

### C3.3: PROJECT SPECIFICATIONS

#### **AMENDMENTS TO THE STANDARD AND PARTICULAR SPECIFICATIONS**

In certain clauses in the standard, standardized and particular specifications, allowance is made for a choice to be specified in the project specifications between alternative materials or methods of construction, and for additional requirements to be specified to suit a particular contract. Details of such alternative or additional requirements applicable to this contract are contained in this part of the project specifications. It also contains the necessary additional specifications required for this particular contract.

The number of each clause and each payment item in this part of the project specifications consists of the prefix PS followed by a number corresponding to the relevant clause or payment item in the standard specification.

The number of a new clause or payment item, which does not form part of a clause or a payment item in the standard specifications and which is included here, is also prefixed by PS, but followed by a new number which follows on the last clause or item number used in the relevant section of the standard specifications.

#### **PART A: GENERAL**

##### **A1 SERVICES**

Provision is made in the bill of quantities for payment for searching and exposing of known or unknown services.

##### **PS2 PROGRAMME OF WORK**

###### **(a) General requirements**

The bar-chart programme to be provided by the contractor shall show the various activities in such detail as may be required by the Employer's Agent. Progress in terms of the programme shall be updated monthly by the contractor in accordance with the progress made by the contractor.

In compiling the programme of work, the contractor shall indicate and make due allowance for the following:

- a. Civil works as per the tender drawings, Bill of Quantities and Scope of Works;
- b. Mechanical & Electrical (M&E) Contract. For the M&E contractor, a provision of 22 months from appointment to successful completion of the 28-day Trial Operational Period must be provided. Thereafter the civil contractor and the M&E contractor will be involved with the 2-months operation and training period.

##### **PS3 WORKMANSHIP AND QUALITY CONTROL**

The Employer's Agent shall, however, undertake acceptance control tests for the judgement of workmanship and quality, without accepting any obligations vested with the contractor in terms of the contract with specific reference to quality of materials and workmanship. Such acceptance control test done by the Employer's Agent shall not relieve the contractor of his obligations to maintaining his own quality control system.

The Employer's Agent shall, for the purpose of acceptance control on products and workmanship, assess test results and measurements.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Where small quantities of work are involved, a lot shall mean a full day's production for a specific item of work subject to acceptance control testing.

#### **PS4 PAYMENT**

##### **(b) Rates to be inclusive**

VAT shall be excluded from the rates and provided for as a lump sum in the Summary of Bill of Quantities.

##### **(e) Materials on the site**

In addition, the Employer's Agent may at his sole discretion also allow payments under "Materials on Site" in respect of any construction materials if stored off-site providing that:

- (a) The site selected for this purpose is approved by the Employer's Agent;
- (b) Such land is physically separated from any production plant or operation;
- (c) Only materials for use under this contract is stockpiled on such land;
- (d) The contractor has provided proof of an agreement with the owner of such land that the owner has no claim whatsoever on any materials stockpiled on such land;
- (e) Materials obtained by the contractor for or on behalf of emerging subcontractors (SMME's) shall remain the responsibility of the contractor after payment has been made in respect of materials on site;
- (f) A cession form for the material has been provided to the approval of the Employer.

##### **(f) Payments Certificates**

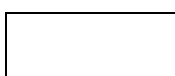
With reference to Sub-Clause 6 of the General Conditions of Contract, the Employer's Agent's certificate will be issued only after receipt by him of a draft certificate prepared by the Contractor in the form prescribed by the Employer's Agent.

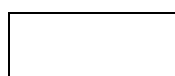
The cost of duplicating and delivering copies of the Employer's Agent's Certificate to the Contractor, the Employer's Agent and the Employer shall be borne by the Contractor. A total of three copies of the certificate (A-4 size) will be required by the Employer's Agent and the Employer.

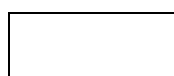
#### **PS4 EXTENSION OF TIME RESULTING FROM ABNORMAL RAINFALL**

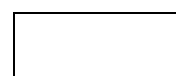
Extension of time will not be considered for normal rainfall but only for abnormal rainfall or saturated conditions and will be calculated in accordance with the following method:

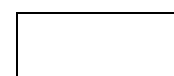
- a) The Contractor shall, in his programme, allow for the anticipated number of working days on which work could be delayed - as given in the Schedule below.
- b) Extension of time will be calculated for each calendar month or part thereof over the full period for the completion of the Work, plus any approved extension thereof, as follows:
  - i) A delay caused by abnormal rainfall will only be accepted for extension of time if, in the opinion of the Employer's Agent, it delays an item or items which lie on the critical path determined by the Contractor's programme. Only delays on working days will be considered;
  - ii) Abnormal rainfall will be days, as approved, on which rain delayed operations, less the anticipated number of days given in the Schedule below;

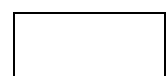
  
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Witness 2

  
Employer

  
Witness 1

  
Witness 2

- iii) The net extension of time determined for each month, which may be negative, shall accumulate algebraically to determine the net number days for extension of time due to abnormal rainfall, but a negative total at the end of the construction period will not be considered;
- iv) Where a portion of a month is involved, a pro rata number of days shall be calculated.

**SCHEDULE:**

Anticipated number of working days on which work could be delayed because of rainfall and saturated conditions.

Month Days	Month Days
January	6
February	9
March	3
April	2
May	2
June	1
July	0
August	0
September	0
October	1
November	2
December	5
<b>Total</b>	<b>31</b>

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PORTION 2: VARIATIONS AND ADDITIONS TO THE STANDARDISED SPECIFICATIONS**

**PSA GENERAL**

**PSA1 GENERAL (SANS 1200A)**

**PSA2 INTERPRETATIONS**

**PSA2.1 APPLICATION**

Except for the work and activities specified in terms of the Project Specification for Labour Intensive Construction (LIC) and save by arrangement with the Engineer, the contractor will not be restricted in the use of resources and in particular the use of mechanical plant.

**PSA 2.3 DEFINITIONS**

**PSA 2.3(d) LABOUR INTENSIVE CONSTRUCTION**

For the purpose of the Contract, the following definitions shall apply in respect of quantification and remuneration of temporary labour employment on labour intensive Construction (LIC) work:

Task : a quantified activity  
Day : a working day comprising 9,25 ordinary working hours. Refer wage order for civil engineering industry (Labour Relations Act).

Daily Task : a task that is required to be completed within a given day

Task Work : work paid for by the completed task or job

Task Rate : the remuneration of a day's work, regardless of output/production rate

Daily Wage : refer daily rate

Labour Intensive Construction (LIC): construction work executed with as great a proportion of labour as is technically feasible to produce the standard of construction specified, and also referred to in the Project Specification by the use of the acronym 'LIC'.

Labour Based Construction : (for the purpose of this Contract) shall have the same meaning as "labour intensive construction".

**PSA2.8 ITEMS IN SCHEDULE OF QUANTITIES**

Amend the first sentence as underlined below: -

".....stated in the relevant Sub-Clause 8 of the applicable Standardized Specification or in the Measurement and Payment clause of the applicable Standard Specification, particular Specification Section or Project Specification in addition to the cost of the Contractor....."

**PSA 5 CONSTRUCTION**

**PSA 5.1 SURVEY**

**PSA5.1.1 Setting out the Works**

The Contractor is responsible for the setting out of the Works from the information given on the drawings or from information provided by the Engineer.

Benchmark data will be given to the Contractor timorously. Benchmarks that are to be disturbed by the temporary or permanent works must be referenced by the Contractor, prior to the disturbing thereof, at the Contractor's cost.

**PSA5.1.3 Setting out of Tasks for Labour Intensive Work**

  
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Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

The Contractor shall be responsible for the setting out of all Daily Tasks and Task Work whether LIC work is specified in the Project Specification for such tasks or not.

PSA5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES  
(Sub-clause 5.4) (Refer Sub-clause PS8.2.)

PSA5.5 DEALING WITH WATER ON THE WORKS (Sub-clause 5.5)

The Contractor's attention is drawn to the fact that, apart from normal dealing with stormwater and seepage water which may influence the construction of the temporary or permanent Works, special arrangements and de-watering measures will have to be made to control and/or remove water for the protection of excavations: (Refer also Sub-clause PS8.4)

PSA5.8 GROUND AND ACCESS TO THE WORKS

The Contractor shall provide temporary access to the Works and to the dumping areas / spoil site, as may be required by him and to the approval of the Engineer.

PSA5.9 WORKMAN'S COMPENSATION ACT

All labour employed on the Site shall be covered by the Workmen's Compensation Act. The Contractor shall pay in full, such amounts, as are due in terms of the Act, including the payment of the necessary levies. The manner in which Workman's Compensation will be handled, shall be resolved by the Contractor with all the relevant parties at the commencement of the Contract.

PSA 8 MEASUREMENT AND PAYMENT

PSA8.1.1 Method of Measurement, All Sections

Amend Sub-clause 8.1.1 as underlined below:-  
"Except where otherwise specified in Clause 8 of a Standardized Specification or in the Measurement and Payment clause of an applicable Standard or Particular Specification section or in the Project Specification or in the Preamble to the Schedule, all items ....."

PSA8.2 PAYMENT

PSA8.2.1 Fixed-Charge and Value-Related Items (Sub-clauses 8.2.1 and 8.3)

The tendered sums for the fixed-charge items in the P & G Section of the Schedule of Quantities shall not be subject to any variation if the actual value of the work done exceeds or falls short of the Tender Sum within the limits stated in Clause 50 of the General Conditions of Contract (GCC).

PSA8.2.2 Varied Payment for Time-Related Items (Sub-clauses 8.2.2 and 8.4)

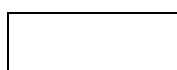
The tendered sum for each relevant time-related item in the P&G Section of the Schedule of Quantities shall be appropriately adjusted pro rata to any authorised extension or to any certified reduction to the Time for Completion of the Works, in full settlement of any time-related costs.

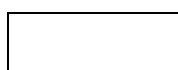
The said adjustments will be made in the Interim Payment Certificate issued with or following upon the issue of the Completion Certificate, irrespective of the actual period required for the completion of the Works.

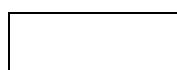
Payment for the sums tendered for the above said time-related items will be adjusted on the basis of the total for each item being calculated as follows:

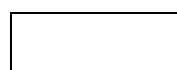
$$P = C \times \frac{T_e}{T_t}, \text{ wherein}$$

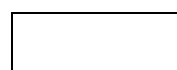
- P = Adjusted amount certified for payment under the relevant time-related item;  
C = Amount tendered for the relevant time-related item, appropriately adjusted (when applicable), for the designated operation;  
T<sub>t</sub> = Time for Completion as stated in the Contract Document; and  
T<sub>e</sub> = Time for Completion (T<sub>t</sub>) plus any extensions of time for completion authorised, or minus any reduced time for completion certified, up to

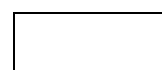
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

the date of the substantial completion of the Works as certified by the Engineer in terms of the General Conditions of Contract;

and provided that for any time-related item which relates to a duration of construction as specified in the Schedule of Quantities, the term "time for completion" in the description of the above formula shall be held to be substituted by the term "duration of construction".

The final amount paid under the time-related items in accordance with the above formula will be taken to be an agreed amount in full compensation for time-related charges adjusted for varied time for completion. The adjusted sums will, however, be subject to contract price adjustment if applicable to the Contract.

PSA8.3.2 Establishment of Facilities on the Site

PSA 8.3.2.1 Facilities for Contractor (Sub-clauses 8.3.2.2 and 8.4.2.2)

The tendered sums for the Sub-clauses 8.3.2.2(a) to (e) and 8.4.2.2(a) to (e) as scheduled by the Engineer, whether grouped or individually, shall include all costs for the installation, maintenance and removal of the fencing as specified in Sub-clause PS7.7 in addition to all other facilities specified and as required by the Contractor for his own purposes.

PSA 8.3.2.2. (c) Laboratories

Unit: Sum

The tendered sums for the Sub-clauses 8.3.2.2(c) and 8.4.2.2(c) shall cover the Contractor's overhead costs, profit and all costs related to the use of an outside or private laboratory, or both, as the case may be. The sum tendered shall be paid to the Contractor in full.

PSA8.3.2.2 (i) Access to the Works

Unit: Sum

PSA8.4.2.2 (ii) (Fixed-charge and time-related item)

The tendered sums for the items "access to the Works" in the P & G Section A of the Schedule of Quantities shall cover all the Contractor's costs for the work required for the provision and maintenance of access to and on the Site of Works as specified in Sub-clause 5.8.

The rates shall include for the supply, placing, maintenance and removal on completion of the Works (if any) of gravel on temporary access roads and the re-stabilisation of roads as may be required.

PSA8.4.6 Liaison with Authorities and the community  
(Time-related item)

Unit: Sum

The tendered sum shall cover all the Contractor's direct costs of liaison with Authorities and the Community (Sub-clause PS8.1.1) and all other costs incidental to the required liaison.

PSA8.4.7 Under-utilization of Resources: Cost incurred due to delays occasioned by circumstances described in Clauses 54(1) and 54(2) of the General Conditions of Contract (GCC).

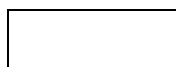
In the event of delays in the execution of the Works due to the circumstances described in Clauses 54(1) and/or 54(2) of the General Conditions of Contract (GCC), and in the event of the agreement by the Employer to bear resultant additional Costs incurred by the Contractor in the continuing of the Works pursuant to Clause 54(2)(b) of the General Conditions of Contract (GCC), payment of the increased Cost (if any) incurred by the Contractor will be made in terms of Sub-clause 54(4) of the General Conditions of Contract (GCC) and the valuation and/or assessment of the said increased Cost shall be based on the tender rates for the following items, discarding the tendered rates for time-related items which may be scheduled elsewhere in the Schedule of Quantities :-

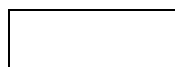
#### TIME-RELATED ITEMS

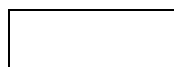
Under-utilization of Resources Costs: Compensation in terms of Clause 54(4) for delays due to circumstances described in Clauses 54(1) and 54(2) of the General Conditions of Contract (GCC).

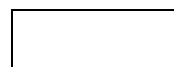
For duration of delay, unless otherwise stated, and for the following resources: -  
(PROVISIONAL ITEMS):-

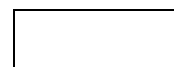
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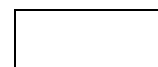
  
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Employer

  
Witness 1

  
Witness 2

(As listed, if any) Labour	Unit: Sum per working day
(As listed, if any) Supervision and Head Office Overhead Costs	Unit: Sum per working day
(As listed, if any) Other resources, not covered by (a) to (c) above: to be specified by Tenderer	Unit: Sum per working day

The unit for measurement shall be the working day on which the Contractor has been delayed in or prevented from continuing with the construction of the Works, with a working day and a working week being deemed to have a maximum of 9.25 and 46 ordinary working hours. The sum per working day tendered under the time-related items (a) to (d) above shall represent the Contractor's total Cost for under-utilization of his resources, based on the assumption that no work can be proceeded or started with. The tendered rates must be based on the assumption that one period of delay of duration equal to the working days scheduled in the Schedule of Quantities occurs approximately during the middle-third of the authorised time for completion of the Works.

The final amounts paid under the time-related items for under-utilization of resources costs will be based by the Engineer on an assessment of the said costs (due consideration being given to the generalities of Clauses 4 and 37 of the General Conditions of Contract (GCC) in respect of plant, equipment, labour, supervision, overheads and losses in profit due to the under-utilization of the Contractor's said resources. The amounts payable in interim certificates for under-utilization of resources costs will be subject to contract price adjustment, if applicable; the total amount will, however, be excluded from the total Tender Sum when variations in the Tender Sum in terms of Clause 50 of the General Conditions of Contract (GCC) are determined.

The payment items will be applicable only to delays in the execution of the works and additional costs which in the opinion of the Engineer are incurred as a result of the circumstances described in Clauses 54(1) and 54(2) and which are outside the control of the Contractor. The provision of this clause shall in no way prejudice the right of the Employer or the Contractor to cancel the Contract in terms of the provisions of Clause 54 of the General Conditions of Contract (GCC).

## PSA8.8 TEMPORARY WORKS

### PSA8.8.2 Accommodation of Traffic

#### PSA8.8.2 (a) Dealing with traffic in general Unit: Sum

(Time-related item)

Accommodation of Traffic shall be measured for payment at the tendered lump sum under Temporary Works in the P & G Section A of the Schedule of Quantities. The sum tendered and paid shall include full compensation for the installation and all subsequent moving and re-establishment and final removal of lighting, signboards, traffic signs, barricades, drums, flashing lights, labour, transport or any other item required for the safe accommodation of traffic on public roads, all to the satisfaction of the Engineer and, where applicable, in accordance with the requirements of the Employer and as specified in Sub-clause PS8.2.1.

Although the tender sum for Accommodation of Traffic shall be paid out as specified for time-related items during the construction period, the sum tendered will be a fixed amount and will not be subject to adjustment due to a possible extension or reduction of the Time for Completion or for any other reason whatsoever.

### PSA8.8.7 Protection of Surveyor's Pegs

The costs to the Contractor for the location, protection and replacement (if any) of survey beacons, pegs and benchmarks in terms of Sub-clause 5.1.2, shall be covered by the items "other fixed-charge and time-related sums" in the P & G Section of the Schedule of Quantities.

## PSA8.9 SETTING OUT OF THE WORKS AND TASKS Unit: Sum

Tenderer	Witness 1	Witness 2	Employer	Witness 1	Witness 2

(Fixed-charge and time-related item)

The cost to the Contractor for the setting out of the Works and for the checking of the Surveyor's pegs and Benchmarks in terms of Clause 14 of the General Conditions of Contract (GCC) and PSA5.1.1, and for the setting out of Tasks in terms of PSA5.1.3, shall be covered by the tendered items under "other fixed-charge and time-related items " in the P & G Section A of the Schedule of Quantities.

PSA8.10

**ADDITIONAL SITE/SPECIAL MEETINGS**

In the case of additional meeting/inspections being required due to the Contractor not keeping to his programme (including completion date) or to poor quality work, the amount will not be included, but an amount of R2 000.00 per meeting will be deducted from the subsequent Payment Certificate.

PSA8.11

**HEALTH AND SAFETY**

Payment for compliance with the requirements of this Section of the Specification shall be from the sum price under fixed-charged, value-related items and time related items in terms of requirement of clause PSA4.1 and PSA4.3 respectively.

*Tenderer*

*Witness 1*

*Witness 2*

*Employer*

*Witness 1*

*Witness 2*



**PSAB ENGINEER'S OFFICE (SANS 1200 AB)**

**PSAB3 MATERIALS**

**PSAB3.1 NAME BOARDS**

Notwithstanding the provision of Sub-clause 3.1, 1 (one) name board shall be erected and the boards shall comply with the format and size shown on the Drawings.

**PSAB3.2 OFFICE BUILDING**

A dedicated office for the Engineer is required. The following furniture is to be supplied:

1. Office size of at least 12m<sup>2</sup> and ceiling height of at least 2.5m. Suitable wall and ceiling isolation with one (1) lockable door and at least two (2) opening windows of glazed area at least 3m<sup>2</sup>;
2. A work desk with a top of at least 1500x900mm with two (2) lockable drawers;
3. One (1) Executive chair and two (2) visitor chairs;
4. Plan table where plans of A0 size can be unfolded;
5. 12000 BTU Air conditioner with heating and cooling function;
6. Toilet facilities for the exclusive use of the Engineer or the Engineer's site personnel.

Although ski-cabins or similar structures will be acceptable as offices even if they might not comply with the requirements specified for floor area and ceiling height, the use of such structures will be subject to the approval of the Engineer.

The Contractor must consult with the Engineer prior to the supply and erection of the office.

**PSAB4 PLANT**

**PSAB4.1 SURVEY EQUIPMENT**

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

- 1 No. Tachometer capable of reading to 20 seconds of arc with tripod;
- 1 No. Engineer's automatic level with tripod;
- 2 x Tachometer staffs with staff bubble;
- 2 x levelling staffs graduated in 5 mm intervals with staff bubble;
- 1 No. 3 m pocket tape
- 1 No. 30 m Fibreglass measuring tape;
- 1 No. 100 mm steel measuring tape;

All steel pegs, shovels, picks, etc. which the Engineer's Representative may require during the Contract.

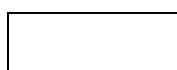
The instruments may, by arrangement, be shared between the Contractor and the Engineer's Representative.

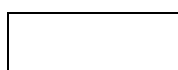
The Contractor shall maintain the equipment in good working order and keep it clean throughout the contract period. The Contractor shall keep the equipment continuously insured against any loss, damage, or breakage and he shall indemnify the Engineer and the Employer against any claims in this regard. Upon completion of the Works, the ownership of the equipment shall revert to the Contractor.

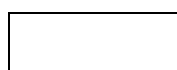
**PSAB5 CONSTRUCTION**

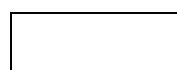
**PSAB5.1 NAME BOARDS**

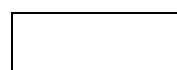
Delete the words "on completion of the contract," and substitute it with: -

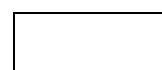
  
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Employer

  
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Witness 2

"....by the end of the defects liability period, or at such other earlier time as the Engineer may instruct or approve."

PSAB5.3      ENGINEER'S ASSISTANTS

One survey assistant shall be allocated to the Engineer by the Contractor. The assistants shall be able to read and write either Afrikaans or English and shall be available to the Engineers as assistants at all reasonable times during the construction period.

PSAB8      MEASUREMENT AND PAYMENT

PSAB8.2.1      Engineers Office      Unit: Sum

(Fixed-charge and time related item)

The tendered sum shall include all costs for the supply and maintenance of the engineer's office (PSAB3.2).

PSAB8.2.4      Survey Equipment and Assistants      Unit: Sum

(Fixed-charge and time related item)

The tendered sum shall include all costs for the supply and maintenance of the survey equipment (PSAB4.1) and the employment of assistants for the Engineer (PSAB5.3).

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

## PSC SITE CLEARANCE

### 1. PSC1 CONSTRUCTION

#### 2. PSC1.1 INDIVIDUAL TREES (CLAUSE C5.2.3.2)

The penalty for damaging or removing trees not specifically instructed by the Engineer to be removed, shall be R5500-00 per tree.

