



public works
& infrastructure

Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

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DEPARTMENT OF PUBLIC WORKS AND INFRASTRUCTURE
BILLS OF QUANTITIES
FOR
JAN KEMPDORP :
NEW MAGISTRATES COURT
ERF 253, JAN KEMPDORP

VOLUME 3

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October 2023

REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF PUBLIC WORKS AND INFRASTRUCTURE
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NEW MAGISTRATES COURT
ERF 253, JAN KEMPDORP

VOLUME 3

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October 2023

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Director-General
Department of Public Works and Infrastructure
Government of the Republic of South Africa

FOR ATTENTION

Mr Lebogang Molhala
Private Bag X5002
Kimberley
8300

Sir,

FIXED CONSTRUCTION GUARANTEE FOR THE EXECUTION OF A CONTRACT IN TERMS OF JBCC 2000 (EDITION 6.2 OF MAY 2018)

- With reference to the contract between _____
_____ (hereinafter referred to as the "contractor") and the Government of the Republic of South Africa in its Department of Public Works and Infrastructure (hereinafter referred to as the "employer"), Contract/Tender No: KIM 01/2024, for the New Magistrates Court, Jan Kempdorp (hereinafter referred to as the "contract") in the amount of R _____, (hereinafter referred to as the contract sum),
I/We, _____
in my/our capacity as _____ and hereby
representing _____ (hereinafter referred to as the "guarantor") advise that the guarantor holds at the employer's disposal the sum of R _____, (being 5% of the contract sum (excluding VAT)), for the due fulfilment of the contract.
- The guarantor hereby renounces the benefits of the exceptions *non numeratae pecuniae*, *non causa debiti*, *excussionis et divisionis*, and *de duobus vel pluribus reis debendi* which could be pleaded against the enforcement of this guarantee, with the meaning and effect whereof I/We declare myself/ourselves to be conversant, and undertake to pay the employer the amount guaranteed, on receipt of a written demand from the employer to do so, stating that the employer has a right of recovery against the contractor in terms of 33 C of the contract.
- Subject to the above, but without in any way detracting from the employer's rights to adopt any of the procedures provided for in the contract, the said demand can be made by the employer, at any stage prior to the expiry of this guarantee.
- The amount paid by the guarantor in terms of this guarantee may be retained by the employer on condition that upon the issue of the last final payment certificate, the employer shall account to the guarantor showing how this amount has been expended and refund any balance due to the guarantor.

Tender no: (Insert Tender Number)

5. The **employer** shall have the absolute right to arrange his affairs with the **contractor** in any manner which the **employer** deems fit and the **guarantor** shall not have the right to claim his release on account of any conduct alleged to be prejudicial to the **guarantor**. Without derogating from the foregoing, any compromise, extension of the **construction period**, indulgence, release or variation of the **contractor's** obligation shall not affect the validity of this guarantee.
6. The **guarantor** reserves the right to withdraw from this guarantee at any time by depositing the guaranteed amount with the **employer**, whereupon the **guarantor's** liability ceases.
7. This guarantee is neither negotiable nor transferable, and
 - (a) must be surrendered to the **guarantor** at the time when the **employer** accounts to the **guarantor** in terms of clause 4 above, or
 - (b) shall lapse on the date of the last certificate of practical completion.
8. This guarantee shall not be interpreted as extending the **guarantor's** liability to anything more than payment of the amount guaranteed.

SIGNED AT _____ ON THIS _____ DAY OF _____ 20__

AS WITNESS

1. _____
2. _____

By and on behalf of

(insert the name and physical address of the guarantor)

NAME: _____

CAPACITY: _____
(duly authorised thereto by resolution attached marked Annexure A)

DATE: _____

- A. No alterations and/or additions of the wording of this form will be accepted.
- B. The physical address of the guarantor must be clearly indicated and will be regarded as the guarantor's *domicilium citandi et executandi*, for all purposes arising from this guarantee.
- C. This GUARANTEE must be returned to: _____

DPW-10.3 (EC): VARIABLE CONSTRUCTION GUARANTEE - JBCC 2000 PRINCIPAL BUILDING AGREEMENT (EDITION 6.2 OF MAY 2018)

Director-General
Department of Public Works and Infrastructure
Government of the Republic of South Africa

FOR ATTENTION

Mr Lebogang Motlhalo
Private Bag X5002
Kimberley
8300

Sr,

VARIABLE CONSTRUCTION GUARANTEE FOR THE EXECUTION OF A CONTRACT IN TERMS OF JBCC 2000 (EDITION 6.2 OF MAY 2018)

1. With reference to the contract between _____
_____ (hereinafter referred to as the "**contractor**") and the Government of the Republic of South Africa, in its Department of Public Works and Infrastructure, (hereinafter referred to as the "**employer**"). Contract/Tender No: **KIM 01/2024**, for the **New Magistrates Court, Jan Kempdorp** (hereinafter referred to as the "**contract**" in the amount of R _____, { _____ } (hereinafter referred as the **contract sum**),
I/ We, _____
in my/our capacity as _____ and hereby
representing _____ (hereinafter referred to as the "**guarantor**") advise that the **guarantor** holds at the **employer's** disposal the sum of R _____ { _____ } being 10% of the **contract sum** (excluding VAT),
for the due fulfillment of the contract.
2. I/ We advise that the **guarantor's** liability in terms of this guarantee shall be as follows:
 - (a) From and including the date on which this guarantee is issued and up to and including the date of payment of the amount in the last final payment certificate, the **guarantor** will be liable in terms of this guarantee to the maximum amount of 10% of the **contract sum** (excluding VAT);
 - (b) The **guarantor's** liability shall reduce to 3 % of the **contract value** (excluding VAT) as determined at the date of the last certificate of practical completion, subject to such amount not exceeding 10% of the **contract sum** (excluding VAT);
 - (c) The **guarantor's** liability shall reduce to 1 % of the **contract value** (excluding VAT) as determined at the date of the last certificate of final completion, subject to such amount not exceeding 10 % of the **contract sum** (excluding VAT);
 - (d) This guarantee shall expire on the date of the last final payment certificate.
 - (e) The **practical completion certificate** and the **final completion certificate** referred to in this guarantee shall mean the certificates issued in terms of the contract.

Tender no: **KIM 01/2024**

3. The guarantor hereby renounces the benefits of the exceptions *non numerate pecunia; non causa debiti; excussionis et divisionis*, and *de duobus vel pluribus reis debendi* which could be pleaded against the enforcement of this guarantee, with the meaning and effect whereof I/we declare myself/ourselves to be conversant, and undertake to pay the employer the amount guaranteed on receipt of a written command from the employer to do so, stating that the employer has a right of recovery against the contractor in terms of 33.0 of the contract.
4. Subject to the above but without in any way detracting from the employer's rights to adopt any of the procedures provided for in the contract, the said demand can be made by the employer at any stage prior to the expiry of this guarantee
5. The amount paid by the guarantor in terms of this guarantee may be retained by the employer on condition that upon the issue of the last final payment certificate, the employer shall account to the guarantor showing how this amount has been expended and refund any balance due to the guarantor
6. The employer shall have the absolute right to arrange his affairs with the contractor in any manner which the employer deems fit and the guarantor shall not have the right to claim his release on account of any conduct alleged to be prejudicial to the guarantor. Without derogating from the foregoing, any compromise, extension of the construction period, indulgence, release or variation of the contractor's obligation shall not affect the validity of this guarantee
7. The guarantor reserves the right to withdraw from this guarantee at any time by depositing the amount guaranteed with the employer, whereupon the guarantor's liability ceases.
8. This guarantee is neither negotiable nor transferable, and
 - (a) must be surrendered to the guarantor at the time when the employer accounts to the guarantor in terms of clause 5 above, or
 - (b) shall lapse in accordance with clause 2(d) above
9. This guarantee shall not be interpreted as extending the guarantor's liability to anything more than the payment of the amount guaranteed.

SIGNED AT _____ ON THIS _____ DAY OF _____ 20__

AS WITNESS

1. _____

2. _____

Tender no: KIM 01/2024

By and on behalf of

(insert the name and physical address of the guarantor)

NAME: _____

CAPACITY: _____
(duly authorised thereto by resolution attached marked
Annexure A)

DATE: _____

- A. No alterations and/or additions of the wording of this form will be accepted.
- B. The physical address of the guarantor must be clearly indicated and will be regarded as the guarantor's *domicilium citandi et executandi*, for all purposes arising from this guarantee.
- C. This guarantee must be returned to: _____

PG-01.2 (EC) SCOPE OF WORKS – JBCC 2000 PRINCIPAL BUILDING AGREEMENT (Edition 6.2 of May 2018)

Project title:	<i>Jan Kempdorp: Justice: Magistrate Offices: Construction of a new building.</i>		
Tender / Quotation no:	KIM 01/2024	Reference no:	19/2/4/2/2324/7

C3. Scope of Works

C3.1 EXTENT OF THE WORKS

The works comprise the construction of a new single storey, part basement magistrates court with total building area approximately 400m² including extensive site works. The basement section comprises of reinforced concrete structure with mainly infill brickwork and ground floor of mainly loadbearing brickwork with reinforced concrete ring beams. Roof structure is structural steel roof trusses covered with sheet metal roof covering. Finishes are generally plaster and paint and floor finishes mainly power floated concrete and tiling.

The site is situated at erf 253, Jan Kempdorp.

C3.2 ORDER OF THE WORKS

No specific requirements

C3.3 BUILDINGS OCCUPIED

Not applicable

C3.4 ACCESS

Not applicable

C3.5 STANDARD MINIMUM REQUIREMENTS

In terms of section 5(2) of the Construction Industry Development Board Act, 2000 (Act no. 38 of 2000) (the Act), the Construction Industry Development Board is empowered to establish and promote best practice standards, Standard Requirements and Guidelines which includes the following but not limited to:

- C3.5.1 cidb Best Practice: Green Building Certification, No. 34158 Government Gazette, 1 April 2011
- C3.5.2 cidb Standard for Developing Skills through Infrastructure Contracts, No. 36760 Government Gazette, 23 August 2013
- C3.5.3 cidb Standard for Indirect Targeting for Enterprise Development through Construction Works Contracts, No 36190 Government Gazette, 25 February 2013
- C3.5.4 cidb Standard for Contract Participation Goals for Targeting Enterprises and Labour through Construction Works Contracts, No. 41237 Government Gazette, 10 November 2017
- C3.5.5 cidb Standard for Minimum Requirements for Engaging Contractors and Sub-Contractors on Construction Works Contracts, No. 41237 Government Gazette, 10 November 2017
- C3.5.6 cidb Standard for Minimum Requirements for Engaging Contractors and Sub- Contractors on Construction Works Contracts, No. 42021 Government Gazette, 9 November 2018

C3.5.7 cidb Standard for Developing Skills through Infrastructure Contracts, No 48491 Government Gazette, 23 April 2023.

C3.6 CONTRACT PARTICIPATION GOALS AND CIDB BUILD PROGRAMME

Provision has been made within the Contract Participation Goal section in the Bill of Quantities for the respective CPGs. Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

Monthly progressive reports to be submitted to the Employer's representative indicating the percentage targets achieved which must be reconciled upon completion of the project and to form part of the final account.

The contractor shall achieve in the performance of this contract the following Contract Participation Goals (CPGs) as indicated below.

C3.6.1 Minimum Targeted Local Material Manufacturer Contract Participation Goal

The Minimum Targeted Local Building Material Manufacturers CPG is not applicable to this project.

C3.6.2 Minimum Targeted Local Building Material Suppliers Contract Participation Goal

The Minimum Targeted Local Building Material Suppliers CPG is applicable to this project.

It is the requirement of the employer that the contractor enhances the use of local Small, Micro and Medium Enterprise Local Material Suppliers (SMME's) in executing this contract, irrespective whether a minimum percentage Participation Goals is applicable or not.

The Minimum Targeted Local Manufacturers of Material Contract Participation Goal shall be achieved in accordance with the cidb Standard for Contract Participation Goals for Targeting Enterprises and Labour through Construction Works Contracts as published in the Government Gazette Notice No. 41237 of 10 November 2017, as amended in cidb Best Practice Project Assessment Scheme Notice No. 43726 of 18 September 2020 – Condition of Contract.

A targeted supplier is a targeted enterprise that

- owns, operates or maintains a store, warehouse or other establishment in which goods are bought, kept in stock and regularly sold to wholesalers, retailers or the public in the usual course of business; and
- engages, as its principal business and in its own name, in the purchase and sale of goods.

Note: Adapted from SANS 10845-7:2015, definition 2.14

Preference shall be given to the local material suppliers where feasible in the wards and municipal district in the towns of Jan Kempdorp and provided that:

- Such materials comply in all respects with the specific requirements of PW371 and SANS specifications,
- The none availability of such materials shall not adversely affect the desired progress of the specific works,
- The use of such suppliers shall not constitute grounds for any claim for increased cost in respect thereof,
- Materials of at least 5% (Five Percent) of the total value of materials purchased excluding VAT to be sourced from within **40km** of the project site,
- Material of at least 5% (Five Percent) of the total value of materials purchased excluding VAT to be sourced from within **150km** of the project site.

Failure to achieve the minimum specified value as indicated in the CPG B-1 of Quantity Section for Targeted Local Material Manufacturer participation will result in a thirty percent (30%) penalty of the prorated targeted value of materials not complied with, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

The bidder shall submit monthly reports in terms of monthly achievement and accumulative targets achieved including audited supporting documentation to the Employer's Representative.

C3.8.3 Minimum Targeted Local Labour Skills Development Contract Participation Goal

The Minimum Targeted Local Labour Skills Development CPG is applicable to this project.

It is the requirement of the employer that the contractor enhances the use of local labour in executing this contract. This is required to be done through the use of both traditional building techniques and labour-intensive construction techniques careful and considered construction planning and implemented on the project irrespective whether a minimum percentage Participation Goal is applicable or not.

The Minimum Targeted Local Skills Development Contract Participation Goal shall be achieved in accordance with the cidb Standard for Contract Participation Goals for Targeting Enterprises and Labour through Construction Works Contracts as published in the Government Gazette Notice No. 41237 of 10 November 2017, as amended in cidb Best Practice Project Assessment Scheme Notice No. 43726 of 18 September 2020 – Condition of Contract..

Targeted labour: individuals who:

- a) are employed by the principal contractor, sub-contractor or targeted enterprises in the performance of the contract;
- b) are defined as the target group in the targeting data; and
- c) permanently reside in the target area or who are recognized as being residents of the target area on the basis of identification and association with and recognition by the residents of the target area.

Adapted from SANS 10845-7:2015, definition 2.12

Targeting of labour by skills categories is only permissible within categories of semi-skilled and unskilled labour.

Contract participation goals for semi skilled and unskilled labour shall be limited to 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 and in a manner that does not compromise worker health and safety. In the case of targeted labour, the certification of records shall be in accordance with SANS 10845-8.

Beneficiaries will be sourced from the wards, municipal districts and town of Jan Komadorp for the full duration of the Construction Period, employed by either the principal contractor, sub-contractors or targeted enterprises. The total number of working days to complete the Works amount to 600 working days working days. The minimum CPG participation for Targeted Local Labour Skills Development is 30% (thirty Percent), expressed as a percentage of the total number of working days required to complete the Works. The contractor shall sustain or exceed the CPG in the performance of the contract. Failure to achieve the minimum Targeted Local Labour Skills Development CPG will result in a payment reduction of R5 000 (Excluding VAT), per working day which training has not been provided to the workforce in attendance, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

The bidder shall submit monthly reports in terms of monthly achievement and accumulative targets achieved including audited supporting documentation to the Employer's Representative.

C3.6.4 CIDB BUILD PROGRAMME: Minimum Targeted Enterprise Development Contract Participation Goal

The Minimum Targeted Enterprise Development Contract Participation Goal is applicable to this project.

The aim of this best practice standard for indirect targeting for enterprise development in accordance with the Standard for Indirect Targeting for Enterprise Development (published in Government Gazette 36190 of 25 February 2013), as amended in cidb Best Practice Project Assessment Scheme Notice No. 43726 of 18 September 2020 – Condition of Contract, is to promote enterprise development by providing for a minimum Contract Participation Goal (CPG) of **5% (Five Percent)** of the contract amount as defined in the Standard (Tender amount, excluding allowances and VAT) on selected contracts to be undertaken by joint-venture partners or to be sub-contracted to developing contractors that are also to be beneficiaries of enterprise development support from the main contractor.

The bidder shall submit monthly reports in terms of monthly achievement and accumulative targets achieved including audited supporting documentation to the Employer's Representative.

The lead partner or main contractor shall dedicate a **minimum 5%** of the tender value at the time of award, excluding allowances and VAT, to provide developmental support to targeted subcontractor or joint venture partner applicable to contracts in Grades 7 to 9, General Building and Civil Engineering contracts. Preference will be given to General Building, Electrical, Mechanical and Plumbing Enterprises.

Failing to achieve the targeted Contract Skills Development Goal will result in A) a thirty percent (30%) penalty of the value of the portion not achieved, excluding VAT, and B) the issuing of completion certificates only after the completion certificate of achieving the skills development goal, counter-signed by the relevant individuals has been submitted, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

C3.6.4.1 Criteria

The main or lead partner of the successful bidder shall:

- (a) There must be a needs analysis for indirect targeting and development or skill standard and should be development in at least any two developmental areas namely:
 - Administrative and cost control systems
 - construction management systems and plans
 - **planning, tendering and programming**
 - business; technical; procurement skills
 - **legal compliance**
 - credit rating/history; financial loan capacity/history
 - contractual knowledge
- (b) The above needs analysis shall be mutually agreed upon between contractor and targeted enterprise
- (c) The contractor shall appoint an enterprise development coordinator to:
 - perform needs analysis on the targeted enterprise to identify developmental goals
 - develop a project specific enterprise development plan to improve the targeted enterprise/s performance in the identified developmental areas
 - provide internal mentorship support to improve the targeted enterprise/s performance
 - monitor and submit to the employer's representative a monthly enterprise development report thereby reporting on the progress of the agreed development areas with the targeted enterprise/s
 - submit a project completion report to the Employer's representative for each targeted enterprise.

C3.6.4.2 Management

The contractor shall provide a competent person/s to provide internal mentorship to the Targeted Enterprise/s in the two agreed developmental areas.

C3.6.4.3 Competence Criteria for an Enterprise Development Co-ordinator

The enterprise development co-ordinator shall have the following competencies:

- Minimum experience of 5 years in the construction industry at Managerial level as a Site Agent, Contract Manager, Site Manager, Construction Manager, Business Development Manager or Enterprise Development Manager
- Minimum experience of 2 years in training and development in Building or Construction; and
- National Diploma or B Degree in the Built Environment or Business Management

C3.6.4.4 Format of Communications

The contractor shall submit to the Employer's Representative

- *Project interim reports* in the specified format (**ED105P**) detailing interim values of the CPG that was achieved together with an assessment of the enterprise development support provided should be tabled and discussed at least monthly at progress meetings between employer's representative and the contractor;
- *Project completion report* in the specified format (**ED101P**) to the Employer's Representative for acceptance within 15 days of achieving practical completion. The report shall include the value of the CPG that was certified in accordance with the contract, cidb registration numbers of each and every targeted enterprise, and the value of the subcontracted works or of the joint venture entered into; and the participation parameter
- *Enterprise development declaration* (**ED104P**).

C3.6.4.5 The Key Personnel

The contractor shall appoint an Enterprise Development Co-ordinator and a competent person/s to provide internal mentorship.

C3.6.4.6 Management Meetings

The contractor shall report to the Employer's Representative on the implementation and progress of the targeted enterprise development and CPG at monthly progress site meetings.

C3.6.4.7 Forms for contract administration

The contractor shall submit to the Employer's Representative the following proformas:

- Form ED 105P Project Interim Report
- Form ED 104P Enterprise Development Declaration
- Form ED 101P Project Completion Report

C3.6.4.8 Records

The contractor shall:

- keep records of the targeted enterprise development
- keep records of the payments made to the targeted enterprises in relation to the CPG.
- ensure all the documentation required in terms of the Standard is provided with each monthly progress payment certificate and according to a prescribed format where applicable.

C3.6.4.9 Payment Certificates

The contractor shall:

- achieve the measurable CPG and providing enterprise development support to the targeted enterprise/s as per the Standard
- submit payment certificates to the Employer Representative at intervals determined in the Contract.

C3.6.4.10 Compliance requirements

Non-compliance with the Best Practice Project Assessment Scheme

The wording of regulation 27A of the cidb regulations makes provision for the Board to enforce the cidb code of conduct in the event of clients being found to be in breach of the best practice project assessment scheme.

- Not including the requirements of the cidb standards in the conditions of tender
- Not registering the award of contract on the cidb Register of Projects (RoP)
- Not reporting practical completion on the cidb Register of Projects (RoP)

3.6.5 CIDB BUILD PROGRAMME: Minimum Targeted Contract Skills Development Goal (CSDG)

The Minimum Targeted Contract Skills Development CPG is applicable to this project.

The contractor shall achieve or exceed in the performance of the contract the Contract Skills Development Goal (CSDG) established in the Standard for Developing Skills through Infrastructure Contracts (published in Government Gazette No 48491 of 23 April 2023 and the cidb Best Practice Project Assessment Scheme Notice No 43726 of 18 September 2020 – Condition of Contract.

Failing to achieve the targeted Contract Skills Development Goal will result in A) a thirty percent (30%) penalty of the value of the portion not achieved, excluding VAT, and B) the issuing of completion certificates only after the completion certificate of achieving the skills development goal, counter-signed by the relevant individuals has been submitted, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

The contractor shall apportion the learners in the different construction activities based on the scope of work. The cost of accommodating learners will be determined by using Table 3 in the Standard and this cost will be used to determine the value in Rand and will be added to the provision for training as provided for in the Preliminary and General section in the Bill of Quantities/Pricing schedules/Activity schedule.

