchgear and control gear Assemblies
SANS 10142-1	Wiring of Premises Part 1: Low Voltage Installations


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



SANS 60044	Instrument Transformers
SANS 60439	Low-voltage switchgear and control gear assemblies
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60947	Low-voltage switchgear and control gear
SANS 61643	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems
SANS 1213	Mechanical cable glands
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
SANS 10199	The design and installation of earth electrodes
IEC 50086	Conduit systems for cable management
SANS 10292	Earthing of low-voltage distribution systems
SANS 62305-3	Protection against lightning: Physical damage to structures and life hazard

Standards are often tailored to the conditions of their country or origin (in terms of permissible voltages, expected ambient temperatures, etc.). Therefore, and unless normatively referenced to the contrary in a Standard of higher precedence, the decreasing order of precedence of Standards shall be:

- South African Sectoral Standards and Specifications (SANS, NRS, etc.)
- ISO Standards
- IEC Standards
- British Standards (BS EN)
- European National (EN) Standards

Where Standards of the same order are not in agreement with each other, the Standard with the most rigorous requirements shall apply.

PG 3 GENERAL LV ELECTRICAL WORKS TECHNICAL SPECIFICATIONS

IMPORTANT NOTE:

A Project Specific Specification (PG 4 below) takes precedence over a General Specification (this section). Should there be a conflict between a Project Specific Specification and a General Specification, the Project Specific Specification shall be used unless otherwise stated or instructed by the Engineer. For all specifications not covered under the Project Specific Specification (PG 4 below) the General Specification (this section) and applicable Regulations and Standards (PG 2 above) shall prevail.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 3.1 SWITCHBOARDS & MCCs: GENERAL SPECIFICATION****PG 3.1.1 General Requirements for Motor Starters**

- Each motor starter section shall be provided with an isolation and short circuit protection device.
- Every individual motor starter unit shall include all equipment, components and wiring necessary to safely and reliably operate the driven plant item. It shall be possible to manually operate plant from the front panel of its functional unit, notwithstanding any failure or deselection of any automatic control system, networking/communication facility, PLC, SCADA, or telemetry system. In order to achieve this, the appropriate push buttons/keypads and indicators shall be provided on the front of the panel.
- If the power supply fails whilst a motor is running, the line contactor shall open. On restoration of the power supply, the motor starter shall immediately be made available to restart the motor without manual attendance or intervention on receipt of a start command (be it initiated manually or automatically). However, where a hardwired automatic control facility is available, a power-on delay timer (adjustable between zero and 60 seconds) shall be provided in the hardwired circuit.
- Where a 'healthy' signal is required, it shall confirm that the functional unit isolation device is closed, the starter control supply is healthy, no fault condition exists, emergency stop(s) are released, the local isolator (where fitted) is closed. The 'healthy' signal shall be used to provide the 'drive available' input signal to any automatic control schemes or automatic duty selection routines.
- Each functional unit shall provide any automatic control schemes (including auto duty selection routines) with the following status signals as a minimum, as well as all others as specified in the Project Specific Specification:
 - Manual/auto mode
 - Running
 - Tripped
 - E/Stop activated
- Each motor starter shall be provided with an emergency stop circuit, which together with its components shall comply with BS EN 418. A field 'twist to reset' emergency stop button shall be provided. On operation of the emergency stop circuit, the motor line contactor shall immediately open, and the emergency stop circuit shall lock out until it is reset. A front of panel 'emergency stop operated' indication lamp and a status signal for PLC monitoring shall be provided. A composite starter may have a common emergency stop circuit controlling all of its constituent drives.
- Where and if identified in the Project Specific Specification, specific process or driven plant interlocks shall be hardwired into the motor starter, and when operated, shall stop and inhibit the drive.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Front of panel pushbuttons shall be provided for manual start (forward, and where applicable; reverse), and manual stop. A front of panel control selector switches shall be provided for 'Manual/Off/Auto' or 'Remote/Local' as specified.
- Front of panel indicator lamps shall be provided for 'running' and 'tripped', and a digital ammeter shall be provided for motor circuits; other front of panel indications e.g. specific fault indication lamps, hours run meter, number of starts counter, etc.

PG 3.1.2 Enclosures

- All conductors and terminals that form part of a Switchboard or MCC, including earth conductors and the earth bar, shall be enclosed within it. An earth stud may be provided as a part of a cable glanding facility.
- Switchboard and MCC assemblies shall be constructed of materials capable of withstanding the mechanical, electrical and thermal stresses to which it may be subjected and the environmental and operating conditions likely to be encountered in normal service.
- All boards, panels and cubicles shall be vermin and dust proof and the minimum degree of protection shall be:

Location	Description	Minimum rating
Indoor	Clean, dry areas (e.g. inside substations or motor control rooms)	IP44 (doors closed) IP2X (inter-compartment & doors open)
Outdoor	Located outside buildings	IP65 (doors closed) IP2X (inter-compartment & doors open)

- Where heat is generated within the enclosure, it shall, where possible, be designed to dissipate naturally from the enclosure surface. Where this is not possible, ventilation openings shall be provided that maintain the highest practicable IP rating of the enclosure, subject to a minimum of IP42. Where cooling air is drawn into the enclosure, dust filters shall be provided where practicable.
- For all variable speed drives and soft-starters (without bypass contactors) installed in indoor MCC assemblies, mini-extraction fans shall be installed inside the drive compartment to dissipate heat, without compromising the assembly's IP rating.
- Particular attention shall be given to the ventilation of outdoor mounted boards, to eliminate build-up of excessive heat inside the boards caused by the solar radiation or internal heat generation.
- Purpose-made gland plates shall be protected against corrosion by electro-plating, galvanising, or be made of stainless steel and shall not be painted.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 3.1.3 Construction of Free-Standing MCCs, Switchboards and DBs**

- Free-standing Switchboards and MCCs shall be constructed from steel with a structural frame permanently clad with side plates, so as to provide a multi-compartmented structure that is rigid with all doors and covers removed, and such that it will not deform during transport or installation. The enclosure doors and covers shall themselves be suitably braced so as to be rigid and not deform or flex when fully equipped and handled.
- Each compartment formed within the enclosure for the purpose of housing components or equipment shall be provided with dedicated mounting plates for that purpose, which when removed do not expose any other compartment or live parts. Cabling shall only be terminated on or in the enclosure at gland plates provided for that purpose.
- The minimum metal thickness of the enclosure's constituent parts shall be as follows:
 - External cladding: 2mm
 - Internal partitions: 1.6mm
 - Doors and removable panel covers: 2mm
- Free-standing Switchboards and MCCs shall be mounted on and bolted to a rigid hot-dip galvanised steel 100 x 50 x 6 mm channel base.
- The maximum height of any Switchboard or MCC (including its base) shall be 2100 mm above finished floor level. No equipment other than busbars and/or inter panel control wiring shall be installed higher than 1900 mm above finished floor height, neither shall any equipment, other than cable glands and inter panel control wiring be installed lower than 300 mm above finished floor level.
- Compartment single doors shall have vertical hinges mounted on their left-hand side, and all doors shall have an angle of opening that is limited to 95 degrees.
- Any cover which is required to be removed for adjustment, access, or maintenance and exceeds 0.75 m² in area, shall be provided with supporting lips, lift-off hinges, locating dowels, or handles, in order to facilitate safe removal and replacement.
- The Switchboard or MCC shall be constructed for front and rear access.
- Any apertures between compartments (including busbar compartments) through which the copper-work or cabling passes, shall be effectively closed off to minimise the possibility of an arc fault propagating between compartments.
- Unless detailed otherwise specified in the Project Specific Specification, the Switchboard or MCC shall be constructed so as to facilitate future extension by the addition of extra full height sections at either end. To accommodate this, any covers, fixings, etc. shall be flush with the end faces of the enclosure, and the end sections of busbars and earth bars shall be prepared for future extension.

PG 3.1.4 Power distribution within a Switchboard or MCC

- The power distribution and circuit protective arrangements within a Switchboard or MCC shall be designed so as to co-ordinate with the characteristics of the electrical system(s)


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



connected to the incoming terminals of the Switchboard or MCC, including emergency or temporary supplies and specifically noting the following:

- maximum prospective RMS short circuit current from all simultaneously available sources of supply, together with any fault contribution from large motors directly connected to the Switchboard or MCC,
- the maximum available earth fault current, and the maximum earth fault loop impedance, and
- up-stream protective device ratings and settings.

PG 3.1.5 Functional unit short-circuit protection and isolation

- The Switchboard or MCC shall be provided with separate incoming isolation for every electrical power system (including emergency or temporary supplies) connected to it.
- Every motor starter compartment shall be provided with a door interlocked isolation device, which shall isolate all sources of supply that enter the motor starter compartment. Where a functional unit; e.g. a motor starter, etc., comprises a group of interlocked compartments, the isolation device shall be located in the compartment receiving the supply.
- Separate isolating devices shall be switch-disconnectors suitable for on-load switching. They shall be capable of being padlocked in the isolated 'off' position at the compartment door, and at the isolating mechanism with the compartment door open. Any isolator mechanism extension shafts shall be provided with guide brackets as necessary to prevent excessive shaft deflection.
- The compartment door shall be mechanically interlocked such that it shall not be possible to open the door when the isolating device is in the 'on'/'closed' position or when the operating handle is padlocked in the 'off'/'open' position. Where the means of isolation is only accessible from within the compartment, it shall be protected to a level of IP2X.

PG 3.1.6 LV Switchgear (Circuit Breakers and Isolators)

- Circuit breakers shall be either air circuit breakers (ACBs) or moulded case circuit breakers (MCCBs), as indicated on the single-line diagram for the Switchboard or MCC.
- CBs shall have a rated service short-circuit breaking capacity not less than that of the maximum prospective fault current at the point of connection in the power system, which shall be taken to be the busbar rated short-time withstand current specified for the Switchboard or MCC. Incomer CBs shall have a rated short-time withstand current and time not less than that of the busbars.
- CBs with rated currents over 100A shall have built-in protection, that will discriminate with both up-stream and down-stream protective devices, as appropriate to the application.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- ACBs for incomer and feeder applications shall be fitted with adjustable electronic protection. MCCBs shall be fitted with adjustable thermal-magnetic or adjustable electronic protection unless otherwise specified.
- Special maintenance tools, where required, shall be provided with each breaker.
- Cables connected directly to CB terminals will generally not be permitted. Adequately sized cable/busbar adapters shall be provided.
- Isolators or switch-disconnectors shall be suitable for the continuous rated duty of the circuit it controls.
- The utilisation category of the switch-disconnector shall be AC23 for motor switching duties, and AC22 for switching of mixed resistive and inductive loads, with an appropriate utilization category (A for frequent switching and B for infrequent switching).
- Rotary switch-disconnectors shall be provided with a 'break-before-make' operation for each pole. The rotary switch, or changeover switch formed by the proprietary interlocked interconnection of two switch-disconnectors or fuse switches, shall incorporate a centre 'off' position.
- Switch-disconnectors for motor starter or variable speed drive duties, that incorporate a test position, shall enable the control circuit supplies while ensuring isolation of the main supply.