#### 3. PSC1.2 TOPSOIL (CLAUSE C5.6)

Topsoil shall be stored in designated stockpile areas for later use as indicated by the Engineer.

#### 4. PSC1.3 REMOVAL AND RE-ERECTION OF FENCES

All existing fences on the Site through which the Works have to be executed, shall be temporarily removed. The removal shall be carried out in such a manner that all materials shall be re-usable for re-erection on completion of the Works. The fences shall be so re-erected in such a manner that they are in a similar condition to that prior to removal. Where required, the Contractor shall supply and install new materials, should the existing materials not be suitable for re-use.

#### 5. PSC1.4 DEMOLITION OF STRUCTURES (CLAUSE C5.8)

The existing building(s) that must be demolished will be indicated by the Engineer at the bridge site(s). The building(s) is to be demolished and the rubble disposed of as indicated by the Engineer. Any material retrieved will be given to the current owner of the structure.

### 6. PSC2 MEASUREMENT AND PAYMENT

#### 7. PSC2.1 BASIC PRINCIPLES (CLAUSE C8.1)

The transport of cleared and grubbed materials and debris and the disposal thereof by the Contractor away from the Site shall not be measured separately and all costs in connection therewith shall be included in the rates for the relevant items.

#### 8. PSC2.2 REMOVAL AND RE-ERECTION OF FENCES

The removal and re-erection of existing fences shall be measured and paid per linear meter. The rate shall include the cost of removal of the fences, the temporary storage of the components, the re-erection of the components on completion of the Works and any costs relating to the loading and transportation of the components. The supply and installation of new materials, where required, will be paid for at daywork rates.

#### 9. PSC2.3 REMOVE STRUCTURES (CLAUSE C8.2.8)

DEMOLISH AND  
Unit : Sum

The rate shall cover the cost of the removal of all structures on the site, the disposal thereof at the dumping site, the levelling and shaping of the site and the backfilling of any holes with material of at least the same quality as that of the in situ material. The rate shall also cover the cost of removing cleaning and handing over of all usable material to the Employer / Current Owner.

Payment for the removal of individual structures will be made pro rata in the relation of the area thereof to the total area of structures that has to be demolished and removed.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

## PSD EARTHWORKS

### PSD1 SCOPE

The following work in this Section 1200 D shall be carried out using Labour Intensive Construction (LIC) Methods and for such work it shall be held that this specification covers earthworks carried out by hand tools and equipment or, where so permitted in the project specification, by restricted plant usage in accordance with PSD4 :-

- a) Clear and strip site;
- b) Restricted excavation and backfilling;
- c) Remove, stockpile and spread excavated material;
- d) Filling and compacting holes where trees and stumps have been cleared;
- e) Selecting and removing unsuitable material;
- f) Spreading and compacting surplus excavated material on Site;
- g) Hauling of material under (a) to (f) above up to 100 m by wheelbarrow.

### PSD2 INTERPRETATIONS

#### PSD 2.3 DEFINITIONS

For LIC Methods the definition for "restricted excavation" shall read:- "an excavation required to be carried out using only hand tools and equipment or, where so permitted in the project specification carried out with restricted use of plant."

### PSD3 MATERIALS

#### PSD3.1 METHOD OF CLASSIFYING

For LIC Methods add at the beginning:-

"Subject to the restrictions on the use of plant ....."

#### PSD3.2 CLASSES OF EXCAVATION

For LIC Methods the excavation of material will be classified as follows:-

"Soft excavation": Soft excavation shall be excavation in material that can be efficiently removed or loaded by manual operations with a pick and shovel, without the use of handheld pneumatic (compressor driven) tools such as paving breakers or prior ripping, and boulders up to 25 kg in mass.

"Intermediate excavation" : Intermediate excavation shall be excavation (excluding soft excavation) in material that requires to be broken up by the use of handheld pneumatic tools before removal or loading by equipment equivalent to that specified for soft excavation and boulders of mass more than 25 kg up to 50 kg, or material that requires to be loosened and broken up by a back-acting excavator of flywheel power exceeding 0,10 kW per mm of tined-bucket width or material that requires ripping by a bulldozer of 35 t mass with a single-tine ripper and flywheel power of 220kW, for the material to be removed or loaded as soft material.

"Hard rock excavation": Hard rock excavation shall be excavation in material that requires to be broken up by drilling and blasting with explosives and/or wedging and splitting before removal or loading by equipment equivalent to that specified for soft excavation, and boulders of mass more than 50 kg.

In the event of the Engineer instructing that boulders in excess of 50 kg mass or isolated ridges of rock be broken up by sledgehammer or by heating and cooling (fire and water), such operations will be measured and paid for separately from other excavations.

#### PSD3.3 MATERIAL SUITABLE FOR EMBANKMENTS AND TERRACES

For LIC Methods in paragraph (b) "300 mm" shall read "150 mm".

### PSD4 PLANT

#### PSD4.1 GENERAL

There shall be no restriction on the use of mechanical plant and equipment for work identified in the Schedule of Quantities as "Bulk" or "Mass" earthworks.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Where it is required that the work be carried out using LIC Methods (Refer PSD1) the first two sentences of 4.1 shall read:

"Except where permitted in the project specification, the Contractor shall use only hand tools and equipment such as picks, shovels, sledgehammers and wheelbarrows. Although, for the purpose of classifying excavations, particular items of plant are specified in PSD3.1.2, the Contractor is not obliged to provide or use those specified items of plant for carrying out the work but he may use such plant for the excavation that is so classified as an exception to the restriction on plant."

**PSD4.2 COMPACTION PLANT**

For LIC Methods the Contractor shall, save by arrangement with the Engineer, not use compaction plant larger than manually-operated self driven "pedestrian" compactors.

**PSD4.3 HAUL VEHICLES**

Although, for the purpose of classifying haulage, particular items of plant are identified in PSD5.2.5.2, the Contractor shall not be obliged to use wheelbarrows for the haul of materials over terrain where it may be impracticable to push a wheelbarrow manually.

**PSD5 CONSTRUCTION**

**PSD5.1 DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL FROM EXCAVATION (SUB-CLAUSES 5.1.4.3 AND 5.2.2.3).**

Surplus material from excavations which is suitable to use in fills shall be placed and spread in fills or placed in embankments in areas on the Site designated by the Engineer and compacted to at least 90% Mod. AASHTO density (98% for cohesion less materials).

Unsuitable material from excavations shall be disposed of by spreading as uncompacted fill or by placing in embankments in areas designated by the Engineer during the Contract. When ordered by the Engineer, the material shall be compacted to at least 90% Modified AASHTO maximum density (98% for cohesion less materials), or to such greater density as directed by the Engineer.

**PSD5.2 DISPOSAL AND SPOIL SITE(S) (SUB-CLAUSE 5.2.2.3)**

Except when it is required and designated by the Engineer that surplus and unsuitable material from excavations shall be disposed of on the Site, such material shall be disposed of to Spoil Sites in accordance with the terms specified in Portion 1 of the Project Specification.

Haulage shall be payable on transport outside the freehaul distance in terms of PSD5.2.5.1.

**PSD5.2 EMBANKMENTS**

For LIC Methods, the first sentence of the third last paragraph shall read:

"The material of each embankment shall, unless otherwise approved, be deposited in layers of thickness before compaction, not exceeding 150 mm."

**PSD5.3 BACKFILLING AGAINST STRUCTURES**

For LIC Methods all trenches and excavations outside structures shall be carefully refilled with approved material in layers of thickness not exceeding 150 mm before compaction. During the placing of each layer, the filling shall be well stamped and compacted.

**PSD5.4 FREEHAUL**

For LIC Methods freehaul shall be 2,5 m or the average distance of a single throw with a standard shovel full of soil, whichever is the greater distance.

**PSD5.5 OVERHAUL**

For LIC Methods, transportation of all excavated material beyond the freehaul distance in terms of PSD5.2.5.1 will be regarded as overhaul. Overhaul will be classified as

Wheelbarrow haul or Tractor and trailer haul or Truck (long) haul, based on the following ranges, unless otherwise approved by the Engineer :-

Distance beyond the end of the freehaul in terms of PSD5.2.5.1 by the shortest practicable route

*Tenderer*

*Witness 1*

*Witness 2*

*Employer*

*Witness 1*

*Witness 2*

- a) Wheelbarrow haul Up to 100 m
- b) Tractor and trailer haul Over 100 m up to 0,5 km
- c) Truck or long haul Over 0,5 km

The Contractor shall not incur overhaul expenses without prior approval/authorization by the Engineer.

**PSD5.6 BULK EXCAVATION, PLACING, COMPACTION AND FINISHING (SUB-CLAUSES 5.2.2, 5.2.3 AND 5.2.4)**

The excavation of undulating sand dunes on Site and on a borrow site as applicable, the placing of excavated materials in embankments and fills and the compaction of the embankments and fills shall be classified as "bulk" earthworks for the purpose of this contract.

**PSD5.7 COMPACTION OF CUT AREAS**

All cut areas in sandy soil shall be compacted to 100% Mod AASHTO to a depth of 300 mm after final finishing.

**PSD5.8 EXPLOSIVES (CLAUSE 5.1.1.3)**

The Contractor shall use explosives for blasting in connection with the Works only where approved by the Engineer. Such approval, however, shall not relieve the Contractor of his responsibilities in terms of the Contract.

The Contractor shall submit to the Engineer for his approval, before any blasting preparation on Site is commenced, details of his proposed blasting programme, the methods to be used and the precautions to be adopted. The Contractor shall use only moderate charges of explosives at any time and the utmost care shall be taken to avoid unnecessary shattering of rock or disturbance of the ground.

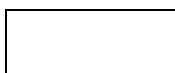
Blasting shall not be permitted in any situation or position where, in the opinion of the Engineer, it is likely to endanger any existing foundations, structures, pipelines, power and telephone lines or other services. In such situations, the rock shall be excavated by drilling and wedging or by other suitable methods other than blasting, as approved by the Engineer.

The prior consent for blasting given by the Engineer shall in no way relieve the Contractor of any of his obligations under this Contract and the Engineer shall have the power to withdraw his consent for blasting and order other means or methods of excavation in rock.

**PSD6 TOLERANCES**

**PSD6.1 POSITION, DIMENSIONS AND LEVEL FOR BULK EARTHWORKS**

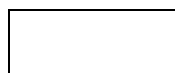
Except that finished levels shall comply with Sub-clause 6.1(b) (3) for Degree of Accuracy II, a degree of accuracy III shall be applicable to bulk earthworks.



*Tenderer*



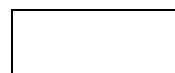
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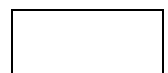
*Witness 2*



*Employer*



*Witness 1*



*Witness 2*

**PSG CONCRETE (Structural)**

**PSG1 MATERIALS**

**PSG1.1 CEMENT (Clause 3.2.1)**

All Cement to be used shall conform to SANS EN 197-1. Only CEM I 42,5 cement shall be used in construction of the Works.

**PSG1.2 STORAGE OF CEMENT (Clause 3.2.3)**

A first-in-first out circulation shall be followed to ensure that no cement shall be older than two (2) months from the date of manufacture.

**PSG1.3 AGGREGATES (Clause 3.4.1)**

The maximum size of the coarse aggregate shall be 20 mm unless otherwise indicated on the drawings.

**PSG2 PLANT**

**PSG 2.1 FORMWORK**

**PSG2.1.1 FINISH (CLAUSE 4.5.2)**

All concrete, save for water retaining structures against which earth will be backfilled, shall be finished rough.

All exposed concrete surfaces shall be finished smooth to Degree of Accuracy I. (Sub clause 6.2.3), unless otherwise indicated on the drawings.

**PSG2.1.2 TIES (CLAUSE 4.5.3)**

No system leaving holes through the walls will be permitted. Ferrules shall be of the permanent sacrificial type.

Sacrificial holes formed in reinforced concrete walls during the fixing of formwork shall be repaired with 1:3 cement-sand mortar. All grouting material shall be thoroughly punned in.

**PSG2.1.3 CHAMFERS (NEW CLAUSE 4.5.4)**

All rectangular edges or corners shall be chamfered off to 20 mm x 20 mm unless otherwise indicated on the drawings.

The scheduled prices for formwork shall include for forming of chamfers.

**PSG3 CONSTRUCTION**

**PSG3.1 REINFORCEMENT**

**PSG3.1.1 FIXING TOLERANCES (CLAUSE 5.1.2)**

Reinforcement shall be positioned as shown on the drawings (read together with the bending schedules) and maintained in those positions within the tolerances given in Clause 6.2 to degree of accuracy I, unless otherwise indicated on the drawings.

**PSG3.2 FORMWORK**

**PSG3.2.1 CLASSIFICATION OF SPECIAL FINISHES (CLAUSE 5.2.1)**

**PSG3.2.1.1 RUBBED SURFACE FINISH**

*Tenderer*

*Witness 1*

*Witness 2*

*Employer*

*Witness 1*

*Witness 2*

Where a rubbed surface finish is specified or scheduled the surface shall first be treated as a smooth finish as specified in SANS 1200 G sub clause 5.2.1(b).

After sufficient time has elapsed to allow the mortar to set, the surface shall be saturated by water. Rubbing shall then be carried out with a medium coarse carborundum stone and a small amount of mortar until all form marks, projections and irregularities are removed and a uniform surface obtained.

Leaving the paste produced by the rubbing in place, rubbing shall be continued with a fine carborundum stone and water. Rubbing shall be continued until the entire surface is of a smooth even texture and uniform colour. After the final rubbing the surface shall be washed down to remove surplus paste and powder.

### PSG3.3 HOLES, CHASES AND FIXING BLOCKS (Clause 5.3)

Substitute the contents of the clause with:

#### a) General

Holes, recesses and boxed-out openings shall be allowed in concrete structures, as specified, for the subsequent installation of mechanical equipment and/or pipe work.

#### b) Preparation of openings for the installation of equipment

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

- i) Remove all shuttering and boxing remaining in the holes;
- ii) Make any alterations required to the position and shape of the holes;
- iii) Thoroughly clean the sides of the holes so as to obtain a satisfactory bond surface for the new concrete; and
- iv) Free all surfaces of the pipes/specials of all coatings, and thoroughly scrape and clean the pipes/specials.
- v) Apply a wet-to-dry concrete adhesive (two component, solvent free, polysulphide modified epoxy compound) immediately before grouting.

#### c) Grouting of voids

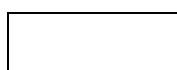
The concrete ingredients shall be mixed and placed as dry as possible to obtain a dense, waterproof concrete. Where a watertight seal is required, the concrete shall constitute a non-ferrous, non shrink grout. The grout shall be worked around the puddle flange, if any, and the pipe barrel or body of the special, and shall be vibrated in layers so as to obviate any falling away from pipe/special surface 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.

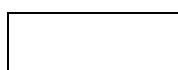
Smooth formwork that has been suitably strengthened for use with a vibrator shall be provided for facing the concrete around each pipe/special.

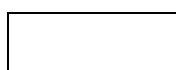
### PSG3.4 PIPES AND CONDUITS EMBEDDED IN CONCRETE (Clause 5.4)

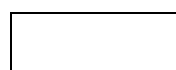
Except with the written approval of the Engineer, no pipes other than those shown on the drawings shall be embedded in concrete, and the approval of the Engineer for the position of all services to be embedded shall be obtained before concreting commences. The clear space between pipes of any kind embedded in reinforced concrete and the clear space between such pipes and reinforcement shall not at any point be less than:

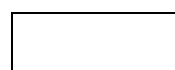
- i) 40 mm; or

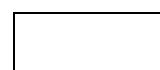
  
Tenderer

  
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Witness 2

  
Employer

  
Witness 1

  
Witness 2



- ii) 5 mm plus the maximum size of coarse aggregate,  
whichever is the greater.

PSG3.5 CONCRETE

PSG3.5.1 COMPACTION (Clause 5.5.6.3)

Delete the words:

“or (if approved) by spading, rodding or forking”.

PSG3.5.2 CONCRETE SURFACE FINISH (Clause 5.5.10.2)

Delete the words:

“Degree of Accuracy II” and substitute with: “Degree of Accuracy I unless otherwise indicated on the drawings”.

PSG3.5.3 WATERTIGHT CONCRETE (Clause 5.5.11)

Add to Clause 5.5.11 the following:

1. Definition (Clause 2.3)

For purposes of this Contract, all reservoirs, chambers and manholes will be regarded as water retaining structures.

The requirements of the Department of Water Affairs Specification DWS0750 (refer to Section 5) shall apply in addition to SANS 1200G.

2. Construction joints

i) General

Construction joints in the reinforced concrete walls shall consist only of horizontal joints. If under abnormal conditions a vertical construction joint is unavoidable it may only be constructed with the approval of the Engineer.

Construction joints shall only be placed at intervals shown on the drawings or as directed by the Engineer. The exact position of construction joints shall be marked on the formwork in order to obtain truly horizontal joints.

A sealant using an approved PVC water stop (water bar) shall be placed, as specified, at all construction joints.

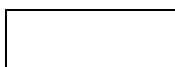
ii) Preparation of Surface

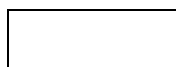
Prior to placing any further concrete the joint must be clean, damp and free of laitance. During the period when the concrete has set but is still green all loose material shall be removed, without disturbing the aggregates, by light brushing. Where this is not possible, or if the concrete has already set, the surface film shall be removed by mechanical means appropriate to the degree of hardness of concrete so as to expose the aggregate over the entire surface and leave a sound, irregular surface.

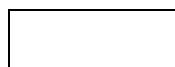
3. Ferrule Cup Holes

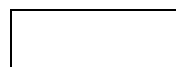
No system leaving holes passing through the walls will be permitted. Ferrules shall be of the permanent sacrificial type.

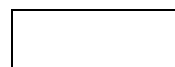
Holes formed in reinforced concrete walls during the fixing of formwork shall be repaired on the waterside face with an approved epoxy or non-shrink grout. On the dry face the holes left in the concrete shall be repaired with 1:3 cement-sand mortar. All grouting material shall be thoroughly punned in.

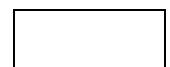
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

PSG4	TOLERANCES
PSG4.1	PERMISSIBLE DEVIATIONS
PSG4.1.1	SPECIFIED PDS (CLAUSE 6.2.3)

The following permissible deviations for location of holding down bolts shall apply:

- the centre line of a holding-down bolt from its designated location in plan:  
plus 1 mm, minus 1 mm
- the top of the bolt from its designated elevation:  
plus 5 mm, minus 3 mm

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<i>Tenderer</i>	<i>Witness 1</i>	<i>Witness 2</i>	<i>Employer</i>	<i>Witness 1</i>	<i>Witness 2</i>

## PSHA STRUCTURAL STEEL WORK (SUNDRY ITEMS)

### PSHA3 MATERIALS

#### PSHA 3.1 Structural Steel

All steel used for the fabrication of structural steel components shall comply with the requirements of SABS 1431 Grade 300WA steel, unless otherwise stated.

#### PSHA 3.2 Welding Consumables

Only low hydrogen electrodes or electrodes with a controlled hydrogen content shall be used for welding, unless otherwise agreed to by the Engineer in writing.

##### Add the following:

a). Steel tank

Minimum thickness of tank plates:

Depth of Tank	Position of Plates	Min. thick-ness of plate (mm)
1, 0-1, 22	Top, bottom and sides	3,0
2, 0-2, 44	Top, bottom and sides	3,0
3, 0-3, 66	Bottom and first module of sides	4,5
	Top and remaining layers	3,0
4, 0-4, 88	Bottom and first module of sides	6,0
	Second module of sides	4,5
	Top and remaining side modules	3,0

b). Stiffening of Tank Plates

Tank plates will be stiffened by means of by adequate embossing or welding ribs to the plates.

c). Tank Plates Flanges

a. Tank plates will be provided with the necessary flanges with a minimum width of 44 mm. The corners of the flanges must be welded. Flanges must have holes at 75 mm c/c for 14 mm bolts. Bolts must be in accordance with the Specifications of SABS 135.

d). Tank Roof

The roof construction must be the same as the construction of the tank. An opening (450 x 450 mm) with a lockable cover must be provided opposite the inside ladder. The positioning must be such that the control valve on the inlet pipe can be reached. The roof must be provided with a suitable ventilator.

e). Joint Sealant

The joint sealant must be non-toxic, not water soluble, tasteless and odourless. The joint sealant must seal effectively for the temperature conditions.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

## PSHA5 CONSTRUCTION

### PSHA 5.2.3 Holes for Fasteners

The punching of holes is not acceptable and all holes shall be drilled.

### PSHA 5.2.4 Welding

All welding shall be carried out in accordance with BS 5135 and SABS 044, Parts I, II and III (Chapter 1). Where the BS and SABS specifications are contradictory, the SABS Clause shall apply.

Field welding shall be carried out with a direct current welding machine and shall only be allowed for secondary structural elements.

Surfaces to be welded shall be free of filings, rust, grease, paint and other materials which may be detrimental to the quality of the weld. Mill scale which cannot be removed by brushing may remain on the metal.

Elements shall remain in alignment and be free of warps and bends on completion of the welding and all weld splash shall be removed.

### PSHA 5.2.6 Handrails

Handrails shall be standard hot-dipped galvanised "Monoweld" rails or approved equal, securely fixed to the structure as prescribed by the manufacturer.

### PSHA 5.2.7 Ladders

Steel ladders must be galvanised. Ladders must be installed or fixed in the position as indicated on the Drawings or directed by the Engineer.

### PSHA 5.2.8 Open Grid Floors

Open grid floors shall be of approved make, type and pattern with dimensions and bearing capacities as shown on the Drawings or as directed by the Engineer. The plates shall be cut and framed by the Contractor to suit the layout in such a manner that each separate grid unit can be removed without having to dismantle any pipes, valves or other fittings.

The open grid floor shall be supported by suitable steel supports as shown on the Drawings.

The directions of the bearer and transverse bars of the grids shall be the same for all individual components of the floor and as shown on the Drawings or as directed by the Engineer.