C3.6.5.1 Methodology

The contractor shall achieve the measurable contract skills development goal by providing opportunities to learners requiring structured workplace learning using one or a combination of any of the following in relation to work directly related to the contract or order:

Method 1: structured workplace learning opportunities for learners towards the attainment of a part or a full occupational qualification;

Method 2: structured workplace learning opportunities for apprentices or other artisan learners towards the attainment of a trade qualification leading to a listed trade (GG No. 35625, 31 August 2012) subject to at least sixty percent (60%) of the artisan learners being holders of public TVET college qualifications;

Method 3: work integrated learning opportunities for University of Technology or Comprehensive University students completing their national diplomas;

Method 4: structured workplace learning opportunities for candidates towards registration in a professional category by a statutory council.

The contract skills participation goals, expressed in Rand, shall not be less than the contract amount multiplied by a percentage (%) factor given in Table 1 in the Standard for the applicable class of construction works.

Table 1: Contracting skills development goals for different classes of engineering and construction works contracts

Class of construction works as identified in terms of Regulation 25 (3) of the Construction Industry Regulations 2004		Construction skills development goal (CSDG) (%)
Designation	Description	
Ct	Civil Engineering	0.25
CE and GB	Civil engineering and General Building	0.375
EE	Electrical Engineering works (buildings)	0.25
EP	Electrical Engineering works (Infrastructure)	0.25
GB	General Building	0.5
ME	Mechanical Engineering works	0.25
SB	Specialist	0.25

The contractor shall apportion the learners in the different construction activities based on the scope of work. The cost of accommodating learners will be determined by using Table 2 in the Standard and this cost will be used to determine the value in Rand and will be added to the provision for training as provided for in the Preliminary and General section in the Bill of Quantities/Pricing schedules/Activity schedule.

Table 2: National Cost of Training per Headcount

Source: *with Standard for Skills Development*

Type of Training Opportunity	Provision for stipends (Unemployed learners only)	Provisions for mentorship	Provisions for additional costs*	Total costs	
				Unemployed learners	Employed learners
Method 1					
Occupational qualification	R7 000	R0	R9 000	R16 000	R9 000
Method 2					
TVET College graduates	R14 000	R0	R9 000	R23 000	N/A
Apprenticeship	R14 000	R0	R12 000	R26 000	R12 000
Method 3					
P1 and P2 learners	R24 000	R20 000	R4 500	R48 500	N/A
Method 4					
Candidates with a 3 year diploma	R37 000	R20 000	R4 500	R61 500	R20 000
Candidates with 4 year qualification	R47 000	R20 000	R4 500	R71 500	R20 000

Note: the required CPG will be recalculated based on the awarded tender amount and "Contract amount" once the beneficiaries have been appointed and actual costs are known. The national cost of providing training opportunities will increase by CPI on an annual basis based on April CPI. Should the rates increase after bid award or during construction the rates will be adjusted as a re-measurable item.

- The successful contractor may employ part/full trade qualification learners, work integrated learners or candidates directly or through a Skills Development Agency (SDA), (A1 - List of cidb accredited SDAs).
- The successful contractor must employ at least sixty percent (60%) of the learners from an FET / TVET college should the contractor select to have part/full occupational qualification learners and trade qualification learners contributing to the CSDG.
- The successful contractor shall employ at least **forty percent (40%)** from eligible part/full, work integrated learners or candidates in the employment of the employer.
- The successful contractor shall ensure that no single method shall contribute more than seventy five percent (75%) of the CSDG for the contract.
- The successful contractor may only place thirty three percent (33%) employed employees or that of his subcontractors contributing to the CSDG.
- The contractor shall employ at least sixty percent (60%) of the learners from a Public FET / TVET college should the contractor select to have trade qualification learners (Method 2) contributing to the CSDG.
- One of the objectives of the project is to train work integrated learners – P1 and P2 learners, professional candidates.

C3.6.5.2 Management

- The successful contractor must keep site records regarding the part/full work integrated learners' or candidates' progress, site attendance, hours worked and other relevant information as required by the Standard.
- The successful contractor shall provide the required number of appropriately qualified mentors to the maximum number of part/full occupational qualification learners, trade qualification learners, work integrated learners in the proportion as specified in the Standard.

- (c) The successful contractor shall provide a supervisor to manage the training of the part/full work integrated learners, candidates
- (d) The successful contractor shall submit to the employer's representative a baseline training plan in the specified format (Pro-forma A2) for the part/full work integrated learners, candidates within 30 days of start of the contract.
- (e) The successful contractor shall submit to the employer's representative project interim report in the specified format (Pro-forma A3) on the progress of each of part/full work integrated learner, candidate every three months.
- (f) The successful contractor shall submit to the employer's representative the names and particulars in the specified format (Pro-forma A4) of the supervisor, mentors for the part/full, work integrated learners or candidates within 30 days of start of the contract.
- (g) The successful contractor shall keep a daily record of all the part/full work integrated learners, candidates on site and their daily activities and shall be made available to the employer's representative on request.
- (h) The successful contractor shall submit to the employer's representative the reports on the progress and status of the part/full work integrated learners or candidates with the monthly invoice for the payment certificate
- (i) The successful contractor shall have health and safety inductions for all part/full work integrated learners or candidates.
- (j) The successful contractor shall conduct entry and exit medical tests of all part/full work integrated learners or candidates.
- (k) The successful contractor shall provide personal protective equipment (PPE) to all part/full work integrated learners or candidates at the start of their employment on site.
- (l) Based on the agreed skills methods the contractor may employ part/full Work Integrated Learners and/or Candidates directly or through a Skills Development Agency (SDA), training provider or skills development facilitator (Form A1 - List of birth accredited SDAs). The contractor shall ensure that no more than one Method shall be applied to any individual concurrently in the calculation of the CSOG for the contract.

C3.6.6 NATIONAL YOUTH SERVICE TRAINING AND DEVELOPMENT PROGRAMME (NYS)

The National Youth Service Training and Development Programme is applicable to this project.

The programme shall be implemented in terms of the Implementation of the National Youth Service Programme under the Expanded Public Works (EPWP) and shall be priced in the CPG section of the Bills of Quantities. Monthly reports are to be submitted to the Employer's Representative.

Failure by the contractors to achieve the specified number to be trained in the NYS section of the CPG section within the Bills of quantities will result in a Payment reduction as per bill of quantities per person, excluding VAT, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

C3.6.7 LABOUR-INTENSIVE WORKS

Labour Intensive Works is applicable to this project.

Where labour intensive work is specified in the Bill of Materials and specified by "LI" the contractor must price for and include in rates. Contractors are expected to use their initiative to identify additional activities that can be done labour-intensively to comply with the set minimum labour intensity target. Allowance must be made for submitting monthly reports illustrating the value of the works executed under Labour Intensive Works.

Failure by the contractor to achieve the specified value of the Labour Intensive Participation Goal as stipulated within the Bills of Materials will result in a **thirty percent (30%)** penalty of the value of the works not done by means of labour intensive methods, excluding VAT, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

Employer's objectives:

The employer's objectives are to deliver public infrastructure using labour-intensive methods in accordance with EPWP Guidelines.

Labour-intensive works:

Labour-intensive works shall be constructed/maintained using local workers who are temporarily employed in terms of the scope of work.

Labour-intensive competencies of supervisory and management staff:

Contractors shall only engage supervisory and management staff in labour-intensive works that have completed the skills programme including Foremen/ Supervisors at NQF level 4 "National Certificate: Supervision of Civil Engineering Construction Processes" and Site Agent/ Manager at NQF level 5 "Manage Labour-Intensive Construction Processes" or equivalent QCTO qualifications (See Appendix C) at NQF outlined in Table 1

C3.6.7.1 GENERIC LABOUR-INTENSIVE SPECIFICATION

Contractors are referred to the Guidelines for the Implementation of Labour-intensive Infrastructure Projects under the Expanded Public Works Programme (EPWP) for the generic labour-intensive specification applicable to the contract.

This specification establishes general requirements for activities which are to be executed by hand involving the following:

- trenches having a depth of less than 1.5 metres
- stormwater drainage
- roads
- sidewalks and non-motorised transport infrastructure
- water and sanitation

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.

Hand excavateable material

Hand excavateable material is:

a) granular materials:

- i) whose consistency when profiled may in terms of Table 3 be classified as very loose, loose, medium dense, or dense; or
- ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100mm;

b) cohesive materials:

- i) whose consistency when profiled may in terms of Table 3 be classified as very soft, soft, firm, stiff and stiff / very stiff; or
- ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100mm;

Note



- 1) A boulder is material with a particle size greater than 200mm, a cobble and gravel is material between 60 and 200mm.
- 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 400mm and drives a cone having a maximum diameter of 20mm (cone angle of 60° with respect to the horizontal) into the material being used.

Table 3: 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 30-40 mm; can be moulded 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 10 mm, 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 a 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 moulded 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.

Trench excavation

All hand excavatable material in trenches having a depth of less than 1,5 metres shall be excavated by hand.

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 tampers,

- a) to 90% Mod AASHTO;
- b) such that in excess of 5 blows of a dynamic cone penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that backfill does not comprise more than 10% gravel of size less than 10mm and contains no isolated boulders, or
- c) 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.

Excavation

All excavatable material including topsoil classified as hand excavatable shall be excavated by hand. Harder material may be loosened by mechanical means prior to excavation by hand. Any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

Clearing and grubbing

Grass and bushes shall be cleared by hand.

Shaping

All shaping shall be undertaken by hand.

Loading

All loading shall be done by hand. Haulage equipment should be selected in a manner that allows loading by hand to the greatest extent possible.

Haul

Excavation material shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 50m.

Offloading

All material, however transported, is to be off-loaded by hand, unless tipper-trucks are utilised for haulage.

Spreading

All material shall be spread by hand.

Compaction

Small areas may be compacted by hand provided that the specified compaction is achieved. Appropriate rollers should be used where higher (than can be achieved by hand) levels of compaction are required or for large areas.

Grassing

All grassing shall be undertaken by sprigging, sodding, or seeding by hand.

Stone pitching and rubble concrete masonry

All stone required for stone pitching and rubble concrete masonry, whether grouted or dry, must be collected, loaded, off loaded and placed by hand.

Sand and stone shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150m.

Grout shall be mixed and placed by hand.

Manufactured Elements

Elements manufactured or supplied by the Contractor, such as manhole rings and cover slabs, precast concrete planks and pipes, masonry units and edge beams shall not individually, have a mass of more than 320kg. Where the mass of an element exceeds 55 kg, consideration should be given to the size of the element relative to its total mass related to the number of workers who would be needed to lift such mass.

C3.7 Submission of Accrual Reports

The Contractor shall submit accrual reports to the client representative at the end of March and September each year for the duration of the Service Contract period from the date of appointment up to and including project closeout. This is to ensure that PMTE complies with the accounting framework GRAP, which requires that PMTE disclose all its accruals as at the end of each reporting date.

C3.8 Submission of Monthly Local Material Utilisation Report (Local Content)

Submission of Monthly Local Material Utilisation Report (Local Content) “not applicable” to this project.

The Contractor shall, when applicable to this project, be responsible for record keeping, documenting and submission of monthly local material utilization report, with supporting documentation to the Employer's representative within 7 working days of the beginning of the successive month, in terms of DTI&C designated industry/sector/sub-sector schedule as per the PA36 and Annexures C



attached to the tender document. The final percentage achievement to be reconciled upon completion of the project and form part of the final account.

Failure by the contractor to achieve the specified percentage of local content per designated industry/sector/sub-sector as listed will result in a thirty percent thirty percent (30%) penalty of the value not achieved, excluding VAT, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control.

Examples of calculating CPGs and related penalties

CPGs values are based on the Tender Amount at the time of the award. Determining the actual values is based either on the Tender Amount including allowances and Vat or the Tender Amount at the time of award excluding allowances and VAT, where Allowances include the following:

- Provisional amounts
- CPG allowances
- Nominated and/or selected subcontractors
- Contract price adjustment (Not provided for within the B of Q by NDPWI)
- Contingency amounts (Not provided for within the B of Q by NDPWI)

CPG values in the CPG Bill of Quantities Section will be recalculated based on the "Tender Amount" or the "Contract Amount" which ever applicable and the provisional amounts adjusted accordingly. Sanctions (penalties) are applicable to all CPGs where the contractor fails to achieve the minimum specified requirements, unless the contractor can prove to the Employer's satisfaction that the non-achievement was beyond his/her control. No penalties will be applied should the CPG value, based on the original "Tender Amount" or the "Contract Amount", has been achieved.

1.1 Targeted Local Building Material Manufacturers CPG

When applicable, the CPG is expressed as a percentage of the "Contract Amount", i.e. the Tender Amount at the time of award excluding allowances and VAT.

CPG calculation example:

"Tender Amount" = R150 Mil all inclusive of allowances and VAT
"Contract Amount" = R130 Mil (Tender Amount at the time of award excluding allowances and VAT)
CPG to be achieved = 5% as specified in the Scope of Works (PG01.2)
CPG target value = R130 Mil x 5% = R 6.5 Mil (Value of material to be purchased from local manufacturers, excluding VAT)

Calculation of penalty:

Percentage penalty applicable = 10% as specified in the Scope of Works (PG01.2)
CPG target value = R6,5 Mil excluding VAT
CPG Achieved = R5,5 Mil (R1 Mil shortfall) excluding VAT
Penalty = R1 Mil x 10% = R100 000 excluding VAT

1.2 Targeted Local Building Material Suppliers CPG

When applicable, the CPG is expressed as a percentage of the "Contract Amount", i.e. the Tender Amount at the time of award excluding allowances and VAT.

CPG calculation example:

"Tender Amount" = R150 Mil all inclusive of allowances and VAT
"Contract Amount" = R130 Mil (Tender Amount at the time of award excluding allowances and VAT)
CPG to be achieved = 5% as specified in the Scope of Works (PG01.2)
CPG target value = R130 Mil x 5% = R 6.5 Mil (Value of material to be purchased from local suppliers, excluding VAT)

Calculation of penalty:

Percentage penalty applicable = 20% as specified in the Scope of Works (PG01.2)
CPG target value = R6,5 Mil excluding VAT
CPG Achieved = R5,5 Mil (R1 Mil shortfall) excluding VAT
Penalty = R1 Mil x 20% = R200 000 excluding VAT

1.3 Targeted Local Labour Skills Development CPG

When applicable, the CPG is expressed as a percentage of the total number working days required to Any reference to words "Bid" or "Bidder" herein and/or in any other documentation shall be construed to have the same meaning as the words "Tender" or "Tenderer".

complete the Works.

CPG calculation example:

"Tender Amount" = R150 Mil all inclusive of allowances and VAT

"Contract amount" = R130 Mil (Tender Amount at the time of award excluding allowances and VAT)

Number of working days required to complete the Works based on the construction period = 600 days

CPG percentage participation to be achieved = 30% as specified in the Scope of Works (PG01.2)

Required number of working days training to be provided = 180 days (600 x 30%)

Calculation of penalty:

Payment reduction = R 5 000 per day for not providing training as specified in the Scope of Works (PG01.2)

CPG = 600 working days x 30% = 180 working days training to be provided

CPG Achieved = 160 days (20 days shortfall where no training was provided)

Penalty = 20 days x R5 000 payment reduction per day = R100 000 excluding VAT

1.4 Cidb BUILD Programme: Enterprise Development

When applicable, the Enterprise Development CPG expressed as a percentage of the "Contract amount" = Tender amount at the time of award excluding allowances and VAT. Failure to achieve the minimum Targeted Local Labour Skills Development CPG will result in a payment reduction of an amount specified in the Scope of Works (PG01.2) per working day where training was not provided.

The monetary value of training to be provided is stipulated in the CPG BoQ section. The number of beneficiaries to be trained is dependent on the "Contract Amount" as well the number of beneficiaries appointed which will generally resort under the Grade 1 and 2 cidb categories. The provisional amount will therefore be adjusted in terms of the "contract Amount", the number of beneficiaries to be trained and the actual cost for providing the training

Part 1: Calculation of 5% CPG example:

"Tender Amount" = R150 Mil all inclusive of allowances and VAT

"Contract Amount" = R130 Mil (Tender Amount at the time of award excluding allowances and VAT)

CPG percentage participation to be achieved = 5% as specified in the Scope of Works (PG01.2) CPG

value = R6,5 Mil (Value of work to be subcontracted to emerging enterprises)

Calculation of penalty

Percentage penalty applicable = 30% as specified in the Scope of Works (PG01.2)

CPG Minimum 5% = R6,5 Mil

Achieved = R5,5 Mil (Only subcontracted work to the value of R5,5 Mil, i.e. R1 Mil shortfall)

Penalty = R1 Mil x 30% = R300 000 Excl. VAT

Part 2: Calculations in terms of training to be done:

The number of enterprises to be developed is subject to the contract amount and the apportionment of the work as per Example 1 below.

Number of enterprises to be trained = 6 x 1 GB subcontractors

Total cost for training = R 1 660 000

Calculation of penalty

Total number of enterprises to be trained = 6

Total number trained = 4 (2 Shortfall)

Training cost per beneficiary = R1 660 000 / 6 = R 276 666,67 per beneficiary

Penalty = R 276 666,67 x 2 x 30% = R166 000 Excl. VAT

B of Q Item	Description	Unit	Rate	Quantity	Amount (R)
5	Enterprise Development				
5.1	Enterprise Development of Targeted Enterprise or JV partners				
5.1.1	Appointment of training coordinator	Per Quarter	45 000	8	360 000
5.1.2	Appointment of Mentor / Training Service provider	Per Quarter	135 000	8	1 080 000

B of Q Item	Description	Unit	Rate	Quantity	Amount (R)
5.1.3	Needs Analysis and Enterprise Development Plan per Targeted Enterprise	No.	5 000	6	30 000
5.1.4	Monitoring and Internet reporting per targeted enterprise	Per Quarter	20 000	6	120 000
5.1.5	Project Completion report per Targeted Enterprise	No.	5 000	6	30 000
	Provisional Sum to be carried over to CPG bill of quantities				1 680 000
Contract amount Tender amount excl. allowances and VAT,		130 000 000			
CPG Monetary value (5%) to be subcontracted to beneficiaries for training		6 500 000			
No of enterprises based on the CPG value		6	Grade 1 / 2		
Contract period (months)		24	GBICE ETC		
Note: Rates to be determined by PQS and adjusted to accepted quotation amounts					

1.5 Cidb BUILD Programme: Skills Development (Principal contractor including subcontractors and consultants)

When applicable, the contract skills development participation goals, expressed in Rand, shall be no less than the 'contract amount' multiplied by a percentage (%) factor for the applicable class of construction works

The monetary value of training to be provided is stipulated in the CPG BnQ section. The number of beneficiaries to be trained is dependent on the "Contract Amount" as well the number of beneficiaries appointed which will generally resort under the Grade 1 and 2 cidb categories. The provisional amount will therefore be adjusted in terms of the "Contract Amount", the number of beneficiaries to be trained from which Method and the actual cost for providing the training

CPG Calculation

Table 2: Contracting skills development goals for different classes of engineering and construction works contracts

Source: cidb Standard for Developing Skills through Infrastructure Contracts as published in the Government Gazette Notice No. 43495 of 3 July 2020 (Page 1)

Class of construction works as identified in terms of Regulation 25 (3) of the Construction Industry Regulations 2004		Construction skills development goal (CSDG) (%)
Designation	Description	
CE	Civil Engineering	0.25
CE and GB	Civil engineering and General Building	0.375
EE	Electrical Engineering works (buildings)	0.25
EP	Electrical Engineering works (infrastructure)	0.25
GB	General Building	0.5
ME	Mechanical Engineering works	0.25
SB	Specialist	0.25

"Contract amount" = Tender amount at the time of award excluding allowances and expenses, and VAT

Contractor CPG:

CPG calculation

"Contract amount" x factor from Table 3 above.

CPG calculation example:

"Tender Amount" = R150 Mil for GB, all inclusive of allowances and VAT

"Contract Amount" = R130 Mil (Tender Amount at the time of award excluding allowances and VAT)

Factor for GB = 0,5% (as per Table 2 above)

CPG in R value = R130 Mil x 0,5% = R650 000 i.e. total notional cost of training to amount to R650 000

Calculation of penalty:

Percentage penalty applicable = 30% as specified in the Scope of Works (PG01 2)

CPG value = R650 000

Any reference to words "Bid" or "Bidder" herein and/or in any other documentation shall be construed to have the same meaning as the words "Tender" or "Tenderer"

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Achieved = R550 000 = R100 000 Shortfall
Penalty = R100 000 x 30% = R30 000 Excl. VAT

Calculations based on "Contract Amount" after bid award and appointment of beneficiaries

Actual CPG training requirement value after award upon selecting method/s of training and appointment of beneficiaries = R676 000 (Table 4 below) and the provisional amount allowed for to be adjusted accordingly. The new monetary value of training required will then form the basis for determining penalties applicable. No penalties will be applied should the CPG value, based on the "Contract Amount" be achieved.

Table 4: Notional cost recalculation upon appointment of beneficiaries

Source: *Guideline Standard for Developing Skills through Infrastructure Contracts* as published in the Government Gazette Notice No. 43455 of 3 July 2020 (Page 10)

Skills Types	Number of learners	Notional Cost / Learner / Quarter	Notional cost / learner / year	Total Notional Cost over 12 months Contract
Method 2: Workplace learning opportunities, with unemployed TVET graduates	2	R23 000	R92 000	R184 000
Method 3: Candidacy for an unemployed learner with a 3-year qualification	2	R46 500	R246 000	R492 000
Total	4			R676 000

Note: the required CPG will be recalculated based on the awarded tender amount and "Contract Amount" once the beneficiaries have been appointed and actual costs are known

Note: The notional cost of providing training opportunities will increase by CPI on an annual basis based on April CPI as published by Stats SA. The rates will be adjusted as an adjustment to the provisional amounts should the rates increase after bid award or during the construction period

1.5 National Youth Service Programme (NYS) CPG

When applicable, a separate NYS Bill of Quantities will be included in the tender documentation will indicate the number of beneficiaries to be trained.