PG 3.1.7 *Contactors, Relays and Timers*

- Contactors and relays shall be selected so as to be suitable for the foreseeable operating duty (utilisation category) and operational frequency. They shall operate reliably under reduced voltage conditions by closing (i.e. pulling in and holding) at 85%, and remaining closed at 60%, of the rated coil voltage, and shall be suitable for continuous operation at 110% of the rated coil voltage.
- Contactors shall comply with SANS 60947-4-1, and shall be electro-magnetically operated air-break multi-pole block type construction. They shall readily accept a wide variety and configuration of auxiliary contact blocks, which shall have their terminals protected to IP2X.
- Relays and timers shall be totally enclosed plug-in devices. The bases shall be keyed in order to differentiate between differing relays and timers, and their differing coil/electronics operating voltages, and to prevent incorrect insertion. Bases shall be fitted with retaining clips, and each relay/timer shall have its pin configuration printed on the side of its casing.
- Relay/timer bases shall have screw clamp type terminals protected to IP2X, which shall be accessible with a screwdriver whilst the relay/timer is plugged in.
- Relays shall be provided with a transparent enclosure, visual indication that the relay is in the energised and closed state, and a manual test button.
- Timers shall operate electronically or be synchronously driven, and shall be provided with linearly calibrated time interval scales. The smallest indicated time interval shall be 10% (or less) of full scale, with a repeatability of 1% (or better) of full scale. Timers shall be provided with 'energised' and 'timed out' indicators.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Where timers require to be viewed by operators, they shall be flush front of panel mounted behind a transparent lockable cover.
- Contactors shall satisfactorily withstand the thermal and dynamic effects arising from the magnitude and duration of through fault currents dictated by the characteristics of the associated protective devices and shall be selected in accordance with the kW/current rating.
- Contactors shall be triple-pole electromechanically operated air-break type, held in or latched pattern as specified.
- Contactors shall be classified as utilisation category AC3 uninterrupted duty for motor starting and as utilisation category AC1 intermittent duty, Class 1, 60% for heater duty.
- Contactors shall be fitted with the required auxiliary contacts. These shall be rated at not less than 6A and shall be positively driven in both directions.
- Auxiliary relays for control purposes shall be of the multiple pole type and shall preferably possess the feature of field convertible contact configuration.
- Auxiliary time delay relays shall be of electronic or synchronous motor-driven type and the time setting shall be infinitely adjustable over the range of 5 - 100% of the maximum delay. Timing relays deriving the delay function by thermal or pneumatic means will not be acceptable.
- Auxiliary relays shall have a minimum of 4 individual contacts and shall preferably have the facility to add an extension block with an additional four (4) individual contacts.

PG 3.1.8 Control switches and pushbuttons

- Control selector switches shall be of a rotary spring-loaded type, with an AC11 rating, and shall have clearly identified switch positions. Where switches are lockable, the key shall be held captive in the abnormal or over-ride position.
- Pushbuttons shall comply with SANS 60947-5-1 and shall be of a 22mm diameter, flush bezel type.
- Emergency stop pushbuttons shall be of a mushroom headed push to stop, stay-put and twist-to-release type. Key type release buttons shall not be used.
- Pushbuttons shall be coloured as follows:

Function	Colour
Start	Green
Stop	Red
Reset	Black
Emergency Stop	Red
Lamp Test	Black
Close	Green
Open	Green


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Function	Colour
On	White
Off	Black
Forward	Green
Reverse	Green

- Pushbuttons shall be of the one-hole fixing, oil tight pattern.
- Contacts shall be adequately rated for the circuit duty but shall not be less than 10A, 230V AC or 120V DC rating.
- In addition, the operator shall carry an internationally acceptable symbol indicating its function or shall have mounted immediately above it a clear legend of its function or action.

PG 3.1.9 Indicating lamps

- Indicating lamps shall be suitable for use on either 230V AC or 24V DC control supplies, and shall be light emitting diode (LED) type. Lamps suitable for use on 230V AC shall incorporate a step-down transformer. Indicating lamps shall be continuously rated for a voltage of 10% in excess of the rated voltage.
- Lamps shall comprise 22mm diameter units incorporating either a multi-cluster array of LEDs or a single high intensity surge protected LED; replaceable from the front of panel without any special tools.
- Unless detailed otherwise in the Project Specific Specification, the MCC shall be provided with indicating lamps coloured in accordance with the primary colour coding scheme, which shall be as follows:

Function	Colour
Emergency / hazardous condition	Red
Emergency stop operated	Yellow
Alarm / abnormal condition	Yellow
Tripped / fault condition	Yellow
Warning	Yellow
Normal condition	Green
On	Green
Running	Green
Closed condition	Green
Open condition	White
Available	White
General indication	White
Mandatory operation required by operator	Blue


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 3.1.10 Power measuring instruments and current transformers**

- Display instruments used to indicate voltages and currents shall be preferably digital instruments, shall comply with IEC 60051 and have an accuracy class of 1.5. They shall be flush front of panel mounted.
- External zero adjustment for all analogue instruments shall be possible on all indicating instruments to facilitate adjustment without dismantling the instrument.
- Instruments shall be scaled to 120% of the anticipated designed indication. Ammeters shall be provided with compressed scales to accommodate motor starting or other in-rush currents, and ammeters monitoring motor currents shall be provided with an adjustable red pointer to indicate full load current.
- Meters and relays shall be capable of withstanding, without damage, the secondary currents associated with the maximum available through fault current.
- Instruments shall be provided with shrouded connections to their rear, and ammeter circuits with a full-scale deflection in excess of 25A shall be connected via current transformers (CTs). Apart from CT and ammeter circuits, instrument circuits shall be fused.
- They shall provide data output signals for presentation to PLC, SCADA, telemetry, etc.
- Where the Project Specific Specification indicates that instruments shall provide fieldbus communication with a control system, this shall be via an open protocol compatible with the proposed control system.
- Run hour meters shall be of a 5-digit minimum non-re-settable odometer type, with visual indication of operation, and a minimum resolution of one hour.
- Current transformers (CTs) shall be air insulated, shall comply with SANS 60044, and shall have short circuit ratings in excess of those prevailing at the point of connection. They shall bear individual rating plates, which shall clearly identify the winding polarities (primary or secondary), together with the connection details of any multi-ratio windings.
- Current transformer accuracy classes shall be selected as follows unless otherwise indicated on single-line diagrams:

Type of circuit	Class	Comments
Indication	3 or 5	To match the % accuracy of the instrument
Measurement	0.5 or 1	To match the % accuracy of the instrument
Motor protection	10P10	Or as required by protection device manufacturer
Power system protection	10P20	Or as required by protection device manufacturer
Power system unit protection	X	As specified by protection device manufacturer

- One pole of the secondary winding of each CT (or group of CTs) shall be connected to earth via a link. All connections to the CT secondary winding shall be made via a proprietary shorting terminal test block. Provision shall be made for attaching test links.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Current transformers shall be of the low-impedance type and shall, where ratio, class and output requirements permit, preferably be of the ring-type bar-primary design.
- Current transformers shall be rated to withstand the thermal and magnetic stress resulting from the maximum available through fault current.
- Bridging terminals for current transformers shall be provided at the outgoing terminals where external connections are required. In addition, terminal blocks shall be provided to permit secondary injection tests on protective relays.

PG 3.1.11 Variable Frequency Drives (VFDs)

- The VFD motor starter shall comprise a variable frequency converter (VFC), phase shift transformer(s) (where required), and all other components necessary to provide the full speed and torque control of an a.c. cage induction motor over the specified operating speed range up to the motor's rated speed and full load current.
- Unless otherwise specified in the Project Specific Specification, VFCs shall have uncontrolled rectifiers (i.e. diode front-end) with the specified pulse number (6/12/18). Either a.c. line reactors or d.c. link chokes shall be provided with all 6-pulse VFCs to reduce input current harmonics.
- Where a phase shift transformer is required to achieve the specified rectifier pulse number, the transformer shall be provided as an integral component of the VFD and, unless otherwise specified in the Project Specification, shall be of the dry type and housed in a dedicated section of the VFC enclosure.
- VFDs shall be capable of operating under the service conditions specified in Clause 4 of SANS 61800 Part2, the Site Conditions specified in Section B: 3.2 above and the service conditions specified in the Project Specific Specification. Functional features and performance requirements shall be in accordance with Clauses 3 and 6 of SANS 61800 Part 2 respectively as varied.
- The output rating of the VFDs shall be selected to suit the associated motor and shall take into account the operating speed range.
- Every VFD motor starter shall be provided with incoming supply isolation and short circuit protection as well as an input contactor if specified in the Project Specific Specification.
- The VFD shall provide the specified motor protection either as an integral part of the VFD or by way of a separate motor protection relay.
- Where any semiconductor or special d.c. circuit fuses are used in the VFD power circuit, a spare set shall be provided. A list of all fuses, type, ordering code and supplier and supplier details shall also accompany the spare fuses.
- The VFD control system shall incorporate comprehensive diagnostics to provide fault supervision and status indication in accordance with Clauses 3.2 and 3.3 respectively of SANS 61800 Part 2 and any additional requirements specified in the Project Specific Specification.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- The Contractor shall ensure that the suppliers of the VFD and the associated motors confirm that their standard equipment is fully compatible and, if not, that the necessary equipment design changes (e.g. enhanced motor insulation) and/or supplementary equipment (output filters or reactors) is provided to ensure compatibility.
- The MCC shall permit adequate heat rejection from the VFD compartments and the Contractor shall provide estimates of the total heat rejection from the MCC. The location of the MCC and VFD panels, and the ventilation arrangement, shall be as specified in the Project Specific Specification.
- All VFDs shall comply with the requirements of product standard SANS 61800-3 for Category C2/C3 as appropriate and an EMC filter shall be provided as part of a VFD if necessary, to achieve the required electromagnetic compatibility.
- Any VFD input harmonic filters or line reactors and any output filters (i.e. dU/dT, common mode or sine filters) or reactors shall be provided as part of the VFD and shall be included in the supply price. Output filters shall be provided where required to ensure motor insulation compatibility and/or control of bearing currents. Output reactors shall be provided if motor supply cables exceed the allowable length.
- The design of dedicated VFD input harmonic filters shall take account of the supply impedance provided in the Project Specific Specification, any background voltage harmonics, any other reactances (e.g. transformers) or capacitors (e.g. power factor correction), or other filters connected to the power system, so as to avoid possible resonance problems.
- The VFD control panel/operator interface shall be mounted on the front of the MCC panel doors. Control parameter adjustment shall be easily achievable by menu-driven option selections, with engineering options protected from unauthorised changes by the use of multi-level password protection.
- All operator controls and indications shall be available front of panel, either via an operator interface/keypad, or by using discrete push-buttons and lamps, etc.
- The VFD shall incorporate on-board protection, control and monitoring features, which shall include, as a minimum, the following:
 - On
 - Unit ready
 - Overload
 - Failure
 - Current limit
 - Over voltage
 - Manual start and stop
 - Raise and lower speed
 - Current operating status
 - Speed indication



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



- The VFD shall be such that when set in the 'manual' mode, operation from the control panel/operator interface shall be as follows:
 - a start command shall cause a normal ramped start up to the pre-set speed;
 - a stop command shall cause a normal ramped down stop and shutdown of the drive.
- All diagnostic and fault messages shall be stored, whether reset or not and it shall be possible to recall them from the operator interface/control panel.
- All VFD function parameters shall be programmable from a dedicated keypad, or via a standard programming software package to be provide to the Commissioning Engineer and the Client at no additional cost. A serial communications port to RS232/RS485 standard or other network communication port shall be provided for dedicated communication with the VFD, and via which all programmable, control, monitoring and diagnostic functions available locally at the VFD shall be accessible.
- A copy of the configuration/standard programming software shall be provided with each VFD.
- The motor starter control circuit supply shall be provided with a functional test facility, whereby the functionality of the control circuit and its equipment and components can be fully demonstrated with the compartment door(s) open, but whilst the motor circuit supply remains isolated at the functional unit isolating device.
- A control selector switch shall be provided for 'Normal/Test' selection inside the relevant compartment.
- The test supplies shall be arranged to be de-energised when the motor circuit supplies are energised. The test supply shall be provided with short circuit protection and shall be capable of isolation.

PG 3.1.12 Motor protection

- As a minimum, every motor starter circuit shall be provided with a thermal overload unit connected to monitor the current in each energised winding of the motor. Unless otherwise specified in the Project Specific Specification, motors of over 30kW shall be provided with electronic overload protection, and motors of over 75kW shall be provided with electronic motor protection relays. Intelligent multifunction electronic relays shall be provided if specified in the Project Specific Specification.
- Thermal overloads shall be scaled and adjustable such that the motor rated current is midrange and shall provide a temperature compensated thermal element for each supply phase to the motor. The unit shall provide single phasing protection and incorporate auxiliary tripping contacts with a manual test facility. The unit shall be capable of being manually or automatically reset (set to auto). Unless otherwise specified in the Project Specific Specification, thermal overloads shall be trip class 10.
- Electronic overload units shall incorporate the features required of a thermal overload, together with provision for the adjustment of tripping and reset times. In addition, stalled


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



rotor protection shall be provided, together with integral thermistor protection where required. Where required, electronic overloads shall be suitable for use in conjunction with power electronics (soft starters or variable frequency converters).