#### Add the following:

#### **Floor plate Floors**

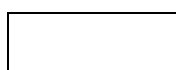
The requirements of Clause PSHA1.7 are also applicable to floor plate floors. The pattern of adjacent plates must be in the same direction.

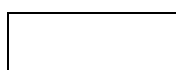
#### **Steel covers, hatches, etc.**

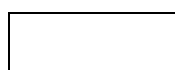
Steel covers, hatches, etc shall be manufactured in accordance with the details shown on the Drawings and shall be installed or fixed in the positions as shown or directed by the Engineer. All covers and similar items shall be manufactured from one single plate unless otherwise directed or approved.

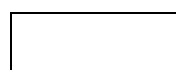
#### **Construction of steel tanks**

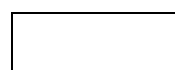
Inlet and outlet connections must be welded to the tank at the positions indicated on the drawings or prescribed by the Engineer.

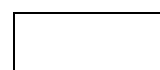
  
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Tank plates will be assembled on site. Additional (5%) bolts, nuts, washers and joint sealant must be provided on site. Each plate must be marked carefully to indicate the exact position of the specific plate.

## **PSHA7 TESTING**

### **PSHA 7.1 Test Certificates**

Test certificates for commercial quality steel and any steel in accordance with SABS 1431, shall be submitted to the Engineer.

#### **Add the following:**

#### **Testing and sterilizing of reservoirs**

On completion of the reservoir it shall be thoroughly cleaned with clear water from a high velocity nozzle and the cleaning operation must be carried out in such a manner that all undesirable matter is removed through the scour outlet. No stones and the like shall be flushed into the scour outlet.

After cleaning of the reservoir it shall be filled with water. The Engineer will inspect the reservoir, in the presence of the Contractor, for any visible signs of leakage or other defects. The structure will be considered to be watertight if there is no head loss.

The Contractor shall be responsible for repairing any leaks or other defects to the satisfaction of the Engineer and all costs in connection therewith shall be borne by the Contractor.

During the scouring of pipes and the final filling of the reservoir, the Contractor shall add chlorine of the type as directed by the Engineer and at a concentration of 10 mg/l to sterilize the pipelines and reservoirs.

## **PSHA 8 MEASUREMENT AND PAYMENT**

### **PSHA 8.3.4 Open Grid floors and Floorplate Floors**

The rate per square meter for open grid and floor plate floors shall include the complete supporting system with fasteners to the applicable floors as indicated on the Drawings. Corrosion protection shall not be measured separately, and the rate for the corrosion protection as specified must be included in the relevant rates.

#### **Add the following:**

a). Steel tank

The steel tank will be measured and paid for as a unit and the rate must allow for all material and construction of the tank as specified. The rate includes the plates, fastening material, ladders, ventilators, inlet pipe, outlet pipe, corrosion protection and all material and work that are needed to construct the tank in accordance with the Specifications.

b). Testing and sterilizing of reservoirs

The testing and sterilizing of reservoirs and related pipelines shall be paid under a sum in the Schedule of Quantities. The sum shall include the cleaning and flushing of the reservoirs and related pipelines, the testing of the reservoirs, the required chlorine and all requirements of the specification.

c). Steel covers, hatches, etc

Steel covers, hatches and similar shall be measured and paid for per unit and each different size and type shall be measured separately. The rate shall include the supply, fixing and installation, as well as fixing materials, frames and supports. Corrosion protection shall not be measured separately. This item will not apply to valve chamber covers as these shall be measured in accordance with SABS 1200 G and SABS 1200 L.

d). Pipe clamps

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Steel pipe clamps shall be measured and paid per unit for each type indicated on the Drawings. The rate shall include all materials, cutting welding, bolts and installation. Corrosion protection shall not be measured separately

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## **PSL MEDIUM - PRESSURE PIPELINES (SANS 1200 L)**

### **PSL1 SCOPE**

The following activities of this Section 1200 L shall be carried out using the LIC Methods :-  
Handling and transporting of pipes up to the sizes given below.

Laying (including bedding) of pipes as follows:-

Fibre cement : up to 250 Φ for 4 m lengths  
up to 200 Φ for 5 m lengths  
uPVC of HDPE : up to 600 Φ for 6 m lengths  
Glass Fibre : up to 300 Φ for 12 m lengths  
Steel (all variants) : up to 150 Φ for 6 m lengths

Bedding of all pipes.

Casting of anchor blocks.

Building of brick valve and hydrant chambers as well as construction of chambers with pre-cast manhole rings and pre-cast concrete lids with the exception that all pre-cast items shall be obtained from a supplier approved by the Engineer.

### **PSL3 MATERIALS**

#### **PSL3.2 SEWER LINES (Sub-clauses 3.2 to 3.7)**

##### **PSL3.2.1 uPVC Pipes and Specials**

Medium sewer pressure lines shall be uPVC (classes as specified) manufactured to SANS 966-1:2006 respectively and bearing the relevant SANS mark of approval with the exception of pipes supplied by the Employer.

uPVC pipes shall have spigot and socket mechanical joints, supplied with rubber rings. All bends shall be long radius bends, unless otherwise indicated on the drawings.

##### **PSL3.2.2 Steel pipes and Specials**

All steel pipes of diameter up to and including 150 mm diameter shall be of medium class galvanised, in accordance with SANS 62, with threaded ends and couplings, unless otherwise indicated. Steel pipes over 150mm shall be in accordance with SANS 719.

Unless otherwise indicated on the drawings, all galvanised steel pipes smaller than 100 mm shall be connected with threaded sockets, pipes from 100 mm diam. to 150 mm diam. to have flanges or flexible couplings. Pipes larger than 150 mm diam. will be Grade B steel t=4,5mm and will have flanged joints. The sockets, flanges and fittings shall be of approved make and shall be suitable to sustain the specified test pressure.

Exposed threaded sections at pipe connections, where galvanising has been removed by threading, shall be treated with an approved cold galvanising preparation after installation on Site.

Where flanges are specified the flanges will be in accordance with BS 4504 or SABS 1123 and shall be supplied complete with all packing's, nuts, bolts and washers. Viking Johnson couplings complete with all seals, bolts, nuts etc. shall be used where detailed. Where new installations couple up with existing installations, the Contractor shall ascertain what the flange drillings are of all existing fittings prior to any placement or order, and shall confirm this information with the Engineer.

##### **PSL3.9.7 Corrosion Protection of Fittings / Specials**


Steel specials shall be hot drip galvanised and painted.


All bolts, nuts and washers of couplings, saddles and fittings shall be galvanized.


##### **PSL3.10 VALVES**


GATE (SLUICE) VALVES shall be right hand closing with spigot (plain) ends suitable for coupling to the type of pipes specified under PSL3.2.1, and in compliance with SANS 665, Class 16 or flanged where specified by the Engineer and shall conform to the following:


  
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### PSL3.10.1 General


Gate valves for raw sewage, raw water, effluent and general duties where some solids might be present shall be resilient seated. Unless otherwise specified, the valves shall be of the non-rising spindle type. The valves shall be capable of withstanding the nominal pressure and specified test pressure and shall have the capability to seal drip tight bi-directionally. The valves shall be manufactured in accordance to SANS 664.


For water sludge's as well as on primary sludge, waste activated sludge, and digested sludge duties knife gate valves will be used.


### PSL3.10.2 Cast iron gate valves with resilient seals


Resilient seal gate valves may be used on raw sewage, raw water, effluent and general duties where some solids may be present but must not be used on high solid applications such as sludge and grit duties. The valves shall comply with the following:


- (a) The valves shall comply with SANS 664 or SANS 665, Class 10 or higher as required.
- (b) The valves shall be double flanged.
- (c) Valves shall have non rising spindles unless otherwise specified or necessary because of space restrictions. Non-rising spindle valves shall be fitted with indicators showing the valve opening position.
- (d) Hand wheels shall be of cast-iron.
- (e) The spindle shall be of grade 316 stainless steel or better.
- (f) Fixing lugs for end of travel limit switches shall be provided
- (g) Hand wheel size and construction shall permit easy opening of the gate when subjected to a differential pressure equal to the maximum operating pressure anticipated. Suitable gearboxes shall be fitted to provide easy opening when necessary. These gearboxes shall be grease filled.
- (h) Valves larger than DN 150 shall be provided with bypass arrangements.
- (i) The gate shall have optimally placed guides of wear resistant plastic so as reduce the torques as well as reduce wear between the rubber and the coating on the body. The bore of the body shall be straight through design in order to allow cleaning with a badger.
- (j) The valve shall utilise 3 independent bonnet seals which shall include a set of stem steels embedded in non-corrosive material, a back seal to prevent leakage when changing seals, and wiper ring to protect against debris entering the valve. The gland sealing arrangement must be replaceable under pressure as per SANS 664 specification. Two friction washers (sizes 50mm – 200mm) and thrust ball bearings (250mm – 600mm) shall be incorporated to ensure smooth spindle operation as well as to reduce opening and closing torques. A full circle thrust collar shall be utilised to ensure low torque operation. O-ring stem seals shall be replaceable under pressure for sizes 50mm – 200mm.
- (k) Spindles shall be made of stainless steel. The stem threads shall be rolled to maintain steel structure and increase strength and, to ensure smooth thread edges and consequently a low operating torque.
- (l) The rubber bonnet gasket shall fit in a recess in the valve bonnet preventing blow out of the seal under surge conditions. The bonnet bolts shall pass through the gasket and sunk into the bonnet and sealed for corrosion protection.
- (m) Every valve shall be internally and externally fusion bonded epoxy powder coated as standard with a minimum DFT of 250 microns. An edge protecting ring shall permanently be fitted around the body and bonnet joint in order to protect the coating during transportation and installation. Quality control recordings on dry film thickness and pin hole tests must be accompany the valve on delivery.


  
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#### PSL3.10. Knife-Gate Valves

Knife-gate valves must be used on water sludge's as well as on primary, waste activated and digested sludge duties. They shall also be used on other high solids application and may be used for duties specified under Clause "Cast Iron Gate Valves with Resilient Seals". The valves shall comply with the following:

- (a) Valves shall have cast iron bodies, stainless steel blades, cast hand wheels, and no carbon steel parts.
- (b) Valves for water sludge's shall be anti-clockwise closing. Valves for primary, waste activated and digested sludge's shall be clockwise closing.
- (c) Valves shall have chamfered blade edges and resilient body seals, and may have either rising or non-rising spindles. Gate position indication shall be provided if the overall design does not make this apparent. The blade shall be loaded through its central plane during opening and closing and this shall be achieved by the use of a clevis link or similar. Blade faces shall be surface ground.
- (d) Blade scrapers shall be incorporated to protect the body seal and valve chest. As the valve is opened, the scrapers shall clean the blade surfaces before these contacts the body seal. The scrapers shall be of a non-elastomeric, non-metallic material and shall be designed to cause minimal damage to the blade.
- (e) Suitable sealing shall be provided to prevent leakage from the valve and it shall be possible to adjust these seals while the valve is in line under pressure.
- (f) Valves shall be drop tight but need not be designed for bi-directional flow unless called for in the Detailed Specification.
- (g) Internal and external surfaces of the valve body shall be protected with a water resistant, non-toxic and non-tainting, FBE pipe coating in accordance with System – "Fusion Bonded Epoxy".
- (h) Valves shall be double flanged and shall suit the standard flange rating but may incorporate drilled and tapped fastener holes (the type of valve which is clamped between two flanges will be considered for acceptance only in positions where it is very likely that the pipe or flanged item on either side will never have to be removed or if isolation will not be necessary if it is removed). Fasteners may be studs or setscrews manufactured to suit the tapping depth.

#### PSL4 PLANT

##### PSL4.1 HANDLING AND RIGGING

For LIC Methods, in terms of Clause PSL1 the Contractor shall use manual labour and handheld equipment for pipe handling and laying, except that the Contractor may use a tractor and trailer for distributing the pipes and specials along the length of the trench and a tripod with block and tackle for lowering pipes into position, subject to the proviso in terms of Sub-clause 4.1.

#### PSL5 CONSTRUCTION

##### PSL5.1 Depths and Cover

Main lines shall be laid generally so that the cover to the top of the pipe barrel from finished surface shall be 900 mm except at points of intersection with other services where it may be necessary to lay water mains shallower than 800 mm or deeper than 900 mm, or at other points where it is directed by the Engineer to lay pipes deeper or shallower. The minimum cover at road crossing will be 1000mm.

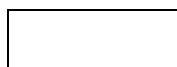
##### PSL5.2 LAYING

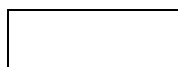
###### PSL5.2.1 General

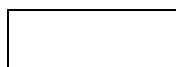
For LIC Methods, manually operated devices shall be used in lifting and lowering of pipes and specials.

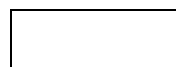
##### PSL5.3 VALVE CHAMBERS

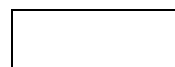
###### PSL5.3.1 Sluice Valve Chambers

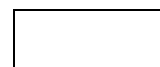
  
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Sluice valves shall be housed in valve boxes or chambers as detailed on the Drawings.

**PSL5.4 CONNECTION TO EXISTING WORKS**

The medium pressure lines must be connected to existing pipelines at the points as indicated on the drawings. The contractor in liaison with the local authority will carry out the connection work. (Refer Sub-clause PS4.4)

**PSL7 TESTING**

**PSL7.1 GENERAL**

**PSL7.1.1 Working Pressure of Gate Valves**

The Contractor shall ensure that the differential pressure across valve gates does not exceed the manufacturer's stated maximum working pressure.

**PSL7.1.2 Test Pressure and Time of Test (Sub-clause 7.3.1)**

The test section shall be subject to a pressure test, at pressure not less than 75% and not exceeding 100% of the appropriate allowable maximum working pressure for the class of pipes, for the highest and lowest point respectively of the section being tested. This pressure shall be obtained by continuous pumping so as to ensure a gradual increase of pressure until the specified value is obtained.

**PSL8 MEASUREMENT AND PAYMENT**

**PSL8.1 GENERAL**

The tendered rates for the supply of materials shall cover the cost of all protective coating and linings. No extra payment will be made for temporary water supply connections for testing and testing, which will be held to be included in the price for laying of pipes, valves and specials.

**PSL8.1.1 Supply, Lay, etc. of Pipes**

The tender rate per metre shall, in addition to the costs specified in Sub-clause 8.2.1, cover the cost of the supplying and fitting of the additional coupling for cut pipes. Unused off-cuts shall become the property of the Contractor.

The tendered rate shall further cover the costs of disinfection and testing as specified in PSL5.10 and PSL7.1 respectively.

**PSL8.2.2 Supplying, Laying, etc. of Specials complete with Couplings**

The rate per number extra-over the rate for Sub-clause 8.2.1 shall cover the cost of the corrosion protection specified in terms of PSL3.9.7.

**PSL8.2.11 Anchor/Thrust Blocks**

Notwithstanding Sub-clause 8.2.11, the construction of anchor and thrust blocks in compliance with the dimensions shown on the drawings or as ordered by the Engineer, will be measured by the cubic metre of 15 MPa/37,5 concrete. The tender rate shall cover the cost of the concrete and formwork required.

No separate payment will be made to cover the cost of over break in the excavation.

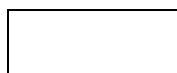
**PSL8.2.13 Valve and Hydrant Chambers, etc.**

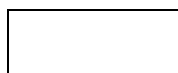
The unit rate shall, in addition to the costs specified in Sub-clause 8.2.13, cover the cost of painting the top of the surface box as specified in PSL3.11.6.

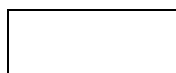
**PSL8.2.16 Valve and Hydrant Marker Posts**

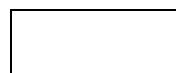
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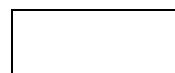
The tendered rate shall cover all costs for the supply of materials and installation of marker posts as specified in PSL5.3.1.

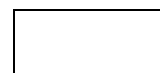
  
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## **PSLB BEDDING (PIPES) (SANS 1200 LB)**

### **PSLB1 SCOPE**

The following work in this Section 1200 LB shall be carried out using Labour Intensive Construction (LIC) Methods :-

Selecting material suitable for bedding from excavation.

Hauling bedding material up to 0,5 km by wheelbarrow.

(Note : The activities which relate to placing and compacting of bedding under and around pipes, ducts and cables are covered under the specification Sections dealing with pipe laying).

### **PSLB3 MATERIALS**

#### **PSLB3.1 Bedding and Selected Fill Blanket (Sub-clauses 3.1 and 3.2)**

It is expected that the compatibility factor of material most likely to be available from trench excavations will be less than 0,4. However, although the material may not comply with the grading requirements, sandy soil from trench excavations will be acceptable as bedding layer and selected fill blanket for pipes and ducts.

Imported dune sand should be acceptable as bedding and selected fill blanket.

It is anticipated that for bedding in waterlogged conditions, the coarser sands from trench excavations will have to be selected.

#### **PSLB3.4.1 Bedding Selection (Sub-clause 3.4.1)**

The Contractor will be required to select the coarser sand from trench excavations for bedding under pipes where pipes are to be laid on a trench bed which is in waterlogged conditions.

#### **PSLB3.4.2 Suitable Material not Available from Trench Excavation**

For LIC Methods, in the 3rd line "0,5 km" shall read "2,5 km".

### **PSLB4 PLANT**

#### **PSLB4.1.1 Placing and Compacting**

Except that the Contractor may use a tractor with trailer or a truck as the case may be to haul bedding material, where it is required that the work is to be carried out using LIC Methods, the Contractor shall use only hand tools such as shovels, wheelbarrows and hand tampers in the placing and compaction of bedding.

### **PSLB5 CONSTRUCTION**

#### **PSLB5.1.2 Details of Bedding**

uPVC and HDPE pipes shall be laid in bedding for flexible pipes as shown on Dwg SANS 1200 LB 3(d) respectively.

### **PSLB8 MEASUREMENT AND PAYMENT**

#### **PSLB8.1.3 Volume of Bedding Materials**

The volume of bedding material will be measured net, excluding the volume occupied by the pipe.

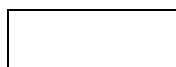
#### **PSLB8.1.5 Disposal of Displaced Material**

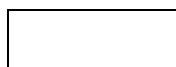
For LIC Methods, in the 3rd line "0,5 km" shall read "2,5 m".

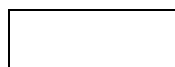
#### **PSLB8.1.6 Free haul**

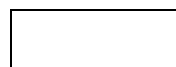
For LIC Methods, in the first line "0,5 km" shall read "2,5 m".

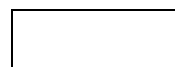
#### **PSLB8.2.1 Provision of Bedding from Trench Excavation**

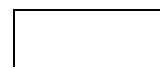
  
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For work that is required to be carried out using LIC Methods, “0,5 km” shall read “2,5 m” in the 1st and 4th lines.

PSLB8.2.5 Overhaul of Material for Bedding Cradle and Selected Fill Blanket

For LIC Methods, Sub-clause 8.2.5 shall read as follows:-

- (a) Wheelbarrow haul           Unit: m3.m
- (b) Tractor with trailer haul   Unit: m3
- (c) Truck haul               Unit : m3.km”

Items (a), (b) and (c) will be applicable only to such bedding from trenches and other necessary excavation as is hauled for distances in excess of 2,5 m with the written approval of the Engineer. The volume will be computed as specified in Sub-clause 8.1.3 and the distance will be the distance in excess of 2,5 m by the shortest practicable route in one direction measured to the nearest 3 m for (a) above and the nearest 0,1 km for (c) above. The rate shall cover the cost of transporting the bedding material over the additional distance beyond the free-haul distance specified and as directed by the Engineer on Site.

For LIC Methods, the free-haul for transport of bedding material selected from trench excavations, measured from any point along a trench, shall be the free-haul distance in accordance with PSD5.2.5.1 plus the distance from the specified centreline of the trench to the actual top edge of the trench plus, when applicable, the distance by the shortest practicable route from the edge of the trench to the toe of the stockpiled excavated material furthest from the trench. Overhaul shall be measured from the end, or up to the beginning, or between the end and beginning, as applicable, of the free haul distance(s)".

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## PA BUILDING WORK

### 10. PA1 SCOPE

This section of the Specifications deals specifically with all the building work associated with the Works.

Concrete work, steelwork, cladding, pipelaying, mechanical and electrical equipment, etc. forming part of or to be housed in a building erected in terms of this specification shall conform to the requirements of the relevant standardized or particular specifications referred to in the Project Specification.

### 11. PA2 INTERPRETATIONS

The relevant SABS 1200 Standardized Specifications such as Site Clearance, Earthworks, Earthworks (pipe trenches), Concrete (structural), Low pressure pipelines, Bedding (pipes), Sewers and Stormwater drainage shall also apply to the work under this section.

### 12. PA3 MATERIALS

All materials used for the Building Work shall, where such mark has been awarded for a specific type of material, bear the SABS mark.

#### PA3.1 Brick and Plasterwork

Cement, sand and water shall conform to the requirements of SABS 1200 G - Concrete.

Unless otherwise described, cement mortar shall be composed of six parts by volume of sand to one part by volume of cement. The materials are to be mixed dry until the mixture is of a uniform colour and then clean water is to be added gradually through a fine rose and the mixture turned over until the ingredients are thoroughly incorporated.

Cement mortar must be mixed in small quantities and must be used within one hour of mixing, as the use of cement mortar that has commenced to set will not be permitted.

Plaster on concrete ceilings, beams, columns etc. shall be mixed one part cement to three parts sand.

Bricks shall be of the best quality sound hardburnt pressed bricks or in the absence of clay bricks, concrete bricks; even in size and shape and equal to a sample submitted to and approved by the Engineer prior to commencement of work.

Clay bricks shall conform with the requirements of SABS 227 and concrete bricks to SABS 987.

Damp proof courses, unless otherwise described, shall be an asphaltic damp proof course with a base of fibre felt, and complying with the requirements of SABS 248 Horizontal Damp Proof Courses, and with a mass of 3,25 kg/m<sup>2</sup> or a plastic damp proof course of 15 micron thickness as Type B, complying with the requirements of SABS 952.

#### PA3.2 Fascia's, Barge Boards and Window sills

Nutec fascia's and barge boards, where specified, shall be 10mm thick pressed sheets, 200mm wide free from cracks, twists, blemishes or other defects and complying with the requirements of SABS 685.