Calculation of penalty:

Payment reduction per person not trained as stipulated in the NYS Bill of Quantities = R 2 500 per person

Total number of NYS Beneficiaries as stipulated in the NYS Bill of Quantities = 25

Total Number of NYS beneficiaries trained = 20 (shortfall of 5 beneficiaries)

Penalty = 5 x R2 500 = R12 500 Excl. VAT

1.7 Labour Intensive Works CPG

When applicable, the work to be done by way of Labour intensive methods are specified in the Bills of Quantities with a "L".

CPG calculation example:

"Tender Amount" = R150 Mil (all inclusive of allowances and VAT)

"Contract Amount" = R130 Mil (Tender Amount at the time of award excluding allowances and VAT)

CPG value = R10 Mil (This value of labour-intensive works specified in the Bills of Quantities)

Calculation of penalty:

CPG value = R10 Mil

Percentage penalty applicable = 30% as specified in the Scope of Works (PG01.2)

CPG Achieved = 9 Mil (R1 Mil shortfall)

Penalty = R1 Mil x 30% = R300 000 Excl. VAT

PG-02.2 (EC) PRICING ASSUMPTIONS - JBCC 2000 PRINCIPAL BUILDING AGREEMENT (Edition 6.2 of May 2018)

Project title:	<i>Jan Kempdorp: Justice: Magistrate Offices: Construction of a new building.</i>		
Tender / Quotation no:	KIM 01/2024	WCS no:	Reference no: 19/2/4/2/2324/7

C2.1 Pricing Assumptions

C2.1.1 BILLS OF QUANTITIES / LUMP SUM DOCUMENT

The bills of quantities / lump sum document forms part of and must be read and priced in conjunction with all the other documents forming part of the contract documents, the Standard Conditions of Tender, Conditions of Contract, Specifications, Drawings and all other relevant documentation.

The prices and rates to be inserted by the Tenderer in the Bill of Quantities shall be the full inclusive prices to be paid by the Employer for the work described under the several items, and shall include full compensation for all cost and expenses that may be required in and for the completion and maintenance during the defects liability period of all the work described and as shown on the drawings as well as all overheads, profits, incidentals and the cost of all general risks, liabilities and obligations set forth or implied in the documents on which the Tender is based.

Each item shall be priced and extended to the "Total" column by the Tenderer, with the exception of the items for which only rates are required, or items which already have Prime Cost or Provisional Sums affixed thereto. If the Contractor omits to price any items in the Bill of Quantities, then these items will be considered to have a nil rate or price.

No alterations, erasures, omissions or additions is to be made in the text and/or conditions of these Bills of Quantities. Should any such alterations, amendments, notes or addition be made, the same will not be recognized, but reading of these Bills of Quantities as originally prepared by the Quantity Surveyor will be adhered to.

The contractor is cautioned that the use of any quantities appearing in these Bills of Quantities for the purpose of ordering material, it is done at own risk and no liability whatsoever will be admitted by the Employer or Quantity Surveyor for the correctness of such Quantities. Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for waste.

The prices and rates to be inserted by the Tenderer in the Bills of Quantities shall be the full inclusive prices to be paid by the Employer for the work described. Such prices and rates shall cover all costs and expenses that may be required in and for the execution of the work described, and shall cover the cost of all general risks, liabilities, and obligations set forth or implied in the documents on which the tender is based, as well as overhead charges and profit. Market related prices shall be inserted as these will be used as a basis for assessment of payment for additional work that may have to be carried out. The Employer reserves the right to balance the Bill rates where deemed necessary within the Tendered Amount.

A price or rate is to be entered against each item in the Bills of Quantities, whether the quantities are stated or not. An item against which no rate is/are entered, or if anything other than a rate or a nil rate (for example, a zero, a dash or the word "included" or abbreviations thereof) is entered against an item, it will also be regarded as a nil rate having been entered against that item, i.e. that there is no charge for that item. The Tenderer may be requested to clarify nil rates, or items regarded as having nil rates; and the Employer may also perform a risk analysis with regard to the reasonableness of such rates.

**PG-02.2 (EC) PRICING ASSUMPTIONS - JBCC 2000
PRINCIPAL BUILDING AGREEMENT (Edition 6.2 of May 2016)**

Should the full intent and meaning of any description not be clear, the bidder shall, before submission of his tender, call for a written directive from the principal agent, failing which it shall be assumed that the contractor has allowed in his pricing for materials and workmanship in terms of National Best Practice.

All items for which terminology such as "inclusive" or "not applicable" have been added by the Tenderer will be regarded as having a nil rate which shall be valid irrespective of any change in quantities during the execution of the Contract.

The Tenderer is required to check the Bills of Quantities and the numbers of the pages and should any be found to be missing or in duplicate, or should any of the typing be indistinct, or any doubt of obscurity arise as to the meaning of any description or particulars of any item, or if this Tender Enquiry contains any obvious errors, then the Tenderer must immediately inform the Principal Agent and have them rectified or explained in writing as the case may be. No liability whatsoever will be admitted by reason of the Contractor having failed to comply with the foregoing instruction.

The contractor is cautioned that the use of any quantities appearing in these Bills of Quantities for the purpose of ordering material, it is done at own risk and no liability whatsoever will be admitted by the Employer or Quantity Surveyor for the correctness of such Quantities. Unless otherwise stated, items are measured not in accordance with the drawings, and no allowance is made for waste.

No alterations, erasures, omissions, or additions are allowed to be made to the text and/or conditions contained in these Bills of Quantities. If any such alteration, amendment, note or addition is made, it will not be recognised and the Bills of Quantities will be deemed to be as originally drawn up by the Quantity Surveyor.

A price or rate is to be entered against each item in the Bills of Quantities, whether the quantities are stated or not. An item against which no rate is/are entered, or if anything other than a rate or a nil rate (for example, a zero, a dash or the word "Included" or abbreviations thereof) is entered against an item, it will also be regarded as a nil rate having been entered against that item, i.e. that there is no charge for that item. The Tenderer may be requested to clarify nil rates, or items regarded as having nil rates; and the Employer may also perform a risk analysis with regard to the reasonableness of such rates.

All items for which terminology such as "inclusive" or "not applicable" have been added by the Tenderer will be regarded as having a nil rate which shall be valid irrespective of any change in quantities during the execution of the Contract.

The Tenderer shall fill in rates for all items where the words "rate only" appear in the "Total" column. 'Rate Only' items have been included where:

- (a) variations of specified components in the make-up of a pay item may be expected; and
- (b) no work under the item is foreseen at tender stage but the possibility that such work may be required is not excluded.

For 'Rate Only' items no quantities are given in the "Quantity" column but the quoted rate shall apply in the event of work under this item being required. The Tenderer shall however note that in terms of the Tender Data the Tenderer may be asked to reconsider any such rates which the Employer may regard as unbalanced.

Descriptions in the Bills of Quantities are abbreviated and comply generally with those in the "PW 371" and the principles contained in the latest version of the Standard System for Measuring Builders' Work in South Africa. It is the intention that the abbreviated descriptions be fully described when read with the applicable measuring system and the relevant preambles and/or specifications. However, should the full intent and meaning of any description not be clear, the bidder shall, before submission of his tender, call for a written directive from the principal agent, failing which it shall be assumed that the contractor has allowed in his pricing for materials and workmanship in terms of National Best Practice.



**PG-02.2 (EC) PRICING ASSUMPTIONS - JBCC 2000
PRINCIPAL BUILDING AGREEMENT (Edition 6.2 of May 2018)**

The price quoted against each item of this Bills of Quantities shall cover the full inclusive cost of the complete work to which it refers, as described in the Conditions of Contract and Specifications and as shown on the Drawings and shall allow for labour, material, transporting, loading, storage, supervisor, commissioning, wastage, as well as the builders profit and attendance.

The Tenderer must ensure that he fully completes all columns of the Bill of Quantities including the Final Summary. The fully priced bill of quantities must be submitted with the tender or The Final Summary and the Section Summary pages MUST be returned with the tender document as indicated the PA-03 Notice and Invitation to Tender / PA-04 Notice and Invitation for quotation.

The tenderers are to ensure that they have read and understood the project specifications included in C3 Scope of Work. All the information provided in the Scope of Works form part of the work and must be included in the rates.

"The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself before submitting his tender (as far as is practicable) as to:

- (a) the form and nature of the Site and its surroundings, including subsurface conditions,
- (b) the hydrological and climatic conditions,
- (c) the extent and nature of work and materials necessary for the execution and completion of the Works,
- (d) the means of access to the Site and the accommodation he may require

and, in general, shall be deemed to have obtained all information (as far as is practicable) as to risks, contingencies and all other circumstances which may influence or affect his Tender."

C2.1.2 VALUE ADDED TAX

The contract sum must include for Value Added Tax (VAT). All rates, provisional sums, etc. in the bills of quantities / lump sum document shall be in Rands and cents and shall include all levies and taxes (other than VAT). VAT will be added in the summary of the Bill of Quantities. The rates must however be net (exclusive of VAT) with VAT calculated and added to the total value thereof in the Final Summary. All rates and amounts quoted in the Bill of Quantities

C2.1.3 CORRECTION OF ENTRIES

Incorrect entries shall not be erased or obliterated with correction fluid but must be crossed out neatly. The correct figures must be entered above or adjacent to the deleted entry, and the alteration must be initialed by the Tenderer.

C2.1.4 ARITHMETICAL ERRORS

Arithmetical errors found in the Bill of Quantities as a result of faulty multiplication of addition, will be corrected by the Engineer at the tender evaluation stage, as set out in the Tender Data

C2.1.5 TRADE NAMES

Tenderers attention is drawn to the fact that wherever trade names or references to any catalogue have been made in these Bills of Quantities, it is purely to establish a standard for the required material. If use is made of any other equally approved material in lieu of the prescribed trade name or catalogue, the necessary price adjustments will be made.

C2.1.6 CONTRACT DOCUMENTS

The Tenderers are advised to examine the bills of quantities, drawings and specifications including all other contract documents and make themselves thoroughly acquainted with the nature and requirements of the work, as no claim for extra payment in this regard will be entertained. Should any parts of the drawings not be clearly intelligible to the Tender, he must, before submitting his tender, obtain clarification from the Principal Agent.

C2.1.7 FIXED PRICE CONTRACT

The Bills of Quantities document is not a fixed price contract and the Tenderers are to take note that contract price adjustments (CPAP) are applicable to this contract.

C2.1.8 PAYMENTS

Interim valuations and payments will be prepared on a monthly basis, all in terms of the conditions of contract.

The contractor is to note that no payment will be made for materials stored off site and in the case of materials being stored on site, payment will only be made for such materials on condition that they have not been delivered to the site prematurely a tax invoice and proof of payment (ownership) is submitted by the Contractor.

C2.1.9 ACCOMMODATION ON SITE

It is imperative to note that no living quarters for construction workers on site will not be permitted for the full duration of the contract unless otherwise stated in the contract data or permission be granted by the Employer.

C2.1.10 SUBMISSION OF LOCAL MATERIAL UTILISATION REPORT (LOCAL CONTENT)

Submission of Local Material Utilisation Reports is not applicable this project.

C2.1.11 CONTRACT PARTICIPATION GOALS

The contractor shall achieve in the performance of this contract the following Contract Participation Goals (CPGs) as indicated below:

Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation

Monthly progressive reports to be submitted to the Employer's representative indicating the percentage targets achieved which must be reconciled upon completion of the project and to form part of the final account

C2.1.11.1 MINIMUM TARGETED LOCAL BUILDING MATERIAL MANUFACTURERS CONTRACT PARTICIPATION GOAL

The Minimum Targeted Local Building Material Manufacturers CPG is applicable to this project.

Provision is made within the Preliminaries section in the Bill of Quantities for the Minimum Targeted Local Building Material Manufacturers CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.1. Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

C2.1.11.2 MINIMUM TARGETED LOCAL BUILDING MATERIAL SUPPLIERS CONTRACT PARTICIPATION GOAL

The Minimum Targeted Local Building Material Suppliers CPG is applicable to this project.

Provision is made within the Preliminaries section in the Bill of Quantities for the Minimum Targeted Local Building Material Suppliers CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.2. Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

C2.1.11.3 MINIMUM TARGETED LOCAL LABOUR CONTRACT PARTICIPATION GOAL

The Minimum Targeted Local Labour Skills Development CPG is applicable to this project.

Provision is made within the Preliminaries section in the Bill of Quantities for the Minimum Targeted Local Labour CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.3. Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

C2.1.11.4 MINIMUM TARGETED ENTERPRISE DEVELOPMENT CONTRACT PARTICIPATION GOAL

The Minimum Targeted Enterprise Development Contract Participation Goal is applicable to this project.

A 5% provision has been allowed for within the Contract Participation Goal section in the Bill of Quantities for the Minimum Targeted Enterprise Development CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.4. The provision allowed is for the appointment of training coordinator, mentor, training service providers and training of the beneficiary enterprises. The provisional amount will be adjusted in accordance with the actual Contract Amount (Awarded tender amount excluding allowance, provisional amounts and VAT) of the awarded bid.

Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

The contractor shall complete a separate bill of quantities upon the award of the project and identification of the respective beneficiaries and the appointment of the training coordinator, mentor, training service providers of which the cost will be offset against the provisional amount allowed in the Bills of Quantities.

C2.1.11.5 MINIMUM TARGETED TARGETED CONTRACT SKILLS DEVELOPMENT GOALS (CSDG)

The Minimum Targeted Contract Skills Development CPG is applicable to this project.

**PG-02.2 (EC) PRICING ASSUMPTIONS - JBCC 2000
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A 0.5% provision has been allowed for within the Contract Participation Goal section in the Bill of Quantities for the Minimum Targeted Skills Development CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.5. The provision amount allowed is for:

- stipends payable to the beneficiaries
- appointment of training coordinator
- appointment of mentor (where applicable)
- appointment of training service providers
- other additional costs as per Table 3 of the Standard

Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

The contractor shall complete a separate bill of quantities upon the award of the project and identification of the respective beneficiaries. The CPG value to be achieved will be based on the actual contract amount which will be offset against the provisional amount allowed for within the Contract Participation Goal section in the Bill of Quantities.

Payment

The contractor shall upon the appointment of beneficiaries, provide a breakdown of all the associated costs. The contractor shall provide a payment schedule as to how the CPG costs will be claimed against for inclusion in the monthly payment certificates.

(c) Payment to the contractor to accommodate Part/Full Occupational qualification and Trade qualifications:

Should the contractor select Part/Full Occupational qualification and Trade qualifications learners, then the employer shall make provision for payment to the contractor as indicated in Table 3 of the Standard.

The contract skills participation goal, expressed in Rand, shall not be less than the contract amount multiplied by a percentage (%) factor given in Table 2 in the Standard for the applicable class of construction works. Should the contractor select Part/Full Occupational qualification and Trade qualifications learners, then the employer shall make provision for payment to the contractor as indicated in Table 2 of the Standard.

Table 2: Contracting skills development goals for different classes of engineering and construction works contracts

Source: *Job Standard for Developing Skills through Apprenticeship Contracts* as published in the Government Gazette Notice No. 40491 Government Gazette 25 April 2023 (Table 2, Page 7)

Class of construction works as identified in terms of Regulation 25 (3) of the Construction Industry Regulations 2004		Construction skills development goal (CSDG) (%)
Designation	Description	
CE	Civil Engineering	0.25
CE and GB	Civil engineering and General Building	0.375
EE	Electrical Engineering works (buildings)	0.25
EP	Electrical Engineering works (infrastructure)	0.25
GB	General Building	0.5
ME	Mechanical Engineering works	0.25
SB	Specialist	0.25

No provision for an additional payment item for the payment of the supervisor and/or mentors for the provision of training as provided for in the Contract Participation Goal section in the Bill of

**PG-02.2 (EC) PRICING ASSUMPTIONS - JBCC 2000
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Quantities for the training of part/full time occupational learners and/or trade qualification learners.
The associated cost is deemed to be included in general supervision on site.

The contractor shall complete a separate bill of quantities upon award, indicating the type and number of beneficiaries as well as the associated Notional Cost of Training to be provided, on which payment will be based.

- (b) Payment to the contractor to accommodate Work Integrated Learners and Candidates for professional registration:

Should the contractor select Work Integrated Learners and/or Candidates for professional registration, then the employer shall make provision for payment to the contractor as indicated in Table 3 of the Standard.

Provisional amounts have been included in the Contract Participation Goal section in the Bill of Quantities for the training of Work Integrated Learners and Candidates for professional registration. The contractor shall price his Profit and Attendance (all inclusive of associated costs to the contractor for implementation and reporting), based on the provisional amount in the Contract Participation Goal section in the Bill of Quantities.

The contractor shall complete a separate bill of quantities upon award, indicating the type and number of beneficiaries as well as the associated Notional Cost of Training to be provided, on which payment will be based.

The CPG value to be achieved will be based on the contract amount as defined by the Standard, which will be offset against the provisional amount allowed for within the Contract Participation Goal section in the Bill of Quantities.

The contractor shall apportion the cost of accommodating work integrated learners (P1 and P2 learners) and candidates for professional registration by using Table 3 in the Standard and this cost will be used to determine the Rand value and will be used in determining the contract participation goal in the Bills of Quantities.

Table 3: The notional cost of providing training opportunities per quarter

Source: *cidb Standard for Developing Skills through Infrastructure Contracts* as published in the Government Gazette Notice No. 48491 Government Gazette, 23 April 2023 (table 3, Page 9)

Type of Training Opportunity	Provision for stipends (Unemployed learners only)	Provisions for mentorship	Provisions for additional costs*	Total costs	
				Unemployed learners	Employed learners
Method 1					
Occupational qualification	R7 000	R0	R9 000	R16 000	R9 000
Method 2					
TVET College graduates	R14 000	R0	R9 000	R23 000	N/A
Apprenticeship	R14 000	R0	R12 000	R26 000	R12 000
Method 3					
P1 and P2 learners	R24 000	R20 000	R4 500	R48 500	N/A
Method 4					
Candidates with a 3 year diploma	R37 000	R20 000	R4 500	R61 500	R20 000
Candidates with 4 year qualification	R47 000	R20 000	R4 500	R71 500	R20 000

Note: The notional cost of providing training opportunities will increase by CPI on an annual basis based on April CPI. Should the rates increase after bid award or during construction the rates will be adjusted as a provisional item.



Example. Training Target Calculation for a R65,7m GB contract

Contract amount	R65 700 000
Contract duration	12 Months
CSDG	0,50%
Minimum CSDG target	0,50% x R65 700 000 = R328 500 (Minimum requirement)

Skills Types	Number of learners	Notional Cost / Learner / Quarter	Notional cost/learner/year	Total Notional Cost over 12 months Contract
Method 2: Workplace learning opportunities with unemployed TVET graduates	1	R22 000	R88 000	R88 000
Method 3: Candidates for an unemployed learner with a 3-year qualification	1	R61 500	R246 000	R246 000
Total	2			R338 000

C2.1.11.6 NATIONAL YOUTH SERVICE TRAINING AND DEVELOPMENT PROGRAMME

The National Youth Service Training and Development Programme is applicable to this project.

The programme shall be implemented in terms of the Implementation of the National Youth Service Programme under the Expanded Public Works (EPWP) and shall be priced in the CPG section of the Bill of Quantities

Provision has been made within the Preliminaries section in the Bill of Quantities for the National Youth Service Training and Development Programme CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.6

Prescribed Profit and Attendance percentages have been stipulated in The Contract Participation Goals section in the Bill of Quantities, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.

C2.1.11.7 LABOUR-INTENSIVE WORKS

Labour Intensive Works is applicable to this project.

Where labour intensive work is specified in the Bill of Quantities and indicated by 'L.I.' the contractor must price for and include in rates. Contractors are expected to use their initiative to identify additional activities that can be done labour-intensively to comply with the set minimum labour intensity target. Provision has been made within the Contract Participation Goal section in the Bill of Quantities for the monthly reporting illustrating the value of the works executed under Labour Intensive Works CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.7 and any other supplementary specifications.

Prescribed Profit and Attendance percentages have been stipulated, all inclusive of associated costs to the contractor for implementation and allowance for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation

C2.2 Submission of Accrual Reports

Any reference to words "Bid" or "Bidder" herein and/or in any other documentation shall be construed to have the same meaning as the words "Tender" or "Tenderer".

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The Contractor shall submit accrual reports to the client representative at the end of March and September each year for the duration of the Service Contract period from the date of appointment up to and including project closeout. This is to ensure that PMTE complies with the accounting framework GRAP, which requires that PMTE disclose all its accruals as at the end of each reporting date. Allowance must be made for submitting reports to the Employer's Representative on a monthly basis in terms of monthly and accumulative targets achieved with audited supporting documentation.



public works
& infrastructure

Department:
Public Works and Infrastructure
REPUBLIC OF SOUTH AFRICA

BILL OF QUANTITIES

Item No		Quantity	Rate	Amount
	<u>BILL No. 1</u> <u>PRELIMINARIES</u> <u>WORK GROUP</u> Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 190 <u>MEANING OF TERMS "TENDER / TENDERER"</u> Any reference to the words "Tender" or "Tenderer" herein and/or in any other documentation shall be construed to have the same meaning as the words "Bid" or "Bidder"			
	Carried to Collection		R	
	Section No. 4 PRELIMINARIES Bill No. 1 PRELIMINARY AND GENERAL ITEMS			

BUILDING AGREEMENT AND PRELIMINARIES

The JBCC Principal Building Agreement (Edition 6.2 - May 2018) prepared by the Joint Building Contracts Committee shall be the applicable building agreement, amended as hereinafter described, to be read in conjunction with the Contract Data issued with the tender.

The JBCC General Preliminaries (May 2018) published by the Joint Building Contracts Committee for use with the JBCC Principal Building Agreement (Edition 6.2 - May 2018) shall be deemed to be incorporated in these bills of quantities, amended as hereinafter described.

The contractor is deemed to have referred to the abovementioned documents for the full intent and meaning of each clause.

The clauses in the abovementioned documents are hereinafter referred to by clause number and heading only.