- Electronic underload protection shall be provided for all centrifugal pump, fan, or directly driven mixer motor circuits above 30kW. When detecting underload, the device shall measure the true motor power (and not just the phase angle), shall be configured to detect an unloaded running motor condition, and shall incorporate start delay, motor trip, and manual/auto reset (set to auto) facilities. The unit shall incorporate a digital percentage load display.
- Where required on drives of less than 30kW, the underload unit shall be provided with overcurrent protection providing the same facilities as a thermal overload. When required on larger drives, underload protection shall be provided as an integral part of an electronic overload or motor protection relay, and where applicable shall be suitable for use in conjunction with power electronics.
- All protection devices shall operate in a fail-safe manner via electrically maintained relays which de-energise on a fault condition. On sensing a trip condition, the devices and relays shall electrically lock out the emergency stop circuit and shall be reset manually using a front of panel common fault reset pushbutton. In addition, they shall automatically reset on control supply switch on and upon power restoration in the event of a power loss.
- Electronic motor protection relays and digital overload and underload devices which provide operator interfaces shall have front of panel mounted displays and controls.

PG 3.1.13 Busbar and Busbar Trunking

- The main distribution circuit through the Switchboard or MCC shall comprise a main and distribution busbar system, comprising of 3 phase and neutral busbar system. The rated current of the busbar system shall match the rating of the main incomer.
- All main and distribution busbars, risers and droppers shall be air-insulated and shall be fabricated from hard drawn, high-conductivity copper. Aluminium busbars will not be permitted. Busbars shall be tinned for wastewater treatment works (WWTW) applications. If pre-tinned copper work is provided, cut surfaces may remain bare, providing the current path is unaffected and suitable contact lubricants are used before tightening joints.
- Main busbars shall be enclosed together within the top of the Switchboard or MCC. No other conductors shall be run in the busbar compartment. Access to the busbars shall be through covers, requiring the use of a tool for removal. All internal fixings shall be held captive. No components shall be placed in a busbar compartment.
- Main and distribution busbars shall be continuous over each section, extending to over the full length of the Switchboard or MCC with the same current rating and cross-sectional area throughout their length.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Main busbars, distribution busbars and all flexible connections, shall be adequately sized, braced and supported to withstand any electromagnetic forces and thermal effects to which they may be subjected, including the occurrence of fault currents, up to the full fault levels specified.
- The vertical riser buses shall be copper full height and rated for the section total load. Small openings in the vertical barriers shall permit the plug-on control unit contacts to pass through and engage with the vertical bus bars. Unused plug-on openings in the vertical barriers shall be equipped with plastic snap-in closing plugs.
- All busbar connections shall use joints secured against loosening. Joints and Tee-off connections in busbars shall be made by means of high-tensile bolts, nuts and approved locking washers. A minimum of two such bolts shall be used per joint or tee. The joints shall not be taped in order to facilitate visual inspection and checking of bolt tensions. The joint contact areas shall be smooth, very flat and polished or tinned for dry jointing.
- Busbars shall be provided with phase colour markers, red, white, blue (and black in the case of four wire systems). Such colour identification may take the form of coloured bands at intervals along the busbar run of not more than 800 mm. The combined width of the colour bands per phase shall not be less than 300 mm per 800 mm busbar length. The use of the convention, Red, Rear, Right shall be employed.
- The maximum length of any cable connections from a busbar shall be 1000 mm.

PG 3.1.14 Internal Wiring and Field Connections

PG 3.1.14.1 General

- All wiring within the Switchboard or MCC shall run directly between terminals, without any joints or other connections. Wiring shall be carried out using multistrand, single-core PVC-insulated copper conductor, 660/1 000V grade (minimum), to SANS 1507, sized and derated where required for the currents to be carried. Single-strand conductor shall not be used and no conductor shall be less than 1.5mm² cross-sectional area.
- All bus wiring and interconnections between compartments within the Switchboard or MCC shall be contained within the enclosure and shall be segregated in wireways separate from other compartments. Where such wiring is terminated in a compartment, it shall be segregated from all other wiring in that compartment. All wiring and cabling entering or leaving a compartment or passing through a partition shall do so via a permanently fixed bush.
- Wiring between components shall be:
 - carried out in a neat and systematic manner,
 - contained in non-metallic trunking, and
 - run to compartment doors in spiral wrapping or netting.
- Any wire containment system shall securely locate the wiring and provide 25% spare capacity on completion. Cableways shall have furthermore sufficient space to enable the


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



installation and removal of any cable without the need to remove any other cable or component. Cableways shall incorporate adequate facilities to locate and support the cables.

- Wiring on compartment doors shall be similarly supported and shall be provided with support and protection across the door to compartment side wall transition, whilst permitting the door to be fully opened without straining the wiring. Wiring system accessories shall not deteriorate with heat or propagate flame.
- Wiring shall be segregated according to need; circuits that enter the compartment without isolation shall be separately segregated and loomed with spiral wrapping and identified. Control circuits shall be wired in twisted pairs or screened cables, and together with data network cabling, shall be physically segregated from power circuits by barriers. If lightning and/or surge protection measures have been used to protect individual circuits, these circuits shall be segregated from the wiring of other unprotected circuits.
- Cable-ways or chambers shall not contain any equipment or components.
- Where field cables are terminated other than in the base of the enclosure, cable-ways or cable chambers shall be provided to transport the cables through the enclosure to the compartment or cable box at which they are glanded or terminated. Careful thought should be given to the termination of power cables and their location within the assembly.

PG 3.1.14.2 Gland Plates

- All field cables and wiring shall enter the enclosure through gland plates, which shall be located so as to facilitate the spreading of cable cores.
- Gland plates shall be rigidly supported and maintain the IP rating of the enclosure.
- Gland plates and cable boxes shall minimise the effects of eddy currents and be suitable for the type of cable used. Single core cable gland plates shall be made of non-magnetising material.
- Gland plates for bottom access cabling shall be located at least 300 mm above the finished floor level.
- Each compartment gland plate shall be an integral part of the construction of that compartment.

PG 3.1.14.3 Identification

- All wires shall be identified at both ends using colour coded alpha-numeric ferrules. Within a compartment, a wire shall have the same identifier at both ends; and this identifier shall not be duplicated within a functional unit.
- Components and wiring shall be installed such that the identification of every wire is clearly visible and readily accessible on completion of the Assembly installation at site. Horizontal wiring identifiers shall be read left to right, and vertical wiring identifiers shall be read bottom to top.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- All conductors shall be identified in conformity with the approved circuit and connection diagrams. No number shall be used more than once in each panel except where electrically identical. Wires/conductors shall have the same number on either end of the wire and all wires which are electrically identical shall have the same wire number.

PG 3.1.14.4 Termination

- Wiring shall be terminated using crimped cable ends, lugs or any other approved method that is appropriate for the conductor size and type of termination. All of the strands forming the conductor shall be connected at the point of termination. Soldered connections shall only be used on electronic equipment where it is not practicable to use any other termination method.
- Wiring with a cross-section area of less than or equal to 6mm^2 shall be terminated in terminals mounted on DIN rail. Wiring with a cross-section area of greater than 6mm^2 shall be terminated in bolted terminals.
- All wiring entering or leaving a compartment shall do so via terminal rails, with the exception of specialised signal or data circuits, which may be cabled directly to dedicated connections on electronic equipment located at the periphery of the component mounting plate.
- The conductor shall be clamped in such a manner that the captive clamping screw does not come into contact with the conductor. Conductors of cross-section above 16mm^2 shall be terminated using stud type terminals; similarly mounted and grouped on DIN rail.
- No more than two conductors shall be connected to one side of a terminal. Where it is necessary to connect adjacent terminals together, proprietary shorting bars or combs shall be used.
- Spare cores shall be terminated at both ends or tied back, but shall not be cut short.
- All terminals shall be protected to IP2X, including stud type terminals; which shall be shrouded to achieve this. Terminals shall be segregated according to function and operating voltage; by grouping or by terminal rail mounted partitions or barriers. All stud type terminals shall be provided with individual segregating barriers.
- All circuit terminal rails shall include 10% spare space.
- Terminals shall be grouped together and segregated according to operating voltage and function by terminal rail mounted barriers. Stud type terminals shall be provided with individual segregating barriers.
- Terminals shall face the compartment door for ease of connection.
- Terminals shall be located and spaced so as to enable the easy disconnection and reconnection of conductors, whilst providing sufficient space for the looming and spreading of cable cores. Where practicable, the layout of terminal rails shall be such that cores from the same field cable are not split between non-adjacent groups of terminals.
- All wiring of external connections shall be brought out to individual terminals on a readily accessible terminal block.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- All spare contacts are to be wired back to terminals.

PG 3.1.15 Earthing

- The Switchboard or MCC shall incorporate facilities for connecting to the main incoming earth terminal, subject to its location being clearly identified and easily and safely accessible with the Switchboard or MCC energised. The Switchboard or MCC earthing system may comprise either an earth bar extending the full length of the Switchboard or MCC or, for Switchboard or MCC with less than or equal to two (2) functional units and a supply rating of less than 100A, a stud arrangement.
- Earth bars shall:
 - be manufactured from high conductivity copper (tinned for WWTW applications);
 - be located in a safe and easily accessible position;
 - have a minimum number of joints;
 - have at least one disconnecting link;
 - have facilities for connection to the main incoming earth terminal (the Municipal/Eskom earthing system and/or from a local earth electrode system) at each end of the bar;
 - be rated and tested at a minimum of 60% of the busbar fault withstand capacity;
 - have a cross-sectional area of not less than 500mm², nor less than 50mm in width;
 - be securely connected in each panel or cubicle to bare metal.
- Provision shall be made for the connection for the following connections to the fixed portion of the earth bar:
 - electrical installation main bonding conductors;
 - functional earthing conductors external to the Switchboard or MCC;
 - equipotential bonding conductors external to the Switchboard or MCC;
 - other equipment protective conductors external to the Switchboard or MCC;
 - the Switchboard or MCC main earth bar/circuit, which shall be terminated onto the fixed portion;
 - an additional 2 No. spare terminations.
- All metallic non-current carrying parts of the Switchboard or MCC shall be bonded together and connected to the Switchboard or MCC earth busbar.
- Each compartment shall include an earth stud connected to the main earth bar or stud by separate connections or by a common vertical earth tape. Earth conductors to each compartment shall be sized to withstand the fault level, subject to a minimum cross-sectional area of 6mm².
- The following shall be directly connected to the compartment earthing terminal by earthing conductors with a minimum cross sectional of 4mm² or braided straps of similar rating:
 - compartment door,
 - any removable cover,

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



- component/equipment mounting rails and earth terminals.
- A compartment may contain subsidiary earth terminals or bars to which the following circuits may be specifically connected:
 - 'clean' earths from instrumentation circuits and equipment,
 - functional earths; e.g. from telecommunications equipment,
 - surge protection earths; e.g. direct connections from lightning protection units.
- These earth terminals or bars shall be separately connected directly back to the Switchboard or MCC main earth bar with 6mm² minimum cross-section conductor.
- Cable gland plates associated with a compartment shall be provided with an earth stud, which shall be connected directly to either the compartment earthing terminal, or to the main earth bar, with a conductor of 6mm² minimum cross-sectional area.
- Doors having components mounted on them shall be bonded to the main structure by means of flexible copper earth connection arranged so that it cannot be trapped as the door is opened or closed. Metal hinges shall not be considered sufficient to ensure electrical continuity.
- Where cables carry low level high frequency signals or are installed where there is a significant risk of high frequency interference; (e.g. in signal circuits connected to equipment containing power electronics), they shall where necessary have their screens/braids capacitively connected to earth in a proprietary manner, and proprietary means shall be included to provide 360° earthing for field cable braids/screens.