Internal asbestos cement sills shall be in single lengths cut between reveals, fitted with fixing lugs and solidly bedded in 3:1 cement mortar with a slight projection beyond the finished wall face below. Sills shall be pressed asbestos cement of approved manufacture 152x15mm thick, set level.

#### PA3.3 Paintwork

##### PA3.3.1 Primers

Plastered surfaces must be cleaned down and have one coat alkali resisting primer of an approved brand applied in strict accordance with the manufacturer's instructions, before any undercoats are applied.

Galvanised metal surfaces must be treated with one coat Metal Etch Primer complying with the requirements of SABS 723.

Steel surfaces must be treated with one coat Type Zinc Chromate Primer complying with the requirements of SABS 679.

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Steel windows and doors and steel door frames, before being built in, must have all loose primer together with all rust spots, dirt, etc. removed and be treated with one coat red oxide or zinc chromate primer complying with the requirements of SABS 909.

Wood surfaces to receive paint finish must be cleaned down, all knots treated with knotting and be primed with Type I Wood Primer externally and Type III Wood Primer internally, both complying with the requirements of SABS 678.

PA3.3.2 Emulsion paint for interior use must be Grade I Emulsion Paint complying with the requirements of SABS 663. Emulsion paint for exterior use must be of the Synthetic Polymer Base Type complying with the requirements of SABS 634.

PA3.3.3 High Gloss Enamel Paint Shall be used on all surfaces other than specified above. High Gloss enamel paint must be Grade I paint complying with the requirements of SABS 630 for decorative High Gloss Enamel Paints with a Non-Aqueous Solvent Base, for Interior and Exterior use.

Undercoats for paints, except Emulsion paints, must be Type I undercoat Paint complying with the requirements of SABS 681.

#### **PA3.4 Doors, Windows and Glazing**

##### **PA3.4.1 Doors**

Unless indicated otherwise on drawings, all doors and doorframes shall be of solid hardwood. Frames shall be fitted with suitable tie bars and braces at bottom, and lugs for building in, three to each jamb of frames without fanlights and four to each jamb of frames with fanlights. All doors shall be provided with locks to the requirements of SABS 4 and each lock shall be provided with a duplicate key.

##### **PA3.4.2 Windows**

Steel windows must be of approved manufacture and design, constructed of rolled mild steel sections, properly mitred and welded at angles with welding cleaned off smooth on all faces and complying with the requirements of SABS 727. Window types and sizes shall be as specified on the drawings.

##### **PA3.4.3 Glazing**

Sheeting glass for glazing, unless otherwise specified, must be flat drawn clear glass of the thicknesses indicated below:

For panes not exceeding 0,65 m<sup>2</sup> : 3mm  
For panes exceeding 0,65 m<sup>2</sup> and not exceeding 1,5 m<sup>2</sup> : 4mm

#### **PA3.5 Tiling**

##### **PA3.5.1 Adhesives and Grouts**

a) **Wall adhesive**

A grey, cement-based thin bed, wall tile powder adhesive for fixing tiles to walls.

b) **Floor adhesive**

A grey, cement-based thick bed, floor tile powder adhesive for fixing heavy tiles to floors or walls.

c) **Wall grout**

A cement-based, plasticized grouting compound for wall tile installation.

d) **Bonding agent**

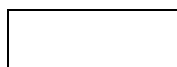
A latex modified for use with adhesives and grouts to improve water resistance.

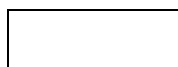
e) **Silicone sealant**

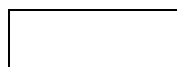
A silicone-based sealant of nearest approximate colour to tile, used to seal expansion joints (made at consistent interval positions) on large tiled surfaces.

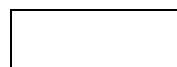
##### **PA3.5.2 Tiles**

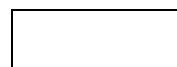
Tiles shall be of first grade quality glazed ceramic tiles, white in colour, a maximum size of 160mm square, of a maximum thickness of 5mm, unless otherwise specified.

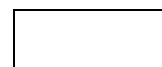
  
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#### PA4 PLANT

Plant, equipment, tools, scaffolding, etc. utilised in building work shall be of suitable capacity, condition and design to ensure the satisfactory and timeous completion of the Works within the specified period and in terms of these specifications and good building practices.

Only registered artisans (e.g. plumbers, electricians, etc.) shall be employed on any work where this is compulsory building practice.

#### PA5 CONSTRUCTION

##### PA5.1 Brick- and Plasterwork

###### PA5.1.1 Normal Brick Walls

Brickwork must be built in stretcher bond. No false headers are to be used and none but whole bricks except where legitimately required to form bond. The bricks are to be well wetted (saturated in hot weather) with water before being laid and the course of bricks last laid is to be well wetted before bedding fresh bricks upon it. All perpend and angles are to be kept plumb. The brickwork is to have the joints flushed up at every course solid throughout the whole width of the course, and each course is to be laid on a solid bed of mortar. Pointing is to be done as the work proceeds.

The joints of all walls to be plastered are to be raked out 15mm as the work proceeds to form a key for plaster or screed. All walls are to be built up in regular and horizontal courses and carried out so that no part built is more than 1,2m higher than any adjoining walls. Mortar beds generally are not to exceed 12mm thickness.

###### PA5.1.2 Face brick walls

In all faced brickwork the bond must be set out on the first level course of brickwork, at floor level internally and two courses below ground level externally. The bond, if necessary, is to be broken in the centre of panels under windows or to piers between windows. All perpend must be kept true and all courses must be built to gauge rods. Facings must be carefully protected from damage, mortar droppings, paint splashes, etc. during the whole period of the Contract and, on completion, they must be thoroughly cleaned down and left perfect. The practice of oiling facings on completion will not be allowed.

###### PA5.1.3 Reinforced Brick Lintols

Brick lintols are to be built of normal, sound, well burnt, good quality building bricks, similar to the facings where exposed, properly bonded longitudinally and bedded and pointed in cement mortar as described. Special care must be taken to ensure solid bedding, particularly where the reinforcement occurs.

The lintols are to be reinforced with **straight** continuous mild steel rods of the size and number scheduled. The rods must each extend 300mm on each side of the opening and are to be evenly spaced across its thickness in the first horizontal joint above the soffit.

Brick lintols in cavity walls must have all rods placed below the solid sections of the walls, except for those rods specifically scheduled to occur below the cavity.

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Where two or more openings are less than 665mm apart, the lintol shall be continuous over all such openings and the dividing piers, plus 300mm bearing at each extreme end as before, shall have such height and reinforcement as scheduled for widest opening spanned.

Span in mm	Min. height of lintols above soffit course, in brick courses	Reinforcement per half brick thickness of wall above for solid walls	
		No. of Rods	Dia (mm)
600	2	1	6
900	3	2	6
1200	3	2	6
1500	4	3	6
1800	4	3	6
2400	6	3	6

In addition to any reinforcing specified in the table above one layer of brick reinforcing shall be placed at every alternate brick course above the lintol. The brick reinforcing thus placed shall extend at least 300mm on each side of the opening.

All brick lintols are to be supported by two 114 x 38 timber bearers (on edge) for a duration of 7 days. Extreme care shall be taken beforehand to ensure a level and straight support.

#### PA5.1.4 Damp proof courses

The sheeting is to be cut into strips of the required width and laid on all foundation walls to the full thickness of the walls and without any longitudinal joints. At ends, angles and intersections the sheeting must be lapped 150mm and sealed.

Under all window sills exposed to the weather, the sheeting must be laid on the brickwork in the first joint immediately below the sill and turned up with an easy bend and tucked into window frame.

Over reinforced brick lintols exposed to the weather, the sheeting must be laid to form damp proof course as detailed above for solid walls and cavity walls.

#### PA5.1.5 Reinforcing in Brick walls

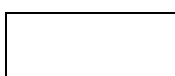
Reinforcing (brickforce) of an approved manufacture shall be placed on **every** fifth course in all brick walls. In halfbrick and cavity walls 80mm wide reinforcing mesh shall be used and 150mm wide mesh in the case of the one-brick walls.

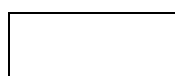
#### PA5.1.6 Plasterwork

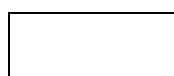
All chases must be cut and electrical conduiting and boxes fixed before any plastering is done. On no account will chasing be allowed in finished plaster work, and if such chasing is necessary, the entire wall surface must be hacked off and replastered.

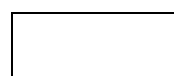
Except where otherwise described, all external plaster is to be finished with a wooden float and all internal plaster is to be finished with steel trowel, all to perfectly true and even surfaces, free from tool marks and other defects on completion.

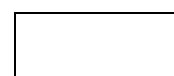
All finished surfaces are to be protected from injury. All joints in brickwork are to be well raked out, all surfaces, brickwork and concrete, to be plastered must be brushed down to remove all dirt and dust and be thoroughly wetted directly before plastering. Concrete surfaces must be roughened or hacked as necessary to give a proper key for plaster. The surfaces must then be slushed with coarse cement grout before plastering is commenced. The surfaces of all internal plaster must be steel trowelled to a smooth even and true finish. External plaster must be finished to a true and even surface with wood float. Plaster must be returned into reveals and soffit of openings and all angles and edges must be true and straight. All plaster surfaces must be free from blemish and any cracks, blisters, or other defects must be cut out and made good and the whole left perfect at completion. Plaster on walls must be not less than 12mm

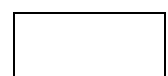
  
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or more than 20mm in thickness, and plaster on concrete work must be not less than 10mm or more than 15mm in thickness, except where specifically otherwise described.

#### PA5.1.7 Slip joints

Slip joints shall be provided between brickwork and concrete slabs and beams by level-lining up and steel trowelling smooth the bearing surfaces of brickwork with 3:1 mortar and covering the bearing surface before concrete is cast with 2 layers of 0,500mm (five hundred micron) black general purpose sheeting membrane.

The ends and sides of beams and edges of concrete slabs shall be separated from the brickwork with 12mm polystyrene placed vertically against the brickwork before the concrete is cast.

#### PA5.1.8 Beam filling

Unless otherwise specified, beam filling shall be half brick thick, built in cement mortar, cut in between roof timbers and carried hard up to underside of roof covering and flushed up in mortar with a groove formed between covering and mortar. Care shall be taken to protect cladded surfaces from mortar, prior to beam filling.

#### PA5.1.9 Securing of Roofs

Roof plates shall be fixed to walls with bands of 1,6mm thick galvanised hoop iron, 32mm wide, built six (6) courses deep into brickwork or embedded 300mm deep into concrete, at not exceeding 1,5 metre centres, and well lapped and spiked to plates and to roof trusses where adjacent, otherwise taken up to and lapped round the nearest purlin and well spiked thereto. A layer of brickforce shall be provided at each alternate course above the building in of the hoop iron to fix the roofs.

#### PA5.2 **Rainwater Goods**

All gutters, downpipes and flashings shall be 0,6mm thick galvanised sheet iron. Rates for sheet iron eaves gutter and rainwater pipes shall include for short lengths and for lapped, rivetted and soldered joints. Eaves gutters are to be screwed or welded to fascia boards or roof timbers/beams with 38x3mm galvanised mild steel gutter brackets at approximately 900mm centres, or as otherwise described. Rainwater pipes are to be fixed with sheet iron ears to and including 25x76x150mm wrot and chamfered hardwood blocks, plugged to brickwork or concrete and oiled, or with 38x14 gauge galvanised hoop iron straps built into walls not more than 2 meter apart, bent around pipe and bolted at back.

Flashings shall be properly cut, lapped and shaped to render a waterproof finish. Flashings turned up against walls must be finished with cover flashings bent to shape, dressed over the underflashing and with top edge wedged into joint of brickwork and pointed or secured by other approved means.

Asbestos-cement fascias and barge boards shall be secured with screws or bolts. Where joints occur in the length they are to be covered with two channels 40mm girth with web to suit thickness of plates formed from 0,5mm thick galvanised sheet iron cut to shape, bent as required and with the webs rivetted together back to back. Tongues 15mm wide by 15mm long must be left projecting at both ends of flanges and clamped down over edges of fascias or barge board when in position.

#### PA5.3 **Paintwork**

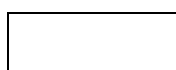
All surfaces not being painted, such as face brickwork, sills, floors and stained woodwork, must be covered up and protected against paint and distemper sports before any painting is commenced. All floors must be swept clean and walls dusted down before any paintwork is commenced and no sweeping or dusting must be done while painting is in progress.

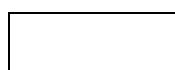
All plastered wall; ceiling and similar surfaces must be perfectly dry and in a fit state to receive the finishings, before the work is put in hand.

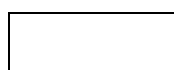
All coats of paints, etc. must be thoroughly dry before subsequent coats are applied, and rubbed down where necessary.

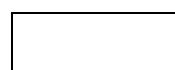
All work must be finished to colours approved by the Engineer.

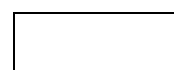
The tints of undercoats must approximate those of the finishing colour and in order to indicate the number of coats applied and to avoid misses when applying a succeeding coat a slight difference shall be made in the tint of each coat.

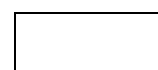
  
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The Contractor must provide all necessary dust sheets, covers, etc., and shall exercise all necessary care to prevent marking the surfaces of joinery, walls, floors, glass, electrical fittings, etc., and must keep all parts of the works perfectly clean and free at all times from spotting, accumulation of rubbish, debris or dirt arising from the painting operations. Any surface disfigured or otherwise damaged must be completely renovated or replaced as necessary, by the Contractor at his own expense. The premises must be left clean and fit for occupation at the completion of the work.

#### **PA5.4 Floor Finishes**

Where a floated concrete floor finish is specified on the drawings, the requirements of SABS 1200G or GA, whichever is relevant, shall apply.

Granolithic finish to floors, treads and risers of steps, thresholds, landings etc., must be composed of two parts hard stone chippings; half part sand and one part cement, steel trowelled to a true and even surface. The granolithic must be laid before the concrete surface bed has matured, otherwise the surface of the concrete must be thoroughly cleaned with a wire brush and a coat of neat cement grout applied immediately before the granolithic is laid. The granolithic must be laid in panels not exceeding 6 m<sup>2</sup> in areas, and jointed to lines of panels and lined into smaller squares as directed with sunk V-joint. The joints between the panels should coincide with joints in the concrete surface bed, where these occur. No dusting on of colouring pigment will be allowed.

Terrazzo floor tiles shall be even in size and shape, free from cracks, chips, twists, blemished or other defects, uniform in colour and equal to samples to be submitted to and approved by the Engineer. Special care must be taken to preserve arises and faces during transit and handling. Pointing, etc.: Terrazzo floor tiles are to be bedded and jointed solidly in cement mortar and unless otherwise described, flush pointed on all exposed faces with semi-dry cement mortar pressed in. On no account must liquid grout be poured in. Terrazzo floor tile work must be well protected to prevent all possibility of damage or discolouration and thoroughly cleaned on completion.

Vinyl floor tiles shall be fixed on to a screed of thickness at least 25mm. The screed shall have a wood floated finish and shall be smooth with no obstruction greater than 3mm protruding and with the screeded surface level in such a way that no gap greater than 5mm would show underneath a 3m straight-edge or part thereof.

Vinyl tile adhesives shall carry the same product name as the vinyl tiles and the adhesives shall be applied as stipulated by the supplier.

The acceptable tolerance of the final tiled floor shall be similar to that specified for the screeded surface underlying the tiles.

#### **PA6 TOLERANCES**

Where tolerances are not specified in the clauses above those generally accepted as re-presenting good workmanship in the building trades shall apply.

#### **PA7 TESTING**

The Engineer reserves the right to order any tests, whether at place of manufacture or on site, necessary to evaluate the quality of the work and to ensure the finished building conforms to all the specified requirements.

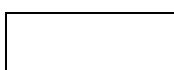
#### **PA8 MEASUREMENT AND PAYMENT**

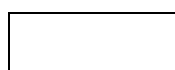
##### **PA8.1 Schedule Items**

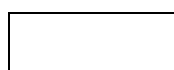
###### **PA8.1.1 Brickwork**

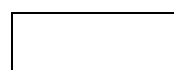
Brickwork, if measured as a separate item, shall be measured in square metre of the nett brick-walled area (with the wall width and type of brick-finish, indicated). No deductions will be made for small openings such as air bricks, etc. The tendered price per square metre of brickwork shall include also for the following:

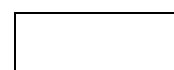
- a) Brick forcing (every fifth layer)
- b) Reinforcing of lintols
- c) Miscellaneous items built into brickwork shown on the drawings such as air bricks.

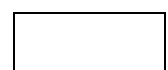
  
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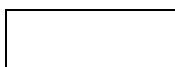
  
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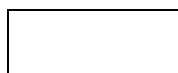
PA8.1.2 Wall, ceiling, roof and floor finishes

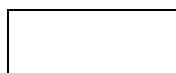
Cement plaster on walls and ceilings, roof screeds, floor screeds, paint and any other finish described or specified, shall if measured as separate item be measured in square metre of the nett surface area. No deductions shall be made for small openings nor shall additions be made for small protrusions and reveals. No separate payment shall be made for the processes involved and material supplied for the complete painting of all fixtures and fittings, as specified herein and the costs thereof shall be included in the tendered price for the supply, manufacturing and erection of all such items to be erected.

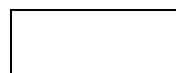
PA8.1.3 Miscellaneous

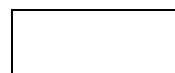
- a) Doors and windows shall be measured per unit of door or window complete with door frame, lock keys, glazing, painting, etc., for each type and size of door or window or as a lump sum payment for all doors and windows included in the door and window schedule of the Works.
- a) Other items of building work, fixtures and fittings, shall be measured and paid for in the units of measurement listed in the Schedule of Quantities.

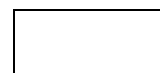
  
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## **PB CORROSION PROTECTION OF STEEL PIPES AND FITTINGS**

### **PB1 SCOPE**

This specification covers various corrosion protection systems for steel pipes for the conveyance of water at ambient temperatures.

### **PB2 EXTERNAL COATING SYSTEMS**

#### **PB2.2 Epoxy Paints**

For surface preparation, abrasive blast cleaning to SA 2,5 of ISO 8501:1:1988.

Copon EP 2300, Copon KSIR 88, Sigmaguard EHB and Carboline 891 have to comply to SABS 1217 Type 1A, with a dry film thickness of 300 µm.

Copon Solvent Free Hotcote has to comply to SABS 1217 (1984) Type 1C with a minimum dry film thickness of 350 µm and maximum 500 µm..

Fusion Bonded Epoxy coating systems shall comply to SABS 1217 Type 2 with a dry film thickness of 300 µm.

The epoxy coatings shall not be immersed within the following periods after application:

- a) Copon EP 2300 : 28 days
- b) Copon KSIR 88, Copon Hotcote and Copon Repair Kit (EPR1 & EPR3) : 7 days
- c) Sigmaguard EHB : 10 days (5°), 5 days (15°), 3 days (20°)

Repair on epoxy linings which have to be put into operation within 7 days, have to be repaired with Hycote Code 151 JHC 21.

Edges with epoxy paint shall have a radius of 3 mm or 50% of the pipe wall thickness (smaller of two).

Epoxy paint lining shall continue around pipe edge for each of the following:

- a) Flanged end onto both flange faces, extending for 50 mm (min) onto pipe outer wall beyond flange.
- b) Ends suitable for straight or stepped couplings or flange adaptors onto pipe outer wall for 250 mm (min) from pipe end.
- c) Ends suitable for flange adaptors, incorporating a restraining flange onto pipe outer wall from pipe end, up to and including both faces of the restraining flange as well as 50 mm (min) beyond the restraining flange.

The Contractor has to supply to the Engineer the necessary equipment for accurate measurement of paint thickness and pin holes.

Apply Plascothane recoatable enamel code CPC 3 000 series as a top coat on Copon exposed to the sun.

#### **PB2.3 Hot-dip Galvanize**

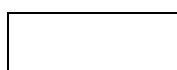
Unless otherwise specified steel pipes smaller than 150 mm dia shall be hot-dipped galvanized. Hot-dip galvanizing to be in accordance with SABS ISO1461 and 14713 except that minimum thickness shall be 105 micron. Cut ends and small damaged areas shall be repaired by the application of a zinc-rich epoxy (single pack) to the same standard (ZINC GALV 1 - Dulux or POLY GALV - Plascon).

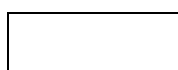
Only heavy duty galvanizing will be approved and all items to be provided with a SABS approval certificate.

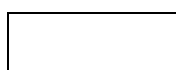
#### **PB2.4 Denso HT Petrolatum Tape**

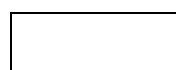
Chip off weld scale and remove grease, then wire brush to remove all loose rust, burnt bitumen/coal tar enamel and dirt to a Standard St 2 of SIS 055900 (Swedish Standard).

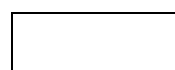
Chamfer any raised edges or steps in the existing coating.

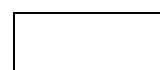
  
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Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
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## Apply Denso Priming Solution

Apply Denso HT Tape of appropriate width uniformly in a spiral fashion to provide a 55% overlap on the pipe and for not less than 200 mm along the length of the intact factory coating.

Apply uniform tension to ensure the tape is smooth and free from wrinkles. Do not apply excessive tension that will stretch the tape nor insufficient or uneven tension that will give rise to air bubbles and wrinkles.

### For flexible coupling and flanges

Apply Denso Mastic so as to create a smooth profile suitable for over-wrapping. Wrap a suitable width of Denso HT Tape over the coupling. Ensure that there are no air voids under the tape. Apply a double layer of Denso Layflat polyethylene sheeting over the whole length of the repair and for 100 mm beyond each end of the repair. Tape the ends of the Layflat with two complete turns of 100 mm wide adhesive Denso PVC tape to seal the ends.

Denso fabric baked mastic blanket can be used as an alternative for Denso HT Tape. After priming, pack potential air void areas such as under the bolts with Denso Mastic. Place the Mastic Blanket in position and press it for all air voids. Start under the pipe and work upward. Over wrap the Mastic Blanket with two layers of Denso Layflat sheeting and secure the ends with 100 mm wide adhesive Denso PVC tape.