Where any item is not relevant to this agreement such item is marked N/A signifying "not applicable".

Where standard clauses or alternatives are not entirely applicable to this agreement such amendments, modifications, corrections or supplements as will apply are given under each relevant clause heading and such amendments, modifications, corrections or supplements shall take precedence notwithstanding anything to the contrary contained in the abovementioned documents.

TENDERER'S SELECTIONS

Before submission of his tender the contractor is to complete the tenderer's selections in the contract data for organs of state and other public sector bodies.

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Section No. 1
PRELIMINARIES
Bill No. 1
PRELIMINARY AND GENERAL ITEMS

STRUCTURE OF THIS PRELIMINARIES BILL

Section A : A recital of the headings of the individual clauses in the aforementioned **JBCC Principal Building Agreement**

Section B : A recital of the headings of the individual clauses in the aforementioned **JBCC General Preliminaries**

Section C : Any special clauses to meet the particular circumstances of the project

PRICING OF PRELIMINARIES

Should the contractor select Option A in the contract data for organs of state and other public sector bodies for the adjustment of preliminaries, the amounts entered against the relevant items in these preliminaries are to be divided into one or more of the three categories provided namely fixed (F), value related (V) and time related (T)

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PRELIMINARIES
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PRELIMINARY AND GENERAL ITEMS

PRICING OF BILLS OF QUANTITIES

The contractor is to allow opposite each item for all costs in connection therewith. All prices to include, unless otherwise stated, for all materials, fabrication, conveyance and delivery, unloading, storing, unpacking, hoisting, labour, setting, fitting and fixing in position, cutting and waste (except where to be measured in accordance with the standard system of measurement) patterns, models and templates, plant, temporary works, returning of packaging, duties, taxes (other than Value Added Tax), imposts, establishment charges, overheads, profit and all other obligations arising out of this agreement.

Items left unpriced will be deemed to be covered in prices against other items throughout these bills of quantities and no claim for any extras arising out of the contractor's omission to price any item will be entertained.

Prices for all construction equipment, temporary works, services and other items shall include for the supply, maintenance, operating cost and subsequent removal and making good as necessary.

VALUE ADDED TAX

Provision is made in the summary page of these bills of quantities / lump sum document for the inclusion of Value Added Tax (VAT)

SECTION A: JBCC PRINCIPAL BUILDING AGREEMENT

INTERPRETATION

1 A1.0 DEFINITIONS AND INTERPRETATION

Clause 1.0

The following definitions replace corresponding definitions or are added to the definitions in the JBCC PRINCIPAL BUILDING AGREEMENT (Edition 6.2 of May 2018), whatever the case may be:

ADVERSE WEATHER CONDITIONS: Adverse weather and inclement weather has the same meaning and used interchangeably and means any weather conditions i.e.:

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Rain, wind, snow, frost, temperature (cold or heat) that are not in the norm for the area where the construction takes place and during which no work is possible on site

AGREEMENT: The completed Form of Offer and Acceptance, the completed JECCE Principal Building Agreement and contract data for organs of state and other public sector bodies, the contract drawings, the priced document and any other documents reduced to writing and signed by the authorised representative or representatives of the parties

CONSTRUCTION PERIOD: The period commencing on the date of possession of the site by the contractor and ending on the date of practical completion

CONTRACT PERIOD: The period commencing on the date of the letter of acceptance and ending on the date of final completion

COST FLUCTUATION shall mean contract price adjustment provision (CPAP) for the adjustment of fluctuation in the cost of labour, plant, material and goods as stated in the schedule

DEFAULT INTEREST: No Clause

GUARANTEE FOR CONSTRUCTION: A security in terms of the DPWL's Guarantee for Construction forms, obtained by the contractor from an institution approved by the employer [CD]

INTEREST: The interest rates applicable on this contract, whether specifically indicated in the relevant clauses or not, will be the rate as determined by the Minister of Finance from time to time, in terms of section 80(1)(b) of the Public Finance Management Act, 1998 (Act No 1 of 1998) as amended, calculated as simple interest, in respect of debts owing to the State, and will be the rate as published by the Minister of Justice and Correctional Services from time to time, in terms of section 1(2) of the Prescribed Rate of Interest Act, 1975 (Act No 55 of 1975) as amended, calculated as simple interest, in respect of debts owing by the State

LETTER OF ACCEPTANCE: The letter of formal acceptance of the Contractor's or Service Provider's Tender / Bid, issued and signed by the Employer

PAYMENT CERTIFICATE: A certificate issued at regular agreed intervals [CD] by the principal agent to the parties certifying the amount due and payable in terms of Clause 25.3

PRINCIPAL AGENT: The person or entity appointed by

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the employer and named in the contract data for organs of state and other public sector bodies. In the event of a principal agent not being appointed, then all the duties and obligations of a principal agent as detailed in the agreement shall be fulfilled by the employer's representative as named in the contract data for organs of state and other public sector bodies.

TARGETED SUBCONTRACTORS: Subcontractors that must be appointed to a total of 30% or more of the contract sum by the contractor, projects with a contract sum of the amount determined by the Minister in terms of the latest Preferential Procurement regulations, as may be amended from time to time.

F: _____ V: _____ T: _____

Item

2 A2.0 LAW, REGULATIONS AND NOTICES

Clause 2.0

F: _____ V: _____ T: _____

Item

3 A3.0 OFFER AND ACCEPTANCE

Replace **Clause 3.3** with the following:

This agreement shall come into force on the date of **letter of acceptance** and continue to be of force and effect until the end of its **latent defects** liability period (22.0) notwithstanding termination (29.0) or the certification of **final completion** (21.0) and final payment (25.0)

F: _____ V: _____ T: _____

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4	A4.0 CESSION AND ASSIGNMENT Clause 4.0 Clause 4.0 Ref Clause 6.7 (CD) - Clause 4.2 Replace Clause 4.3 with the following: Where a contractor cedes any right or any monies due to or to become due under this agreement as security in favour of a financial institution, the prior written consent of the employer, which consent shall not be unreasonably withheld, must be obtained F: V: T:	Item		
5	A5.0 DOCUMENTS Clause 5.0 Replace last sentence of Clause 5.2 with the following: The original signed agreement shall be held by the Employer Replace Clause 5.4 with the following: The Bills of Quantities shall not be used as a specification of material and goods or methods unless so instructed by the Principal Agent. The contractor may not use the Bills of Quantities for purpose of ordering material. All dimensions and quantities must be determined on site before ordering. In the event of discrepancy between the drawings and Bills of Quantity, the drawings shall take preference Replace Clause 5.5 with the following: The parties may publish or disclose on any platform only the contract scope and contract amount F: V: T:	Item		
	Carried to Collection Section No. 1 PRELIMINARIES Bill No. 1 PRELIMINARY AND GENERAL ITEMS		R	

6 A6.0 EMPLOYER'S AGENTS

Clause 6.0

Replace Clause 6.5 with the following:

Where the principal agent and/or an agent fails to act or is unable to act or ceases to be the principal agent or an agent in terms of this agreement, the employer shall appoint another principal agent and/or an agent

Add the following as Clause 6.7:

In terms of the clauses listed hereunder, the employer has retained its authority and has not given a mandate to the principal agent, notwithstanding other provisions in the contract. The employer shall sign all documents in relation to clauses 4.2, 14.1.4, 14.1.1, 14.6, 15.1.4, 15.4.1, 23.1, 23.2, 23.3, 23.7, 23.8, 26.1, 26.7, 26.12

I V.....
T.....

Item

7 A7.0 DESIGN RESPONSIBILITY

Clause 7.0

Replace first sentence of Clause 7.2 with the following:

Any design responsibility undertaken by a subcontractor shall not devolve on the contractor except for items that require specific component design and or compatibility design and or shop drawings and or the assembly thereof

F..... V.....
T.....

Item

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R

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INSURANCES AND SECURITIES

8 A8.0 WORKS RISK

Clause 8.0

Replace Clause 8.4 with the following:

The contractor shall bear the full risk of damage to and/or destruction of the works by whatever cause during construction of the works and hereby indemnifies and holds harmless the employer against any such damage. The contractor shall take such precautions and security measures and other steps for the protection and security of the works as the contractor may deem necessary

F..... V.....
T.....

Item

9 A9.0 INDEMNITIES

Clause 9.0

Add the following to the end of the first sentence of Clause 9.2.7:

"... due to no fault of the contractor

9.2.9 No Clause

9.2.10 No Clause

Add the following as clause 9.3:

The employer's rights to claim damages for the contractor's omissions and actions will not be affected.

F..... V.....
T.....

Item

10 A10.0 INSURANCES

Clause 10.0

Replace Clause 10.1 with the following:

The party responsible shall effect and keep the respective insurances [CD] in force, in favour of the employer as beneficiary, from the date of possession of the site until the issue of the certificate of practical completion and with an extension to cover the contractors obligations after the date of practical completion [8.2.2]

**Add the following as Clause 10.1.5 1-
Hi Risk Insurance**

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In the event of the project being executed in a geological area classified as a "High Risk Area", that is an area which is subject to highly unstable sub-surface conditions that might result in catastrophic ground movement event by sinkhole or doline formation the following will apply:

Add the following as Clause 10.1.5.1.1: Damage to the works

The contractor shall, from the date of possession of the site until the date of the **certificate of practical completion**, bear the full risk of and hereby indemnifies and holds harmless the **employer** against any damage to and/or destruction of the **works** consequent upon a catastrophic ground movement as mentioned above. The **contractor** shall take such precautions and security measures and other steps for the protection of the **works** as he may deem necessary.

When so instructed to do so by the principal agent, the contractor shall proceed immediately to remove and/or dispose of any debris arising from damage to or destruction of the **works** and to rebuild, restore, replace and/or repair the **works**, at the contractor's own costs.

10.1.5.1.2 Injury to persons or loss of or damage to property

The **contractor** shall be liable for and hereby indemnifies and holds harmless the **employer** against any liability, loss, claim or proceeding arising at any time during the period of the contract whether arising in common law or by statute, consequent upon personal injuries to or the death of any person whatsoever resulting from, arising out of or caused by a catastrophic ground movement as mentioned above.

The **contractor** shall be liable for and hereby indemnifies the **employer** against any and all liability, loss, claim or proceeding consequent upon loss of or damage to any moveable, or immovable property, or personal property, or property contiguous to the site, whether belonging to or under the control of the **employer** or any other body or person whatsoever arising out of or caused by a catastrophic ground movement, as mentioned above, which occurred during the period of the contract.

10.1.5.1.3 Replace Clause with the following:

It is the responsibility of the **contractor** to ensure that he has adequate insurance to cover his risk and liability as mentioned in 10.1.5.1.1 and 10.1.5.1.2. Without limiting the **contractor's** obligations in terms of the contract, the **contractor** shall, within twenty-one (21) calendar days of the date of letter of acceptance, but before commencement of the **works**, submit to the

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employer proof of such insurance policy.

10.1.5.1.4 Replace Clause with the following:

The employer shall be entitled to recover any and all losses and/or damages of whatever nature suffered or incurred consequent upon the contractor's default of his obligations as set out in 10.1.5.1.1; 10.1.5.1.2 and 10.1.5.1.3. Such losses or damages may be recovered from the contractor or by deducting the same from any amounts still due under this contract or under any other contract presently or hereafter existing between the employer and the contractor and for this purpose all these contracts shall be considered one indivisible whole

10.2 Replace Clause with the following:

Where practical completion in sections is required (20.0), or where the works is for alterations and additions, the contractor shall effect and keep in force contract works insurance (10.1.1), supplementary insurance (10.1.2), public liability insurance (10.1.3) and where applicable, removal of lateral support insurance (10.1.4) and other insurances (10.1.5) in favour of the employer as beneficiary

10.6 No Clause

Add the following as Clause 10.11:

In the event that an insurer dispute the amount of the claim to be paid to the employer, the contractor shall be liable to the employer for the difference between the claim (as determined by the employers QS appointed on the project) made by the employer and the amount that the insurer is willing to pay

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11 A11.0 SECURITIES

Clause 11.0

Add the following as to the relevant related Clauses as follows:

Add the following to Clause 11.1:

In respect of contracts with a contract sum up to R1 million, the security to be provided by the contractor to the employer will be a payment reduction of five per cent (5%) of the value certified in the payment certificate (excluding VAT).

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In respect of contracts with a contract sum above R1 million, the contractor shall have the right to select the security to be provided in terms of C 1.0 Securities, as stated in the schedule. Such security shall be provided to the employer within fifteen (15) working days from commencement date. Should the contractor fail to select the security to be provided or should the contractor fail to provide the employer with the selected security within fifteen (15) working days from commencement date, the security in terms of C 1.0 Option C shall be deemed to have been selected.

The payment reduction of the value certified in a payment certificate shall be mutatis mutandis in terms of 25.12.1 + 25.12.5

11.1.1 No Clause

11.1.2 No Clause

11.2.2 No Clause

11.3 No Clause

Replace Clause 11.4.1 with the following:
Hand over the site to the contractor and withhold an amount equal to ten percent (10%) of each interim payment certificate until practical completion is achieved. The value certified shall be subject to the adjustments in terms of 25.12.6 to 25.12.10

11.5 No Clause

11.6 No Clause

11.7 No Clause

11.8 No Clause

11.9 No Clause

11.10 No Clause

Add the following as Clause 11.11:
Where the security as a cash deposit of ten percent (10%) of the contract sum (excluding VAT) has been selected:

Add the following as Clause 11.11.1:
The contractor shall furnish the employer with a cash deposit equal in value to ten percent (10%) of the contract sum (excluding VAT) within fifteen (15) working days from commencement date. Failure to furnish the employer with a cash deposit within fifteen (15) working days Clause 11.4 will apply mutatis mutandis.

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Add the following as Clause 11.11.2:
The employer shall be entitled to recover expense and loss from the cash deposit in terms of Clause 27.0 provided that the employer notifies the Contractor in which event the employer's entitlement shall take precedence over his obligations to refund the cash deposit security or portions thereof to the contractor.

Add the following as Clause 11.11.3:
Within fifteen (15) working days of the date of practical completion of the works the employer shall reduce the cash deposit to an amount equal to three per cent (3%) of the contract value (excluding VAT) and refund the balance to the contractor.

Add the following as Clause 11.11.4:
Within fifteen (15) working days of the date of final completion of the works the employer shall reduce the cash deposit to an amount equal to one per cent (1%) of the contract value (excluding VAT) and refund the balance to the contractor.

Add the following as Clause 11.11.5:
On the date of payment of the amount in the final payment certificate, the employer shall refund the remainder of the cash deposit to the contractor.

Add the following as Clause 11.11.6:
The parties expressly agree that neither the employer nor the contractor shall be entitled to cede the rights to the cash deposit security.

Add the following as Clause 11.12:
The contractor shall provide construction guarantee of the amount of 10% of the contract sum (excluding VAT) as follows:

Add the following as Clause 11.12.1:
The contractor shall furnish the employer with an acceptable variable construction guarantee equal in value to ten per cent (10%) of the contract sum (excluding VAT) within fifteen (15) working days after issuance of the letter of acceptance. Failure to submit an acceptable variable construction guarantee within fifteen (15) working days Clause 11.4 will apply mutatis mutandis.

Add the following as Clause 11.12.2:
The variable construction guarantee shall reduce and expire in terms of the Variable Construction Guarantee form included in the invitation to tender.

Add the following as Clause 11.12.3:
The employer shall return the variable construction

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guarantee to the contractor within fourteen (14) calendar days of it expiring.

Add the following as Clause 11.12.4:

Where the employer has a right of recovery against the contractor in terms of 27.0, the employer shall issue a written demand in terms of the variable construction guarantee.

Add the following as Clause 11.13:

Where security as a fixed construction guarantee of five per cent (5%) of the contract sum (excluding VAT) and a five per cent (5%) payment reduction of the value certified in the payment certificate (excluding VAT) has been selected:

Add the following as Clause 11.13.1:

The contractor shall furnish a fixed construction guarantee to the employer equal in value to five per cent (5%) of the contract sum (excluding VAT).

Add the following as Clause 11.13.2:

The fixed construction guarantee shall come into force on the date of issue and shall expire on the date of the last certificate of practical completion.

Add the following as Clause 11.13.3:

The employer shall return the fixed construction guarantee to the contractor within fourteen (14) calendar days of it expiring.

Add the following as Clause 11.13.4:

The payment reduction of the value certified in a payment certificate shall be mutatis mutandis in terms of 25.12.1 - 25.12.5.

Add the following as Clause 11.13.5:

Where the employer has a right of recovery against the contractor in terms of 27.0, the employer shall be entitled to issue a written demand in terms of the fixed construction guarantee or may recover from the payment reduction or from both.

Add the following as Clause 11.14.1:

Where security as a cash deposit of five per cent (5%) of the contract sum (excluding VAT) and a payment reduction of five per cent (5%) of the value certified in the payment certificate (excluding VAT) has been selected:

Add the following as Clause 11.14.2:

The contractor shall furnish the employer with a cash deposit equal in value to five per cent (5%) of the contract sum (excluding VAT) within fifteen (15) working days from commencement date. Failure to submit a

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cash deposit within fifteen (15) working days Clause 11.4 will apply mutatis mutandis.

Add the following as Clause 11.14.3:

Within fifteen (15) working days of the date of practical completion of the works the employer shall refund the cash deposit in total to the contractor.

Add the following as Clause 11.14.4:

The payment reduction of the value certified in a payment certificate shall be mutatis mutandis in terms of 25.12.1 - 25.12.5.

Add the following as Clause 11.14.5:

Where the employer has a right of recovery against the contractor in terms of 27, the employer may recover from the payment reduction or cash deposit or from both.

Add the following as Clause 11.15:

Where security as a payment reduction of ten per cent (10%) of the value certified in the payment certificate (excluding VAT) has been selected.

Add the following as Clause 11.15.1:

The payment reduction of the value certified in a payment certificate shall be mutatis mutandis in terms of 25.12.8 to 25.12.10.

Add the following as Clause 11.15.2:

The employer shall be entitled to recover expense and loss from the cash deposit in terms of 27.0 provided that the employer notifies the Contractor in which event the employer's entitlement shall take precedence over his obligations to refund the cash deposit security or portions thereof to the contractor.

Add the following as Clause 11.16:

Payments made by the guarantor to the employer in terms of the fixed or variable construction guarantee shall not prejudice the rights of the employer or contractor in terms of this agreement.

Add the following as Clause 11.17:

Should the contractor fail to furnish the security in terms of 11.2 the employer, in his sole discretion, and without notification to the contractor, is entitled to change the contractor's selected form of security to that of a ten per cent (10%) payment reduction of the value certified in the payment certificate (excluding VAT).

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EXECUTION

***2 A12.0 OBLIGATION OF THE PARTIES**

Clause 12.0

12.1.1 No Clause

Replace Clause 12.1.5 with the following:

Give possession of the site to the contractor within ten (10) working days after approval of the Health and Safety Plan or the issue of a construction permit by the Department of Labour, if applicable, after the contractor complied with the terms of 12.2.22

12.1.8 No Clause

12.1.8 No Clause

Replace Clause 12.2.2 with the following:

The priced Bills must be submitted to the Employer within fourteen (14) calendar days from date of request. Where the priced document contains errors or discrepancies and/or prices considered by the employer or principal agent to be imbalanced or unreasonable the employer or principal agent and the contractor shall adjust such prices without any change to the contract sum.