PG 3.1.16 *Labelling for Switchboards and MCCs*

- Safety signs and labels shall be provided wherever necessary in relevant languages so as to unambiguously communicate safety and functional guidance to any person who may operate the Switchboard or MCC or otherwise come into contact with any part of the electrical system forming a part of the Switchboard or MCC and shall be provided for the specific identification of every component contained within the Switchboard or MCC.
- Signs and labels shall be located in such a manner that:
 - it is obvious as to the nature and location of the hazards or component(s) to which they relate,
 - when mounted on any enclosure cover or plate, there is no possibility of that cover or plate being interchanged with any similar item on that Switchboard or MCC or on any other MCC/DB supplied to the same site,
 - they are not fixed to easily removable parts (e.g. trunking covers, etc.), unless their purpose is to warn of the consequences of removing a removable part,
 - they are at all times adjacent to the item to which they refer, and accommodate situations where components could be moved along a DIN mounting rail,
 - they will not be obscured by any equipment, components, or wiring, etc,
 - they are legible and will remain easily read throughout the life of the Assembly,


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Signs and labels shall be securely and permanently fixed using an appropriate number of corrosion resistant, mechanical fixings. The fixing of labels, safety signs and notices shall not affect the IP rating of the Switchboard or MCC.
- Short individually fixed labels covering several items only shall be used in lieu of long multi-legend labels; e.g. above a row of indicator lamps.
- Safety signs and labels shall be of such size that the legend thereon is clearly legible from the operating position (or a 3m distance), and the pictograph and its accompanying text shall be chosen so as to provide the appropriate communication in an explicit and unambiguous manner.
- Safety signs and labels fixed to the outside of the enclosure shall be manufactured from 1.5mm thick anti-reflective polycarbonate with the legend reverse screen printed, or alternatively from 3mm thick bevel-edged clear perspex rear engraved with black characters. Internal labels may be manufactured from a laminated plastic material which shall normally provide a black legend against a white background. Where specifically agreed with the Engineer, internally mounted labels and charts, e.g. for distribution boards, etc., may be of permanently printed plastic, plastic laminated thin card, or thin card protected behind Perspex.
- As a minimum, safety signs shall be fitted to removable covers over busbars and live connections, and to doors of compartments containing:
 - incoming supply cable termination points,
 - internal switching and isolation devices,
 - incoming or internal means of isolation; stating the highest voltage controlled by the means of isolation,
 - functional units incorporating capacitors,
 - more than one supply or multiple control circuits originating elsewhere,
 - equipment located in a 'safe area' but associated with certified apparatus located in a hazardous area; a sign shall also be fitted at the safe area cable termination rail.
- A safety sign identifying the operating voltage shall be placed in any compartment where there is equipment, components, or wiring, that can be energised at above extra low voltage.
- Where there is no suitable standard symbol or pictograph, an application specific sign may be produced using simple and appropriate symbols, pictographs, and text, to indicate the hazard in a simple and straight forward manner that is acceptable to the Engineer.
- Multipurpose signs shall be used where there is a need to communicate multiple hazard messages.
- The text of every label, excluding individual internal component identification labels, shall be as agreed with the Engineer.
- Every Switchboard or MCC shall be provided with a name plate detailing the following:
 - Manufacturer's name or trademark,
 - Manufacturer's contact details,
 - Manufacturer's type designation, serial/identification number,


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Date of manufacture,
- Rated operational voltages, frequencies, and number of phases,
- Continuous busbar rating,
- Short circuit withstand current and duration,
- IP rating.
- An application name shall be prominently displayed on the Switchboard or MCC, as detailed in the Particular Specification.
- Each compartment shall be identified with a designation label which shall include the full plant functional name and the alpha numeric reference cross referenced to as-built drawings and documentation contained in the Operation and Maintenance Manual. For rear access Switchboards or MCCs, a duplicate designation label, mounted adjacent to the gland box, shall also be provided at the rear of each compartment.
- The material used shall be selected having regard to the size and fixing methods of the label and the label shall not warp in service. Labels mounted on the outside of the Switchboard or MCC shall be rectangle in form and be manufactured of either:
 - Laminated plastic, engraved so as to produce black letters on a white background,
 - Engraved sandwich board ("Trifoliate", "Darvic" or equal),
 - Reverse engraved acrylic material ("Perspex") with filled letters and reverse sprayed.
- For outdoor applications (where specified) labels shall be brass or aluminium (with letters filled in black), lightly sanded with fine grit paper and clear lacquered.
- Labels for door mounted components and labels used inside the Switchboard or MCC shall be to the same standard or may alternatively be printed using an approved, propriety system.
- Text characters shall be uniform in height, in upper case (except where standard abbreviations of units are used, e.g. kWh, kVA, etc.) and of the following minimum dimensions:
 - application labels: 8mm
 - compartment designation labels: 6mm
 - information or warning labels: 6mm
 - component identification labels: 3mm
- All components shall be clearly labelled. Internal components shall be clearly identified by individual labels to indicate the equipment to which they relate. The component identification labels shall correlate with the SLD drawings and documentation. If this is not practical due to space restrictions, common labels (e.g. diagrams may be used).
- Current transformers shall be provided with separate and individual identification and rating plates.
- Each distribution board shall be provided with a circuit chart laid out in a way that matches the orientation and layout of the protective devices in the distribution board.
- A typed circuit chart shall be permanently fixed inside each Switchboard or MCC or immediately adjacent to the distribution board. The chart shall be laid out in accordance


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



with the physical arrangement of the protective devices that it is easy to relate the circuit chart details to the appropriate protective device. As a minimum, the chart shall be enclosed in a transparent protective cover attached to the inside of the compartment door.

PG 3.1.17 Installation and Shipping Requirements

- Switchboards and MCCs shall be preferably shipped in sections to facilitate field handling for transportation and installation. The shipped sections shall be joined together to form a complete unit assembly.
- Preparation for shipment shall protect the Switchboard or MCC auxiliary devices accessories, etc. against corrosion, breakage or vibration injury during transportation and handling.
- Disassembly shall be into the largest components or sub-assemblies possible, consistent with packing, road transport and handling limitations.
- All parts shall be clearly and lastingly match marked to facilitate field erection prior to disassembly and packing for transport. Instructions shall be provided for reassembly of sections in the field or accompanied by a qualified representative from the Manufacturer.
- The Contractor shall be responsible for delivery including loading and unloading of all equipment to site.
- The Contractor shall provide information (in time) regarding specialised handling and storage requirements/techniques for equipment on the site until finally installed in the operating location.

PG 3.2 LOW VOLTAGE CABLES: GENERAL SPECIFICATION

PG 3.2.1 General

- Cables shall be manufactured strictly in accordance with SANS 1507.
- Cables shall be delivered, stored and handled in accordance with the manufacturer's instructions. Where the performance of the cable is likely to be adversely affected by the ingress of moisture, it shall be adequately sealed at both ends.
- Cable selection and sizing should comply with SANS 10142-1. Cables and their wireways shall, where required by SANS 10400 Part T to be protected against the effects of fire, be selected and installed in accordance with the provisions of such code.
- Cables shall have copper or aluminium conductors according to SANS 1411-1. Cores of cross-sectional area greater than 1.5 mm² shall be stranded or flexible.
- Where neutral conductors are to be provided, they shall be of the same cross-sectional area as the associated phase conductor, unless otherwise specified in the Particular Specification and drawings.
- Unless otherwise specified, all LV cables shall have copper conductors to SANS 1411-1. Cores of cross-sectional area greater than 1.5 mm² shall be stranded or flexible. Where


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



neutral conductors are to be provided, they shall be of the same cross-sectional area as the associated phase conductor, unless otherwise specified in the design documentation and drawings.

- All LV cables used in an electrical installation shall be as specified in the Particular Specification (or cable schedule as part of the Particular Specification) and shall comply with either of the following:
 - PVC/SWA/PVC
 - Cables shall comply with SANS 1507-3 and be rated at 600/1000 V.
 - Single core cables shall have aluminium wire armouring.
 - Multicore cables comprising five conductors and above shall have each core individually coloured, or, where not available, be coloured white with phase identification in black numerals.
 - XLPE/SWA/PVC
 - Cables shall comply with SANS 1507-4 and be rated at 600/1000 V.
 - Single core cables shall have aluminium wire armouring.
 - PVC/PVC
 - Cables shall comply with SANS 1507-3 and be rated at 600/1000 V.
 - XLPE/PVC
 - Cables shall comply with SANS 1507-4, and be rated at 600/1000 V.
 - Single Core PVC
 - Cables shall comply with SANS 1507-2 and be rated at 600/1000 V.
 - The insulation shall be phase coloured, and, where used in single phase systems, line cables shall be red, neutral cables black and earth cables yellow and green.
 - Flat Twin and Earth PVC
 - Copper conductors shall comply with SANS 1411-1, PVC insulated to SANS 1411-2, laid up with a bare copper earth continuity conductor between them, with PVC bedding to SANS 1411-2.
 - Cables shall be rated at 300/500 V.

PG 3.2.2 Installation of Cables

- The cable installation shall comply with the requirements of SANS 10142-1.
- Cables shall be installed strictly in accordance with the cable route drawings.
- Cables installed in groups shall run in straight lines and not cross over each other, except where transposing of cables is required to reduce capacitive or inductive effects.
- Cables installed above ground shall, as far possible, run parallel with the lines of building construction. Cables and wireways shall then only be installed in horizontal and vertical runs, and the installation shall be as visually unobtrusive as possible.
- Cables buried below ground shall, as far as possible, follow features of the site such as roadways and building lines.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Cables and their support systems shall not be fixed to protective barriers, guards or directly to guard-rails.
- Cables shall not be exposed to direct sunlight after installation. If the cable route compels the support system to be in direct sunlight, the Contractor shall ensure cables are covered with a suitable canopy or cover of the same material as the support system (tray). Cables shall be installed strictly according to the manufacturer's requirements.
- No joints or repairs to outer sheathings or insulation shall be allowed in low-voltage cables without the prior approval of the Engineer.
- Propriety (i.e. suited to and manufactured for such use) cable support systems shall be used.
- Unarmoured cables shall only be used with the approval of the Engineer and where there is no risk of mechanical damage.

PG 3.2.2.1 Cable Trenching

- The proposed trench route shall be surveyed for the presence of underground cables and/or services before digging commences.
- Where surplus material has to be disposed of, the Contractor shall remove it from site and dispose of it in a location of his choosing in accordance with statutory environmental regulations.
- The cable trench shall be excavated along the routes indicated on the relevant drawings.
- Should the Contractor, during the excavation operations, come across obstacles (or other interferences, e.g. soil drenched with hydrocarbon-based solvents such as spilt oil, which could adversely affect cable insulation), the Contractor shall report the matter to the Engineer, who shall then advise an appropriate course of action.
- The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.
- The Contractor shall remove all sharp projections, which could damage the cable where the trench is excavated through rocky formations, and shall remove all loose rocks, material, etc. from the bottom of the trench.
- Trenches shall be excavated to a maximum depth of 500mm for all LV cables with a width of 300 – 450mm.
- The following minimum clearances shall be maintained:

Service	Vertical	Horizontal
Data and Telecom Cables	300mm	300mm
Water pipes	300mm	300mm
Sewer pipes	300mm	800mm
Storm water pipes	300mm	600mm
LV cables on same route	100mm	One cable diameter of larger cable


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Where a cable will cross over other services, the cable shall not be installed at a depth less than 600mm below ground level, and if this is not possible the cable shall be installed underneath the other service and shall be protected in the prescribed manner by means of concrete slabs. The depth of the cable shall be maintained for one metre on either side of the crossing.
- Sufficient lengths of cable shall be left at the beginning and end of the cable routes to allow for the termination of the cables. The Contractor shall take the necessary precautions to protect the cable ends until they are terminated. The cable ends shall be sealed by means of lead or heat shrink sealing caps to ensure that the cable is waterproof.
- The excavated material shall be backfilled in layers of 200mm and shall be well compacted and consolidated to 90% MOD AASHTO. Where the Engineer deems necessary, the Contractor shall use a mechanical vibrator to compact the trench.
- Electrical warning tape, consisting of two tapes laid side-by-side and overlapping (such that their combined width is 150% of a single tape width), shall be installed on all cable routes (LV and MV), 200mm above the top cable layer. Where a cable route exceeds 600mm in width, multiple warning tapes shall be run, in such a way that the space between adjacent warning tapes does not exceed 150mm.
- Where cables cross other services such as water pipes, sewage pipes and other cables, or where the chance exists that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs. The slabs shall protect the cable for a distance of 500mm on either side of the crossing.