If the pipe runs through very wet soils it is recommended that Denso S105 Paste be used in preference to Denso Priming Solution, and the coupling be wrapped with Denso PVC Self Adhesive Tape using a 55% overlap in place of Layflat Sheeting.

For welded joints and straight pipe lengths

After completion of Denso HT Tape wrapping and approval by the Engineer, apply 0,3 mm adhesive PVC outerwrap with 55% overlap over the whole length of the wrapping and for 100 mm beyond each end.

All flanges, couplings and flange adaptors in contact with soil shall be protected with Denso HT Tape.

## **PB2.5 External Protection of Pipes, Valves and Fittings in Valve Chambers**

### PB2.5.1 Protection in the Workshop

Abrasive blast cleaning to Grade Sa 2½ of ISO 8510: 1: 1988. The anchor pattern profile achieved shall be angular and of magnitude 30 µm minimum and mean 50 µm unless otherwise specified for a particular primer. Apply one coat of Plascon recoatable Epoxy MIO Primer EPH11 at 125 µm DFT.

### PB2.5.2 Patch Repairs of Primer after Installation

Wash all primed surfaces with a suitable detergent (Plascon Aquasolv) or equivalent, and water to remove all traces of mud, grease, dirt any other deleterious matter. Rinse with clean water to ensure no traces of detergent remain on the surfaces.

Areas of damage exposing the underlying metal must be thoroughly cleaned by mechanical wire brushing to remove all traces of corrosion products.

Areas without a factory primer must be cleaned with Derostan 24 that can be diluted with water as per manufacturer's instructions.

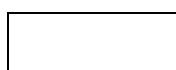
Patch repair with Plascon EPH11 (125 µm).

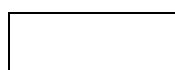
### PB2.5.3 Top Coats after Installation

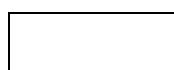
Unless top coats are applied immediately after the patch priming, wash all surfaces with detergent (Plascon Aquasolv) and water, rinse and dry.

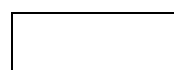
Apply two separate coats of solvent borne, mineral and fibre filled bituminous solution (ABE Super Laykold) to a dry film thickness of 300 µm per coat. Application shall be by stiff brush or airless spray.

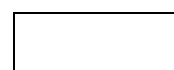
The application shall overlap at least 50 mm onto the coating or wrapping of the incoming pipe, where applicable.

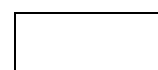
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

#### **PB2.5.4 General Notes**

The applications of all coatings shall be in strict accordance with the respective paint manufacturer's recommendations. Particular note shall be taken of over coating and curing procedures and times.

#### **PB2.5.5 Additional external protection for pipes cast into chamber walls**

After the concrete has cured for 7 days, wire brush or scabble the exterior and interior surfaces of the wall to remove laitance. Dry brush to remove all loose powder.

Mix ABE Super Laykold and water (1:1 ratio) and apply as a primer to the concrete and the pipe surfaces. After  $\pm$  1 hour apply a thick coat of ABE Super Laykold to the concrete and the pipe and immediately embed 250 mm wide ABE non-woven Polyester membrane 'SBP' into the Super Laykold. After  $\pm$  3 hours apply another coat of Super Laykold.

This additional protection is required on the inside and outside of the walls.

### **PB2.6 External Protection of Pipes and Fittings above Ground**

#### **PB2.6.1 Protection in the Workshop**

Abrasive blast cleaning to Grade Sa 2½ of ISO 8501: 1: 1988. The anchor pattern profile achieved shall be angular and of magnitude 30 µm minimum and mean 50 µm unless otherwise specified for a particular primer. Apply one coat of Plascon recoatable Epoxy MIO Primer, EPH11 at 125 µm DFT.

#### **PB2.6.2 Patch Repairs of Primer on Site**

Wash all primed surfaces with a suitable detergent (Plascon Aquasolv) or equivalent, and water to remove all traces of mud, grease, dirt and any other deleterious matter. Rinse with clean water to ensure no traces of detergent remain on the surfaces.

Areas of damage exposing the under laying metal must be thoroughly cleaned by mechanical wire brushing to remove all traces of corrosion products.

Patch repair all primer damage with Plascon EPH11 (125 µm).

#### **PB2.6.3 Protection on Site**

Unless topcoats are applied immediately after patch priming, wash all surfaces with detergent (Plascon Aquasolv) or equivalent and water, rinse and dry.

Apply one coat ABE Super Laykold to a dry film thickness of 300 µm and one coat bitumen aluminium paint (ABE Silvakote) to dry film thickness of 20 µm.

All damaged protection after installation shall be restored to Engineer's approval.

### **PB2.7 Pipes and Fittings Partially above Ground**

Apply Denso SS Primer.

Apply Denso Fabric Backed SS Tape, using a minimum of 300 mm overlap. Apply only sufficient tension to ensure a smooth wrap, without stretching the tape.

Saturate the fabric backing on tape with Denso Base coat, a cementitious latex, at a spread of 2 kg/m². The aid of a fluted aluminium roller is recommended to assist with the full saturation of the fabric.

Allow 24 hours to cure if overcoating with a water-based product, or 48 hours if overcoating with a solvent based top coat.

Apply one coat ABE Super Laykold to a dry film thickness of 300 µm and one coat bitumen aluminium paint (ABE Silvakote) to dry film thickness of 20 µm.

### **PB2.8 External Protection of Pipes and Fittings in Buildings**

#### **PB2.8.1 Protection in the Workshop**

Abrasive blast cleaning to Grade Sa 2½ of ISO 8501 : 1 : 1988.

The anchor pattern profile achieved shall be angular and of magnitude 30 µm minimum and mean 50 µm unless otherwise specified for a particular primer. Apply one coat of Plascon recoatable Epoxy MIO Primer, EPH11 at 125 µm DFT.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PB2.8.2 Patch Repairs of Factory Applied Primer and Apply Universal Coat on Site**

Wash all primed surfaces with a suitable detergent and water to remove all traces of mud, grease, dirt and any other deleterious matter. Rinse with clean water to ensure no traces of detergent remain on the surfaces.

Areas of damage exposing the underlying metal must be thoroughly cleaned by mechanical wire brushing to remove all traces of corrosion products. These areas must be patch primed as specified in PB2.9.2.

**PB2.8.3 Alkyd Enamel Based Finishing Coats**

Apply two alkyd-based enamel finishing coats to SABS 630 Grade 1 (dry film thickness 25 mm each). Final colour will be as specified by the Engineer.

**PB3 INTERNAL LINING SYSTEMS**

**PB3.1 Cement-Mortar Lining**

Section PJ of the Particular Specification covers the Cement-Mortar lining of pipes.

**PB3.2 Epoxy Paints**

Refer clause PB2.2.

For surface preparation, abrasive blast cleaning to SA 3 of ISO 8501:1:1988.

**PB4 GENERAL**

The Contractor shall submit the name of the company, which will do the corrosion protection to the Engineer for his approval.

The area at welded joints to be repaired on site is:

Coating : 200 mm wide  
Lining : butt weld joint - 100 mm wide  
spigot & socket joint - refer Project Specification.

**PB5 BOLTS, NUTS AND WASHERS**

**PB5.1 Bolts, Nuts and Washers for Exposed Flanges and Couplings**

All bolts, nuts and washers which will be exposed after installation (e.g. in valve chambers, pump stations, etc) shall be hot-dip galvanized in accordance with the requirements of SABS ISO 1461 and SABS 14713 (as amended), for heavy duty applications unless otherwise specified.

**PB5.2 Bolts, Nuts and Washers for Buried Flanges and Couplings**

Unless otherwise specified, all bolts, nuts and washers for flanges and couplings which will be buried after installation shall be hot-dip galvanised in accordance with the requirements of SABS ISO 1461 and SABS 14713 (as amended) for heavy duty applications. These flanges and couplings shall be protected with Denso HT Petrolatum Tape as specified in paragraph PB2.4.

**13. PARTICULARS OF REQUIRED ELECTRICAL WORK**

**PC1 SCOPE OF WORK**

The scope of work is as per the items the listed in the schedule of quantities.

**PC2 GENERAL INFORMATION**

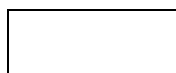
The general technical specification covers the manufacture, installation, testing and commissioning, as well as Equipment and material used for electrical installations. These requirements shall be read in conjunction with the Standards and Codes as specified below

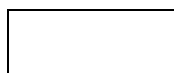
**PC3 STANDARDS AND CODES**

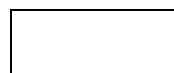
Where reference is made to any code of practice or standard specification the latest amendment or edition shall apply. The Contractor shall ensure that it is acquainted with the contents of such documents. The following documents will be applicable:

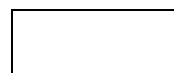
The Machinery and Occupational Safety Act, Act No 6 of 1983.  
SANS 1507 – Electric Cables

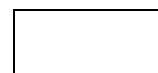
  
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Employer

  
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SABS 0225-1991  
SABS 657  
SANS 2001-CSI

SABS 03  
SABS 044  
SABS 763  
SABS 171  
SABS 754  
SABS 1418 Parts 1 and 2

Installation Work shall be carried out in full compliance with the mentioned codes of practice and also in accordance with good engineering practice.

All materials and Equipment shall be new and of high quality which complies with the relevant standard specification, and other standard specifications as may be applicable from instance to instance. The Contractor shall ensure compliance with these specifications and if requested by the Engineer, shall prove compliance at its own cost.

#### PC 4 REGULATIONS

The manufacture of Equipment and the complete installation shall be carried out and tested in accordance with the latest issues or amendments of the following regulations, as applicable:

SANS Code of Practice 10142 for the Wiring of Premises.

The National Building Regulations.

The local Municipal By-laws and Regulations as well as the regulations of the local Supply Authority.  
The Standard Regulations of any Government Department or public service company where applicable.

The local Fire Regulations.

Johannesburg Water Internal Regulation and Requirements

#### PC 5 INSTALLATION WORK

It shall remain the Contractor's responsibility to carry out the Work in accordance with this document, to provide the logistics and infrastructure required for the Works, to provide adequate fulltime supervision at the Works, to programme and manage the Works, to ensure compliance with codes, standards and regulations, to provide registered and qualified Site staff at all times and in accordance with the Applicable Laws.

The Engineer shall inspect the installation from time to time during the progress of Work. Discrepancies will be pointed out to the Contractor and these shall be remedied at the Contractor's expense. Under no circumstances will these inspections relieve the Contractor of his obligations in terms of this Tender nor will these inspections be regarded as final approval of the Works or portions thereof.


Where the Engineer has appointed a full-time representative at the Works, this representative shall not be regarded as relief of the Contractor's obligations in terms of the documents.


The Contractor shall notify the Engineer timeously when the installation reaches important stages of completion (e.g. before closing cable trenches, before casting concrete, etc.) so that the Engineer's representative may schedule his inspections in the best interest of all Parties concerned. Failure to do so may result in the Engineer instructing the Contractor to re-open trenches, etc. at the Operator's cost, so that inspections may be carried out at a later stage.


The Engineer's inspection shall only be carried out after the Contractor has carried out his own preliminary inspections to ensure that the Works are completed and comply with the documents. The Engineer's inspection shall therefore not be regarded as supervision, fault listing, quality assurance or Site management.


#### PC 6 MATERIAL AND EQUIPMENT


All material shall be of high quality and suitable for the conditions on Site. These conditions shall include weather conditions as well as conditions under which materials are installed, stored and used. Should the materials not be suitable for use under temporary Site conditions, then the Contractor shall at his own cost provide suitable protection until these unfavourable Site conditions cease to exist.


  
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Witness 2



The Contractor shall where requested to do so, submit samples of Equipment and material to the Engineer for his approval prior to installation. Samples may be retained in the Engineer's possession until the Termination or Expiry of this Tender after which they will be returned.

Imported material or Equipment shall only be used in lieu of locally manufactured material or Equipment, when imported Equipment or material is specified in this Tender or the Engineer issues written approval for the use of imported material or Equipment. Even in such a case, the Contractor shall inform the Engineer if locally manufactured Equipment or material that can successfully replace specified imported material or Equipment becomes available during the course of the installation.

PC 7 WORKSHOP DESIGNS AND DRAWINGS

The Contractor shall submit to the Engineer detailed or workshop drawings of all items to be manufactured, assembled or installed, for approval, prior to the commencement of the manufacture or construction of such Works.

PC 8 SAFETY PRECAUTIONS AND REQUIREMENTS

The Contractor will be responsible for the safety of its personnel on site. All Applicable Laws shall be strictly followed in this regard and all the necessary precautions and measures shall be taken to ensure the safety of personnel, the public and equipment.

As work is to be carried out in close proximity to live operational equipment, the Contractor will ensure that only suitably qualified personnel are employed on site. The Contractor will provide CVs of all personnel he intends to use on site. The Engineer will veto the appointment of any person he deems un-qualified to work in the environment. This does not absolve the contractor of any responsibility in this regard.

The Contractor will liaise closely with the client's responsible engineer on site in order to familiarise himself with local site conditions. The Contractor will provide the engineer with a training schedule for workers prior to work commencing.

PC 9 ENGINEER'S DRAWINGS

The electrical drawings and schedules are of a schematic nature and unless specific dimensions to electrical equipment are shown, these drawings shall not be scaled to determine physical dimensions or position and fit. The Contractor will at all times satisfy himself of the accuracy of the drawings supplied, and no responsibility for the accuracy thereof is assumed or accepted by the Engineer.

PC 10 EQUIPMENT TO BE USED

**Copper Cable**

All equipment used shall be approved by the Engineer.

**Joints and terminations**

PC 11 LOW VOLTAGE CABLES

This section covers the installation of cables for the distribution of electrical power in soil, buildings and structures for system voltages up to 1 kV at 50 Hz.

All cables shall be new and unused and unless cables are made to order, only cables from fresh stock shall be supplied.

All PVC SWA cables shall be manufactured according to SANS 1507-3.

All other insulated wire shall be manufactured to SANS 1411 parts 1 and 2.

Cables and wire will be of local manufacture, Aberdare or similar and equal.

Cables shall be manufactured and supplied in one length to the required lengths unless these lengths exceed a standard drum length, in which case a ruling shall be obtained from the Engineer.

Unless otherwise specified herein or approved, cables with copper conductors shall be used throughout.

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Copper conductors shall be of high conductivity annealed or hard-drawn stranded copper and the cores may be shaped or circular but the cross-sectional area of each conductor shall not be less than that specified herein.

Unless otherwise specified herein or approved, all un-armoured cable shall be installed in metal trunking, sleeves or conduit.

PC 12 COMPETENCE OF PERSONNEL

It is a definite requirement that the Contractor shall only employ personnel fully conversant with the cable manufacturer's recommendations to lay, joint and terminate cables.

Cables and cable accessories shall be installed in accordance with the manufacturer's installation instructions.

PC 13 CABLE TERMINATIONS

General

Connection of cables to switchgear shall always be effected in such a way that the various phases, seen from the front of the switchgear will be in the following positions where practically possible:

- conductor no 1            left (red)
- conductor no 2            centre (white)
- conductor no 3            right (blue)

Exposed armouring is not acceptable.

All cable ends shall be supplied with the necessary earth connection.

A P4000 channel or other approved means of support shall be provided to remove mechanical stress from the glands.

Cable cores shall be marked with heat-shrunk sleeves where necessary to identify the phases. Refer to clause 5.2.1 (d) of SANS 0142.

The current-carrying capacity and breakdown voltage of the cable end shall be the same as for the complete cable.

Cables shall be terminated in accordance with the recommendations laid down by the manufacturers of the cables and glands employed.

**Cable Terminations with Heat-shrinkable Materials**

The complete kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable.

An illustrated set of instructions for the installation of the materials shall accompany every kit.

The terminations shall make minimal, if any, use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk on to the terminations is preferred above other methods.

The kits shall include suitable boots for the covering of the terminal studs on the Equipment. The ends shall be terminated strictly in accordance with the termination manufacturer's specification and shall withstand the same test voltage as the rest of the cable.

The materials shall comply with VDE 0278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials or installation.

The heat-shrinkable and other materials used for the terminations shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

Terminations shall be made of a material that gives lasting protection against ultra-violet radiation.

The cores of all cables terminated outdoors and the cores of 3,3 kV and higher voltage cables terminated indoors, shall be completely covered with a shrunk-on protective layer against surface tracking, ultra-violet radiation and weathering.

Outdoor terminations shall be designed to prevent flash-over under wet or contaminated conditions and to ensure additional mechanical strength. This shall be achieved with shrunk- on insulating spacers and rain sheds.

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Heat shrinkable termination kits of the "RAYCHEM" type shall be used for all high voltage (above 1 kV) terminations and shall be applied strictly in accordance with the manufacturer's recommendations.

#### PC 14 CONNECTION OF CABLE CONDUCTORS

When cutting away insulation from cable conductors to fit into lugs, care shall be taken that no strands are left exposed. Under no circumstances may any of the conductor strands be cut away to fit into lugs.

Care shall be taken to ensure that copper strand is not damaged or scored.

Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductors, need not be lugged, but the correct size terminals shall be used.

Ferrules shall be used where cable conductors are connected directly to Equipment with screws against the conductor strands.

Suitable lugs shall be used and shall preferably be solidly sweated to cable conductor ends. Lugs may be crimped using mechanical, hydraulic or pneumatic tools specifically designed for this purpose, on condition that evidence is submitted that the system used complies with the performance requirements of BS 4579, Part 1, "Compression joints in copper".

Lugs crimped to cable with a cross-sectional area of more than 16mm<sup>2</sup> shall entail the use of either pneumatic or hydraulic crimping tools. Under no circumstances may a lug be crimped by means of a hammer and/or punch.

Lugs crimped to aluminium shall be subjected to thorough inspection with relation to the material and quality of crimping by the Engineer.

Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug and shall be manufactured of cadmium plated high tensile steel.

#### PC 15 CABLE JOINTS

##### **General**

Joints in cable runs will not be allowed unless authorized by the Engineer.

Jointing shall only be carried out by personnel competent in jointing the types of cable used and shall be carried out strictly in accordance with the manufacturer's instructions.

The Contractor shall notify the Engineer timeously of the day on which jointing is to be carried out in order that an inspection may be arranged if so required. Any cable joint not inspected by the Engineer because of insufficient notice being given, shall be opened for inspection and redone at the discretion of the Engineer at the cost of the Contractor.

During outdoor jointing operations, the joint bays shall be adequately covered by tents of waterproof material suitable supported. When necessary, a trench shall be excavated around the bay to prevent the ingress of moisture. The sides of the hole shall be draped with small tarpaulin or plastic sheeting to prevent loose earth from falling in during jointing operations.

Joints shall be fully waterproof and airtight and shall be free of voids and air pockets.

The joint shall not impair the anti-electrolysis characteristics of the cable.

The crossing of cores in joints shall not be permitted under any circumstances.

The electrical continuity of all the conductors, screens and armouring shall not be impaired by the joints and the earth continuity shall be accomplished within the joints, i.e. no external earth continuity conductor that will be subject to corrosion, is acceptable. The joints shall be completely covered by a watertight sheath to prevent corrosion.

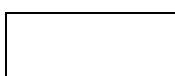
In the case of joints in cables with an outer PVC anti-electrolysis sheath, the joints shall be subject to the same electrical insulation test as the outer sheath of the cable.

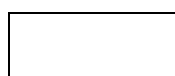
Low voltage cable joints shall be of the epoxy resin type.

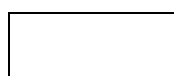
High voltage cable joints shall be of the heat shrinkable type.

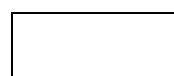
##### **Cable Joints with Heat Shrinkable Materials**

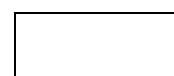
The complete joint kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable.

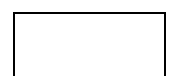
  
Tenderer

  
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Witness 2

  
Employer

  
Witness 1

  
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An illustrated set of instructions for the installation of the materials shall accompany every kit.

The joints shall make minimal, if any, use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk on to the joint, is preferred above other methods.

The materials shall comply with VDE 0278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials or installation.

The heat-shrinkable and other materials used for joints shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

Heat-shrinkable joints kits of the RAYCHEM type shall be used for all high voltage (above 1 kV) joints.

Where cable joints are required to be made in the course of a cable run, a joint hole shall be excavated of sufficient size to enable the cable jointer to work efficiently and unimpeded.

## PC 16 CABLE AND CABLE ROUTE IDENTIFICATION

Cables shall be identified at all terminations (both ends). The identification of HV cables installed in cable ladders, ducts or to structures shall be to SANS 0142, Clause 7.1.3(c).

All cables shall be marked with the "OVALGRIP" markers with the international colour code secured to the cable with "INSULOK" cable ties as distributed by "BOWTHORPE-HELLERMANN-DEUTSCH (PTY) LTD" or exact equivalent approved by the Engineer.

The use of PVC tape with punched characters or punched metallic bands or tabs is not acceptable.

The identification number of cables shall be shown on the "as built" drawings of the installation.

Cable route markers shall consist of concrete blocks in the shape of truncated pyramids, approximately 300 mm high, 150 x 150 mm at the top and 250 x 250 mm at the bottom.

Aluminium plates shall be cast into the top of the blocks in such a manner that they cannot be pried loose. The wording "ELECTRICAL CABLE" shall be stamped on the plates as well as direction arrows and the cable voltage rating.

Cable markers shall be installed on the surface along all the underground routes and shall project 35 mm above normal ground level unless the projected markers could be a hazard to pedestrian or other traffic in which case they shall be installed flush with the surface.

Cable markers shall be installed at the beginning and ending of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all Joints, above cable pipe entries and exits and at intervals not exceeding 50 m along the cable route and at each cable joint.

The position of cable markers shall be indicated on the "as built" drawings.

## PC 17 INSTALLATION OF CABLES IN PURPOSE-BUILT TRENCHES (CABLE DUCTS)

### General

This paragraph covers the installation of cables in building trenches, service ducts, etc.

The trenches, ducts, etc. inside buildings will be constructed and installed by others.