Replace Clause 12.2.5 with the following :

Effect and keep in force insurances in favour of the employer as beneficiary where the contractor is responsible for providing insurances (10.0) (CD)

Replace Clause 12.2.13 with the following:

Designate a competent person full time on site to continuously administer and control the works on site and to receive and implement notices and contract instructions on behalf of the contractor

Add the following as Clause 12.2.22:

Within fourteen (14) working days of the date of the letter of acceptance submit to the principal agent an acceptable health and safety plan, required in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993)

Add the following as Clause 12.2.23:

The contractor shall within reasonable time inform the agents regarding inspection of the works before covering / closing [B 12.0]

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	The contractor shall provide, maintain and remove on completion of the works an office for the exclusive use of the principal agent, minimum size 4 x 3 x 3m high internally, suitably insulated and ventilated, provided with electric lighting and fitted with boarded floor, desk, chair, drawing stool, drawing board and lock-up drawers for drawings. The office shall be kept clean and fit for use at all times [12.2.18] Main notice board The contractor shall provide, erect where directed, maintain and remove on completion of the works a notice board size 3 x 3m as type Drawing GFN 063, constructed of suitable boarding with flat smooth surface and with edging bead 19mm thick round outer edges and projecting 12mm from face of boarding and rounded on front edge. The board shall be securely fixed to hoarding, where hoarding is provided, or fixed to and including a suitable supporting structure of timber or tubular posts and braces. The board is to be painted ivory white and the bead and 12mm wide dividing lines dark green. All wording shall be inscribed in dark green as per the coat of arms for SA. All wording shall be executed in dark green painted sans serif lettering [12.2.18]. For Volume T.....		
13	A14.0 - PRELIMINARY 14.0.0.0 14.0.0.1 14.0.0.2 14.0.0.3 14.0.0.4 14.0.0.5 14.0.0.6 14.0.0.7 14.0.0.8 14.0.0.9 14.0.0.10 14.0.0.11 14.0.0.12 14.0.0.13 14.0.0.14 14.0.0.15 14.0.0.16 14.0.0.17 14.0.0.18 14.0.0.19 14.0.0.20 14.0.0.21 14.0.0.22 14.0.0.23 14.0.0.24 14.0.0.25 14.0.0.26 14.0.0.27 14.0.0.28 14.0.0.29 14.0.0.30 14.0.0.31 14.0.0.32 14.0.0.33 14.0.0.34 14.0.0.35 14.0.0.36 14.0.0.37 14.0.0.38 14.0.0.39 14.0.0.40 14.0.0.41 14.0.0.42 14.0.0.43 14.0.0.44 14.0.0.45 14.0.0.46 14.0.0.47 14.0.0.48 14.0.0.49 14.0.0.50 14.0.0.51 14.0.0.52 14.0.0.53 14.0.0.54 14.0.0.55 14.0.0.56 14.0.0.57 14.0.0.58 14.0.0.59 14.0.0.60 14.0.0.61 14.0.0.62 14.0.0.63 14.0.0.64 14.0.0.65 14.0.0.66 14.0.0.67 14.0.0.68 14.0.0.69 14.0.0.70 14.0.0.71 14.0.0.72 14.0.0.73 14.0.0.74 14.0.0.75 14.0.0.76 14.0.0.77 14.0.0.78 14.0.0.79 14.0.0.80 14.0.0.81 14.0.0.82 14.0.0.83 14.0.0.84 14.0.0.85 14.0.0.86 14.0.0.87 14.0.0.88 14.0.0.89 14.0.0.90 14.0.0.91 14.0.0.92 14.0.0.93 14.0.0.94 14.0.0.95 14.0.0.96 14.0.0.97 14.0.0.98 14.0.0.99	Item	
14	A14.0 - NOMINATED SUBCONTRACTORS Clause 14.0 14.1 Clause 6.7 (CD) - Clause 14.1.4 14.1.5 No Clause Replace "principal agent" with "employer" [6.7 (CD)] in Clause 14.4.1 Ref Clause 6.7 (CD) - Clause 14.6 For Volume T.....	Item	
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15	A15.0 SELECTED SUBCONTRACTORS Clause 15.0 Ref Clause 6.7 (CD) - Clause 15.1.4 & Clause 15.5 15.1.5 No Clause Replace Clause 15.1.2 with the following: The principal agent shall call for tenders from a list of tenderers agreed between the contractor and the employer Replace 'principal agent' with 'employer' (6.7 (CD)) in Clause 15.4.1 F..... V..... T.....	Item		
16	A16.0 DIRECT CONTRACTORS Clause 16.0 F..... V..... T.....	Item		
17	A17.0 CONTRACT INSTRUCTIONS Clause 17.0 Replace Clause 17.0 with the following: The contractor shall comply with and duly execute all contract instructions issued at any contract instruction for the contract within 21 days of the date of practical completion or within 21 days of the date of practical completion, including good physical loss and repairing damage to the works in terms of 6.0 and 21 Add the following clause as Clause 17.5: Minutes of meetings shall not constitute a site instruction unless recorded in a written contract instruction issued by the principal agent in terms of this contract / agreement. F..... V..... T.....	Item		
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	<u>COMPLETION</u>			
18	A18.0 INTERIM COMPLETION Clause 18.0 F..... V T.....		N/A	
19	A19.0 PRACTICAL COMPLETION Clause 19.0 Replace Clause 19.5 with the following: On issue of the only or last certificate of practical completion the employer shall be entitled to possession of the works and the site. On issue of the certificate of practical completion for a section, the employer shall be entitled to possession of such section. Add the following as Clause 19.8: WORKS COMPLETION (1) Within seven (7) calendar days of the date of practical completion the principal agent shall issue to the contractor a works completion list defining the outstanding work and defects apparent at the date of practical completion to be completed or rectified to achieve works completion. (2) Where, in the opinion of the contractor, the works completion list has been completed the contractor shall notify the principal agent who shall inspect within seven (7) calendar days of receipt of such a notice. Where, in the opinion of the principal agent, the Works Completion list: (2)(a) Has been satisfactorily completed, the principal agent shall forthwith issue a certificate of Works Completion to the contractor with a copy to the employer. (2)(b) Has not been satisfactorily completed, the principal agent shall forthwith identify the works completion list items that are not yet complete and inform the contractor thereof. The contractor shall repeat the procedure in terms of 19.8(2). (3) Should the principal agent not issue a works completion list, in terms of 19.8 (1) or 19.8 (2)(b), within seven (7) calendar days from the end of the inspection period, the contractor shall notify the employer and principal agent. Should the principal agent not issue such Works Completion list within seven (7) calendar days of receipt of such notice, the employer may within			
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seven (7) calendar days issue to the contractor a Works Completion list. Should the employer:

(3)(a) Not issue such works completion list within seven (7) calendar days, then the certificate of Works Completion shall be deemed to have been issued on the date of expiry of the initial notice period and works completion shall be deemed to have been achieved on such date

(3b) Issue a works completion list and the work on Works Completion list not have been completed or where further defects have become apparent, the employer shall forthwith identify such items on the updated works completion list and notify the contractor. The contractor shall repeat the procedure in terms of 19.8(2)(b) until such items have been completed to the satisfaction of the employer

(4) Should the works completion list not be completed to the satisfaction of the employer within a period of twenty one (21) working days of the issue first works completion list the contractor shall be liable to a daily penalty as described in 8.12.0

(5) The defects liability period in terms of 21.1 shall commence with the issue or deemed issue of the certificate of Works Completion in terms of 19.8(2)(a) or 19.8(3).

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20 A20.0 COMPLETION OF SECTIONS

Clause 20.0

Add the following as Clause 20.2.1.A
A certificate of Works Completion [19.8]

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21 A21.0 DEFECTS LIABILITY PERIOD AND FINAL COMPLETION

Clause 21.0

Replace Clause 21.1 with the following:
The defects liability period for the works shall commence on the calendar day following the date of works completion and end at midnight (00:00) ninety (90) calendar days from the date of works completion (00) or when work on the list for completion has been

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satisfactorily attended to (21.6) whichever is the later (if we use works completion)

Replace Clause 21.6 with the following:

On the expiry of the ninety (90) calendar days defects liability period (21.1) for items not indicated as items with an extended liability as indicated in B14 and on receipt of the contractor's notice to the principal agent

And/or

On the expiry of the defects liability period as indicated in B14, for items indicated in B14 and on receipt of the contractor's notice to the principal agent, the principal agent shall:

- (1) inspect the works And within ten (10) working days either issue a list for final completion detailing all outstanding work or defects that must be attended to, or rectified to achieve final completion or
- (2) issue the certificate of final completion to the contractor with a copy to the employer for that part of the works where defects liability period has expired

21.6.1 Omit Clause

21.6.2 Omit Clause

Add the following as Clause 21.13:

The ninety (90) calendar days defects liability period for the works (21.1) is replaced with an extended defects liability period of three hundred and sixty-five (365) calendar days in respect of the listed applicable elements in B14

Add the following as Clause 21.14:

Penalties will be applied if the items on the completion list have not been attended to within a period of ninety (90) calendar days (21.1). If additional defect items have being added to the list during this period, then the Principal Agent and Contractor will agree on a revised completion date. Failing in achieving the revised date will result in penalties being applied.[B12.0]

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22 **A22.0 LATENT DEFECTS LIABILITY PERIOD**

Clause 22.0

22.3.2 No Clause

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23 **A23.0 REVISION OF THE DATE FOR PRACTICAL COMPLETION**

Clause 23.0

Ref Clause 6.7 [CD] - Clause 23.1

Ref Clause 6.7 [CD] - Clause 23.2

23.2.13 No Clause

Replace Clause 23.3 with the following:

Further circumstances that delays practical completion due to any other cause beyond the contractor's reasonable control that could not have reasonably been anticipated and provided for which the contractor may be entitled to a revision of the date for practical completion, with or without an adjustment of the contract value as determined by the Employer [6.7 CD]

Ref Clause 6.7 [CD] - Clause 23.7

Ref Clause 6.7 [CD] - Clause 23.8

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24	A24.0 PENALTY FOR LATE OR NON-COMPLETION Clause 24.0 Replace Clause 24.1 with the following: Where the contractor fails to bring the works, or a section thereof, to practical-, works-, or final- completion by the applicable completion date [CD], or the revised applicable completion date, the contractor shall be liable to the employer for the penalty [CD]. Replace Clause 24.2 with the following: Where the employer elects to levy such penalty the employer, or the principal agent on instruction from the employer, shall give notice thereof to the contractor. The principal agent shall determine the penalty due from the later of the date for practical- works-, or final- completion [CD], or the revised date for practical- works-, or final- completion, up to and including the earlier of: Replace Clause 24.2.1 with the following: The actual or deemed date of practical- works-, or final- completion, of the works, or a section thereof [23.7.1] For Vt T. <u>PAYMENTS</u>	kern	
25	A25.0 PAYMENT Clause 25.0 Replace Clause 25.2 with the following: The principal agent shall issue at regular agreed intervals [CD] payment certificates, to the contractor with a copy to the employer, up to and including practical completion. Interim Payment certificates may be issued to the contractor between practical completion and the final payment certificate. A payment certificate may be for a nil or negative amount. Add the following to Clause 25.3: 25.3.12 Monthly local content report 25.3.13 EPWP / NYS payment register, labour reports and certified ID document of EPWP/ NYS beneficiaries, Contract between Contractor and EPWP/ NYS beneficiaries, attendance register, (if applicable) 25.3.14 Tax Invoice 25.3.15 Labour intensive report Carried to Collection Section No. 1 PRELIMINARIES Bill No. 1 PRELIMINARY AND GENERAL ITEMS		R

25.3.16 Contract participation goal reports

25.5 No Clause

Replace Clause 25.6 with the following:

Materials and goods will only be certified and paid for upon providing proof of full payment to the supplier and proof of transfer of ownership from the supplier to the contractor by the contractor. Once paid, material and goods shall become the property of the employer and shall not be removed from site without the written authority of the Employer.

25.7.5 No clause.

Replace Clause 25.10 with the following:

The employer shall pay the contractor the amount stipulated in an issued payment certificate, correct in all material respects, within thirty (30) calendar days from the date of receiving the payment certificate, invoice and all other substantiating documentation for items certified in the payment certificate

Replace Clauses 25.12 to 25.12.3 with the following:

The value certified shall be subject to the following percentage adjustments

(Clauses 25.12.1 to 25.12.5 shall be applicable to a contract sum up to R1 million. In the event of a contract sum more than R1 million for Options D & E (C 1.0 Securities [11.0]) Clauses 25.12.1 to 25.12.5 shall be applicable)

25.12.1 Where a security is selected in terms of C 1.0 Securities [11.0], the value of the works in terms of 25.1 and of the materials and goods in terms of 25.4 shall be certified in full. The value certified shall be subject to the following percentage adjustments:

25.12.2 Ninety-five per cent (95%) of such value in interim payment certificates issued up to the date of practical completion

25.12.3 Ninety-seven per cent (97%) of such value in interim payment certificates issued on the date of practical completion and up to but excluding the date of final completion.

25.12.4 Ninety-nine per cent (99%) of such value in interim payment certificates issued on the date of final completion and up to but excluding the final payment certificate in terms of 25

25.12.5 One hundred per cent (100%) of such value in

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the final payment certificate in terms of 25 except where the amount certified is in favour of the employer. In such an event the payment reduction shall remain at the adjustment level applicable to the final payment certificate

(Clauses 25.12.6 to 25.12.10 shall be applicable to a contract sum more than R1 million for Option C (C 1.0 Securities [11.0])

25.12.6 Where security is a payment reduction in term of C 1.0 Option C, value of the works in terms of 25.4 and materials and goods in terms of 25.4 shall be certified in full. The value certified shall be subject to the following percentage adjustments:

25.12.7 Ninety per cent (90%) of such value in interim payment certificates issued up to the date of practical completion

25.12.8 Ninety-seven per cent (97%) of such value in interim payment certificates issued on the date of practical completion and up to but excluding the date of final completion

25.12.9 Ninety-nine per cent (99%) of such value in interim payment certificates issued on the date of final completion and up to but excluding the final payment certificate in terms of 26

25.12.10 One hundred per cent (100%) of such value in the final payment certificate in terms of 26 except where the amount certified is in favour of the employer. In such an event the payment reduction shall remain at the adjustment level applicable to the final payment certificate

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27 **A27.0 RECOVERY OF EXPENSE AND/OR LOSS**

Clause 27.0

Replace Clause 27.1.2 with the following:
Interest due to late payment only

Replace Clause 27.1.4 with the following:
Interest due to late payment only

27.1.5 No Clause

Replace Clause 27.5 with the following:
Where the employer decides to recover an amount due in terms of 27.2 from a construction guarantee, cash deposit or retention money held as security, the employer shall issue a written demand to the contractor before recovering the amount. Should such amount not be paid to the employer within fourteen (14) calendar days of the date of notice by the employer, the employer may recover such an amount from the security.

Add the following as Clause 27.6.
Where a provisional sequestration or provisional liquidation order has been granted or where an order has been granted which commences sequestration, liquidation, bankruptcy, receivership, winding-up or any other process against the contractor or this agreement is controlled in terms of 29, the employer may issue a demand to the guarantor in terms of the construction guarantee or advance payment guarantee held as security.

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SUSPENSION AND TERMINATION

28 A28.0 SUSPENSION BY THE CONTRACTOR

Clause 28.0

28 No Clause
28.1 No Clause
28.1.1 No Clause
28.1.2 No Clause
28.1.3 No Clause
28.1.4 No Clause
28.1.5 No Clause
28.2 No Clause
28.3 No Clause
28.4 No Clause

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29 A29.0 TERMINATION

Clause 29.0

Add the following as Clause 29.1.4:
The contractor's estate has been sequestered,
liquidated or surrendered in terms of the insolvency laws
in force within the Republic of South Africa

Add the following as Clause 29.1.5:
The contractor has engaged in corrupt or fraudulent
conduct in competing for or in executing the contract

Add the following as Clause 29.1.6:
The contractor's obligations in terms of Clauses 10.1.5.1.3,
10.1.4.1 and 12.1.1, such Clauses 5, 6, 8, 9, 10, 11, 12, 13,
15, 19, 20, 21.

Replace Clause 29.7 with the following:
The employer, on notice to the contractor, may recover
damages from the contractor from the date of
termination including, but not limited to, additional costs
incurred in the completion, consultant cost, rental of
alternative accommodation, invitation of completion
tenders, salaries of officials and safeguarding the site, of
the remaining work (25.3.7; 27.1.3)

Replace Clause 29.9 with the following:
The employer has the right of recovery against the
contractor, where applicable, [CD] from:

The guarantee for construction (variable) until the final
payment has been made.

Carried to Collection

R

Section No. 1
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Bill No. 1
PRELIMINARY AND GENERAL ITEMS

DISPUTE RESOLUTION

30 A30.0 DISPUTE RESOLUTION

Clause 30.0

Replace Clause 30.2 with the following:

Where such disagreement is not resolved within ten (10) working days of receipt of such notice it shall be deemed to be a dispute and shall be submitted to Mediation as a first method of dispute resolution failing which the parties will resort to Litigation

30.3 to 30.7.7 No Clauses

Replace Clause 30.8 with the following:

The parties may, by agreement and at any time before Litigation, refer a dispute to mediation, in which event.

30.8.1 No Clause

Replace Clause 30.8.2 with the following:

The appointment of a mediator, the procedure, and the status of the outcome shall be agreed between the parties

Replace Clause 30.8.3 with the following:

Regardless of the outcome of a mediation the parties shall bear their own costs concerning the Mediation and equally share the costs of the mediator and related expenses

Replace Clause 30.9 with the following:

Institution of Litigation shall be commenced and process served within three (3) year from the date of existence of the dispute, failing which the dispute shall lapse

30.10 No Clause

30.12 No Clause

F..... V.....
T.....

Item

SECTION B: JBCC PRELIMINARIES

DEFINITIONS AND INTERPRETATION (B1)

31 Clause 1.1 - Definitions

F..... V..... T.....

Item

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43	Clause 4.5 - Existing premises occupied F:..... V:..... T:.....	Item		
44	Clause 4.6 - Services - known F:..... V:..... T:.....	Item		
<u>MANAGEMENT OF CONTRACT (B5)</u>				
45	Clause 5.1 - Management of the works F:..... V:..... T:.....	Item		
46	Clause 5.2 - Progress meetings F:..... V:..... T:.....	Item		
47	Clause 5.3 - Technical meetings F:..... V:..... T:.....	Item		
<u>SAMPLES, SHOP DRAWINGS AND MANUFACTURER'S INSTRUCTIONS (B6)</u>				
48	Clause 6.1 - Samples of materials F:..... V:..... T:.....	Item		
49	Clause 6.2 - Workmanship samples F:..... V:..... T:.....	Item		
50	Clause 6.3 - Shop drawings F:..... V:..... T:.....	Item		
51	Clause 6.4 - Compliance with manufacturer's instructions F:..... V:..... T:.....	Item		
<u>DEPOSITS AND FEES (B7)</u>				
52	Clause 7.1 - Deposits and fees F:..... V:..... T:.....	Item		
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<u>TEMPORARY SERVICES (B8)</u>			
53	Clause 8.1 - Water F..... V..... T.....	Item	
54	Clause 8.2 - Electricity F..... V..... T.....	Item	
55	Clause 8.3 - Ablution and welfare facilities F..... V..... T.....	Item	
56	Clause 8.4 - Communication facilities F..... V..... T.....	Item	
<u>PRIME COST AMOUNTS (B9)</u>			
57	Clause 9.1 - Responsibility for prime cost amounts F..... V..... T.....	Item	
<u>ATTENDANCE ON SUBCONTRACTORS (B10)</u>			
58	Clause 10.1 - General attendance F..... V..... T.....	Item	
59	Clause 10.2 - Special attendance F..... V..... T.....	Item	
<u>GENERAL (B11)</u>			
60	Clause 11.1 - Protection of the works F..... V..... T.....	Item	
61	Clause 11.2 - Protection/isolation of existing works and works occupied in sections F..... V..... T.....	Item	
62	Clause 11.3 - Security of the works F..... V..... T.....	Item	
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63	Clause 11.4 - Notice before covering work F: V: T:	Item		
64	Clause 11.5 - Disturbance <u>Disturbance</u> All work is to be carried out in such a manner as to cause no unacceptable or unreasonable dust, noise, vibrations, nuisance, inconvenience, annoyance and the like to the public, others, other properties and traffic in so far as they exceed the permissible irritations set by government legislation or by the local authority. Any delays, stoppages and the like arising from or in order to comply with the above will not constitute grounds for an adjustment to the construction period or contract value whatsoever F: V: T:	Item		
65	Clause 11.6 - Environmental disturbance <u>Controlling all forms of pollution</u> The contractor shall be responsible for and take all precautions in controlling by whatever means necessary all forms of pollution emanating from the site during the construction period due inter alia to noise, artificial light, wind-blown sand, dust, deposits of mud, etc The contractor is to ensure that all roads which border the site and are used by the contractor during the execution of the works are kept clean and free of any dirt or debris caused by the execution of the works F: V: T:	Item		
66	Clause 11.7 - Works clearing and clearing F: V: T:	Item		
67	Clause 11.8 - Vermin F: V: T:	Item		
68	Clause 11.9 - Overhand work F: V: T:	Item		
Carried to Collection				
Section No. 1 PRELIMINARIES Bill No. 1 PRELIMINARY AND GENERAL ITEMS				

69 Clause 11.10 - Tenant installations
 Fixed: _____ Value related: _____ Time related: _____

Item

70 Clause 11.11 - Advertising
 Fixed: _____ Value related: _____ Time related: _____

Item

SECTION C: SPECIFIC PRELIMINARIES

Section C contains specific preliminary items which apply to this contract

71 C1.0 CONTRACT DRAWINGS

The drawings issued with the tender documents do not comprise the complete set but serve as a guide only for tendering purposes and for indicating the scope of the work to enable the tenderer to acquaint himself with the nature and extent of the works and the manner in which they are to be executed

Should any part of the drawings not be clearly understood by the tenderer he shall, before submitting his tender, obtain clarification in writing from the principal agent

Fixed: _____ Value related: _____
 Time related: _____

Item

72 C2.0 GENERAL PREAMBLES

The document 'Specification of Materials and Methods to be used (PW371)' is obtainable on the Department's website (<http://www.publiworks.gov.za/> under 'Consultants Guidelines'), and shall be read in conjunction with the bills of quantities and be referred to for the full descriptions of work to be done and materials to be used

Fixed: _____ Value related: _____
 Time related: _____

Item

Carried to Collection

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73 **C3.0 TRADE NAMES**

Wherever a trade name for any product has been described in the bills of quantities / lump sum document, the tenderer's attention is drawn to the fact that any other product of equal quality may be used subject to the written approval of the principal agent being obtained prior to the closing date for submission of tenders.

If prior written approval for an alternative product is not obtained, the product described shall be deemed to have been tendered for.

Fixed: _____ Value related: _____
Time related: _____

Item

74 **C4.0 IMPORTED MATERIALS AND EQUIPMENT**

Where imported items are listed in the tender documents, the tenderer shall provide all the information called for, failing which the price of any such item, materials or equipment shall be excluded from currency fluctuations. (refer to Schedule of Imported Materials and Equipment CPW-23(FC) to be completed by tenderer).

Notwithstanding any provisions elsewhere regarding the adjustment of contract prices, the price of any item, material or equipment listed in terms of this clause shall be excluded from the Contract Price Adjustment Provisions (if applicable).

Fixed: _____ Value related: _____
Time related: _____

Item

75 **C5.0 SECURITY CHECK OF PERSONNEL**

The principal agent may require the contractor to have his personnel and workmen, or a certain number of them, security classified.

In the event of the principal agent requesting the removal of a person or persons from the works for security reasons, the contractor shall do so forthwith and shall thereafter ensure that such person or persons are denied access to the works and the site and/or to any document or information relating to the works.