PG 3.2.3 Cable Sleeves/Ducts

- Cable sleeves that are required for road, street or driveway crossings shall be minimum 110mm PVC unless otherwise specified.
- The Contractor shall liaise with the main civil contractor at all times for the proposed road, street or driveway crossing points including pipe sleeves required for building access.
- Where possible, sleeves should be supplied and installed by the civil contractor unless otherwise specified.

PG 3.2.4 Cable Management Systems

- Cable management systems (cable trays, cable ladders and cable mesh) shall be selected and installed strictly in accordance with their manufacturer's guidelines, with a safety factor of 1.5 after taking into account maximum permissible loading and all external factors (not limited to wind, snow and thermal expansion). Upon demand to do so, the Contractor must furnish all data and calculations he used to derive the type and spans of the systems to the Engineer.
- Notwithstanding above, the deflection of a cable management system due to installed cable weights shall be, in accordance with IEC 61537, limited to 1/100th of the span.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Except where it is to be installed in locations with corrosive atmospheres, cable management systems shall be manufactured of galvanized and/or epoxy-powder coated steel. In locations with corrosive atmospheres, systems shall be manufactured from stainless steel (316 Marine Grade) or aluminium.
- All clamps, clips, hinges screws, bolts, nuts and support fittings used for fastening cable trays or cables shall be of the same material as the cable management system itself.
- Over and above the requirements of SANS 10142-1, all cable tray and ladder systems that will support telecommunication and/or control wiring shall be bonded in accordance with NRS 083-2 (gives details of bonding methods that provide enhanced protection against the effects of electromagnetic cross-interference).
- Cable management systems shall be selected and installed such that spare capacity (weight as well as height and width) of 20 % will be available for the addition of future services (the cable management system to still exhibit a 1.5 safety factor after services were added).
- All cable trays shall be of the heavy duty, increased upstand ("siderail"), type.
- Metal cable trays shall be manufactured from base-perforated (in excess of 30% of the surface area, in accordance with SANS 10142-1, in other words, class D according to Table 4 of IEC 61537) rolled steel. Metal trays manufactured to the following standards shall be used:
 - Less than 150mm wide: 1.2mm minimum thickness with 12mm minimum upstand.
 - 150mm to 450mm: 1.2mm minimum thickness with 19mm minimum upstand.
 - Above 450mm (heavy duty): 2.5mm minimum thickness with 76mm upstand.
- The edges of cable trays are to be turned up on both sides to improve rigidity (return flange cable tray), and, where necessary, the sides of trays shall be reinforced with galvanised steel angles, minimum 25 x 25 x 3mm, with 25 x 3mm cross-braces at 600mm centres.
- Metal cable ladders shall have side rails with 2 mm minimum thickness. Cross rungs shall be spaced at maximum intervals of 300mm (measured between the centres of rungs). Where cables of 10mm² or smaller are installed on cable ladders, the spacing of cross rungs shall be reduced to 125mm.
- Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring only after approval by the Engineer.
- Cable tray and ladder connections shall be suited to and of the same manufacture as the linear sections that they connect.
- The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected.
- Fixing materials shall be compatible with cable management system materials, and offer resistance to corrosion.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Cable trays and mesh shall be mounted with a minimum air gap of 25mm between the underside of the tray and the mounting surface.

PG 3.3 EARTHING

PG 3.3.1 General requirements for earthing and earth grids

- The earth grid shall be constructed in the form of a rectangular arrangement of conductors buried in trenches and divided by longitudinal and transverse conductors into a number of smaller rectangles having mesh dimensions as specified in the relevant layout drawing.
- The horizontal conductors for an earth grid shall be high-conductivity, annealed, stranded bare copper conductors with a cross-sectional area of 70 mm².
- Where horizontal conductors cross each other, they shall be joined by exothermic welding or oxy-acetylene brazing.
- Horizontal conductors shall be buried directly in the ground at 500 mm below finished ground level, in 300 mm wide excavated trenches which shall be backfilled in well-compacted layers.
- Earthing conductors shall be provided to link earthing bars to earth electrodes or grids, except where the conductor ends of ring and foundation earth electrodes are terminated at the earth bars. Earthing conductors shall be bare 70 mm² annealed stranded copper conductors, unless otherwise specified in the Drawings.
- Earth continuity conductors (ECCs) shall be provided:
 - With supply cables to MV switchgear and to LV MCCs/DBs as specified,
 - To earth the exposed conductive parts of all electrical equipment in accordance with SANS 10142: The Wiring of Premises.
- ECCs for MV equipment shall be connected from the MV earthing bar and ECCs for LV equipment shall be connected from the earthing bars in the LV MCCs/DBs from which the equipment receives supply.
- ECCs shall be separate conductors or shall form part of the equipment supply cables as specified in the Project Specific Specification. ECCs which does not form part of a cable shall be annealed copper stranded conductors of the specified cross-sectional area and shall be either bare or PVC-insulated as specified in the Project Specification.
- Unless otherwise specified, the mini-sub MV earth bar shall be separately connected to the closest indoor main earthing bar with a 70 mm² bare copper earth conductor.
- Where the protective earth conductor forms part of the supply cable to an LV motor, it shall be connected to the earth terminal inside the motor terminal box.
- Metal sheaths, metal screens and armouring of single-core cables shall be earthed at both ends of the cables.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 3.3.2 Earthing of Standby Generation**

- A LV standby generator shall be earthed in accordance with SANS 10142-1: The Wiring of Premises Part 1: Low-voltage Installations.
- The earthing connection shall be made with 70 mm² bare copper earth conductor via the installation's main earthing bar(s).
- The Neutral (star point) of the main alternator from the generator shall be solidly earthed to the main earth grid using 70 mm² bare copper earth conductor.

PG 3.4 TESTING & COMMISSIONING**PG 3.4.1 General requirements for testing**

- The installation shall be inspected and tested in accordance with SANS 10142-1.
- Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision for all inspection and testing activities.
- Unless otherwise specified in the Particular Specification, all inspection and test results shall be recorded using proforma documentation (test certificates and schedules) complying with SANS 10142-1.
- The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified in the Particular Specification, the period of notice for witness testing shall be 5 working days.
- Unless otherwise agreed by the Employer, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.
- On completion of manufacture, the Assembly shall be subjected to a factory acceptance test (FAT), comprising the Manufacturer's in-house tests, and the repeat tests witnessed by the Client and the Engineer.
- Once the witnessed FAT has been carried out, signed off, and any remedial works have been completed and re-tested, the Assembly is ready for delivery to site. Once erected in position, the Assembly shall be subjected to a witnessed site acceptance test (SAT).
- Once the SAT has been carried out and signed off, any remedial works shall be completed and re-tested. Plant installation and site cabling will then be carried out by others, and on its completion, witnessed commissioning shall commence.
- The manufacturer shall allow for each test (apart from in-house tests) to be witnessed by both the Client and the Engineers simultaneously. An individual testing activity shall not be considered to have been completed until any results have been recorded, and it has been signed off by the Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- The manufacturer shall provide the Client and Engineers with all reasonable facilities, including testing staff and test equipment, to carry out the inspections and tests, and to check the Assembly for compliance with all of the Client's requirements.
- In order to demonstrate the functionality of each circuit, external devices shall be simulated in a representative manner. A small motor shall be used as a test load where motor starters incorporate power electronics. During development, software may be electronically verified away from the Assembly using a simulation/diagnostic package; notwithstanding this, control systems shall be witnessed tested with the software loaded into the programmable devices, and with simulation of the physical I/O devices.
- Where the Assembly incorporates equipment requiring special testing facilities or procedures, the manufacturer shall ensure that appropriate resources are available; including where necessary, representatives from the equipment Manufacturer.

PG 3.4.2 Factory acceptance tests (FATs)

- The manufacturer shall perform his in-house works tests in accordance with the proposed FAT procedures and shall satisfy himself as to the accuracy and quality of the manufactured Assembly in accordance with the accepted design. Once the in-house FAT has been carried out, signed off by the manufacturer, and any remedial works have been completed and retested, the tests shall be repeated and witnessed by the Client (if required) and the Engineer.
- The in-house and the witnessed FATs shall check compliance with SANS 60439-1, and shall include the following:
 - A thorough external and internal visual inspection.
 - Confirmation of adequate earthing.
 - Secondary injection testing of all protective circuits shall be carried out, except where discrete current transformers are used; in which case sufficient primary injection testing shall be carried out to prove the ratio and the polarity.
 - Insulation tests shall be performed across all main and distribution busbar joints.
 - All busbars shall be subjected to a single witnessed reduced voltage dielectric 'flash' test; the in-house test shall also be at a reduced voltage.
 - All power circuits shall be subjected to insulation resistance tests.
 - The operation of every mechanical device and interlock shall be verified.
 - All circuits and their functionality shall be tested as detailed in the Control Philosophy and MCC and Local Control Table.
- When testing the performance of any software, it shall be demonstrated using the hardware intended to be incorporated within the Assembly, and where this is not possible appropriate operator interfaces, programming units, and terminal units, etc. shall be provided. Where it is necessary to demonstrate an interface with a piece of unavailable equipment to be supplied by others, appropriate means to replicate that equipment and simulate the interface shall be provided.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- The Contractor shall ensure that the rates for FATs includes all travel and accommodation for both the Client and Engineer unless otherwise stated. Travel shall include all travel including vehicle hire and air travel if required. Where the FAT is expected to fall over more than 1-day, appropriate accommodation shall be arranged for the Client and Engineer.
- The Engineer reserves the right to cancel and postpone tests if he finds that the Contractor has not made reasonably sure that the test will be successful. Any extra costs incurred shall be borne by the Contractor.

PG 3.4.3 *Site acceptance tests (SAT)*

- All equipment and every circuit that was altered or disturbed subsequent to the completion of the FAT, or for shipping and site erection, shall be specifically re-tested for integrity and functionality.
- During the SAT, all busbar joints that are re-tightened on site shall be subjected to a further Megger test, and all busbars shall be subjected to a single witnessed full voltage dielectric 'flash' test.
- The process functionality of each aspect of the control system and its operator interface shall be demonstrated, including the correct operation of all I/O and network links external to the Assembly or not otherwise tested during the FAT.
- A CoC shall be provided to the Engineer, before final Testing and Commissioning can start.

PG 3.4.4 *Commissioning and other tests*

- The manufacturer shall provide attendance during the commissioning of the Assembly, whereby the functionality of the Assembly and its control system and software shall be proven. During commissioning the manufacturer shall make such adjustments, software modifications, and circuit changes, as are deemed necessary to provide the level of plant functionality and performance specified by the Client. All such changes shall be immediately incorporated into the 'as installed and tested' documentation and the Operating and Maintenance Manual, by the Contractor.
- The manufacturer shall provide an acceptance document, to detail and record the tests and their anticipated results, and the acceptance document shall have provision for recording and signing off the results.

PG 3.5 DOCUMENTATION & TRAINING

PG 3.5.1 *General*

- All drawings, information, and documentation shall be in English.
- Drawings for acceptance shall be provided on paper copies as specified.
- The following documentation and drawings shall be submitted to the engineer prior to the procurement or manufacturing of Assemblies and related equipment:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Cable block diagrams.
- General arrangement and elevation drawings, compartment door layouts, typical component mounting plate layouts, and foundation plans.
- Electrical schematic diagrams showing all equipment and components incorporated into the Assembly. Known circuitry outside of the Assembly and connected to it, shall be shown on all drawings. Drawings shall be cross-referenced using a grid/line reference system.
- Protective device grading for overcurrent, short circuit, and earth fault/leakage devices incorporated within the Assembly, together with a schedule of proposed settings that will ensure discrimination.
- PLC software and configuration documentation; including ladder logic diagrams and HMI display screens, etc. The documentation shall be complete and annotated with purpose, function, duty, cross-references, and descriptions, etc.; sufficient to guide an unfamiliar person through the operation of the software.