### Installation

Cables shall be installed in one of the following ways:

- On horizontal cable trays;
- On vertical cable trays or metal supports fixed to the side of the trench. Cables shall be clamped in position; and
- Buried in ground.

Cables shall not be bunched and laid on the floor of purpose built trenches.

### Covers

The covering of concrete trenches shall as a rule fall outside the scope of the electrical installation. The Contractor shall, however, be responsible for the cutting or drilling and smoothing of holes for cables through chequer plates, concrete or other coverings as required.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Cables shall enter and exit the trench through sleeves protruding 300 mm beyond the covering. The sleeves shall be permanently secured in position and the open space between the cable and sleeves shall be sealed with a non-hardening, watertight compound.

**Filled Trenches**

Where specified herein, floor trenches shall be filled with sand.

If a sand filling is specified, the cables shall be fixed to non-corroding supports.

Sand-filled trenches other than in substations shall be covered in one of the following ways:

- Reinforced concrete covers;
- Sand and cement screed; and
- Removable chequer plates.

Reinforced concrete covers shall be used where vehicular traffic may be encountered over trenches. Unless otherwise specified herein, allowance for a mass of 2 tons shall be made.

**PC 18 INSTALLATION OF CABLES ON TRAYS, LADDERS AND STRUCTURES**

**Installation**

Cables may be installed in one of the following ways:

- on horizontal cable trays or ladders with purpose-made clamps;
- against vertical cable trays or ladders with purpose-made clamps;
- against horizontal or vertical metal supports or brackets with suitable clamps;
- with clamps which are fixed to the structure.

**Clamps**

On horizontal or vertical cable trays, cables shall be secured by means of "INSULOK" or "PULLTITE" cable ties with maximum spacing as specified in Table 1 below.

On horizontal or vertical cable ladders, cables shall be secured by means of purpose-made, hot dip galvanised, "K"-clamps. This however, does not apply to single core cables.

Where cables are secured to channels cast in concrete, purpose-made hot dip galvanised, "K"- clamps shall also be used. This, however, do not apply to single core cables.

Suitable clamps (cleats) which will secure cables without damage shall be used. Clamps shall consist of adjustable metal wings which clamp to a metal support, or consist of two halves that are bolted together. Wooden blocks shall only be used in exceptional circumstances with the approval of the Engineer. The correct clamp size to fit the cable shall be used. Cables of different sizes may only be fixed by a common clamp when the clamp is specially made to accommodate the various cables.

**Spacing of Supports**

**General**

The most generally known method of supporting cables is the restrained installation where the distance between supports is small enough to prevent any noticeable sag in the cable. Unless otherwise specified herein, this method shall apply to all cable installations.

**Spacing of Supports of Restrained Cables**

The maximum spacing between cleats (clamps) to which cables are fixed in horizontal and vertical cable routes shall be determined from Table 1 below. Additional cleats shall be installed at each bend or off-set in the cable run. The maximum distance between supports or cleats for multi-core control cables shall be 20 times the outside diameter of the cable with a maximum spacing of 500 mm for unarmoured cables and 30 times the outside diameter of the cable with a maximum spacing of 1 m for armoured cables. A minimum of 20 mm ventilation clearance shall be maintained between cables and the wall to which they are cleated. Spacing of supports for cables for high voltage lighting shall be in accordance with Table 8 of SANS 0142.

Table 1: Maximum Spacing of Supports (Cleats) (mm)

Tenderer	Witness 1	Witness 2	Employer	Witness 1	Witness 2

FOR RESTRAINED CABLE				
Cross-sectional area of Cable conductors (mm <sup>2</sup> )	Wire Armoured Cables		Other than Wire Armoured Cables and Unarmoured Cables	
	Horizontal Cable Routes	Vertical Cable Routes	Horizontal Cable Routes	Vertical Cable Routes
1,5	500	750	300	400
2,5	500	750	300	400
4,0	600	750	300	400
6,0	600	750	300	400
10,0	750	900	400	500
16,0	750	1 000	400	500
25,0	900	1 000	400	500
35,0	900	1 000	400	500
Above 35,0	900	1 000	400	500

### Grouping and Spacing of Cables

Cables with a cross-sectional area of more than 16 mm<sup>2</sup> shall as a rule be spaced two outside cable diameters apart, for which no grouping correction factor need be applied.

Where parallel cable runs are installed at different levels (e.g. on parallel cable trays), and where the spacing of the layers is not specified, a minimum spacing of 300 mm shall be maintained.

High voltage cables shall be separated from other cables and services throughout the installation and shall as far as possible be installed in separate floor trenches, pipes or metal channels. Where this is not feasible, a minimum spacing of 500 mm shall be maintained.

Cables for telephone, communication and alarm systems and all other low voltage systems (less than 50 V), shall be separated from power cables. In building ducts a physical barrier shall be provided between power cables and cables for other services. Where armoured cables are used for such other services, they shall be at least 1 m away from power cables or shall be installed on separate cable trays. In the case where unarmoured cables are used for these other services, they shall be installed in separate metal channels or conduits.

Each cable shall be tested after installation in accordance with SANS 150 (up to 1 kV), SABS 97 and SANS 1339 (up to 11 kV), as well as the requirements of the Local and Supply Authorities.

The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests.

The Contractor shall notify the Engineer timeously so that he may witness the tests.

LV cables shall be tested by means of a suitable megger at 2 kV and the insulation resistance shall be tabulated and certified.

HT cables shall be pressure-tested in accordance with Table 2 and the exact leakage current shall be tabulated and certified.

Table 2 : Cable Pressures Testing

Cable Rating (kV)	TEST VOLTAGE (kV applied for 15 minutes)				
	Paper-insulated cables				XLPE-insulated cables
	Between conductors		Conductors to sheath		Conductors to screen
	AC (rms)	DC	AC (rms)	DC	DC
6,6	12	18	12	18	11
11	20	30	20	30	18

On completion of the tests on any cable, the Contractor shall without delay, submit 3 copies of the certified test reports to the Engineer.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

## PC 19 COMPLETION

The Engineer reserves the right to inspect the installation at any stage during the course of construction. Such inspections will, however, not deem the portions inspected as being complete or accepted and the Contractor shall remain responsible to complete the installation fully in accordance with this specification.

The Contractor shall carry out a final "as built" survey of the cable routes and present to the Engineer "as built" route plans of the complete installation.

The following information shall be reflected on the plans or submitted as separate schedules with the plans:

- overall length of each cable;
- locations of all joints (if any) in relation to permanent reference points;
- dimensions shall be shown and the method of triangulation, i.e. two dimensions for each joint, shall be used;
- the location of all cable markers in relation to permanent reference points; and
- identification numbers of all cables.

The Works will be deemed to be incomplete until all tests have been conducted and certified successfully and all "as built" drawings and schedules have been handed to the Engineer.

## PC 20 WIRING, STATERS, CONTROL BOARDS

### General

All wiring shall be done in accordance with the latest edition of SANS 10142-1:2003 as amended.

Any special requirement regarding the type and size of wiring to be installed in a specific installation shall be specified.

### Drawing in of Conductors

Wiring shall only be carried out after the wireway installation is completed, but before painting has commenced. No conductors shall be installed before the wireways have been cleaned of all debris and moisture. Wireways shall contain no sharp edges.

When conductors are drawn through conduit, care shall be taken that they are not kinked or twisted.

### Wiring Method

All wiring shall be carried out according to the loop-in system. When earth continuity conductors are looped between terminals of equipment, the looped conductor ends shall be twisted together and ferruled to ensure that earth continuity is maintained when the conductors are removed from a terminal.

When connecting more than one conductor in a terminal, the strands shall be securely twisted together. Under no circumstances shall strands be cut off.

### Size of Conductors

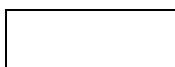
Where conductor sizes are not specified, the following minimum conductor sizes shall be used:

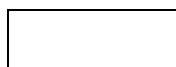
Lighting circuits	= 2,5 mm <sup>2</sup>
Plug circuits	= 4 mm <sup>2</sup>
All the above	= 2,5 mm <sup>2</sup> earth conductor
Motor circuits	= As specified

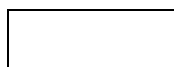
### Different Phases

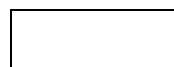
With the exception of three-phase outlets, circuits connected to different phases shall not be present at light, switches or socket-outlet boxes.

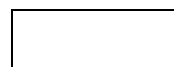
Control Boards

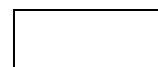
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

All control boards and panels shall be of the totally enclosed type IP54 and shall be dust, moisture and vermin proof.

Control boards shall be of cubicle construction, floor standing mounted and equipped with doors and locks complying with the Employer's requirements. The boards shall be manufactured from heavy plate of thickness not less than 2 mm.

All metal components of the board shall be degreased and sand blasted to remove all stains and rust. Thereafter, the metal shall be treated on inside and outside faces, with a zinc chromate primer and two coats of scratch and oil resistant "electric orange" enamel.

All boards shall be manufactured in accordance with SABS 1180. All face panels shall be fitted with concealed hinges and robust handle operated catches with key operated cylindrical locks.

One common key shall fit all locks and three keys shall be provided by the Contractor.

The system voltage shall be 400/230 volts, 3 phase, 50 Hz. All switchgear shall be designed to operate at 500 volts.

The board shall be designed to withstand a system fault level of 50 kV for 0.2 seconds.

The position and mounting of all control boards shall be in accordance with the Drawings.

#### ELECTRICAL FITTINGS

Busbars shall be enclosed to prevent access whilst energised. Busbars and connections shall comply with BS159 and shall, unless otherwise stated, be of copper and insulated throughout with coloured PVC sleeving or tape. Busbars shall be continuous throughout their length and not reduced in size. The neutral bar shall be full size. Busbars shall be rated at 1.5/ mm<sup>2</sup> based on the maximum current under starting conditions. No other cables shall be accommodated in the busbar compartment. Each cubicle shall be self contained and contain only the equipment for one circuit allowing it to be isolated whilst work is in progress on the equipment and without interference to other equipment. A continuous 20 mm x 5 mm earth bar, with a test link, shall be provided on the board. The bar shall be so located that all cable terminations can be earthed to it.

All metalwork shall be bonded by tinned copper conductors and connected to the main earth bar.

#### SWITCHES AND ISOLATORS

Switches and isolators shall be of the fault making /load breaking type having a continuous rating of not less than the full load rating of the equipment controlled. Switches and isolators shall comply with the requirements of BS 5419 or SABS 152.

All switches and isolators shall be housed in a separate enclosure and they shall be mechanically interlocked with the floor. Provision shall be made to padlock these in the "off" position.

#### FUSES AND CIRCUIT BREAKERS

Moulded case circuit breakers (MCCB) shall be rated to comply with the fault level of the system. They shall be continuously rated for the load of the equipment and shall be fitted with adjustable thermal and magnetic over current releases. MCCB's shall be manufactured in accordance with SABS 156. No MCCB with a fault rating of less than 5 kA shall be used. The mechanism shall be of the clinch free type to ensure that the unit does not remain in the "On" position in an over current situation.

Where MCCB's are utilised for the control of rotating machinery, they shall be equipped with low voltage releases.

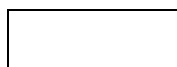
All fuses shall be of the HRC type and shall comply with SABS 172, with a rated breaking capacity of 31 mVA at 415 V 50 Hz at a power factor of 0.4. The fuses shall have a fusing factor of not less than 1.5.

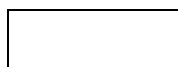
Main fuses shall be mounted on withdrawable fully insulated carriers.

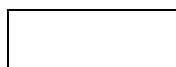
#### STARTERS

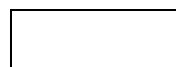
Motor starters shall comply with BS 587 or SABS 1092. Start and stop push buttons stations shall be provided on all starters. Stop buttons shall be of auto lock type mounted on the face panel and recessed to prevent inadvertent activation. All terminals shall be shrouded.

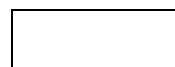
Motor starter coils, when remotely controlled, shall operate at 200/230 V, unless otherwise stated. The starter contactors shall be AC3 with Class 1V mechanical rating in accordance with BS775. Starter

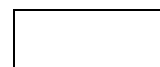
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2



contactors shall be equipped with a minimum of two standard open and two standard closed auxiliary contacts with a rating of 5A. Each motor starter shall be fitted with a pilot light indicating that the motor is running.

All starters shall be protected with an over current relay with single phasing prevention. The Over current relay shall be of the manual reset type and a pilot light shall be provided to indicate that the overload has tripped.

## RELAYS

Control relays shall be contained in a separate cubicle and shall be arranged in groups and compartments in such a manner that one group controlling one section of the panel can be worked on, while the other groups controlling other sections can be kept operative. Control relays shall be of the hermetically sealed type with plug-in pattern. Relays of 24, 48 and 220 V shall each have a different base so that they cannot be interchanged. One spare relay of each type shall be provided on delivery of the panel.

A flow switch with the required relay, in the delivery main of the two pumps, shall be provided for the automatic control of the pumps. The flow switch shall be connected to a delay relay, which shall de-activate the operating pump in the event of zero flow in the delivery pipeline.

To prevent hunting of the operating pump, a delay switch shall be installed for each pump that will allow the pump to remain operative for a pre-determined time after the flow switch has released to the off position. The flow switch shall be connected in a fail safe manner.

An emergency hand operated switch shall also be provided for the manual operation of each pump. A hydraulic pressure switch must be installed on the delivery main to switch the pump motor off with the closure of the mechanical valve at the reservoir. The hydraulic pressure switch shall be of the ASCO type adjustable from 4,1 to 41 bar with a maximum sustainable pressure of 140 bar, a fixed dead band of 0.8bar and a plastic watertight enclosure. The abovementioned parameters shall be checked against the pump set and system characteristics prior to purchase.

Each motor starter shall thus be equipped with the following facilities:

- Soft starter
- Phase failure protection
- Phase rotation protection
- Overcurrent protection
- Overextended starting time protection
- Hour meter
- Stop/start switches
- Over-temperature protection
- Emergency stop switch mounted at each motor
- Alarm to operate with "emergency stop", "Phase failure" and other motor protection activities
- Electrical interlocking allowing only one pump unit to run as specified.
- Flip flop system to interchange pumps
- No-flow protection
- Stopping of motor on the sensing of high pressure on delivery side of a pump
- Indicator lamps as specified
- Connection to the pump control valve

## PC 21 THE INSTALLATION OF SOCKET OUTLETS AND LIGHT SWITCHES

### General

All boxes shall be as described in SANS 0142 as well as to the various SANS or BS Codes referred to in SANS 0142.

Any special requirements relating to a specific installation shall be specified in the Contractor's detailed specification.

Boxes shall be manufactured of heavy gauge sheet steel and shall be hot-dipped galvanised. The boxes shall be fitted with the necessary lugs for the fixing of cover plates.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

The necessary knockouts shall be provided for proper terminations of conduit.

Surface mounted boxes shall consist of a metal switch box and cover plate specially manufactured for the purpose. Boxes shall be fixed to the surface as specified herein. All access holes shall be securely blanked off to render the installation vermin proof.

Circular group type boxes shall be of the long spout pattern manufactured of malleable cast iron and stove enamelled jet black or galvanised unless otherwise specified herein. The two cover fixing holes shall be diagonally opposite each other, drilled and tapped at 50 mm centres. The boxes shall be in accordance with SABS 162 as amended where applicable.

### **Appearance**

The sides of adjacent switches, plugs, pushbuttons, etc. shall be parallel or perpendicular to each other and uniformly spaced. A common escutcheon plate shall be used for flush mounted outlets and accessories where the cover plates do not cover the cut-outs in the finishes.

### **Cover Plates**

Bevelled cover plates which overlap the switchbox and which fit tightly against the wall finishes shall be installed in the case of flush mounted switchboxes. Suitable spiral type steelwire spacers shall be used to fix the cover plate to deep set flush switch-boxes. All fixing screws in cover plates and switch grids shall be supplied and securely fitted.

Cover plates shall be finished in ivory baked enamel, oxidised bronze, and aluminium or as otherwise specified, to match wall finishes.

Cover plates shall be in accordance with SANS 1084 as amended.

### **Cutting of Cover Plates**

Cover plates shall under no circumstances be cut unless specifically authorised in exceptional cases by the Engineer.

### **Building Lines**

All boxes and cover plates shall be installed parallel to and in line with the relevant, horizontal and vertical building lines.

### **Socket Outlets**

Mounting Heights

As specified.

Mounting

Waterproof Socket Outlets. Socket outlets that are exposed to the atmosphere or installed in damp areas, shall be rated at IP 56 or as otherwise specified.

### **Paint Specification**

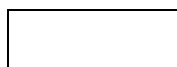
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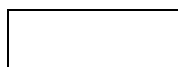
IP Rating

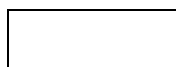
IP 65

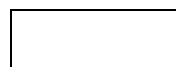
## **PC 22 MEASUREMENT AND PAYMENT**

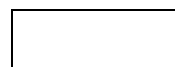
The measurement and payment shall include the Supply and Deliver, install and commission of all isolators, control cables, cable racking, control board, switchgear, etc required to operate the new pumps. Separate items will be scheduled for the electrical work outside and inside the pump house.

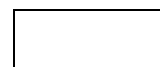
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

## **PD PUMPS**

### **PD1 SCOPE**

Pumps to be replaced, refurbished, serviced are indicated in the schedule of quantities.

This specification covers the manufacture, testing, protection, supply and installation of pumps and base plates. The pump duties shall be specified in the Project Specification. The electrical motors are not included in this section.

### **PD2 INTERPRETATIONS**

#### **14. PD2.1 Supporting Specifications**

The following specifications, where applicable, will form part of this Contract Document and must be read in conjunction with this standard :-

- (a) Project Specification
- (b) Schedule of Quantities

#### **15. PD2.2 Abbreviations**

For the purposes of this Specification, the following abbreviations will apply :-

ANSI	: American National Standards Institute
ASME	: American Society of Mechanical Engineers
ASTM	: American Society for Testing and Materials
AWWA	: American Water Works Association
BS	: British Standards Institution
SANS	: South African Bureau of Standards
SIS	: Swedish Institute of Standards
DIN	: Deutsche Industrie Normen
ISO	: International Organization for Standardization

#### **16. PD2.3 Standards**

Pumps will comply with this Specification and the latest issued of the following standard specifications where applicable :-

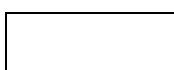
BS 970	: Wrought steel in the form of blooms, billets, bars and forgings
BS 3100	: Specification for steel castings for general engineering purposes
BS 3468	: Austenitic cast iron
BS 4360	: Specification for weldable structural steel
BS 4675	: Mechanical vibration in rotating and reciprocating machinery
BS 4999	: General requirements for rotating electrical machines
BS 5316	: Acceptance tests for centrifugal, mixed flow and axial pumps
BS 4504	: Flanges and bolting for pipes, valves and fittings
SANS 1123	: Steel pipe flanges
ISO 05 59 00	: Pictorial surface preparation standards for painting steel surfaces

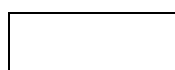
### **PD3 Materials**

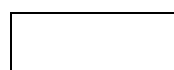
#### **17. PD3.1 General**

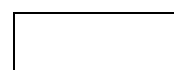
Equipment will be manufactured using new prime quality materials and all components will have a surface finish in relation to their importance, position and intended purpose.

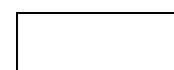
No repair of cast components will be allowed without the prior written approval of the Engineer.

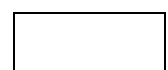
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

Any cast component, which require filling at any fabrication stage after the first anneal, will be subjected to another annealing treatment unless otherwise specified.

Cast components will be homogeneous and free of non-metallic impurities.

### **18. PD 3.2 Materials**

Pump casings will be of cast iron or cast steel dependant on the stresses corresponding to the required test pressures.

Impellers will be cast in approved bronze or stainless steel.

Pump shafts will be of EN 26 steel to BS 970 or similar approved material.

The Tenderer will indicate in his Tender the materials that the manufacturer proposes for each part of the assembly.

### **PD4 PLANT**

The manufacturer will satisfy the Engineer of the sufficiency of his workshops to handle the manufacture, testing and protection of the pumps strictly in accordance with this Specification.

### **PD5 MANUFACTURE**

### **19. PD 5.1 General**

Pumps with non-overloading characteristics and a shaft rotational speed not exceeding 1 500 r/min are preferred.

Pumps will be of the highest quality and suitable for continuous operation over long periods with the minimum of maintenance at high-sustained efficiency.

Arrangements incorporating multiple units coupled in series to achieve the duty specified for each complete pump set must be offered as an alternative only unless it is specified as such.

Designs incorporating a double entry and horizontally split casings will be favoured and preference will be given to an arrangement of the pump casing, which ensures the minimum dismantling of pipework to remove or replace the complete rotating element.

End-suction pumps constructed on the back pull-out principle will be provided with spacer pump motor couplings to enable the pump bearing housing, shaft and impeller to be removed without disturbing the pipework or alignment.

The pump design will make adequate provision for the balancing of residual axial thrust.

The proposed layout of the pumping station will be indicated on the drawings accompanying the tender documents. These must be studied carefully and all alterations to the layout, pipework or buildings required to suit the pump offered, must be set out clearly in letters and drawings accompanying the tender. The final layout shall be agreed upon by the Contractor and the Engineer prior to the commencement of manufacture of any of the equipment.

All equipment offered as well as all work carried out, will comply fully with the requirements of the Occupational Health and Safety Act (Act No. 85 of 1993).

### **20. PD 5.2 Characteristics**

The pumps will have stable non-overloading characteristics.

Detailed performance curves for each pump type (equal duty point) will be provided at the time of tendering. These curves will show the following :-

- (a) Head in metres vs flow in litres per second (from 0% to 120% of duty flow)
- (b) Power absorbed in kW (from 50% to 120% of duty flow)
- (c) Efficiency (from 0% to 120% of duty flow)
- (d) Net positive suction head (N.P.S.H.) curves giving safe operation as well as 3% head decay values.

The efficiency curve will be flat over a wide range in order to provide efficient working at various pump operating conditions.

Pumps will be able to operate without cavitation over the full range as specified without throttling.