Fixed: _____ Value related: _____
Time related: _____

Item

Carried to Collection

R₁

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C6.0 PROHIBITION ON TAKING OF PHOTOGRAPHS

In terms of article 119 of the Defence Act, 44 of 1957, it is prohibited to sketch or to take photographs of any military site or installation or any building or civil works thereon or to be in possession of a camera or other apparatus used for taking of photographs except when authorized thereto by or on behalf of the Minister

The same prohibition is also applicable to all correctional institutions in terms of article 41.1(e) of the Correctional Services Act 8 of 1959

Fixed: _____ Value related: _____
Time related: _____

Item

77

C7.0 HIV/AIDS AWARENESS

It is required of the contractor to thoroughly study the HIV/AIDS Specification (PW 1544) of the Department that must be read together with and is deemed to be incorporated under this Section of the bills of quantities / lump sum document. Provision for pricing of HIV/AIDS awareness is made under items C10.1 to C10.5 hereafter and it is explicitly pointed out that all requirements of the aforementioned specification are deemed to be priced hereunder, as the said items represent the only method of measurement and no additional items or extras to the contract in this regard shall be entertained

The contractor must take note that compliance with the HIV/AIDS Specification is compulsory. In the event of partial or total non-compliance, the principal agent, notwithstanding the provisions of clause A 31.0 of Section A or any other clause to the contrary, reserves the right to delay issuing any progress payment certificate until the contractor provides satisfactory proof of compliance. The contractor shall not be entitled to any compensation of whatsoever nature, including interest, due to such delay of payment

Fixed: _____ Value related: _____
Time related: _____

Item

Carried to Collection

R.

Section No. 1
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C7.1 AWARENESS CHAMPION Selection, appointment, briefing and making available of an Awareness Champion including provision of all relevant services, all in accordance with the HIV/AIDS Specification Fixed: _____ Value related: _____ Time related: _____	Item		
C7.2 AWARENESS WORKSHOPS Selection and appointment of a competent Service Provider approved by the principal agent, provision of a Service Provider Workshop Plan and a suitable venue, conducting of awareness workshops by means of traditional and/or modern multi-media techniques, including follow-up courses, making available all tuition material and performing assessment procedures, all in accordance with the HIV/AIDS Specification Fixed: _____ Value related: _____ Time related: _____	Item		
C7.3 POSTERS, BOOKLETS, VIDEOS, ETC. Provision, displaying, maintaining and replacing when necessary of four plastic laminated posters, booklets and educational videos, etc. for the duration of the construction period, all in accordance with the HIV/AIDS Specification Fixed: _____ Value related: _____ Time related: _____	Item		
C7.4 ACCESS TO CONDOMS Provision and maintenance of condom dispensers fixed in position, including male and female condoms, replenishing male and female condoms on a daily basis as required for the duration of the construction period, all in accordance with the HIV/AIDS Specification Fixed: _____ Value related: _____ Time related: _____	Item		
Carried to Collection			
Section No. 1 PRELIMINARIES Bill No. 1 PRELIMINARY AND GENERAL ITEMS			

R

C7.5 MONITORING

Monitoring HIV/AIDS awareness of workers, providing the **principal agent** with access to information including making available all reports, thoroughly completed and reflecting the correct information, for the duration of the **construction period** and close out, all in accordance with the HIV/AIDS Specification

Fixed _____ Value related _____
Time related: _____

Item

78

C8.0 OCCUPATIONAL HEALTH AND SAFETY ACT

The contractor shall comply with all the requirements set out in the Construction Regulations, 2003 issued under the Occupational Health and Safety Act, 1993 (Act No 85 of 1993)

It is required of the contractor to thoroughly study the Health and Safety Specification that must be read together with and is deemed to be incorporated under this Section of the bills of quantities

The contractor must take note that compliance with the Occupational Health and Safety Act, Construction Regulations and Health and Safety Specification is compulsory. In the event of partial or total non-compliance, the **principal agent**, notwithstanding the provisions of clause A31.0 of Section A or any other clause to the contrary, reserves the right to delay issuing any progress payment **certificate** until the contractor provides satisfactory proof of compliance. The contractor shall not be entitled to any compensation of whatsoever nature, including interest, due to such delay of payment

Provision for pricing of the Occupational Health and Safety Act, Construction Regulations and Health and Safety Specification is made under this clause (refer to Part C8 for Occupational Health and Safety Specification) and it is explicitly pointed out that all requirements of the aforementioned are deemed to be priced hereunder and no additional claims in this regard shall be entertained

Fixed: _____ Value related _____
Time related: _____

Item

Carried to Collection

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C9.0 EMPLOYMENT AND TRAINING OF YOUTH WORKERS ON THE EXPANDED PUBLIC WORKS PROGRAMME (EPWP) INFRASTRUCTURE PROJECTS : NATIONAL YOUTH SERVICE (NYS)

The contractor shall comply with EPWP for **INFRASTRUCTURE PROJECTS** (this document is available on the Department's website), together with all the requirements set out in the "Additional Specification SL : Employment and Training of Youth Workers on the Expanded Public Works Programme (EPWP) Infrastructure Projects : National Youth Service (NYS)" as attached to these bills of quantities

The contractor shall liaise and co-ordinate with the employer and the EPWP Training Service Provider with regard to the priority list, the selection of youth workers, and the employment and training of the identified youth workers

The contractor shall avail the services of an adequately qualified foreman specifically for the EPWP-NYS youth workers, to act as their construction supervisor. The foreman will be responsible for continually monitoring the progress of the youth workers and for addressing questions and issues that may arise from the youth workers

All the requirements in respect of the aforementioned specification are deemed to be priced hereunder and no additional claims in this regard shall be entertained

Fixed: _____ Value related: _____
Time related: _____

Item

Carried to Collection

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PRELIMINARY AND GENERAL ITEMS			

Item No		Quantity	Rate	Amount
	<u>BILL No. 1</u>			
	<u>EARTHWORKS (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 104			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Nature of ground</u>			
	A soils investigation has been carried out on site by the engineer and the report is annexed to these bills of quantities. Descriptions of excavations shall be deemed to include all ground conditions classifiable as "earth" described in the above report and where conditions of a more difficult character are indicated these are separately measured			
	<u>Carting away of excavated material</u>			
	Descriptions of carting away of excavated material shall be deemed to include loading excavated material onto trucks directly from the excavations or, alternatively, from stock piles situated on the building site			
	<u>EXCAVATION, FILLING, ETC BELOW BASEMENT LEVEL (FOR BUKE EXCAVATIONS, ETC REF TO SECTION : EXTERNAL WORKS)</u>			
	<u>Excavation in earth not exceeding 2m deep</u>			
1	Reduced levels under floors	m3	824	
2	Trenches	m3	754	
3	Holes	m3	332	
	<u>Back excavation of vertical sides of excavation in earth for working space including backfilling compacted to 98% Mod AASHTO density</u>			
4	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	2.345	
	Carried to Collection			R
	Section No. 2 LOWER LEVEL BASEMENT INCLUDING ROOF SLAB Bill No. 1 PART II WORKS (PROVISIONAL)			

<u>Extra over trench and hole excavations in earth for excavation in</u>					
5	Soft rock	m3	106		
6	Hard rock	m3	50		
<u>Extra over back excavation in earth for working space for excavation in soft rock</u>					
7	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	236		
<u>Extra over back excavation in earth for working space for excavation in hard rock</u>					
8	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	115		
<u>Extra over all excavations for carting away</u>					
9	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	1,271		
<u>Risk of collapse of excavations</u>					
10	Sides of trench and hole excavations not exceeding 1.5m deep	m2	2,345		
<u>Keeping excavations free of water</u>					
11	Keeping excavations free of all water other than subterranean water	Item			
<u>Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 98% Mod AASHTO density</u>					
12	Backfilling to trenches, holes, etc	m3	430		
<u>G5 filling supplied by the contractor compacted to 95% Mod AASHTO density</u>					
13	Under floors, steps, pavings, etc	m3	824		
14	Backfilling to trenches, holes, etc	m3	167		
Carried to Collection					R
Section No. 2					
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB					
Bill No. 1					
EARTHWORKS (PROVISIONAL)					

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Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 1

EARTHWORKS (PROVISIONAL)

COLLECTION

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Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 1

EARTHWORKS (PROVISIONAL)

Item No	Quantity	Rate	Amount
<u>BILL No. 2</u>			
<u>CONCRETE, FORMWORK AND REINFORCEMENT</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 110			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Cost of tests</u>			
The costs of making, storing and testing of concrete test cubes as required under clause 7 "Tests" of SABS 1200 C shall include the cost of providing cube moulds necessary for the purpose, for testing costs and for submitting reports on the tests to the architect. The testing shall be undertaken by an independent firm or institution nominated by the contractor to the approval of the architect. (Test cubes are measured separately)			
Brick concrete shall consist of twelve parts clean dry full size ash, free from coal or other foreign matter, to one part cement (12:1), the ash graded up to particles which will pass a 16,5mm ring from a minimum which fails to pass a 4,75mm mesh. The finer materials from the screening are to be first mixed with the cement into a mortar and the ash added afterwards and thoroughly incorporated			
<u>Formwork</u>			
Description of formwork shall be deemed to include use and waste only (except where described as "left in" or "permanent"), for fitting together in the required forms, wedging, plumbing and fixing to true angles and surfaces as necessary to ensure easy release during stripping and for reconditioning as necessary before re-use			
The vertical strutting shall be carried down to such construction as is sufficiently strong to afford the required support without damage and shall remain in position until the newly constructed work is able to support itself.			
Carried to Collection			R:
Section No. 2 LOWER LEVEL BASEMENT INCLUDING ROOF SLAB Bill No. 2 CONCRETE, FORMWORK AND REINFORCEMENT			

Formworks to soffits of solid slabs, etc shall be deemed to be slabs not exceeding 250mm thick unless otherwise described

Formwork to soffits of slabs and beams shall include propping exceeding 1.5m and not exceeding 3.5m high unless otherwise described

Formwork to walls and columns is not exceeding 3.5m high above bearing level unless otherwise described

Formwork to sides of all reinforced concrete strip footings and bases have been measured and will be subject to re-measurement at completion to include only formwork to foundation elements as prescribed by the engineer for design reasons. Formwork necessitated by irregularity or collapse of excavated faces will not be measured and the cost thereof shall be deemed to be included in the allowance for taking the risk of collapse of the sides of the excavations, provision for which is made in "Earthworks"

UNREINFORCED CONCRETE

20MPa/19mm concrete

Benching to floor drain (Provisional)

m3

17

25MPa/19mm concrete

2 In filling to cavity of cavity wall in foundations (Provisional)

m3

11

3 Surface beds cast in panels on waterproofing

m3

45

UNREINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES

25MPa/19mm concrete

4 Surface binding under footings and bases

m3

42

REINFORCED CONCRETE

25MPa/19mm concrete

5 Strip footings

m3

101

6 Bases

m3

124

7 Lift shaft base

m3

1

8 Staircase bases

m3

8

Carried to Collection

Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

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CONCRETE, FORMWORK AND REINFORCEMENT

R

9	Surface beds cast in panels on waterproofing	m3	136		
10	Ramps	m3	8		
11	Bottoms and sides of floor drains	m3	40		
12	Slabs including beams and inverted beams	m3	500		
13	Seating bench slabs, etc	m3	1		
14	Stairs including landings, beams and inverted beams	m3	18		
15	Retaining walls in foundations (Provisional)	m3	40		
16	Retaining walls	m3	112		
17	Lift shaft walls	m3	12		
18	Dwarf walls (no foundations)	m3	5		
19	Columns in foundations (Provisional)	m3	11		
20	Columns	m3	34		
<u>TEST BLOCKS</u>					
21	Mixing and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	15		
<u>CONCRETE SUNDRIES</u>					
<u>Finishing top surfaces of concrete smooth with a wood float</u>					
22	Tops of beams, walls, etc	m2	15		
<u>Finishing top surfaces of concrete smooth with a steel trowel</u>					
23	Tops of beams, walls, etc	m2	1		
24	Tops of benching to floor drains to falls	m2	28		
<u>Finishing top surfaces of concrete smooth with a power float</u>					
25	Surface beds, slabs etc	m2	2,627		
26	Surface beds, slabs, etc to falls	m2	139		
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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB					
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CONCRETE, FORMWORK AND REINFORCEMENT					

27	Surface beds, slabs, etc to falls and currents	m2	23
	<u>Finishing top surfaces of concrete to an evenly ribbed non-slip surface</u>		
28	Surface beds, slabs, etc	m2	863
29	Surface beds, slabs, etc to falls	m2	39
	<u>ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK ROUP 111)</u>		
	<u>Rough formwork to sides</u>		
30	Strip footings (Provisional)	m2	361
31	Bases (Provisional)	m2	349
32	Steps in strip footings (Provisional)	m2	9
33	Staircase bases	m2	19
34	Retaining walls in foundations (Provisional)	m2	254
35	Retaining walls in foundations circular exceeding 1m radius (Provisional)	m2	18
36	Inner face of shaft walls with total height exceeding 5m and not exceeding 6.5m high above bearing level	m2	40
37	Outer face of shaft walls	m2	15
38	Rectangular columns in foundations (Provisional)	m2	157
39	Edges, risers, ends and reveals not exceeding 300mm high or wide	m	237
40	Sloping and stepped outer edges of stairs 350mm high extrem	m	61
	<u>Rough formwork to soffits</u>		
41	Slabs over shafts	m2	5
42	Sealing benches	m2	11
43	Beams	m2	27
44	Beams propped up exceeding 3.5m and not exceeding 5m high	m2	16

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R

**SMOOTH FORMWORK (DEGREE OF
ACCURACY II) (WORK ROLUP 111)**

Smooth formwork to sides

45	Retaining walls	m2	707
46	Retaining walls circular exceeding 1m radius	m2	51
47	Dwarf walls	m2	55
48	Outer face of lift shaft walls with total height exceeding 3.5m and not exceeding 5m above bearing level	m2	40
49	Rectangular columns	m2	307
50	Rectangular columns with total height exceeding 3.5m and not exceeding 5m above bearing level	m2	169
51	Beams	m2	1,344
52	Edges exceeding 300mm high	m2	97
53	Edges, risers, ends and reveals not exceeding 300mm high or wide	m	76

2.1.10th formwork to soffits

54	Slabs	m2	1,188
55	Slabs propped up exceeding 3.5m and not exceeding 5m high	m2	792
56	Landings	m2	15
57	Stairs with sloping soffits	m2	7
58	Beams	m2	175
59	Beams propped up exceeding 3.5m and not exceeding 5m high	m2	116

Boxing in smooth formwork to form

60	25 x 25mm Chamfer along top or bottom edge	m	124
61	25 x 25mm Vertical chamfer at corner	m	1,667
62	12 x 12mm Rebata in side along top edge	m	65

Carried to Collection

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
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CONCRETE, FORMWORK AND REINFORCEMENT

R

MOVEMENT JOINTS ETC

Two layers malthoid or similar and approved slip joints between horizontal concrete surfaces or horizontal concrete and brick surfaces including cement mortar bed

63	Exceeding 300mm wide	m ²	36
64	Not exceeding 300mm wide	m	618

"Jointex" or similar and approved expansion joints between horizontal concrete surfaces

65	12mm Joints not exceeding 300mm wide	m	65

"Jointex" or similar and approved expansion joints between vertical concrete surfaces

66	12mm Joints exceeding 300mm high	m ²	38

67	12mm Joints not exceeding 300mm high	m	161

"Jointex" or similar and approved expansion joints between vertical concrete and brick surfaces

68	12mm Joints not exceeding 300mm high	m	320

Saw cut joints

69	12 x 12mm Saw cut joints in top of concrete	m	562

Horizontal joggle construction joints through concrete including thick cement slurry to one face

70	Surface beds not exceeding 300mm thick	m	562

REINFORCEMENT (WORK GROUP 114)

Mild steel reinforcement to structural concrete work

71	12mm Diameter bars	t	1.65

72	10mm Diameter bars	t	2.34

73	8mm Diameter bars	t	3.97

High tensile steel reinforcement to structural concrete work

74	25mm Diameter bars	t	5.47

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75	20mm Diameter bars	t	3.65
76	16mm Diameter bars	t	16.88
77	12mm Diameter bars	t	57.97
78	10mm Diameter bars	t	5.78
<u>Fabric reinforcement</u>			
79	Mesh reference 254 fabric reinforcement in concrete surface beds, slabs, etc	m2	1,187

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CONCRETE, FORMWORK AND REINFORCEMENT

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Item No		Quantity	Rate	Amount
	<u>BILL NO. 4</u>			
	<u>MASONRY</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 116			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Sizes in descriptions</u>			
	Where sizes in descriptions are given in brick units, "one brick" shall represent the length and "half brick" the width of a brick			
	<u>Hollow walls etc</u>			
	Descriptions of hollow walls shall be deemed to include leaving every fifth perpend of the bottom course of the external skin open as a weep hole.			
	<u>FOUNDATIONS (PROVISIONAL)</u>			
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>			
1	Half brick walls	m2	25	
2	One brick walls	m2	325	
3	280mm Hollow walls of two half brick skins including wire ties	m2	215	
	<u>SUPERSTRUCTURE</u>			
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>			
4	One brick walls	m2	9	
	<u>Brickwork of NFP bricks in class II mortar</u>			
5	Half brick walls	m2	89	
6	One brick walls	m2	1,126	
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7	280mm Hollow walls of two half brick skins including wire ties	m ²	721		
<u>BRICKWORK SUNDRIES</u>					
8	Splayed mortar fillet one course high in 50mm cavity	m	216		
9	Closing 50mm cavity of hollow wall vertically with brickwork one brick wide	m	95		
10	Closing 50mm cavity of hollow wall horizontally with brickwork one brick wide	m	323		
<u>Expansion joints with "Jointex" or similar and approved softboard between vertical concrete and brick surfaces</u>					
11	10mm Joints not exceeding 300mm wide	m	990		
<u>Brickwork reinforcement</u>					
12	75mm Wide reinforcement built in horizontally in foundations (Provisional)	m	5,935		
13	75mm Wide reinforcement built in horizontally	m	3,673		
14	100mm Wide reinforcement built in horizontally in foundations (Provisional)	m	4,341		
15	150mm Wide reinforcement built in horizontally	m	2,726		
<u>Prestressed fabricated lintels</u>					
16	110 x 75mm Lintels in lengths not exceeding 3m	m	311		
17	110 x 75mm Lintels in lengths exceeding 3m and not exceeding 4.5m	m	8		
18	110 x 75mm Lintels in lengths exceeding 4.5m and not exceeding 6m	m	5		
19	150 x 75mm Lintels in lengths not exceeding 3m	m	72		
20	150 x 75mm Lintels in lengths exceeding 3m and not exceeding 4.5m	m	8		
21	150 x 75mm Lintels in lengths exceeding 4.5m and not exceeding 6m	m	5		
<u>FACE BRICKWORK</u>					
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	<u>Corobrik Titanium Gun Metal Grey Satin Texture or similar and approved face bricks pointed with recessed horizontal and vertical joints</u>		
22	Extra over brickwork for face brickwork in foundations (Provisional)	m ²	50
23	Extra over brickwork for face brickwork	m ²	672
	<u>Brick-on-edge header course copings, sills, etc of face bricks pointed with recessed joints on all exposed faces</u>		
24	220mm Wide sill set sloping and slightly projecting	m	45
	<u>PAVING (PROVISIONAL)</u>		
	<u>Paving of 100 x 100 x 60mm Sandstone Cosmopolitan Cobble smooth concrete cobblestone paving bricks or similar and approved with butt joints on 20mm thick river sand bed with sand and cement mixture swept into joints and hosed down including preparation of ground or filling</u>		
25	Paving in stretcher bond to falls	m ²	26
26	75mm Wide brick-on-edge edging on 50mm thick mortar bed	m	37
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Bill No. 4

MASONRY

"Sikaflex Tank N" or similar and approved concrete
grey polyurethane sealing compound including
backing cord, bond breaker, primer, etc

5	12 x 12mm in saw cut joints in floors	m	562
6	12 x 12mm in expansion joints in floors	m	366
7	12 x 12mm in expansion joints in slabs, between beams, etc	m	424

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Bill No. 5
WATERPROOFING

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

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WATERPROOFING

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 5

WATERPROOFING

Item No	Quantity	Rate	Amount
<u>BILL No. 6</u>			
<u>CARPENTRY AND JOINERY</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 125			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Joinery</u>			
Descriptions of frames shall be deemed to include frames transoms, mullions, rails, etc.			
Descriptions of hardwood joinery shall be deemed to include pelleting of bolt holes			
<u>Fixing</u>			
Items described as "nailed" shall be deemed to be fixed with hardened steel nails or shot pins to brickwork or concrete			
<u>SKIRTINGS</u>			
<u>Wrought ironwork</u>			
1	22 x 65mm Bullnose skirting nailed	m	307
2	22 x 65mm Bullnose skirting stopped over treads and risers nailed	m	89
<u>DOORS ETC</u>			
<u>"Lotus Ampretti" or similar and approved solid flush back doors hung to steel frames</u>			
3	40mm Internal Horizontal R13 door 813 x 2032mm high	No	25
4	Extra over door for 450 x 600mm opening for louvre panel (elsewhere measured)	No	2
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	<u>"Cubicle Solutions" or similar and approved 12mm Compact High Pressure Laminate modular frameless system toilet doors (one flat colour) with end panels face-fixed to inside of brickwork including grade 304 stainless steel brackets, hat and coat hook, indicator bolt and rise and fall butt auto open hinges, strictly in accordance with the manufacturer's instructions.</u>			
5	Door for opening size 900 x 2125mm high	No	1	
	<u>CILLS</u>			
	<u>Wrought meranti</u>			
6	32 x 150mm Cill with double bullnosed front edge plugged	m	45	
	<u>BEADS, ARCHITRAVES, ETC</u>			
	<u>Wrought meranti</u>			
7	19mm Quadrant beads	m	55	
	<u>FURNITURE, FITTINGS, ETC</u>			
	<u>"Cubicle Solutions" Product Code CSL/GHPL/304/3 Locker or similar and approved with 8mm white Compact High Pressure Laminate carcass and 12mm charcoal Compact High Pressure Laminate doors including standard ironmongery (code CSSH/E112), D shaped keep (code CSLJ/LK/3) for individual padlocks (no locking mechanism), lock cover plate and handle (code CSLJ/LH/8) and 2mm Rowmark brushed aluminium oval numbering discs, strictly in accordance with the manufacturer's instructions</u>			
8	Locker size overall 300 x 450 x 1900mm high (1800mm locker and 100mm plinth)	No	2	
	<u>NOTICE BOARDS, WRITING BOARDS, ETC</u>			
	<u>"Vitrex System 2000 Pin Boards" or similar and approved with standard Florite Premier (colour Misty) pinning material surface beaded all around with a natural anodised aluminium channel surround mitered at the corners, fixed in position to plastered brickwork strictly in accordance with the manufacturer's instructions</u>			
9	Board size 1 500 x 1 200mm high	No	1	