PG 3.5.2 Testing Documentation and Reports

- A factory acceptance test (FAT) document shall be provided to the Engineer prior to the witnessed FAT. This documentation shall show the manufacturer's in-house test procedures and results for all items of equipment, components, hardware, and software. The document shall show hardware checks, the software simulation procedures, and their combined functional testing. It shall comprehensively and clearly show the test results of the in-house testing. The subsequent report of the FAT witnessed by the Engineer shall be appended to this documentation.
- A site acceptance test (SAT) document shall be produced, which shall detail all tests necessary to demonstrate the functionality of the Assembly following its final erection on site. This shall include details of tests and checks on all circuits disconnected for shipping, together with any equipment, components, wiring, or software altered or incorporated into the Assembly; following the completion of the witnessed FATs.
- All drawings, schedules, listings, and other design documentation for acceptance shall be supplied as a comprehensive and integrated package and collated into folders; unless otherwise agreed with the Engineer. Three copies of appropriate documentation shall be submitted on each occasion that agreement is sought.
- A Certificate of Compliance (CoC) shall be provided for all new Assemblies. For all refurbished Assemblies, a letter shall be provided listing all the repairs and stating that the Assemblies are still deemed to be reasonably safe.
- The FAT, SAT, and CoC shall each have been submitted and agreed with the Engineer, prior to the commencement of final testing and site commissioning.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 3.5.3 Certificate of Compliance**

- A Certificate of Compliance (CoC) shall be provided for all new Assemblies. For all refurbished Assemblies, a letter shall be provided listing all the repairs and stating that the Assemblies are still deemed to be safe.
- The original CoC shall be submitted to the client's electrical representative/Engineer.
- A copy of the CoC shall be included in the O&M Manual.

PG 3.5.4 Operating and Maintenance Manual

- One copy of the draft operating and maintenance manual and spare parts list shall be provided at an agreed date; in advance of the date of the start of the final testing and commissioning SATs, for acceptance by the Engineer. Three copies of the final editions shall be provided to the Engineer by an agreed date before successful completion of final testing and commissioning.
- The Operating and Maintenance Manual shall be bound into a suite of hard-backed ring binders, and shall be provided with an index of all drawings pertinent to the Assembly. The index shall include each drawing's origin, number, issue, status, and the Client's drawing number (where issued by the Engineer).
- The Operating and Maintenance Manual shall include the following:
 - All design drawings and documentation relating to the Assembly; as delivered and tested.
 - General arrangement drawings.
 - Single Line Diagrams.
 - A schedule of all installed cables.
 - 'As installed and tested' records showing verification against stated design and installation criteria, including a schedule of all the final settings for all user adjustable equipment and components, and copies of all documentation presented and completed during the FATs, the SATs, and any other specified tests on completion.
 - Schedules of plant and equipment for each compartment/circuit; including a listing of the applicable standards, manufacturer, settings, type number, re-order code, etc., for each item of equipment and component included within the Assembly.
 - Manufacturers' contact details, technical information sheets for all items of equipment and components included within the Assembly. Manufacturers' catalogues may be provided subject to clear identification of the relevant components. All individual manufacturers' equipment/component test certificates and certificates of conformity shall be included.
 - Inspection, testing, and maintenance recommendations, including detailed and specific operation, maintenance, and diagnostic data, and safe isolation information suitable for use by maintenance personnel, shall be provided for all equipment,


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- components, and systems incorporated into the Assembly.
- Schedule of spares provided with the Assembly, including manufacturer, description, part number, order code, and quantity.
 - The Operating and Maintenance Manual shall include detailed descriptions for use by the Client, on how the controlled plant and its management systems are intended to operate and be operated; under both manual and automatic control. Clear and detailed descriptions for each element of the Assembly shall be provided; and shall include system objectives, controlled plant start-up and shut down procedures, automatic control, manual intervention, primary and secondary control routines, plant selection including duty and standby options, local and remote selections, operational and safety constraints, status information, alarms and control interfaces with control systems, fault routines, etc.
 - The Operating and Maintenance Manual shall include 'as-installed and tested' information on both the hardware and software for each programmable device incorporated within the Assembly, including:
 - Overview of system operation in relation to the controlled plant.
 - System configuration.
 - Manufacturers' literature on operation, maintenance and testing of hardware and ancillaries, programming instructions, and diagnostics.
 - Hard copy program; with listings fully documented.
 - Listing of the final settings of all process dependent variables.
 - Permanent back-up copies, licensed in the name of the Client, shall be provided for all software, including operating programmes, application programs, and configuration software for all configurable devices.
 - Any interconnecting leads, protocol conversion modules, connectors, etc. necessary to connect and communicate with each programmable / configurable device to a standard portable Notebook.
 - Manual format shall be A4 size on the filing side which shall be vertical with 20 mm margin for filing.

PG 3.5.5 Training

- General:
 - The LV switchgear and Control Gear training shall form part of the overall training programme.
 - The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the Assemblies.
 - The Assemblies shall be in a complete working order before training shall commence.
 - A training schedule, together with the name and background of the person who will perform the training, shall be submitted to the Engineer for approval.
 - Training and training manuals shall be based on the O&M Manuals.
 - Training manuals shall be delivered for each trainee with two additional copies


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- delivered for archival at the project site. The manuals shall include an agenda, defined objectives for each course.
- Where the Contractor presents portions of the course material by audio-visuals, copies of those audio-visuals shall be delivered to the Employer as part of the printed training manuals.
 - The training shall include operator training and technical/maintenance training.
 - During the installation phase, a person will be designated by the Employer to be closely involved with the installation and commissioning process. The intention is not to interfere with the Contractors' installation team, but to do observation in order to obtain the maximum possible information regarding the installation, to enable efficient maintenance to be undertaken by the Employer after final hand-over and expiring of the guarantee period.
- Operations & Maintenance training sessions
 - There shall be training sessions for the operation and maintenance of the Assemblies.
 - The program for the training shall include instruction for at least one day per Assembly (8 hours) instruction on-site.
 - The program shall at a minimum cover the following:
 - General system overview
 - Functional operation of the system i.e.:
 - System start-up and shut-down procedures
 - System access requirements
 - Alarms
 - Fault Finding
 - Backup Power Procedure
 - Incident Reporting
 - Maintenance
 - Maintenance Schedule
 - Standard Maintenance Procedures
 - Spare Part Lists
- Upon completion of the course, the operators should be fully proficient in the system operation and have no unanswered questions regarding the system.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



PG 4 SECTION D: PROJECT SPECIFIC LV ELECTRICAL WORKS TECHNICAL SPECIFICATIONS

IMPORTANT NOTE:

A Project Specific Specification (this section) takes precedence over a General Specification (PG 3 above). Should there be a conflict between a Project Specific Specification and a General Specification, the Project Specific Specification shall be used unless otherwise stated or instructed by the Engineer. For all specifications not covered under the Project Specific Specification (this section) the General Specification (PG 3 above) and applicable Regulations and Standards (PG 2 above) shall prevail.

PG 4.1 WTW GENERAL

PG 4.1.1 Buildings Small Power & Lighting

- All installation works to be carried out or supervised by a qualified trade tested electrician who has written the exam for SANS 10142 and qualified with a wireman's license. Supervision shall mean full time.
- The entire electrical installation shall be carried out in strict accordance with SANS 10142 part 1.
- Only registered electrician with Department of Labour may issue a Certificate of Compliance.
- ECA registration certificate to be provided to Engineer prior to installation works.

PG 4.1.2 Tubing & Wiring

- All indoor and external tubing required for socket and appliance outlets and lighting shall be 20mm PVC conduit or as otherwise directed in the BoQ.
- Conduit shall be installed after the Civil Contractor has fixed concrete reinforcing and prior to any concrete pour, where required.
- The Contractor shall use the layout drawing as a guide only and shall establish the most suitable and shortest conduit routes on site and in liaison with the civil contractor where required.
- No Surfex or flat twin cabling shall be permitted. All wiring shall be installed in suitable wireways or conduit using Stranded PVC copper wire (Red: Live, Black: Neutral & Green: Earth).
- All conduit routes between DB and equipment shall have suitable draw wires installed to ensure ease of wiring.
- All socket outlet and light switch boxes shall be flush with walls and installed prior to any plastering works.
- All socket and appliance outlet wiring shall be 4mm² PVC Stranded copper single wire.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- All lighting wiring shall be 2.5mm² PVC Stranded copper single wire.

PG 4.1.3 Socket & Appliance Outlets

- All socket outlets shall be double switched 16A CBI or **SANS** approved equivalent.
- Socket outlets shall be installed 500mm above floor height or as otherwise directed on the layout drawings.

PG 4.1.4 Building Lighting

- The following luminaires shall be supplied and installed for the various buildings:

TYPE	DESCRIPTION
Open Channel	2x22W LED Open Channel Fluorescent, 4000K, Colour: White. SABS Approved. Regent Lighting or similar.
Decorative Fluorescent	2x22W LED Decorative Fluorescent with an Acrylic Diffuser, 4000K, Colour: White. SABS Approved. Regent Lighting or similar.
Downlighter	7W LED Downlighter, 50mm Dia, 4000K, Colour: White. SABS Approved. Regent Lighting or similar. Regent Lighting or similar.
Die-Cast	IP65, 24W LED, Square Die-Cast Aluminium Bulkhead with Black Trim, 4000K. SABS Approved. Brand Beka or similar.
Bulkhead	12W Polycarbonate Round Bulkhead with White Trim, 4000K. SABS Approved. Regent Lighting or similar.
Decorative Bulkhead	12W Polycarbonate Round Bulkhead with multi-colour Trim, 4000K. SABS Approved. Regent Lighting or similar (Bedrooms only)
Vapor Proof	2x22W LED Vapour proof Fluorescent, 4000K, Colour: Grey. SABS Approved. Regent Lighting or similar.
Flood Light	Based on drawing: 50W & 100W & 150W LED Die-Cast Aluminium base FloodLight.

- All light switches shall be single pole single throw CBI or **SANS** approved equivalent.
- For the Chlorine Storage and Chlorine Vacuum Rooms, suitable IP65 protected light switches shall be installed on the outside of such rooms.
- All outdoor lighting circuits shall be wired back to a PEC:
 - Make: Royce Thompson 1000SA
 - Operating voltage: 230 ±10%, 50Hz
 - Switching cycles: Minimum of 15 000 and zero crossover voltage with load rating of 1800VA
 - Operating temperature: -20° / +80°


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Warranty: 3 years with clear UV protected dome
 - Surge Protection: 320 Joule metal oxide varistor
 - Ingress Protection: IP65
- The PEC shall be installed in a suitable IP65 enclosure with a glass/polycarbonate window.

PG 4.1.5 Power & Instrumentation Cable Racking

- The cables between the MCC panel and each pump motor or other unit shall be installed on a suitable cable rack comprising of either cable tray or mesh basket to the Engineers approval.
- Only hot dipped galvanised cable racking including all associated joints, bends, elbows, connectors etc. shall be accepted.
- Cable racking shall be minimum 150mm or 300mm wide trays as specified in the BoQ per applicable MCC or pump room. The Contractor may opt to use wider trays but shall adjust the rates accordingly to accommodate such trays at no additional expense.
- Cables to the motors shall exit the MCC from the top gland plate for ceiling mount cable racking systems.
- The Civil Contractor shall break out sections of a wall to allow for the cable rack to pass through the wall, where required.
- The rack shall be suspended from existing ceiling or roof trusses and correctly secured using appropriate fasteners.
- Drop down sections shall allow for the termination of the power and instrumentation cables to each pump section/motor, E/S/transducer.
- The cable rack shall be correctly earthed at each end and between all splices and sections using a minimum 10mm² copper earth core.

PG 4.1.6 Building Security System (where specified in the BoQ)

- The Electrical Contractor shall outsource the complete supply and installation for an alarm system for the buildings where specified in the BoQ.
- All Zones shall be wired back to a monitoring panel with audible alarming.
- The alarm system shall include:
 - Alarm unit
 - Power Supply Unit
 - Keypads mounted at main entrance door
 - Passives for each room
 - Door sensor
 - LED status at the entrance door
 - Communication module for linking back to a security company
 - All tubing, trunking and wiring
- The alarm systems shall be commissioned by a specialist alarm security sub-contractor.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Remote monitoring and response by a local security company is not required at this stage.
- A common alarm signal shall be wired back to the PLC for SMS notification to operating personnel.