Tenderer

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The following quantities shall be guaranteed by the Contractor :-

- (a) Minimum flow rate of the pump at the specified total head.
- (b) Maximum power demand at the specified total head.
- (c) Minimum efficiency at the specified total head.
- (d) Maximum NPSH required by the pump at the specified flow rate.

#### **21. PD 5.3 Pump Casing**

Casings will be free of blow holes, internal projections, cavities or other defects and no welding, burning, filling or plugging of defective castings will be permitted without the Engineer's written permission.

Unless otherwise specified, the dimensions and drilling of the suction and discharge flanges will be to SANS 1123 to the design pressures as specified but with a minimum of 10 Bar. The pressure rating of flanges will at least be equal to the maximum suction static pressure plus the pump shut-off pressure.

Suitable lifting rings will be provided.

#### **22. PD 5.4 Impeller**

Castings will be free of blow holes or other defects and no welding, burning, filling or plugging of defective castings will be permitted without the Engineer's written approval.

All water passages will be polished to a smooth finish. Water passages, which cannot be machined, will be hand ground and filed to template.

Each impeller will, after final machining and dressing, be independently statically balanced and the complete assembled rotating element with coupling will be dynamically balanced in the manufacturer's works.

The critical speed of the rotating element will be considerably higher than the running speed.

#### **23. PD .5 Pump Shaft**

Pump shafts will be of sufficient dimensions to avoid excessive torsional or bending stresses and deflection.

The impeller will be adequately secured to the shaft in such a way as to be readily removable without damage to either shaft or impeller.

Shafts will be protected by means of replaceable sleeves of a suitable non-corrodible material at all areas where wear and/or corrosion could possibly be expected.

#### **24. PD 5.6 Shaft Coupling**

The pump and motor will be connected by a flexible coupling in such a way that they will not uncouple whichever way the impeller may be rotating.

The coupling will accommodate small axial, lateral and angular misalignments without imposing undue stresses on the shaft and bearings.

The coupling will be enclosed in a stationary solid-plate guard to the Engineer's satisfaction.

#### **25. PD 5.7 Bearings and Lubrication**

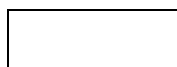
The pump bearings and lubricating system will be suitable for the particular application and will be fully described in the Tenderer's offer.

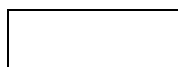
The pump rotating element will be positively located in the axial direction. If specified, thrust bearings will be of the tilting pad-type (Michell or similar).

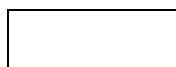
Journal bearings consisting of white metal lined bronze sleeves split on the horizontal centre-line and lubricated with an oil ring will be preferred.

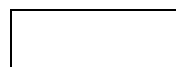
All bearings will be suitable for shaft rotation in both directions.

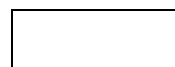
In the case of oil lubrication, adequate provision will be made for the cooling of bearing oil. The pumps will be required to operate continuously in an ambient temperature of 40°C and bearing metal temperatures will not be allowed to exceed 60°C.

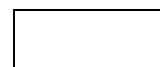
  
Tenderer

  
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Witness 2

  
Employer

  
Witness 1

  
Witness 2

Oil reservoirs of sufficient capacity will be fitted with easily accessible oil level indicators, which are to be clearly marked to indicate the standing and running oil levels.

The entire lubrication system will be fail safe.

## **26. PD 5.8 Glands and Seals**

Pumps incorporating low pressure glands where the pressure at the glands does not exceed the main suction supply pressure will be preferred to pumps with shaft glands exposed to higher pressures.

Low pressure glands of the stuffing box pattern will be such to allow repacking without dismantling of the pump.

If mechanical seals are offered they will be of the bellows-type requiring no separate water supply, will be balanced, and suitable for the water to be pumped. Selection of the mechanical seal shall be done in collaboration with the seal manufacturer/supplier and proof of this may be requested.

Full details of glands and seals, showing all materials, finishes, clearances etc. will be submitted with the Tender.

## **27. PD 5.9 Vent and Drain Fittings**

Bronze vent cocks will be fitted at all local high points to each casing. These cocks will be of adequate size to allow the entrapped air to be released freely. Copper drain pipes will be neatly led from priming cocks, gland and casing drain points to a suitable main tundish. Galvanized drainage pipework of adequate size will be provided and installed to collect the waste water from each pump set and to lead it to a sump in the pumping station.

If specified, an automatic air vent (Armstrong or similar) will be fitted to each pump casing. This device will be suitable for the remote operation of an indicator to show the open and closed positions of the air vent.

## **28. PD 5.10 Base Plate**

The pump and motor base plate will be rigid. The upper face of each base plate upon which the pump and motor are located, will be machined flat and smooth to ensure that the pump and motor are bedded properly without the use of spacers.

For motor units with a mass of more than 200 kg, two jacking bolts at right angles with a lock nut shall be provided at every corner.

The pump and motor will be thoroughly aligned and the base plate then grouted in with a completely stable grout (Embecon or equal) to facilitate vibration-free operation.

## **29. PD 5.11 Monitoring Devices**

### **PD 5.11.1 Pressure Gauges**

Glycerine filled pressure gauges with faceplate diameters of at least 100 mm will be fitted to the inlet and outlet side of each pump.

These gauges will indicate water pressure in kilopascal and will have a range 50% higher, but not more than 50% higher than the normal maximum working pressure.

Gauges for the suction side of pumps will be capable of registering negative pressures of up to 100 kPa.

A combination vent cock and isolating valve will be installed with each pressure gauge.

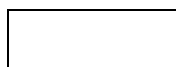
### **PD 5.11.2 Temperature Detectors**

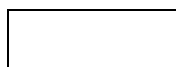
Oil lubricated bearings and glands will be fitted with temperature detectors if required in the Project Specification. These will be platinum resistance thermometers or thermocouples.

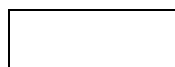
Each temperature detector will be clearly identified by means of an engraved marking on the sheath and will be individually calibrated.

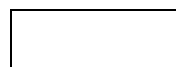
Temperature detectors offered, will be suitable for operation in conjunction with the temperature indicating, monitoring, alarm and trip equipment.

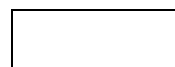
If grease lubricated bearings are offered, the Tenderer will indicate in his Tender if temperature detectors can in fact be used. If temperature detectors are not feasible, an alternative means of monitoring bearings must be offered.

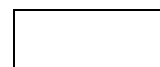
  
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Employer

  
Witness 1

  
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### PD 5.11.3 Thermometers

Standard mercury in glass thermometers will be provided adjacent to temperature detectors if required in the Project specification. Pockets for the thermometers will have chained covers to prevent the ingress of dirt and will be so arranged as to permit accurate measurement of the bearing temperature.

### PD 5.11.4 Vibration Detectors

The bearing housing of each pump will be fitted with vibration detectors if required in the Project Specification, which will cause the pump motor to trip if vibration exceeds a pre-set level.

### PD 5.11.5 No-flow Protection

- (a) Each pump casing will be fitted with a dial-type thermo switch equal or similar to fenwall, to safeguard the pump in the event of inadvertent sustained operation against a closed discharge valve. The thermo switch will be calibrated to close when the temperature of the water in the pump casing exceeds 40°.
- (b) A no-flow paddle type detector will be fitted into the suction pipe of each pump. Alternatively, a low pressure switch, to be fitted to the suction pipe of each pump, which will cause the pump motor to trip if the suction pressure drops below a pre-set level, can be offered.

### PD 5.11.6 Indicator on Automatic Air Vent

If an automatic air vent is specified for the pump casing in the Project Specification, it will be fitted with an indicator to show the open and closed positions of the air vent. The air vent will be suitable for remote operation and the control of the air vent will be mounted on the control panel inside the pumping station.

### PD 5.11.7 Gland Leakage

A device to monitor gland leakage will be supplied and fitted with adjustable alarm contacts designed to close when gland rises to a pre-set value, if required in the Project Specification.

Full detail of all monitoring devices offered must be submitted with the Tender.

## 30. PD 5.12 Vibration and Noise

The pumps as well as the motors will comply with the requirements of BS 4999.

## 31. PD 5.13 Corrosion Protection

### PD 5.13.1 Internal Protection

- (a) All traces of rust, slag, silica or other contaminants will be removed by mechanical wire brushing. The entire surface will then be degreased by a suitable water emulsifiable degreaser (Plascon Code GR or similar). Surface must be clean and dry before painting.
- (b) The internal wetted surfaces of pumps excluding non-corrodible surfaces and components where painting would adversely affect the operation of the equipment, will be thoroughly cleaned by abrasive blasting to Sa 2,5 of SIS 05 59 00 standard.

Successive coats of an approved non-toxic epoxy resin paint (Copon EP 2300 or similar) will then be applied to give a final dry film thickness of 300 µm.

If fusion bonded epoxy is used, the final dry film thickness will be 250 µm.


Drying times between successive layers will depend on environmental conditions and will be strictly in accordance with the requirements of the paint manufacturer.


- (c) Two coats (each coat 25 µm) of a rust preventing composition similar to Fergussons Anodite (type G6988 for potable water pumps and type G2458/V for raw water pumps), after abrasive blasting to Sa 2,5 of SIS 05 59 00, may be offered as an alternative if called for in the Project Specification.


### PD 5.13.2 External Protection


- (a) All traces of rust, slag, silica or other contaminants will be removed by mechanical wire brushing. The entire surface will then be degreased by a suitable water emulsifiable degreaser (Plascon Code GR or similar). Surface must be clean and dry before painting.
- (b) All sharp edges, laminations and protrusions, shall be removed by mechanical grinding.
- (c) External surfaces of pumps as well as base plates, but excluding non-corrodible parts, labels


  
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and components where painting would adversely affect the operation, will be thoroughly cleaned by abrasion blasting to a Sa 2,5 of SIS 05 59 00 standard. Two coats of an approved epoxy resin paint similar to Copon EP 2300 will then be applied to give a dry film thickness of 150 µm followed by a finishing coat of Copon EA4 epoxy enamel paint or similar (dry film thickness 50 µm). Colour as specified in the Project Specification.

- (d) Drying times between successive layers will depend on environmental conditions and will be strictly in accordance with the requirements of the paint manufacturer.
- (e) Two coats (each coat 25 µm) of a rust preventing composition similar to Fergussons Anodite (type G6988 for potable water pumps and type G2458/V for raw water pumps), after abrasive blasting to Sa 2,5 of SIS 05 59 00, may be offered as an alternative if called for in the Project Specification.
- (f) The final coat shall be one coat of universal gloss enamel (Plascon Code G or similar) applied by brush, roller or airless spray to a dry film thickness of 25 microns m. This shall be left to dry for 20 hours. Colour will be as specified in the Project Specification.

### **32. PD 5.14 Designation and Information Plates**

Each pump will be supplied with an information plate - preferably chromium plated - secured to the pump casing in a visible position indelibly marked with the following details :-

- Maker's name, pump type and serial number
- Year of manufacture
- Rated duty of pump in litres per second
- Head in metres at rated duty
- Pump speed in r/min
- Mass of completely assembled pump in kilogram

### **33. PD 5.15 Interchangeability**

Where two or more similar pump units are required, these units will be identical in all respects.

All similar parts of items supplied will be interchangeable without any additional machining or fitting.

### **34. PD 5.16 Recommended Spare Parts**

The Tenderer must submit details of spare parts recommended to be kept in store by the Employer with his Tender.

The detail will include a full description of the parts, part identification, number required, guaranteed delivery time and total price delivered to Site.

### **35. PD 5.17 Operation and Maintenance Manual**

The Contractor will hand over to the Engineer four sets of the Operation and Maintenance Manual compiled for each installation not later than at the time of commissioning of the installation. These manuals are a prerequisite for final take over of the plant.

The Operation and Maintenance Manual will be printed on durable paper and will consist of two parts.

- (a) The first part will contain sections on :-
- (b) Brief description of the plant and installation.
- (c) Concise operating instructions.
- (d) Routine maintenance instruction.
- (e) Precautionary measures, elementary trouble location, rectifying measures and emergency actions.
- (f) Detailed information on equipment.
- (g) Lists of spare parts including names and addresses of suppliers.

### **36. PD 5.18 Drawings**

The drawings included in the Tender Documents are the Engineer's proposal for the plant layout. Should the Tenderer offer alternative layouts, he shall submit drawings with his Tender in order for it to be evaluated.

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Before the Contractor carries out any work, he will submit detailed working drawings to be approved by the Engineer. Approval of these drawings does not relieve the Contractor from his responsibility for the correctness of the drawings.

### **37. PD 5.19 Installation**

The pump set foundation shall consist of a solid concrete block sufficiently massive and rigid to provide continuous support for the base-plate throughout its whole length. The foundation shall be kept 25 mm low to allow for levelling of the base-plate. Foundation bolt pockets in the foundation shall be 100 mm square if shuttered, or 100 mm diameter if drilled.

Steel packers shall be set up and embedded in a quick setting compound to within 6 mm of the final height of the bottom base-plate pad. Steel packers shall be placed adjacent to and on each side of the foundation bolt holes. Alignment of the base-plate shall be done with laminated packers on top of the steel packers already set.

Foundation bolts shall be left for 72 hours after grouting before tightening.

After levelling, alignment and tightening of foundation bolts, the base-plate shall be grouted, with the aid of shuttering on the outside, to 30 mm above the lower flanges of the base-plate. The cavity between the lower flange and the foundation shall be completely filled.

The pump and motor shall be aligned to within  $\pm 0.025$  mm full indicator movement on dial gauge, regardless of the coupling type. After the pump and motor feet are tightened down, ad pipework erected and tightened, both angular and parallel alignment shall be checked and recorded at each quarter revolution. These readings shall be submitted to the 'Engineer and is a prerequisite for handover.

Upon completion, dowel pins shall be fitted to facilitate relocation at any future time.

### **PD6 TOLERANCES**

The tolerances as specified in the appropriate SANS or BS standards will apply to this Contract.

### **PD7 INSPECTION, TESTING AND COMMISSIONING**

#### **38. PD7.1 Testing by Manufacturer**

The Manufacturer will carry out all tests on materials, quality control tests, dimensional checking and routine tests on parts to ensure that the pumps and materials conform to the requirements of the relevant SANS or BS specifications and to this Specification. The Engineer will not necessarily attend these tests but records must be kept and all test results will be made available to the Engineer.

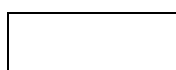
#### **39. PD 7.2 Witnessed Testing**

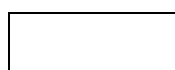
In addition to the above, a number of performance tests will also be carried out in the testing facility of the supplier before equipment is transported to Site. These tests can be carried out in the workshop of the manufacturer/supplier if it is suitably equipped or another approved test facility.

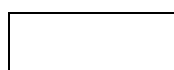
The Engineer may witness these tests and the Contractor will notify the Engineer two weeks in advance of the date and place at which the equipment may be inspected and tested. When tests and inspections have met the satisfaction of the Engineer a certificate of workshop acceptance will be issued. These certificates are a prerequisite before payment for "Materials on Site" can be passed. The Engineer's acceptance will in no way relieve the Manufacturer of any of his obligations to design, manufacture and supply pumps strictly in accordance with the Specification.

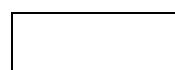
Performance tests will include :-

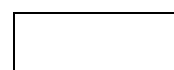
- (a) Hydraulic tests on the pump casing. The test pressure will be equal to  $1\frac{1}{2}$  times the maximum working pressure at the delivery end of the pump. The testing will be done with blank flanges bolted onto the flanges. The pressure will be maintained for at least 15 minutes. No sign of sweating, leaking, undue deformation and stressing or defect of any kind will be evident during the test period.
- (b) Tests to prove that the rotating parts are dynamically balanced.
- (c) Performance tests on pump and driving unit.
- (d) NPSH requirements if called for in the Project Specifications.

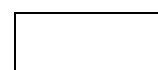
  
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Employer

  
Witness 1

  
Witness 2

If called for in the Project Specification, a performance test shall be carried out in accordance with BS 5316 Part 2 - Class B tests. Unless otherwise stated, the Contractor will be required to conduct the performance test on the combined pump/motor unit.

If a performance test of the pump and its driving unit is not possible at the manufacturer's works, this shall be stated in the Tender with reasons to allow the Engineer opportunity to make alternative proposals.

#### **40. PD 7.3 Testing by an Independent Facility**

The Employer may require that an independent testing facility or institution such as the South African Bureau of Standards carry out performance tests. A separate item for performance testing will be provided in the Schedule of Quantities to allow for this.

#### **41. PD 7.4 Failure to Pass Performance Test**

Should the pump unit fail the performance test, whether performed at the manufacturer's works or at an independent institution, the Engineer shall authorise any amendments to the plant which may be considered necessary to meet the guaranteed quantities within the permissible tolerances laid down in BS 5316 Part 2 - Class B tests and prove with further test that the equipment conform to the Specification.

All costs involved in the re-testing of pump units will be borne by the Contractor.

Should the pump unit fail to pass the test with more than 5% variation on the actual guaranteed figures, the engineer will reject the pump unit and request the Contractor to replace the unit so rejected. Should the pump unit still fail to pass the test, but the actual figures do not vary by more than 5% from the actual guaranteed figures, the Engineer may :-

- (a) Request the Contractor to carry out amendments to ensure the compliance of the unit with the Specification; or
- (b) Accept the equipment but impose a penalty for non-compliance on the Contractor. A sum will be calculated based on the additional energy used over the life expectancy of the equipment and this will be deducted from the Contract price for each pump set for every kilowatt by which the gross demand exceeds the guaranteed figure with permissible tolerances.

Any penalties imposed will apply to the main Contractor only.

#### **42. PD 7.5 Commissioning**

On completion of the installation the Contractor will check all items for satisfactory functioning. He will then inform the Engineer of his intention to commission the plant. The Engineer may request control measurements on pump alignment at this stage.

A detailed programme of his proposed commissioning procedures will be submitted not later than two weeks prior to the commissioning date.

Tests on site will be carried out in accordance with BS 5316 Part 1 - Class C tests.

After a successful running period of 4 hours (to be witnessed by the Engineer) the Contractor will hand over the installation to the Employer as well as the Operation and Maintenance Manuals. The Completion Certificate will only be issued after the units have been in successful operation for 14 consecutive days and the acceptance tests successfully completed.

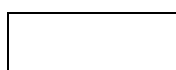
During the first 14 days of operation, the Contractor will rectify any problems with the units on Site within 24 hours of being telephonically notified. During the remainder of the maintenance period, the Contractor will, within 14 days of being notified, commence rectifying any possible problems that the Employer may encounter with the equipment supplied under this Contract.

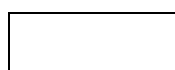
Should the Contractor fail to meet the above requirements, the Employer may appoint others to undertake the necessary repair work at the Contractor's cost.

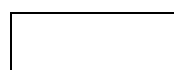
During the Maintenance period the pump units will be operated to suit the water demand requirements of the Employer.

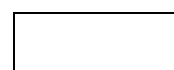
#### **43. PD 7.6 Tests at the Site of the Works**

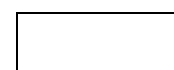
The Engineer may require that site tests are performed to verify performance figures guaranteed by the Contractor. Flow rate, total head and power input to the pump/motor units shall be determined, as accurate as Site conditions permit, for one or more points on the pump curves close to the specified duty point. The Contractor shall provide suitable instruments with recent calibration certificates.

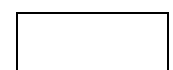
  
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Should these measured and calculated quantities differ from those guaranteed by more than the tolerances allowed by BS 5316 Part 1 - re-testing of the unit at any testing facility, or the recalibration of the measuring instruments.

Should the subsequent test results still fall outside the allowable tolerances, Clause PD7.4 shall apply, and call costs shall be borne by the Contractor. In the event of the subsequent test being successful, costs shall be borne by the Employer.

## PD8 MEASUREMENT AND PAYMENT

### **PD 8.1 Pay Item**

**Unit**

#### **Supply and Deliver**

Supply and deliver the following item :-

Pumps .....No

**Pumps** will be measured per unit for each type and the Tender Price will include for :-

- (i) Pump couplings and coupling material.
- (ii) All fixing material required to secure pump to base-plate.
- (iii) Design, manufacture, purchase, protection, supply, profit, handling and transport.
- (iv) Testing and inspections at Manufacturer's works.
- (v) Packing and temporary protection against damage during transport and delivery.
- (vi) Temporary storage and maintenance during storage if required.
- (vii) Delivery, off-loading, storage on Site and maintenance during storage.
- (viii) Provision of all drawings and Operating and Maintenance Manuals as specified.

#### **Supply and Deliver**

Supply and deliver the following item :-

Base Plates .....No

**Base plates** will be measured per unit of each type and the tender price will include for :-

- (i) Design, manufacture, purchase, protection, supply, profit, handling and transport.
- (ii) Inspection as required.
- (iii) All fixing material required to secure base plate to pump plinth including grout and dowel pins.
- (iv) Packing and temporary protection against damage during transport and delivery.
- (v) Temporary storage and maintenance during storage if required.
- (vi) Delivery, off-loading, storage on Site and maintenance during storage.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

## PE LV ELECTRICAL MOTORS

### PE1 SCOPE

This specification covers low voltage (up to and including 1 000 V) induction motors, slip ring and squirrel cage, of up to 315 kW and at a frequency of 50 Hz.

Motors are to be supplied complete with a suitable cable box for feeder cables, terminal boxes, nuts, locknuts, intermediate disconnecting leads, cable lugs, etc.

Mounting bolts and half-couplings must be included in the motor's price.

Motors of the same manufacture will be used throughout the contract where possible.

### PE2 QUALITY OF MATERIALS

The motors shall be designed, manufactured, tested, delivered, erected and commissioned in accordance with this specification in the first instance, SANS 948 in the second instance and in the third instance other applicable standards as follows:-

BS 96 BS 170 BS 466 BS 587 BS 626 BS 2613 BS 3979

BS 4362 BS 4999 BS 5000 IEC 85

All deviations from these specification must be clearly pointed out at tender stage as deviations not indicated, will not be accepted.

All materials shall be new and of the best quality and of the class most suitable for the purpose specified. All parts shall be capable of withstanding variations of temperature arising under working conditions without distortion, deterioration or setting up of undue strain in any part.