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LOWER LEVEL BASMENT INCLUDING ROOF SLAB
Bil No. 6
CARPENTRY AND JOINERY

"Vitrex System 2000" standard model 2200 vitreous enamel wall mounted white board or similar and approved complete with integral anodised aluminium pen rail and fixing components, fixed in position to plastered brickwork strictly in accordance with the manufacturer's instructions

10	Purpose made white board size 600 x 450mm high	No	3

JOINERY FITTINGS

General

The following cupboard fittings have been measured as complete units i.e. the components of the units have not been separately measured. The descriptions, therefore, of such units shall be deemed to include all components, assembling, housing, notching, glueing, blocking, planting on and screwing with countersunk screws, edge strips, decorative plastic finish, glass, ironmongery, metal work, paint or varnish finishes, etc

The references given in the descriptions are to the respective types of fittings detailed on the architect's drawings as referred to in the various descriptions and annexed to these bills of quantities/accompanying these bills of quantities for tender purposes

Kitchen cupboards and shelving as per Architect's drawing number 605 REV A accompanying these bills of quantities for tender purposes

11	Combination floor and sink cupboard 1800 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and two hinged doors, dividing framework and four drawers (sink elsewhere measured)	No	1

12	320mm Wide x 32mm thick "floating" "Oxyda Stucco" finish shelving	m	3

Control restroom cupboards as per Architect's drawing number 605 REV A accompanying these bills of quantities for tender purposes

13	Combination floor and sink cupboard 1800 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and two hinged doors, dividing framework, four drawers and cut-out in top for sink (sink elsewhere measured)	No	1

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Bill No. 6
CARPENTRY AND JOINERY

Finger prints room locker and cupboard as per
Architect's drawing number 610 REV A
accompanying these bills of quantities for tender
purposes

- 14 Combination floor and sink cupboard 4503 x 600 x
1000mm high with top, sides, bottom, divisions, shelves,
back and six hinged doors, dividing framework, eight
drawers and cut-out in top for sink (sink elsewhere
measured)

No

1

- 15 Wall mounted locker 1200 x 450 x 2125mm high
comprising 16 individual lockers with tops, sides,
bottoms, divisions and return hinged doors with D-
shaped keep for padlocks, door handles etc

No

1

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CARPENTRY AND JOINERY

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 6

CARPENTRY AND JOINERY

Item No		Quantity	Rate	Amount
	<u>BILL No. 8</u>			
	<u>IRONMONGERY</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 132			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Catalogue numbers and finishes to Ironmongery</u>			
	Where applicable catalogue numbers and finishes to ironmongery are indicated, refer to "ASSA ABLOY" standard catalogue or similar and approved			
	<u>HINGES, BOLTS, ETC</u>			
1	J-882T-SIL Single panic bolt T bar 900mm	No	1	
	<u>LOCKS</u>			
2	L-2115-76SS/SL Union mortice sash lock	No	23	
3	L-21315-76SS Union 323 cylinder deadlock	No	4	
4	2X815/TNP 815/631 WC privacy cylinder lock	No	3	
5	CY110MKES3310SN Euro single cylinder lock (MK)	No	1	
6	CY110MKES3333SN Euro double cylinder lock (MK)	No	23	
	<u>HANDLES</u>			
7	SS616R-06SS Handle on blank plate	No	46	
8	FFPG5X50SS Flush finger pull	No	1	
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	IRONMONGERY			

9	SS5D152X304L-05 22mm Diameter tubular pull handle on 152 x 304mm plate	No	3	
10	SS5D152X304R-05 22mm Diameter tubular pull handle on 152 x 304mm plate	No	3	
11	SS5305-0555 Escutcheon on rose profile	No	2	
<u>PUSH PLATES AND KICKING PLATES</u>				
12	SS508S 200W Kick plate 200 x 800mm	No	7	
<u>DOOR CLOSERS</u>				
13	DC5ND Cam action closer EN-4 SIL	No	3	
<u>LETTERS, NAMEPLATES, ETC</u>				
14	SS5056-06SSC17 Cleaner mop and bucket sign	No	1	
15	SS5056-06SSC02 Tea kitchen sign	No	1	
<u>SUNDRIES</u>				
16	870015S Floor door stop satin stainless steel	No	24	
17	RH7024 A11 500B30 patent screws and nuts	No	46	
18	SS8025SS Hat and coat hook with rubber	No	3	
<u>"Cubicle Solutions" or similar and approved</u>				
19	Stainless steel wall mounted 3-roll toilet roll holder	No	2	
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20	Grade 304 Stainless steel wall mounted soap dispenser	No	2
21	Grade 304 Stainless steel wall mounted paper towel dispenser <u>"Franke" or similar and approved</u>	No	2
22	Satin finish stainless steel RDX605 (0.8mm) wall mounted waste bin size 355 x 168 x 463mm high (SKU:7262)	No	2
23	Satin finish stainless steel RDX611 (0.8mm) wall mounted sanitary towel disposal and waste bin size 200 x 165 x 295mm high (SKU:7773)	No	1

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IRONMONGERY

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Item No	Quantity	Rate	Amount
<u>BILL No. 9</u>			
<u>METALWORK</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 136			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Descriptions</u>			
Descriptions of bolts shall be deemed to include nuts and washers			
Descriptions of expansion anchors and bolts and chemical anchors and bolts shall be deemed to include nuts, washers and mortices in brickwork or concrete			
Metalwork described as "holed for bolt(s)" shall be deemed to exclude the bolts unless otherwise described			
The effective fixing length of expansion and chemical expansion bolts is the thickness of the material being fixed to the concrete or masonry surface			
<u>Aluminium windows, doors, shopfronts, etc</u>			
All rates to include for brush pile to all horizontal openings sections of doors and shopfronts, aluminium angles / mild steel angles at thresholds (and reveals where necessary) to doors opening onto patios, docks, balconies, etc for dressing over waterproofing (waterproofing elsewhere measured)			
Windows, doors and shopfronts to have rubber gasket around frames and are to be sealed internally and externally with an approved sealer between the brickwork / concrete and the aluminium frame			
<u>SUNDRY STEELWORK</u>			
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Welded security frame build into brickwork

1	300 x 100 mm x 46kg/m Channel section frame with 8 x 12mm diameter x 300mm long stiffener rods welded on to inside of channel section and 6 x 12mm diameter x 525mm long anchor rods and opening security bars welded on through pre-drilled openings in frame (No 5)	kg	648

Welded bearers to concrete

2	100 x 10mm Thick flat section bearers with 10mm diameter anchor rods welded on at 500mm centres at back including embedding in position to top of concrete walls with Sika AnchorFix-3x adhesive	kg	691

Floor channel gratings, etc

3	25 x 4.5mm Merits RS40 or similar and approved grating with banded edges and non-slip dimples laid loose in framing (framing elsewhere measured)	kg	862
4	30 x 30 x 5mm Angle section bearers with 10mm diameter x 100mm long threaded anchors welded on at 1000mm centres, including embedding to side of concrete wall with Sika AnchorFix-3x	kg	145
5	30 x 30 x 5mm Angle section bearers with 50 x 3mm thick x 75mm long flat section fishtail lugs welded on at 1000mm centres, including embedding in edge of concrete surface bed with Sika AnchorFix-3x	kg	147

SUNDRY GALVANISED STEELWORK**"Franks" or similar and approved mild steel security frame build into brickwork**

6	Security frame size 425 x 965mm high for HDTX850 Combi Unit (Combi Unit elsewhere measured)	No	5

SUNDRY ALUMINIUM WORK**"Trellidor" or similar and approved polycarbonate burglar bars including patented bronze anodised aluminium frame fixed (tamper-proof fixing) to brickwork or concrete reveal of window opening, strictly in accordance with the manufacturer's instructions**

7	Burglar bars for window opening size 900 x 600mm high	No	1

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
Bill No. 9
METALWORK

NATURAL ANODISED ALUMINIUM LOUVRE UNITS

- 8 Double frame fixed louvre unit size 450 x 600mm high with horizontal blades fixed in opening of door including silicone sealant all round on both sides

No

2

STAINLESS STEELWORK

"Euro Steel" stainless steel grade 316 (ASTM A276) or similar and approved stair handrails with polished finish fixed to brickwork or concrete strictly in accordance with the manufacturer's instructions

- 9 75 x 75 x 2.5mm Hollow section continuous handrails

m

107

- 10 Extra over handrails for flat closed end

No

20

- 11 Extra over handrail for L-Intersection

No

22

- 12 Extra over handrail for mitred L-Intersection

No

30

WELDED STEEL SCREENS, GATES, ETC

- 13 Single gate size 900 x 2125mm high of 50 x 50 x 2.5mm hollow section frame, with 10mm thick x 150mm wide horizontal fibre board panels countersunk screwed to frame on one side for the full height of the leaf and the leaf fitted with a pair of suitable hinges welded to 200 x 200 x 10mm thick plate, bolted to wall with and including four 12mm diameter expansion bolts per hinge and with 12mm diameter x 250mm long drop bolt with metal keep in concrete

No

1

- 14 Double gate size 1800 x 2125mm high overall, each leaf of 50 x 50 x 2.5mm hollow section frame, with 10mm thick x 150mm wide horizontal fibre board panels countersunk screwed to frame on one side for the full height of the leaf and each leaf fitted with a pair of suitable hinges welded to 200 x 200 x 10mm thick plate, bolted to wall with and including four 12mm diameter expansion bolts per hinge and with 12mm diameter x 250mm long drop bolt with metal keep in concrete and hasp and staple welded on

No

1

PRESSED STEEL DOOR FRAMES

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Bill No. 9
METAL WORK

	<u>1,2mm Rebated frames suitable for half brick walls</u>		
15	Frame for door 813 x 2032mm high	No	5
	<u>1,6mm Rebated frames suitable for one brick walls</u>		
16	Frame for door 813 x 2032mm high	No	20
	<u>ALUMINIUM WINDOWS, DOORS, ETC</u>		
	<u>Epoxy powder coated (colour matched) aluminium windows, doors, frames and shopfronts including glazing, etc strictly in accordance with relevant AAMA and SANS standards and performance criteria, plugged to brickwork or concrete, as per architect's drawings numbers 800 REV D, 801 REV D and 802 REV D accompanying these bills of quantities for tender purposes (door ironmongery elsewhere measured)</u>		
17	Window size 600 x 600mm high (W1)	No	1
18	Window size 900 x 600mm high (W1)	No	11
19	Window size 900 x 1 200mm high (W2)	No	1
20	Window size 1 800 x 600mm high (W3)	No	1
21	Fixed pane window size 1 550 x 1 300mm high (W14)	No	4
22	Glazed shopfront comprising of double door with sidelights and fanlight size 5 660 x 3 145mm high overall (S3)	No	1
	<u>LOUVRE UNITS</u>		
	<u>Custom made rectangular shaped "Safintra" branded SFL4 Colorplus AZ150 ("Thunderstorm" finish outside only) or similar and approved fixed louvre unit mounted in a metal surround frame into brickwork, including flashings, etc strictly in accordance with the manufacturer's instructions</u>		
23	Louvre unit for 900 x 1 200mm high opening through 280mm cavity wall	No	4
24	Louvre unit for 1 800 x 1 200mm high opening through 280mm cavity wall	No	26
	<u>PRESSED STEEL TRANSFORMER ROOM DOORS AND FRAMES</u>		

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<u>"Bitcon Industries" or similar and approved transformer room doors and frames</u>			
25	Single door and frame size 915 x 2135mm high Type BV suitable for 280mm cavity wall	No	1
26	Double door and frame size 1525 x 2135mm high Type MV suitable for 230mm brick wall	No	2
27	Double door and frame size 1525 x 2135mm high Type MV suitable for 280mm cavity wall	No	1
<u>STEEL ROLLER SHUTTERS ETC</u>			
<u>"Serranda" powder coated galvanised steel slatted (75 x 1.0mm thick slats) roller shutters or similar and approved fixed to brickwork or concrete</u>			
28	Electrically operated "See-Thru" slatted roller shutter for opening size 3.5 x 2.6m high	No	2
29	Electrically operated "See-Thru" slatted roller shutter for opening size 4.88 x 2.6m high	No	1
<u>STEEL CELL DOORS</u>			
30	Standard SAPS solid steel door (cell door and frame) Type T2 size 1018 x 2020mm high overall suitable for 230mm brick wall (refer to Departmental Specification 371)	No	5
31	Standard SAPS steel grille gate (cell door grille gate and frame) Type T3 size 1018 x 2020mm high overall suitable for 230mm brick wall (refer to Departmental Specification 371)	No	9
32	Standard SAPS steel grille gate (cell door grille gate and frame) Type T3 size 1018 x 2020mm high overall in position in steel security screen (security screen elsewhere measured) (refer to Departmental Specification 371)	No	2
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METALWORK

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Bill No. 9

METALWORK

Item No			Quantity	Rate	Amount
	<u>BILL No. 10</u>				
	<u>PLASTERING</u>				
	<u>WORK GROUP</u>				
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 142				
	<u>SCREEDS</u>				
	<u>Screeds on concrete</u>				
1	20mm Thick on floors and landings	m2	286		
2	20mm Thick on narrow widths	m2	3		
	<u>Prepare and apply Flowtex HT heavy duty hand troweled epoxy screed, including Flowprime primer, Scatter coat and two coats Flowshield Sealcoat, or similar and approved epoxy screed, all in accordance with manufacturer's detailed instructions on concrete</u>				
3	7mm Thick on floors and landings	m2	92		
4	7mm Thick on narrow widths	m2	2		
	<u>GRANOLITHIC</u>				
	<u>Untinted granolithic on concrete</u>				
5	15mm Thick on top of seating benches	m2	11		
	<u>INTERNAL PLASTER</u>				
	<u>Cement plaster on brickwork</u>				
6	On walls	m2	3,404		
7	On narrow widths	m2	132		
	<u>Cement plaster on concrete</u>				
8	On counter tops	m2	8		
9	On narrow widths	m2	1		
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	PLASTERING				

EXTERNAL PLASTER

10 On walls

m²

10

**CORNER PROTECTORS, DIVIDING STRIPS,
ETC**11 20mm Thick 'Rubber United' EPDM quality black and
white rubber corner protector Code 21859010 or similar
and approved fixed to brickwork or concrete with
approved adhesive

m

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PLASTERING

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 10

PLASTERING

Item No	Quantity	Rate	Amount
BILL No. 11			
<u>TILING</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 144			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Descriptions</u>			
Unless described as "fixed with adhesive to plaster (plaster elsewhere)" descriptions of tiling on brick or concrete walls, columns, etc shall be deemed to include 1:4 cement plaster backing and descriptions of tiling on concrete floors etc shall be deemed to include 1:3 plaster bedding			
<u>WALL TILING</u>			
<u>75 x 300mm Union white glass tiles fixed with high strength grey cementitious based adhesive to plaster (plaster elsewhere) with 3mm continuous flush joints in both directions</u>			
1	On walls	m2	61
2	On walls in isolated panels, splashbacks, etc	m2	3
3	On narrow widths	m2	1
4	For exposed cutting and fitting around pipe not exceeding 100mm internal diameter	No	2
<u>SUNDRIES</u>			
<u>"HOMELUX" or similar and approved</u>			
5	8mm Stainless steel effect straight edge metal tile trim	m	9
Carried Forward to Summary of Section No. 2			R
Section No. 2 LOWER LEVEL BASEMENT INCLUDING ROOF SLAB Bill No. 11 TILING			

Item No	Quantity	Rate	Amount
<u>BILL No. 12</u>			
<u>PLUMBING AND DRAINAGE</u>			
<u>(PROVISIONAL)</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 146			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>"Polycop" polypropylene pipes:</u>			
Polypropylene pipes 54mm diameter and under shall be seamless copper coloured class 16 pipes jointed with "Fast-fuse" heat welded thermoplastic or brass compression fittings as designed for use with copper pipes as stated			
Pipes shall be firmly fixed to walls etc with coloured nylon snap-in pipe clips with provision for accommodating thermal movement and jointed and fixed strictly in accordance with the manufacturer's instructions			
All pipe diameters are nominal external			
<u>"Polylink" polypropylene pipes:</u>			
Polypropylene pipes 63mm diameter and over shall be class 12 pipes jointed with cast iron "Supraclamp" running joints			
Fusion welded bands, once or twice mitred as necessary, and tees shall be factory manufactured			
Fusion welded bends and tees shall include jointing to pipes with PVC rubber ring double Z joint couplers			
Branch tees shall include flanged and bolted joints to "Polycop" branch pipes in addition and for brass compression male iron to copper straight couplers			
Reducers shall include jointing to pipes with PVC rubber ring double Z joint couplers and reducers shall be of sufficient overall length to accommodate same			
Carried to Collection			R
Section No. 2			
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB			
Bill No. 12			
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)			

All pipes shall be jointed and fixed strictly in accordance with the manufacturer's instructions

All pipe diameters are nominal external

uPVC pipes and fittings:

Soil, waste and vent pipes and fittings shall be solvent welded jointed

uPVC pressure pipes and fittings:

Pipes for water supply shall be of the class stated

Pipes of 40mm diameter and smaller shall be plain ended with solvent welded uPVC loose sockets and fittings

Pipes of 50mm diameter and greater shall have sockets and spigots with push in type integral rubber ring joints. Bonds shall be uPVC and all other fittings shall be cast iron, all with similar push-in type joints

Pipes for water supply shall be of the class stated

Pipes of 40mm diameter and smaller shall be plain ended with solvent welded uPVC loose sockets and fittings

Pipes of 50mm diameter and greater shall have sockets and spigots with push in type integral rubber ring joints. Bonds shall be uPVC and all other fittings shall be cast iron, all with similar pushing type joints

Copper pipes:

Pipes shall be hard drawn and half-hard pipes of the class stated. Class 0 (thin walled hard drawn) pipes shall not be bent. Class 1 (thin walled half-hard) class 2 (half-hard) and class 3 (heavy walled half-hard) pipes shall only be bent with benders with inner and outer formers. Fittings to copper waste, vent and anti-siphon pipes, capillary solder fittings and compression fittings shall be "Cobra Watertech" type or similar and approved. Capillary solder fittings shall comply with ISO 2016. Only compression fittings shall be used in walls or in ground

Carried to Collection

Section No. 2
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
Bill No. 12
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

R

Fixing of pipes

Unless specifically otherwise stated, descriptions of pipes shall be deemed to include fixing to walls etc, casting in, building in or suspending not exceeding 1m below suspension level

Reducing fittings

Where fittings have reducing ends or branches they are described as 'reducing'. In the case of pipes with diameters not exceeding 80mm only the largest end or branch size is given. Should the contractor wish to use other fittings and bushes or reducers he may do so on the understanding that no claim in this regard will be entertained. In the case of pipes with diameters exceeding 80mm all sizes are given and no claim for extra bushes, reducers, etc will be entertained

Wire gratings

Descriptions of gully outlets etc shall be deemed to include wire balloon gratings

Descriptions of gully outlets etc shall be deemed to include wire balloon gratings

Exposed concrete surfaces

Exposed surfaces of concrete stormwater channels, cover slabs, inspection eye marker slabs, gully tops, cleaning eye tops, catchpits, inspection chambers, etc shall be finished smooth with plaster

Excavations

No claim for rock excavation will be entertained unless the contractor has previously notified the quantity surveyor thereof prior to backfilling

"Soft rock" and "hard rock" shall be as defined in "Earthworks"

Laying, backfilling, bedding, etc of pipes

Pipes shall be laid and bedded and trenches shall be carefully backfilled in accordance with manufacturers' instructions

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Section No. 2
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
Bis No. 12
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

Where no manufacturers' instructions exist pipes shall be laid in accordance with clauses 5.1 and 5.2 of each of the following:

SABS 1200 L : Medium-pressure pipelines

I D : Sewers

. F : Stormwater drainage

Pipe trenches etc shall be backfilled in accordance with clauses 3, 5.5, 5.6, 5.7 and 7 of SABS 1200 DR : Earthworks (Pipe trenches)

Pipes shall be bedded in accordance with clauses 3.1 to 3.4.1, 5.1 to 5.3 and 7 of SABS 1200 LB : Bedding (Pipes).