PG 4.1.7 Building Air-Conditioning

- The following air-conditioning units shall be installed in the substation:
 - Office 1 & 2: 9000btu
 - Control Room: 12000btu
 - Laboratory: 12000btu
- Air-conditioners shall be of the split inverter type.
- Units shall be stainless steel with bluchem treatment.
- The units shall be electrically connected to dedicated isolators

PG 4.1.8 Building Lightning Protection

- The Contractor shall supply and install suitable Lightning Protection for the WTW building.
- Such supply and installation shall be outsourced to either Messrs SME Lightning Protection and Earthing or Messrs Pontins Natal.
- The design of the lightning protection shall be forwarded to the Engineer for final approval.

PG 4.2 WTW PUMP ROOM: MCC-1

PG 4.2.1 MCC Accommodation

- The MCC shall be suitably designed to be accommodated in the pump room.
- The MCC shall sit flush with the floor slab and up against the wall. Therefore, back opening access doors are not permitted. Access to all equipment including busbars and cabling shall be from the front, top and bottom.

PG 4.2.2 MCC Layout

- Refer to Drawing E325WS-03.
- The MCC shall consist of the following panel/compartments sections:
 - Incomer: Mains supply, MCCB incl. surge arrestors and metering
 - Backwash pump 1: 7.5kW Soft Starter
 - Backwash pump 2: 7.5kW Soft Starter
 - Air-blower 1: 15kW Soft starter
 - Air-blower 2: 15kW Soft starter
 - Domestic water pump 1: 0.75kW DoL
 - Domestic water pump 2: 0.75kW DoL
 - Flocculant Dosing pump 1: 0.75kW DoL


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Flocculant Dosing pump 2: 0.75kW DoL
- Flocculant Transfer pump 1: 0.75kW DoL
- Flocculant Transfer pump 2: 0.75kW DoL
- Motive water pump 1: 0.75kW DoL
- Motive water pump 2: 0.75kW DoL
- Lighting and small Power section for switchgear
- PLC/Telemetry section
- The MCC shall be free standing and shall have measurements that do not exceed the available space as highlighted above.
- The lighting within the enclosure shall be suitably sized LED lighting to provide sufficient lighting throughout the enclosure and all compartments.
- The MCC shall be designed to accommodate the mains supply, motor starters, local and PLC section.
- Each section shall be separated by mechanical barriers (steel cover plates), which allows for only the insulated common busbars to extend through to each power section including the earth bar which shall extend through the entire width of the MCC. No cabling to be installed between the sections.
- All cable terminations shall be both bottom and top entry.
- The MCC shall be powder coated ELECTRIC ORANGE.
- The MCC shall be designed with the correct ventilation and forced cooling for the motor starters where required.
- The switchboard manufacturer shall allow for terminal blocks for easy terminations.
- The MCC shall be supplied with a suitable cable glanding plate for each section that can be removed to allow for drilling and glanding.

PG 4.2.3 Switchgear & Protection

- All switchgear (isolators, MCCBs, MCBs etc.) used throughout the Switchboard shall be either **Schneider Electric, ABB, Siemens or CBI LV**. No other make or brand shall be accepted.
- Switchgear shall be consistent throughout the Switchboard and shall consist of only one brand as specified above.
- MCCBs shall be fitted with electronic adjustable trip units.
- All switchgear, busbars and associated equipment shall be suitably rated for the following fault levels:
 - 400V Mains Supply from Miniature Substation: 3-Phase: 10 kA
 Phase-Earth: 10 kA
- Each motor starter section shall be equipped with suitably sized isolators or fuses. It is expected that Soft Starter units shall incorporate suitable motor protection features.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- All motors/pumps shall be equipped with remote emergency stops located at each motor and wired/cabled back to each starter for E/S purposes. The Contractor shall make an allowance for new 2.5mm² 2-core PVC SWA cable for such purposes, including E/S switches and Unistrut for mounting.

PG 4.2.4 Metering & Panel Instrumentation

- For the main incomer, a Schneider Electric PowerLogic PM5100 - 3Ph Power Meter shall be installed after the Mains Supply isolator.
- All panel wiring between CTs, busbars, switchgear and metering shall be minimum 2.5mm² cu 1-core PVC panel wire - GREY. House wire shall **NOT** be accepted.
- All metering panel wiring shall be suitably numbered and approved by the Engineer prior to installation.
- Each Motor Starter section shall include the following minimum panel instrumentation irrespective if such instrumentation forms part of the VFD unit:
 - Schneider Electric PowerLogic PM5100 - 3Ph Power Meter
 - Run Hour Meter (signal from VFD)
 - Alarm and operating status lamps
 - Auto/Manual selection
 - Emergency Stop

PG 4.2.5 Motor Starters

- The MCC shall supply 2 x 7.5kW Backwash Pumps.
- The Backwash Pump Starters shall be of the type SOFT STARTER.
- The MCC shall supply 2 x 15kW Air-Blowers.
- The Air-Blower Starters shall be of the type SOFT STARTER.
- All other motors/pumps shall be a standard direct on-line starter.
- SOFT STARTERS shall comply with the minimum general requirements in Particular Project Specification PG3 above.
- SOFT STARTERS shall be either Schneider Electric, Allen Bradley, ABB, Siemens or WEG. No other make or brand shall be accepted.
- The MCC manufacturer in consultation with the drive manufacturer/supplier; shall specify an acceptable SOFT STARTER model suitable and sized for the pump motors. This shall be approved by the Engineer prior to any orders being placed with the respective supplier.
- A copy of the pump specifications will be made available for the MCC manufacturer.
- Each motor starter shall be supplied with electronic protection or form an integral part of the SOFT STARTER.
- Each motor starter compartment shall be supplied with the correct cooling for the drives which shall form part of the MCC.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Each motor starter shall be equipped with an emergency stop including provision for a remote emergency stop located at the pump.
- Each motor starter shall be suitably rated for the application.
- The motor starters shall communicate with a suitable PLC to be installed in the PLC section of the MCC.
- All required auxiliary supplies AC and/or DC including PSUs etc shall be supplied complete with the SOFT STARTERS for incorporation into the MCC. This shall include all communication modules and cabling between drives and the PLC.

PG 4.2.6 PLC

- The MCC shall be supplied with a suitable PLC that shall control and monitor the Starters and other instrumentation equipment and monitoring devices.
- The PLC shall be preferably the same make as the SOFT STARTER.
- The PLC shall be installed in a separate compartment within the MCC and shall be supplied complete with CPU, PSU, input/output modules, rack, comms modules, a UPS and communication equipment to send status and alarms back to the SCADA system.
- A suitable UPS shall be supplied as part of the PLC to ensure uninterrupted supply to the PLC and instrumentation during mains supply failure, minimum 1 hour.
- The PLC compartment shall also be equipped with an HMI screen mounted on the front panel, which shall provide a graphical display of the pump station including operating and status parameters.
- The PLC shall also be supplied with all OEM software including communication cables where required. The software shall be supplied to the Client at no additional cost.

PG 4.3 PLC CONTROL & INSTRUMENTATION

PG 4.3.1 General

- The PLC as specified in the MCC specifications above shall monitor and control the motor starters, pumping duties, pumping speed, water levels, mains supply failure, etc. for each pump station and any other parameter that may be required.
- The Contractor shall sub-contract the total programming and commissioning of all PLC monitoring and control to a specialist System Integrator who has experience on such PLC and SOFT STARTER equipment.
- The System Integrator shall liaise with the Engineer and all other specialists to obtain a full methodology for all monitoring and control for the pump station.
- The Contractors rates for the PLC and instrumentation engineering shall include for all travel and accommodation for the system integrator.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 4.3.2 Basic PLC Control Features**

- As a basic minimum, the PLC shall monitor and control the pump stations as directed below. However, such features and parameters will be confirmed with the Client during commissioning:
- Pump Duty:
 - At any point in time, the duty shall be 1 pump in operation with 1 on standby (rest).
 - The duty shall be shared between both pumps.
 - The anticipated run time per duty shall be 18 hours (to be confirmed/changed during commissioning). After 18 hours run time, the operational pump shall ramp down to rest and the other unit in rest shall ramp up to the current operating speed.
 - After power outages, the duty shall be reset and a new duty cycle started.
 - It is imperative that the PLC be programmed to prohibit both motor starters from operating simultaneously due to supply side constraints.
- Pumping Flow Rate
 - To be determined by mechanical engineer if required.
- Level Control (Clearwater reservoir)
 - The water level at the clearwater reservoir shall be monitored.
 - Should the clearwater reservoir reach a specific volume, the PLC shall send a command signal to the MCC PLC to stop pumping.
 - Pressure sensor to be installed in clearwater reservoir to be able to monitor depth of water within the reservoir.
- Alarms & Status
 - The PLC shall monitor all starter alarms and operating parameters.
 - Alarms and status shall be communicated to the SCADA system.
 - Alarms and status shall also be shown on the front HMI panel.
- Remote Control
 - Reservoir levels

PG 4.3.3 Transducers & Control Instrumentation

- The Contractor shall supply, install and commission all transducers, cabling and other instrumentation.
- Transducers shall be cabled back to the PLC for monitoring and control purposes.
- The make and type of transducer shall be approved by the Engineer prior to any order being placed.
- The Contractor shall supply all such transducers including cabling and termination to the PLC.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



PG 4.4 SCADA & TELEMETRY

PG 4.4.1 Basic Telemetry

- The Contractor shall employ the services of the System Integrator to design and implement a telemetry and SCADA system that monitors and controls the WTW processes.
- The PLC in the MCC shall communicate back to the central SCADA system to be housed in the Control Room.
- The SCADA system shall be housed in the control room together with the telemetry/PLC field interface unit.
- The telemetry/PLC field interface unit shall communicate to the PLC via a standard industrial protocol that is locally supported.
- Communication shall be fibre optic. The supplier shall recommend the most suitable communication system for the entire application.
- Fibre optic cables, if recommended, shall be installed in the same trench as the power cables where applicable.

PG 4.4.2 SCADA System

- The Contractor shall supply and install a basic SCADA system that will monitor and report on all MCC status and alarm conditions for both WTW including future requirements for the entire WTW.
- The SCADA system shall be **Adroit**.
- The Adroit system shall be supplied with sufficient scanned points for inputs and future control outputs. The Contractor shall liaise with the PLC System Integrator to determine the required scan points for quoting purposes.
- The Adroit SCADA shall be supplied together with a suitable high-end desktop PC including 24" HD monitor, keyboard, mouse, latest Windows operating system and a 1-hour backup UPS.
- In addition to the above equipment, the Adroit SCADA system shall be supplied with a GSM modem to send SMS alarms to off-site operators/personnel. The GSM modem shall be supplied with SIM card loaded with sufficient data for commissioning purposes.
- The Adroit system shall be configured with a basic overview mimic/s of the entire WTW showing MCC status, pumping status, levels and alarms.
- Alarms shall be configured to send SMSs.
- The Contractor shall sub-contract the services of a suitable SCADA and telemetry/PLC specialist system integrator to commission the entire Telemetry/PLC and SCADA system.
- The Contractors rates for the Telemetry and SCADA system shall include for all travel and accommodation for the System Integrator/s.
- Training shall be allowed for the Operators.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- As part of the SCADA system, the Contractor shall supply a suitable office desk and chair for the SCADA PC and equipment.