Quality control shall be in accordance with SANS 0157.

Cast iron shall be to BS 1452, Grade 14, or better and shall be tested in accordance therewith.

Mild steel plate for fabricated parts shall be of weldable quality in accordance with BS 4360. No welding, burning in, filling, plugging up or metal deposition to correct defects in writing, following an inspection on the defect.

### PE3 INTERCHANGEABILITY

All similar parts are to be made accurately to dimensions and must be interchangeable with each other, so that a spare part or any part of another similar motor can be used satisfactorily in the relevant position on a motor without recourse to additional machining or filling.

### PE4 DRAWINGS AND INFORMATION FOR APPROVAL

The following drawings and information shall be submitted for approval before manufacture commences :-

- Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown)
- Cross-sectional dimensioned drawings of the cable boxes
- Detailed drawings of the motor base-plate showing full constructional details with dimensions

### PE5 INSPECTION OF MANUFACTURED EQUIPMENT

The Engineer or his appointed representative, reserves the right to inspect the motors or associated parts at any stage of manufacture.

The Contractor shall ascertain whether inspection is required and the Contractor shall then give the Engineer not less than seven days notice of when the inspection may be undertaken.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

## PE6 GUARANTEE AND MAINTENANCE

The complete installation shall be fully guaranteed for a period of twelve months from the date of handing over to the Client. A complete full maintenance service shall indicate with his tender what duties have been included and the time intervals between services. Should the Tenderer fail to provide this information the Engineer will lay down the duties as well as time intervals with which the Contractor shall comply.

Four copies of all test certificates, showing the results of all tests performed, will be supplied at a date not later than the delivery date of the motors.

Three copies of maintenance manuals on each motor shall be supplied with the motor. These manuals must include details of the necessary routine maintenance service and their frequency for all parts including the bearings. A spare parts list giving manufacturers spare parts ordering numbers must also be included.

## PE7 TEMPERATURE RISES

All motors shall be designed for a class B temperature rise, which is an 80 K rise.

The temperature rise of the bearings shall not exceed 50 K under continuous full load conditions.

## PE8 BEARINGS

All bearings shall be of the grease-lubricated type.

Adequate provision shall be made to prevent damage to bearings by any shaft currents, which may be produced.

When the motor shaft is not located axially by its own bearings, it shall be permanently marked to indicate its normal running position and the extent of float in either direction.

Unless otherwise approved in writing, motor bearings shall be designed to allow the motor to run indefinitely when coupled from the driven machine.

Ball or roller bearings shall be loaded conservatively in order that the grease may be renewed at intervals of not less than one year and they shall not be equipped with grease nipples or cups. If these are supplied, they are to be replaced with threaded plugs.

Care shall be taken that bearings are sealed properly in order to prevent ingress of bearing lubricant into windings and cores. For purposes of maintenance, end-shield bearings are preferred. A minimum bearing life of 40 000 hours is required.

## PE9 TERMINAL BOXES

The terminal box for the supply cables shall be suitable for the cables specified and shall be oversized. It shall have a removable cover and gland plate. The degree of protection shall not be less than IP 55.

Cable outlets shall be capable of pointing to any of four directions at 90-degree intervals.

Heaters and embedded temperature detectors shall be wired up to separate secondary terminal boxes. These boxes must be suitable for an armoured multi core cable and must be oversized.

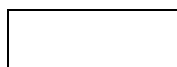
All terminals must be properly and permanently marked for easy identification.

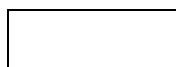
Terminal boxes shall be on the right hand side if viewed from the drive end.

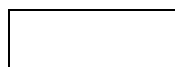
## PE10 INFORMATION PLATES FOR MOTORS

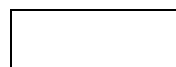
In addition to the information required by SANS 948, the following shall also be marked on the nameplates :-

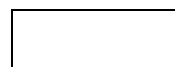
- Year of manufacture
- Order number
- Total mass of motor in kilogram
- Diagram indication the number, type and positions of heaters and temperature detectors if applicable.
- Bearing types and sizes
- Bearing grease interval or bearing replacement interval where pre-packed bearings are used

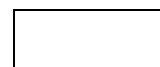
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

## PE11 TEMPERATURE DETECTORS

All motors 50 kW and larger but smaller than 150 kW must be provided with one PTC thermister per winding suitable for class B temperature rise protection i.e. with reference temperatures of 140°C.

All motors of 150 kW and larger shall be provided with one platinum resistance detectors (RTD) of type PT 100 per winding and per bearing. The bearing detectors shall touch the outer bearing race and must be spring-loaded and shall be of the screw type.

The wires of all detectors must be wired to a terminal strip in a suitable terminal box.

## PE12 MOUNTING

The motors shall be mounted as required by the driven equipment supplied.

Each motor shall be mounted on a common base-plate with the equipment driven. When uncoupled from the load, it shall be possible to lift the motor clear without withdrawing the rotor and with the minimum amount of dismantling.

## PE13 MOTOR RATINGS

The kilowatt ratings of all motors will be in accordance with the pumps to be driven plus ten percent.

All motors will be capable of continuous operation over the range of temperatures from minus 10°C to plus 40°C with a 24-hour maximum ambient of 40°C at the specified altitude.

All motors will be suitable for operation at any voltage within the range nominal voltage plus minus 5%. Motors having attained full load temperature shall be capable of making 4 starts within an hour; two of which may occur in succession under the specified conditions of load.

Motors shall be adequately designed to start the driven equipment, taking into account the starting method used.

The starting current shall be limited to 6 times the normal full load current for larger motors.

## PE14 ANTI-CONDENSATION HEATERS IN MOTORS

Anti-condensation heaters shall be built into the stators of the motors.

## PE15 WINDINGS

The stator windings shall be delta-connected for all motors of 3 kW and larger. Each end of each phase winding shall be brought out to the stator terminal box. For a single wound three-phase motor, six stator-winding ends shall be brought out to the stator terminal box. A cable lug shall be supplied for each end of each phase winding.

All insulation material used shall be Class F.

## PE16 ROTATION

All AC motors shall be capable of having their direction of rotation reversed, merely by interchanging the supply leads. AC motors fitted with unidirectional fans, and therefore not capable of being easily reversed, shall be supplied with a double-ended shaft and the holding-down boltholes shall be symmetrical about both centre-lines. This will permit the motor to be rotated through 180 degrees and coupled up to the load, giving an opposite drive. A suitable cover shall be provided for the unused bare shaft extension. The above arrangement also required that two motor terminal boxes be provided diametrically opposite each other. The correct direction of rotation of an unidirectional motor shall be indicated in a permanent manner on the frame.

The normal rotation of the motors shall be co-ordinated by the Contractor with the supplier of the driven equipment.

## PE17 TEST IN THE FACTORY

### 44. PE17.1 Type Tests

One motor of every type, 50 kW and larger, shall be tested for temperature rise, efficiency and pull-out torque. Type test certificates on identical motors will be acceptable in lieu of these tests for motors smaller than 50 kW. Should type tests certificates for motors smaller than 50 kW not be available then the first motor of each size manufactured shall be tested.

The measurement of the temperature rise of the stator windings of the motors shall be by increase in resistance method.

In addition to the type test specified in SANS 948 the following shall be done :-

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- Vibration Test: The amplitude of vibration (peak to peak is to be measured in micrometer).
- Efficiency Test: The efficiency must be measured for full load and rated duty load.
- Temperature detector readings must be taken at all intervals of test.

#### **45. PE17.2 Routine Tests**

The following tests shall be carried out in addition to the routine tests specified in SANS 948 :-

- All the resistances of temperature detectors and heaters shall be measured.

### **PE18 ERECTION AND COMMISSIONING**

#### **46. PE18.1 Erection**

Where possible, motors shall be erected by the motor supplier. Care shall be taken to ensure that adequate tolerance margins are made available to ensure interchangeability with replacement motors. In particular :-

- A minimum of 10 mm of packers shall be provided under the motor-frame of motor bed-plate to allow for adjustments in height.
- Before holding-down bolts are grouted in, the motor shall be lined up and the bolts shall be properly centred in the hole of the bed-plate.

Tenderers shall indicate in the Tender who will erect the motors.

- The Contractor shall satisfy himself that the motors are properly installed, aligned and sufficiently protected and shall check the settings of all motors protection gear before any motor is switched on.
- The engineer must be notified at least 7 days in advance of any commissioning or testing to enable him to be present.

#### **47. PE18.2 Bearing Inspection**

The Engineer shall inspect motors having ball/roller bearings. The grease shall be examined to ensure that it is not hard. Providing that no roughness is felt when the shaft is rotated by hand and that the motor runs without undue noise or vibration, the bearings will be considered acceptable. A complete set of anti-friction bearings shall be provided for each motor and delivered at the same time as the motor.

Should the bearings fail or exhibit symptoms of brineling during the guarantee period, the Contractor, free of charge, without delay, shall change them.

#### **48. PE18.3 Alignment**

After erection, the alignment of the half-coupling between the motor and the driven machine shall be measured. In the case of a pedestal bearing motor, the air gap clearance between the rotor and the stator shall also be measured. A record shall be kept of these figures and they shall be submitted to the Engineer for approval.

A horizontal sleeve bearing or limited end-float roller bearing motor shall be run uncoupled from its load to ensure that it rotates at the axial position indicated on the shaft and that the rotor is free to move to either side of this position. Particular attention shall be paid to ensure that the free running position and the rotor end-float are in agreement with the axial movement of the flexible coupling.

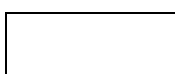
#### **49. PE18.4 Drying Out**

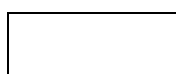
All motors, which have been standing in the open during rain and been flooded or whose cold insulation resistance is below 1,5 megaohm, shall be dried out by the Contractor before they are connected to the supply.

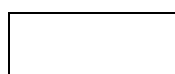
The method adopted for drying-out shall be by applying heat, preferably by circulating current through the windings or, alternatively, by means of space heaters located in and the machine.

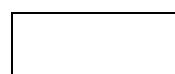
Insulation resistance measurements and temperature readings shall be taken regularly every half hour at the start of dry-out until the motor attains an even temperature and thereafter every hour.

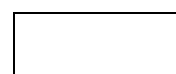
The characteristic dry-out curve of insulation resistance versus temperature shall be plotted and dry-out may be considered complete four hours after the resistance readings have started to rise from the steady minimum value, providing that the winding temperatures have remained steady during this period.

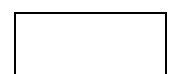
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

The Contractor shall provide all equipment and the personnel required for the drying-out operation. The onus remains on the Contractor to satisfy himself that a motor is dry before it is connected to the supply. Any motor fails as a result of being commissioned in a damp condition, shall be repaired free of charge by the Contractor.

**50. PE18.5 Double Shaft Extensions**

The unused shaft extensions of a double-ended shaft motor shall be covered with an approved rust preventative after the motor is commissioned.

**51. PE19 Measurement and payment**

a.) Removal of electric motor. The unit of measurement shall be the number of electric motors removed from site. The tendered rates shall include full compensation for the disconnecting of the electric motor, removal and transport to motor manufacturer/agent.

**b.) Test motor to determine if motor is refurbishable.**

The tendered rates shall include for all labour, materials, transport and tests to be performed to determine whether the motor can be refurbish

*Tenderer*

*Witness 1*

*Witness 2*

*Employer*

*Witness 1*

*Witness 2*



**PF EPWP LABOUR INTENSIVE SPECIFICATION**

**PF1. LABOUR INTENSIVE COMPETENCIES OF SUPERVISORY AND MANAGEMENT STAFF**

Contractors having a CIDB contractor grading designation of 6CE and higher shall only engage supervisory and management staff in labour intensive works who have either completed, or for the period 1 April 2004 to 30 June 2006, are registered for training towards, the skills programme outlined in Table 1.

The managing principal of the contractor, namely, a sole proprietor, the senior partner, the managing director or managing member of a close corporation, as relevant, having a contractor grading designation of 1CE, 2CE, 3CE and 4CE shall have personally completed, or for the period 1 April 2004 to 30 June 2006 be registered on a skills programme for the NQF level 2. All other site supervisory staff in the employ of such contractors must have completed, or for the period 1 April 2004 to 30 June 2006 be registered on a skills programme for, the NQF level 2 unit standards or NQF level 4 unit standards.

**Table 1: Skills programme for supervisory and management staff**

Personnel	NQF level	Unit standard titles	Skills programme description
Team leader / supervisor	2	Apply Labour Intensive Construction Systems and Techniques to Work Activities	This unit standard must be completed, <b>and</b>
		Use Labour Intensive Construction Methods to Construct and Maintain Roads and Storm water Drainage	} any one of these 3 unit standards
		Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	
Foreman/ supervisor	4	Implement labour Intensive Construction Systems and Techniques	This unit standard must be completed, <b>and</b>
		Use Labour Intensive Construction Methods to Construct and Maintain Roads and Storm water Drainage	} any one of these 3 unit standards
		Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	
Site Agent / Manager (i.e. the contractor's most senior representative that is resident on the site)	5	Manage Labour Intensive Construction Processes	Skills Programme against this single unit standard

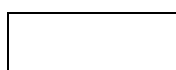
**PF2. EMPLOYMENT OF UNSKILLED AND SEMI-SKILLED WORKERS IN LABOUR-INTENSIVE WORKS**

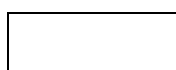
**PF2.1 Requirements for the sourcing and engagement of labour**

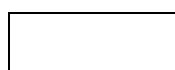
PF2.1.1 Unskilled and semi-skilled labour required for the execution of all labour intensive works shall be engaged strictly in accordance with prevailing legislation and SANS 1914-5, Participation of Targeted Labour.

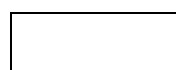
PF2.1.2 The rate of pay set for the EPWP is **R 151.76 per task or per day**.

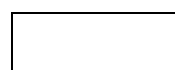
PF2.1.3 Tasks established by the contractor must be such that:

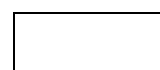
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

- a) the average worker completes 5 tasks per week in 40 hours or less; and
- b) the weakest worker completes 5 tasks per week in 55 hours or less.

PF2.1.4 The contractor must revise the time taken to complete a task whenever it is established that the time taken to complete a weekly task is not within the requirements of (3).

PF2.1.5 The Contractor shall, through all available community structures, inform the local community of the labour intensive works and the employment opportunities presented thereby. Preference must be given to people with previous practical experience in construction and / or who come from households:

- a) where the head of the household has less than a primary school education;
- b) that have less than one full time person earning an income;
- c) where subsistence agriculture is the source of income.
- d) those who are not in receipt of any social security pension income

PF2.1.6 The Contractor shall endeavour to ensure that the expenditure on the employment of temporary workers is in the following proportions:

- a) 60 % women;
- b) 20% youth who are between the ages of 18 and 25; and
- c) 2% on persons with disabilities.

## PF2.2 **Specific provisions pertaining to SANS 1914-5**

### PF2.2.1 **Definitions**

**Targeted labour:** Unemployed persons who are employed as local labour on the project.

### PF2.2.2 **Contract participation goals**

- a) There is no specified contract participation goal for the contract. The contract participation goal shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.
- b) The wages and allowances used to calculate the contract participation goal shall, with respect to both time-rated and task rated workers, comprise all wages paid and any training allowance paid in respect of agreed training programmes.

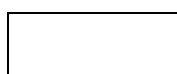
### PF2.2.3 **Terms and conditions for the engagement of targeted labour**

Further to the provisions of clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.

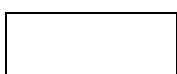
### PF2.2.4 **Variations to SANS 1914-5**

- a) The definition for net amount shall be amended as follows:
- b) Financial value of the contract upon completion, exclusive of any value added tax or sales tax which the law requires the employer to pay the contractor.
- c) The schedule referred to in 5.2 shall in addition reflect the status of targeted labour as women, youth and persons with disabilities and the number of days of formal training provided to targeted labour.

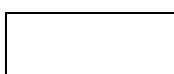
### PF2.2.5 **Training of targeted labour**



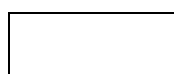
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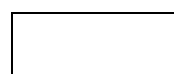
*Witness 1*



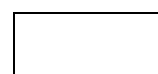
*Witness 2*



*Employer*



*Witness 1*



*Witness 2*

- a) The contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise worker health and safety.
- b) The cost of the formal training of targeted labour will be funded by the provincial office of the Department of Labour. This training should take place as close to the project site as practically possible. The contractor, must access this training by informing the relevant provincial office of the Department of Labour in writing, within 14 days of being awarded the contract, of the likely number of persons that will undergo training and when such training is required. The employer must be furnished with a copy of this request.
- c) A copy of this training request made by the contractor to the DOL provincial office must also be faxed to the EPWP Training Director in the Department of Public Works– Cinderella Makunike, Fax Number 012 328 6820 or email cinderella.makunike@dpw.gov.za Tel: 083 677 4026.
- d) The contractor shall be responsible for scheduling the training of workers and shall take all reasonable steps to ensure that each beneficiary is provided with a minimum of six (6) days of formal training if he/she is employed for 3 months or less and a minimum of ten (10) days if he she is employed for 4 months or more.
- e) The contractor shall do nothing to dissuade targeted labour from participating in training programmes.
- f) An allowance equal to 100% of the task rate or daily rate shall be paid by the contractor to workers who attend formal training, in terms of (d) above.
- g) Proof of compliance with the requirements of (b) to (g) must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

### PF2.3 **LABOUR-INTENSIVE SPECIFICATION**

#### PF2.3.1 Scope

This specification establishes general requirements for activities which are to be executed by hand involving the following:-

- (a) trenches having a depth of less than 1,5 meters;
- (b) Storm water drainage; and
- (c) Low-volume roads and sidewalks.

#### PF2.3.2 Precedence

Where this specification is in conflict with any other standard or specification referred to in the Scope of Works to this contract, the requirements of this specification shall prevail.

#### PF2.3.3 Hand Excavatable Material

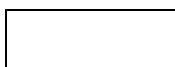
Hand excavatable material is material:-

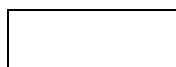
##### (a) Granular Materials

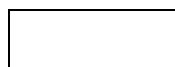
- whose consistency when profiled may in terms of the table below be classified as very loose, loose, medium dense, or dense; or
- where the material is a gravel having a maximum particle size of 10 mm and contains no cobbles or isolated boulders, no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100 mm.

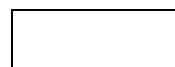
##### (b) Cohesive Materials

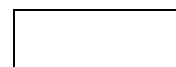
- whose consistency when profiled may in terms of the table below be classified as very soft, soft, firm, stiff and stiff/very stiff; or

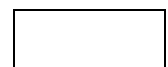
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

- where the material is a gravel having a maximum particle size of 10 mm and contains no cobbles or isolated boulders, no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100 mm.

Note

- (1) A boulder, a cobble and gravel is material with a particle size greater than 200 mm, between 60 and 200 mm.
- (2) A dynamic cone penetrometer is an instrument used to measure the in-situ shear resistance of a soil comprising a drop weight of approximately 10 kg which falls through a height of 400 mm and drives a cone having a maximum diameter of 20 mm (cone angle of 60° with respect to the horizontal) into the material being used.

Consistency of Materials when Profiled

Granular Materials		Cohesive Materials	
Consistency	Description	Consistency	Description
Very loose	Crumbles very easily when scraped with a geological pick	Very soft	Geological pick head can easily be pushed in as far as the shaft of the handle
Loose	Small resistance to penetration by sharp end of a geological pick	Soft	Easily dented by thumb; sharp end of a geological pick can be pushed in 30-40mm; can be molded by fingers with some pressure
Medium dense	Considerable resistance to penetration by sharp end of a geological pick	Firm	Indented by thumb with effort; sharp end of geological pick can be pushed in up to 10mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade
Dense	Very high resistance to penetration by the sharp end of geological pick; requires many blows for excavation	Stiff	Can be indented by thumb-nail; slight indentation produced by pushing geological pick point into soil; cannot be molded by fingers
Very dense	High resistance to repeated blows of a geological pick	Very stiff	Indented by thumb-nail with difficulty; slight indentation produced by blow of a geological pick point

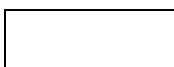
PF2.3.4 Trench Excavation

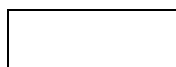
All hand excavatable material in trenches having a depth of less than 1,5 meters shall be excavated by hand.

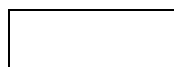
PF2.3.5 Compaction of Backfilling to Trenches (areas not subject to traffic)

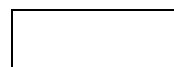
Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100mm. Each layer shall be compacted using hand stampers.

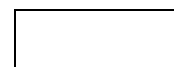
- to 90% Proctor density;
- such that in excess of 5 blows of a dynamic cone penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that the backfill does not comprise more than 10% gravel of size less than 10 mm and contains no isolated boulders; or
- such that the density of the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

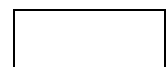
  
Tenderer

  
Witness 1

  
Witness 2

  
Employer

  
Witness 1

  
Witness 2

#### PF2.3.6 Excavation

All hand excavateable material including topsoil classified as hand excavateable shall be excavated by hand. Harder material may be loosened by mechanical means prior to excavation by hand. The excavation of any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

#### PF2.3.7 Clearing and Grubbing

Grass and small bushes shall be cleared by hand.

#### PF2.3.8 Shaping

All shaping shall be undertaken by hand.

#### PF2.3.9 Loading

All loading shall be done by hand, regardless of the method of haulage.

#### PF2.3.10 Haul

Excavation material shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150 m.

#### PF2.3.11 Offloading

All material, however transported, is to be off-loaded by hand, unless tipper-trucks are utilised for haulage.

#### PF2.3.12 Spreading

All material shall be spread by hand.

#### PF2.3.13 Compaction

Small areas may be compacted by hand provided that the specified compaction is achieved.

#### PF2.4 COMMUNITY LIAISON OFFICER

In order to facilitate, inter alia, the smooth preceding of the employment of local labour, a Community Liaison Officer will be appointed in terms of the Contract Data

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

*Tenderer*

*Witness 1*

*Witness 2*

*Employer*

*Witness 1*

*Witness 2*