PG 4.5 LOW VOLTAGE CABLE RETICULATION AND SUPPLY

PG 4.5.1 Eskom Mains Supply: Metering Kiosk-A

- The Contractor shall contact Eskom to ascertain the existing supply point at the Pole Mounted Transformer located due south of the WTW.
- The required supply for the entire works is **100KVA @ 400V**.
- If required, a new 50mm² cu 4-core PVC/SWA/PVC cable shall be installed from the Eskom Metering point at the PMT to the new Metering Kiosk to be installed just on the inside of the WTW fence line as shown on Drawing **E-325WS-01**.
- Refer to **Drawing E-325WS-03**.
- The Contractor shall supply and install a new **Metering Kiosk-A**.
- The Metering Kiosk-A shall be manufactured by the **same Switchboard Manufacturer** who shall supply MCC Panel, DB-A, DB-B, DB-C & DB-D.
- The Kiosk shall be free standing with an IP65 rating.
- The Kiosk shall be designed to accommodate the required metering.
- All cable terminations shall be bottom entry.
- The kiosk shall be powder coated Electric Orange.
- The switchboard manufacturer shall allow for terminal blocks or busbar droppers for easy cable terminations.
- The Kiosk shall be supplied with a suitable cable glanding plate that can be removed to allow for drilling and glanding.
- This outdoor kiosk shall have a minimum rating of IP65.
- The kiosk shall have both back and front access doors.

PG 4.5.2 Cable Reticulation

- The following cables shall be supplied and installed:

From	To	Length (m)	MCB	Cable Size
Meter Box	Kiosk-A	40	150A TP	70mm ² 4-core PVC/ECC/SWA/PVC
Kiosk-A	MCC	100	125A TP	50mm ² 4-core PVC/ECC/SWA/PVC
MCC	DB-A	30	60A TP	16mm ² 4-core PVC/ECC/SWA/PVC
Kiosk-A	DB-B	32	60A DP	10mm ² 2-core PVC/ECC/SWA/PVC
Kiosk-A	DB-C	33	63A DP	6mm ² 2-core PVC/ECC/SWA/PVC
Kiosk-A	DB-D	107	32A DP	6mm ² 2-core PVC/ECC/SWA/PVC


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PG 4.5.3 Cable Reticulation – Pump Motors**

- All new cables shall be supplied and installed with the relevant ECCs.
- The cables to be supplied and installed between each Motor Starter and motor shall be:

From	To	Cable Size
MCC Panel	7.5kW Pumps	4mm ² cu 4-core cu PVC/SWA/ECC/PVC
	15kW Pumps	6mm ² cu 4-core cu PVC/SWA/ECC/PVC
	DoL Pumps	2.5mm ² cu 4-core cu PVC/SWA/ECC/PVC

- Where cable trenches are not possible, suitable cable racking on cable trays or mesh shall be used (refer to Particular Project Specification PG 4.1.5).
- Cable routes shall be accurately measured on site before any cable is cut from the cable drum.
- Cables shall be cut to correct length to ensure that there are no joints required.
- All cables shall be terminated using the correct glands and lugs suitably sized for the cable size.
- Each power cable shall be installed together with a separate earth continuity conductor with the exception of the cables specified with integral ECCs.
- The earth continuity cable shall be buried alongside the power cable and shall be terminated onto the respective earth bars in switchboards and MCCs.

PG 4.6 AREA LIGHTING**PG 4.6.1 Area Flood Lighting**

- Refer to Drawing No. E-325WS-01.
- 150W LED Flood light with an adjustable mounting bracket to control lighting direction shall be installed bearing SABS Mark, colour temperature 4000K.
- The flood lighting shall be installed on 8m mounting height stepped hot dipped galvanized with a meter installed underground, steel poles complete with mounting brackets for the flood light luminaires.
- The flood lighting poles shall be designed by a reputable street/high mast lighting pole manufacturer who can provide a mechanical engineers certificate for the structural integrity of the pole that it will be safe for use when installed with the luminaires.
- The poles shall be fabricated from mild steel with 3 stepped sections consisting of the following minimum sections and sizes:
 - Step D1: 3m x 150mm OD
 - Step D2: 6m x 114mm OD
 - Step D3: 3m x 76mm OD


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- The poles shall be fabricated with base plates including gussets suitable for the pole to be mounted onto a steel reinforced concrete base.
- Cable termination access compartments shall be provided at least 750mm from ground level for the termination of supply cables.
- The access compartments shall be equipped with din rail for the installation of a 6A MCB and an earthing point.
- The pole manufacturer shall supply a design for the concrete mounting base and the Electrical Contractor shall construct the base as per design including the supply of all materials and labour for the base.
- The concrete base shall accommodate a 50mm PVC long radius duct for cable entry into the base of the pole.
- Hold down bolts shall be stainless steel bolts.
- The hold down bolt cage shall be directly earthed using 2 x 70mm² bare copper earthing straps protruding from within the concrete base and connected to a crow's foot earth grid comprising of 3 x 1.5m earth electrodes.
- Each pole shall be equipped with a suitable galvanised luminaire bracket suitable to support the weight of the LED luminaires.
- Each access compartment shall be fitted with a 6A MCB.
- The Contractor shall dress the pole complete with luminaires and 2.5mm² copper 3-core cabtyre cable between luminaires and MCB.
- A total of 2 x LED flood light luminaires shall be supplied and installed on each pole based on the following minimum specifications:

PG 4.6.2 *Lighting Circuits*

- All area flood lights shall be connected as per Drawing No. E-325WS-01.
- Lighting circuits shall be wired using 2.5mm² (Live+Neutral+Earth) Stranded PVC Wire.
- Sockets, Hand dryers and A/C Split unit circuits shall be wired using 4mm² (Live+Neutral+Earth) Stranded PVC Wire.
- The Contractor shall supply and install 4mm² cu 4-core PVC SWA + ECC cable for all lighting circuits.
- The cables shall be terminated into each pole using Pratley No. 2 end connectors supplied with insulating shrouds.

PG 4.7 MAINS SUPPLY: ESKOM APPLICATION

- The Contractor shall make contact with Eskom to determine the existing supply size.
- The required supply for this installation shall be **100kVA @ 400V**.
- The Contractor shall apply for the necessary upgrade to the new WTW on behalf of the Client.
- A provision for this application shall be provided for in the BoQ as a Provisional Sum to be approved by the Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PH COLOUR CODING FOR PIPELINES, PLANT AND EQUIPMENT****PH 1 SCOPE**

The purpose of the colour code is to standardise the usage of colours used within the works.

PH 2 COLOUR CODES – SANS 1091/1092

The colours for identification colour marking of pipelines and equipment shall be as indicated below:

Colour	Code
Arctic Blue	F28
Black	GH19
Brilliant Green	H10
Canary Yellow	C61
Cornflower	F29
Crimson	A03
Emerald Green	E14
Golden Brown	B13
Golden Yellow	B49
Jacaranda	F18
Light Orange	B26
Light Stone	C37
Middle Brown	B07
Pastel Grey	G54
Primrose	C67
Salmon Pink	A40
Signal Red	A11
Verdigris Green	E22
White	HG100



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



PH 3 SPECIFIC USE OF COLOURS

PH 3.1 Labelling, Numbering of Plant, Equipment and Buildings

Room Numbers	White on Black Background
Electrical Circuits	Black on White Background
Plant Equipment Stock Numbers	Black on Yellow Background
Room Size	White on Cornflower (sky blue) Background
Distribution Board ID	Black on Yellow Background
Danger Signs	Signal Red on White Background
Information Signs	White on Emerald Green Background

PH 3.2 Pipelines

Contents of Pipe	Basic Colour	Identification Band (150mm Wide)	Wording
<u>Water</u>			
Potable - cold	Brilliant Green	Cornflower	
Potable – hot	Brilliant Green	Crimson	
Raw	Brilliant Green		RAW
Sludge – all	Brilliant Green		SLUDGE
Supernatant Return (from Sludge)	Brilliant Green	Pastel Grey	
<u>Waste Water</u>			
Raw Sewage	Middle Brown	Black	
Raw Sludge	Middle Brown	Golden Brown	
Humus Sludge	Middle Brown	Jacaranda	
Treated Sludge	Middle Brown	White	
Returned Sludge	Middle Brown	Crimson	
Supernatant Liquor	Middle Brown	Arctic Blue	
Final Effluent	Middle Brown	Brilliant Green	
<u>Chemical Solutions</u>			
Alum	Jacaranda	Arctic Blue	
Bentonite	Jacaranda		BENTONITE
Caustic Soda	Jacaranda	Black	
Copper Sulphate	Jacaranda	Light Stone	
Activated Carbon	Jacaranda	Pastel Grey	


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Lime	Jacaranda	Crimson	
Polyelectrolyte	Jacaranda	Verdigris Green	
Soda Ash	Jacaranda		SODA ASH
Sulphuric Acid	Jacaranda	White	
Chlorine	Jacaranda	Canary Yellow	
Ferric Chloride	Jacaranda	Brilliant Green	
Sodium Hypochloride	Jacaranda	Canary Yellow	
Sodium Chloride	Jacaranda	Canary Yellow – Brilliant Green	
Chloride of Lime	Jacaranda	Canary Yellow – Crimson	
<u>Gases</u>			
Chlorine	Light Stone	Canary Yellow	
Ammonia	Light Stone	Signal Red	
Ozone	Light Stone		OZONE
Chlorine Dioxide	Light Stone	Canary Yellow – Crimson	
Methane	Light Stone	Black	

Contents of Pipe	Basic Colour	Identification Band (150mm Wide)	Wording
<u>Fuel and Oil</u>			
Diesel	Golden Brown	White	
Petrol	Golden Brown	Signal Red	
Hydraulic Oil	Golden Brown	Salmon Pink	
Waste	Golden Brown	Black	
<u>Air</u>			
Blowers	Arctic Blue	Signal Red	
Compressed	Arctic Blue		
Instrument	Arctic Blue	Salmon Pink	
Vacuum	Arctic Blue	Primrose	

Where it is impractical to paint the whole pipeline the basic pipeline colour is to be painted in two 150mm wide bands on either side of the identification bands. Where there is no identification band but wording is specified, the specified wording shall be stencilled on the pipe, in the largest practicable lettering up to a maximum of 75mm in height, in clearly visible locations on either side of all fittings.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PH 3.3 Plant and Equipment**

Items of Equipment	Basic Colour
<u>Pumps</u>	According to pipe contents
<u>Valves</u> (Anti-clockwise opening valves) Body Bonnet, yoke and hand wheel or cap	According to pipe contents Brilliant Green
<u>Valves</u> (Clockwise opening valves) Body Bonnet, yoke and hand wheel or cap	According to pipe contents Signal Red
<u>Electrical Switchgear</u> (other than starting and stopping devices and emergency stop controls)	Light Orange
Exposed moving or rotating machine parts	Light Orange
Cable and conduits	Light Orange
Starting devices	Emerald Green
Stopping devices	Signal Red
Emergency stop controls	Signal Red
Telemetry	Natural Colour
Fire protection equipment	Signal Red
Safety equipment	Emerald Green
Handrails	Golden Yellow
Handrail Stanchions	Black
Crawl Beams	Golden Yellow (50mm black diagonal lines optional)
Demarcation of walkways	Golden Yellow
Housekeeping Markings	Golden Yellow

PH 4 DEMARCATION OF “KEEP CLEAR” AREAS**PH 4.1 Refuse Bin Locations**

All refuse bin locations shall be demarcated in the following manner:

- The position where the “BIN” is to stand shall be indicated by a Golden Yellow (B49) circle (100mm greater than the diameter of the base of the bin) painted on the floor with the word “BIN” stencilled in black across the centre of the circle.
- A 190mm x 190mm “Keep Area Clean” symbolic sign shall be affixed to the wall or other fixture next to the refuse bin to indicate its use as a refuse bin and not as a scrap (metal) bin.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PH 4.2 Fire extinguishers, fire hose reels, electrical distribution boards and other
“Keep Clear” areas**

The equipment shall have a “keep clear” area demarcated on the floor below its immediate position. The demarcation shall be symmetrically 300mm greater than the maximum width of the equipment and extend 500mm from the supporting wall or fixture. An eighty millimetre wide black line, within the demarcated area shall be painted as a border to the demarcation. The remaining inner area shall be painted Golden Yellow and the words **“KEEP CLEAR”** and/or **“UNGABEKI”** stencilled in the yellow block. The lettering shall be 50mm high where possible.

On expanded mesh or similar perforated floor areas a solid metal plate shall be placed below the equipment on which the demarcation shall be painted.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2