Unless otherwise described Bedding of rigid pipe shall be class B bedding

Flush pans

Flush pans shall have straight or side outlets and "P" or "S" traps as necessary

Stainless steel basins, sinks, wash troughs, Urinals, etc.

units shall have standard aprons on all exposed edges and filing keys against walls where applicable

Waste unions

Descriptions of waste unions shall be deemed to include rubber or vulcanite plugs and chains fixed to fittings

Valves, etc

Descriptions of valves etc shall be deemed to include flanged or screwed connections to piping, reducers, supports etc

Sealant to sanitary fittings

Prices for sanitary fittings fixed to walls or abutting walls, drop-in sinks / basins, etc shall include for silicone sealing compound against walls or around fittings

Coding and Marking

All pipes are to be colour coded in accordance with the SABS specifications and all are to be provided with Stainless Steel or Galvanised Steel Name Tags

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Section No. 2
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
Bill No. 12
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

R

Steel sectional water tanks

Tanks shall comply with SABS CKS 414

As-built drawings

The contractor shall prepare an updated set of as built drawings. At completion of the contract the contractor shall hand these drawings to the principal agent for reproducing onto the originals for handing over to the employer

RAINWATER DISPOSAL**Galvanised steel pipes**

1	150mm Pipes	m	29
2	150mm Pipes suspended not exceeding 1m below suspension level	m	44

Extra over galvanised steel pipes for steel fittings

3	150mm 90 degree elbow	No	18

"Fulbore" cast iron outlets

4	150mm x 180 degrees full flow vertical outlet	No	8

SANITARY FITTINGS (WORK GROUP 148)**"Franke" or similar and approved**

5	1.2mm Grade 304 18/10 stainless steel SAPSDF combination wash hand basin and drinking fountain (Code 2520011) size 370 x 450 x 125mm with 40mm concealed waste outlet, self-closing bib tap at the top, the unit fitted with fixing lugs and secured in 25mm deep recess in brickwork	No	1
6	1.2mm Grade 304 18/10 stainless steel HDS heavy duty security type wash hand basin (Code 2520008) size 390 x 322 x 340mm, manufactured with a pressed bowl size 360 x 280 x 140mm deep, complete with a pressed perforated waste outlet, 50mm diameter x 250mm long stainless steel outlet pipe, four 8mm diameter x 250mm long galvanised mild steel threaded rods for fixing the basin to brickwork, including "Wakro" or similar and approved 155LWS metering basin valve and BBD/15 basin spout	No	1

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Section No. 2
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
Bill No. 12
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

7	1.2mm Grade 304 18/10 stainless steel Casace Model CDX 611 drop in sink (Code 19990032) size R25 x 500mm. manufactured with a single end bowl size 343 x 410 x 169mm deep. complete with a 90mm waste outlet fitting and Spazi F1 plumbing kit (Code 1120008)	No	2		
8	1.2mm Grade 304 18/10 polished stainless steel Model H-DIX850C (bolt fixing type) floor mounted wc pan and wash hand basin combination comprising integral pressed bowl with pressed perforated outlet to suit 40mm waste fitting and with 150mm splashback, centre positioned pan and toilet roll holder, bolted to build-in security frame (security frame elsewhere measured), including fittings, etc as per manufacturer	No	5		
	<u>"Vaal" or similar and approved</u>				
9	Rounded Tuscany vitreous china wall mounted basin size 380 x 415mm (Code 700603WH) with three semi-punched tapholes, integral overflow and chain stay hole through the centre semi-punched taphole. bolted to wall with two 10mm bolts (Code 84482000)				
		No	2		
10	Daisy Elite semi close coupled 90 degree outlet open rim wc suite (Code 753400) and matching 9 litre cistern (Code 71150) complete with bid fittings, flush pipe elbow and thermoset soft-close seat	No	2		
	<u>WASTE UNIONS ETC (WORK GROUP 148)</u>				
	<u>"On Tap" or similar and approved</u>				
11	32 x 75mm Chrome plated skited clicker basin waste (GIO-BW2025)	No	2		
	<u>TRAPS ETC (WORK GROUP 148)</u>				
	<u>uPVC</u>				
12	40mm Deep seal "P" or "S" trap	No	2		
	<u>"Cobra Waterlech" or similar and approved</u>				
13	40mm CP Bottle trap	No	2		
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	Section No. 2 LOWER LEVEL BASEMENT INCLUDING ROOF SLAB Bill No. 12 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)				

TAPS, VALVES, ETC (WORK GROUP 148)**"On Tap" or similar and approved**

- 14 10mm Benkiser or similar and approved chromium plated angle regulating valve (Code GIO-5100-AV)

No 2

"Cobra" or similar and approved

- 15 15mm Star chrome plated extended bib tap

No 2

- 16 Karco range single lever raised plain mixer (KO-951R) with cast fixed spout, plug, chain and stay, basin waste, mounting kit, angle valves and 400mm long flexible intake (Code 292CA)

No 2

- 17 Karco range single lever sink mixer (KO-970) with overarm swivel spout and 400mm long flexible intake (Code 292CA)

No 2

SANITARY PLUMBING (WORK GROUP 146)**uPVC pipes**

- 18 40mm Pipes

m 55

- 19 110mm Pipes

m 25

Extra over uPVC pipes for fittings

- 20 40mm Bend

No 20

- 21 40mm Junction

No 8

- 22 40mm Double junction

No 2

- 23 40mm Access bend

No 7

- 24 40mm Access junction

No 4

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Section No. 2
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
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INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

25	110mm End cap	No	2			
26	110mm ABC cleaning eye in end of pipe	No	2			
27	110mm Bend	No	12			
28	110mm Junction	No	6			
29	110mm Pan connector	No	5			
30	110mm Bent pan connector	No	1			
31	110mm Access bent pan connector	No	1			
32	110mm Access pipe	No	1			
33	110mm Access bend	No	1			
34	110mm Access junction	No	6			
35	110mm "GI Two-way" vent valve	No	6			
	<u>Sundries</u>					
36	Testing waste pipe system		Item			
	<u>WATER SUPPLIES (WORK GROUP 148)</u>					
	<u>"Polycop" polypropylene pipes with brass compression fittings</u>					
37	20mm Pipes	m	160			
38	25mm Pipes	m	60			
39	25mm Pipes laid in and including trenches	m	30			
	<u>Extra over "Polycop" polypropylene pipes for brass compression fittings</u>					
40	20mm Fittings	No	55			
41	25mm Fittings	No	20			
	<u>Copper overflow and service pipes</u>					
42	22mm Overflow pipe 500mm girth twice bent	No	6			
43	22mm Service pipe 1000mm girth	No	6			
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<u>Sundries</u>					
44	450 x 450mm Cast iron stopcock box including brick chamber below not exceeding 750mm deep internally	No	2		
45	Testing water supply pipe system		Item		
<u>FIRE INSTALLATION</u>					
Note : Fire installation to comply with the "SABS 0287" unless described otherwise					
<u>FIRE APPLIANCES (WORK GROUP 148)</u>					
<u>"Chubb" or similar approved</u>					
46	SABS approved fire hose reel assembly complete with 30m rubber hose, fire hose reel jacket, chromium plated stop cock, shut-off nozzle, pressure gauge and wall bracket, complete	No	3		
47	5kg Carbon dioxide Fire extinguisher including standard backing board painted red, fixing, etc	No	6		
48	9kg Carbon dioxide fire extinguisher including standard backing board painted red, fixing, etc	No	3		
<u>WATER SUPPLIES TO FIRE APPLIANCES - HDPE PIPING (WORK GROUP 148)</u>					
<u>HDPE or similar approved Class 10 pipes and fittings with welded joints</u>					
49	50mm Pipes laid under surface beds including trenches not exceeding 1000mm deep	m	40		
<u>Extra over HDPE or similar approved Class 10 pipes and fittings</u>					
50	50mm 90 degree bend	No	6		
51	50mm 45 degree bend	No	4		
52	50mm Reducer	No	3		
53	50mm End Cap	No	4		
<u>Sundries</u>					
54	Testing fire water pipe system		Item		
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Section No. 2 LOWER LEVEL BASEMENT INCLUDING ROOF SLAB Bill No. 12 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)					

WATER SUPPLIES TO FIRE APPLIANCES -
STEEL PIPING (WORK GROUP 173)

"Black Steel" SABS 62 or similar approved - Medium
Pressure pipes

Rates for black steel piping to include for degreasing,
 preparing and painting with one coat self-etching primer,
 one coat universal undercoat and two coats fire-red
 enamel paint

55 25mm Pipes m 65

56 32mm Pipes m 35

Extra over steel pipes for steel fittings

57 25mm Bends No 15

58 25mm Tee No 0

59 25mm Reducer No 0

60 25mm Union No 6

61 32mm Tee No 7

62 32mm Bends No 7

63 32mm Reducer No 8

Painting

64 Paint exposed pipes not exceeding 100mm diameter red m 90

Sundries

65 Testing fire water pipe system Item

HOLES ETC (WORK GROUP 148)

Core drilling hole not exceeding 50mm diameter

66 200mm Thick reinforced concrete slab, beam, wall, etc. No 6

Core drilling hole exceeding 50mm and not
exceeding 100mm diameter

67 200mm Thick reinforced concrete slab, beam, wall, etc. No 6

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Section No. 2
 LOWER LEVEL BASEMENT (INCLUDING ROOF SLAB)
 Bill No. 12
 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 12

INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

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Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 12

INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

Item No		Quantity	Rate	Amount
	<u>BILL No. 14</u>			
	<u>PAINTWORK</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 152			
	<u>PAINTWORK ETC TO NEW WORK</u>			
	<u>ON FLOATED PLASTER</u>			
	<u>Prepare and apply Kwartz Fill to surface cracks, one coat PlasterSeal primer and two coats TruVelvet paint or similar and approved</u>			
1	On internal walls	m2	3,532	
	<u>Prepare and apply Kwartz Fill to surface cracks, one coat PlasterSeal primer and two coats EnviroSilk paint or similar and approved</u>			
2	On external walls	m2	10	
	<u>ON SMOOTH CONCRETE</u>			
	<u>Prepare and apply Sikagard®-703 W water repellent impregnation emulsion or similar and approved strictly in accordance with the manufacturer's instructions</u>			
3	On walls	m2	803	
4	On columns	m2	155	
5	On ceilings and beams	m2	3,346	
6	On counter tops	m2	9	
	<u>ON FIBRE-CEMENT</u>			
	<u>One coat bonding liquid, one coat primer and two coats Pure Acrylic PVA paint or similar and approved</u>			
7	On horizontal planks to gate (both sides measured)	m2	12	
	Carried to Collection		R	
	Section No. 2 LOWER LEVEL BASEMENT INCLUDING ROOF SLAB Bill No. 14 PAINTWORK			

ON METAL

Prepare and apply two coats Dulux Grip undercoats and three coats Dulux Pearlq waterbased finishing coats or similar and approved on steel

8	On door frames	m2	40
9	On transformer room doors and frames	m2	31
10	On record room, cell room and strongroom doors and frames	m2	40
11	On gates, grilles, burglar screens, balustrades, etc (both sides measured over the full flat area)	m2	80

Prepare and wash down with Plascon Aquasolve degreaser, apply one coat Plasconate 1B primer (50 to 60 micrometers DFT) and two coats Plascon Metalcare water based enamel paint (25 to 30 micrometers DFT) or similar and approved on galvanised steel

12	On rails, bars, pipes, etc not exceeding 300 mm girth	m	73

ON WOOD

Prepare and apply three coats Woodoc 5 Indoor Polywax Sealer (clear) with added Woodoc Stain Concentrate (maranti shade) or similar and approved as per the manufacturer's instructions

13	On doors	m2	86

Prepare and apply one coat sanding sealer and two coats clear varnish on wood

14	On skatings, rails, etc not exceeding 300mm	m	44

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Section No. 2
LOWER LEVEL BASEMENT INCLUDING ROOF SLAB
Bill No. 14
PAINTWORK

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Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 14

PAINTWORK

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Section No. 2

LOWER LEVEL BASEMENT INCLUDING ROOF SLAB

Bill No. 14

PAINTWORK

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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB			
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3	PRECAST CONCRETE	55	
4	MASONRY	59	
5	WATERPROOFING	62	
6	CARPENTRY AND JOINERY	67	
7	FLOOR COVERINGS, WALL LININGS, ETC	68	
8	IRONMONGERY	72	
9	METALWORK	76	
10	PLASTERING	81	
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LOWER LEVEL BASEMENT INCLUDING ROOF SLAB			

Item No		Quantity	Rate	Amount
	<u>BILL No. 1</u>			
	<u>EARTHWORKS (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 104			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Nature of ground</u>			
	A soils investigation has been carried out on site by the engineer and the report is annexed to these bills of quantities. Descriptions of excavations shall be deemed to include all ground conditions classifiable as "earth" described in the above report and where conditions of a more difficult character are indicated those are separately measured			
	<u>Carting away of excavated material</u>			
	Descriptions of carting away of excavated material shall be deemed to include loading excavated material onto trucks directly from the excavations or, alternatively, from stock piles situated on the building site			
	<u>EXCAVATION, FILLING, ETC</u>			
	<u>Excavation in earth not exceeding 2m deep</u>			
1	Reduced levels under floors	m3	326	
2	Trenches	m3	295	
3	Holes	m3	12	
	<u>Back excavation of vertical sides of excavation in earth for working space including backfilling compacted to 98% Mod AASHTO density</u>			
4	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	943	
	Carried to Collection			
	Section No. 3			
	GROUND FLOOR LEVEL			
	Bill No. 1			
	EARTHWORKS (PROVISIONAL)			

	<u>Extra over trench and hole excavations in earth for excavation in</u>		
5	Soft rock	m3	20
6	Hard rock	m3	9
	<u>Extra over back excavation in earth for working space for excavation in soft rock</u>		
7	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	60
	<u>Extra over back excavation in earth for working space for excavation in hard rock</u>		
8	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	28
	<u>Extra over all excavations for carting away</u>		
9	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	542
	<u>Risk of collapse of excavations</u>		
10	Sides of trench and hole excavations not exceeding 1.5m deep	m2	843
	<u>Keeping excavations free of water</u>		
11	Keeping excavations free of all water other than subterranean water		Item
	<u>Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 98% Mod AASHTO density</u>		
12	Backfilling to trenches, holes, etc	m3	83
	<u>G5 filling supplied by the contractor compacted to 95% Mod AASHTO density</u>		
13	Under floors, steps, pavings, etc	m3	326
14	Backfilling to trenches, holes, etc	m3	10
	<u>Garden soil filling supplied by the contractor</u>		
15	In flower boxes	m3	2
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GROUND FLOOR LEVEL			
Bill No. 1			
EARTHWORKS (PROV.S ONAL)			

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	<u>Coarse river sand filling supplied by the contractor</u>				
16	Under floors etc	m3	36		
	<u>Compaction of surfaces</u>				
17	Compaction of ground surface under floors etc by wetting and compacting with 3 passes of a 15 ton vibratory roller	m2	1,110		
	<u>Prescribed density tests on filling</u>				
18	"Modified AASHTO Density" test	No	12		
	<u>SOIL POISONING</u>				
	<u>Soil insecticide</u>				
19	Under floors etc including forming and poisoning shallow furrows against foundation walls etc, filling in furrows and ramming	m2	723		
20	To bottoms and sides of trenches etc	m2	1,201		
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Section No. 3

GROUND FLOOR LEVEL

Bill No. 1

EARTHWORKS (PROVISIONAL)

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Section No. 3

GROUND FLOOR LEVEL

Bill No. 1

EARTHWORKS (PROVISIONAL)

Item No	Quantity	Rate	Amount
<u>BILL No. 2</u> <u>CONCRETE, FORMWORK AND REINFORCEMENT</u> <u>WORK GROUP</u> Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 110 <u>SUPPLEMENTARY PREAMBLES</u> <u>Cost of tests</u> The costs of making, storing and testing of concrete test cubes as required under clause 7 "Tests" of SABS 1200 G shall include the cost of providing cube moulds necessary for the purpose, for testing costs and for submitting reports on the tests to the architect. The testing shall be undertaken by an independent firm or institution nominated by the contractor to the approval of the architect. (Test cubes are measured separately) Breeze concrete shall consist of twelve parts clean dry furnace ash, free from coal or other foreign matter, to one part cement (12:1), the ash graded up to particles which will pass a 16,5mm ring from a minimum which fails to pass a 4,75mm mesh. The finer materials from the screening are to be first mixed with the cement into a mortar and the ash added afterwards and thoroughly incorporated <u>Formwork</u> Description of formwork shall be deemed to include use and waste only (except where described as "left in" or "permanent"), for fitting together in the required forms, wedging, plumbing and fixing to true angles and surfaces as necessary to ensure easy release during stripping and for reconditioning as necessary before re-use The vertical strutting shall be carried down to such construction as is sufficiently strong to afford the required support without damage and shall remain in position until the newly constructed work is able to support itself. Carried to Collection Section No. 3 GROUND FLOOR LEVEL Bill No. 2 CONCRETE, FORMWORK AND REINFORCEMENT		R	

Formworks to soffits of solid slabs, etc shall be deemed to be slabs not exceeding 750mm thick unless otherwise described

Formwork to soffits of slabs and beams shall include propping exceeding 1,5m and not exceeding 3,5m high unless otherwise described

Formwork to walls and columns is not exceeding 3,5m high above bearing level unless otherwise described

Formwork to sides of all reinforced concrete strip footings and bases have been measured and will be subject to re-measurement at completion to include only formwork to foundation elements as prescribed by the engineer for design reasons. Formwork necessitated by irregularity or collapse of excavated faces will not be measured and the cost thereof shall be deemed to be included in the allowance for taking the risk of collapse of the sides of the excavations, provision for which is made in "Earthworks"

UNREINFORCED CONCRETE

25MPa/19mm concrete

1	In filling to cavity of cavity wall in foundations (Provisional)	m3	5
2	Strip footings	m3	74
3	Surface beds cast in panels or waterproofing	m3	85
4	Apron slabs cast in panels (Provisional)	m3	9

UNREINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES

25MPa/19mm concrete

5	Surface blinding under footings and bases	m3	15

REINFORCED CONCRETE

25MPa/19mm concrete

6	In filling to cavity of cavity wall in foundations (Provisional)	m3	11
7	In filling to cavity of cavity wall	m3	38
8	Bases	m3	4

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Section No. 3
GROUND FLOOR LEVEL
Bill No. 2
CONCRETE, FORMWORK AND REINFORCEMENT

9	Staircase bases	m3	1	
10	Surface beds	m3	2	
11	Ramps	m3	1	
12	Slabs including beams and inverted beams	m3	186	
13	Seating bench slabs, etc	m3	0,3	
14	Lift shaft slabs	m3	1	
15	Wall beams	m3	48	
16	Lift shaft walls	m3	8	
17	Columns in foundations (Provisional)	m3	1	
18	Columns	m3	6	
<u>TEST BLOCKS</u>				
19	Making and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	15	
<u>CONCRETE SUNDRIES</u>				
<u>Finishing top surfaces of concrete smooth with a power float</u>				
20	Surface beds, slabs, etc	m2	730	
21	Surface beds, slabs, etc to falls	m2	89	
<u>Finishing top surfaces of concrete to an evenly ribbed non-slip surface</u>				
22	Surface beds, slabs, etc to falls	m2	4	
<u>Grooves, channels, sinkings, etc in concrete</u>				
23	1 200 x 800 x 5mm Sinking in top	No	2	
24	4 250 x 1 250 x 12mm Sinking in top	No	2	
<u>50 MPa non-shrink grout</u>				
25	Bedding approximately 30mm thick under 290 x 75mm base plate including chamfered edges all round	No	4	
Carried to Collection				R
Section No. 3 GROUND FLOOR LEVEL Bll No. 2 CONCRETE, FORMWORK AND REINFORCEMENT				

26	Bedding approximately 30mm thick under 240 x 100mm base plate including chamfered edges all round	No	39		
27	Bedding approximately 30mm thick under 230 x 190mm base plate including chamfered edges all round	No	23		
28	Bedding approximately 30mm thick under 190 x 140mm base plate including chamfered edges all round	No	9		
<u>ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK ROUP 111)</u>					
<u>Rough formwork to sides</u>					
29	Strip footings (Provisional)	m2	224		
30	Bases (Provisional)	m2	13		
31	Staircase bases	m2	9		
32	Inner face of shaft walls with total height exceeding 5m and not exceeding 6.5m high above bearing level	m2	27		
33	Rectangular columns in foundations (Provisional)	m2	10		
34	Edges, risers, ends and reveals not exceeding 300mm high or wide	m	6		
<u>Rough formwork to soffits</u>					
35	Slabs over shafts	m2	5		
36	Seating benches	m2	3		
<u>SMOOTH FORMWORK (DEGREE OF ACCURACY II) (WORK ROUP 111)</u>					
<u>Smooth formwork to sides</u>					
37	Outer face of lift shaft walls with total height exceeding 3.5m and not exceeding 5m high above bearing level	m2	36		
38	Rectangular columns	m2	30		
39	Rectangular columns with total height exceeding 3.5m and not exceeding 5m above bearing level	m2	47		
40	Beams	m2	12		
41	Inverted beams	m2	131		
Carried to Collection					
Section No. 3 GROUND FLOOR LEVEL Bt No. 2 CONCRETE, FORMWORK AND REINFORCEMENT				R	

42	Inverted beams above concrete	m2	133	
43	Wall beams	m2	338	
44	Edges, risers, ends and reveals not exceeding 300mm high or wide	m	632	
	<u>Smooth formwork to soffits</u>			
45	Slabs	m2	309	
46	Slabs propped up exceeding 3.5m and not exceeding 5m high	m2	330	
47	Slabs propped up exceeding 3.5m and not exceeding 5m high, propped off sloping surfaces	m2	88	
48	Slabs propped up exceeding 5m and not exceeding 6.5m high	m2	146	
49	Beams propped up exceeding 3.5m and not exceeding 5m high	m2	2	
	<u>Boxing in smooth formwork to form</u>			
50	25 x 25mm Vertical chamfer at corner	m	82	
	<u>MOVEMENT JOINTS ETC</u>			
	<u>Two layers 3mm thick hardboard slip joints between horizontal concrete and brick surfaces</u>			
51	Not exceeding 300mm wide	m	411	
	<u>"Jointex" or similar and approved expansion joints between vertical concrete surfaces</u>			
52	12mm Joints exceeding 300mm high	m2	25	
53	12mm Joints not exceeding 300mm high	m	27	
	<u>"Jointex" or similar and approved expansion joints between vertical concrete and brick surfaces</u>			
54	12mm Joints not exceeding 300mm high	m	758	
	<u>REINFORCEMENT (WORK GROUP 114)</u>			
	<u>Mild steel reinforcement to structural concrete work</u>			
55	12mm Diameter bars	l	0.24	
Carried to Collection				R
Section No. 3 GROUND FLOOR LEVEL Bill No. 2 CONCRETE, FORMWORK AND REINFORCEMENT				

56	10mm Diameter bars	t	3.43	
57	8mm Diameter bars	t	1.89	
	<u>High tensile steel reinforcement to structural concrete work</u>			
58	25mm Diameter bars	t	1.53	
59	20mm Diameter bars	t	1.08	
60	16mm Diameter bars	t	4.87	
61	12mm Diameter bars	t	6.67	
62	10mm Diameter bars	t	2.40	
	<u>Fabric reinforcement</u>			
63	Mesh reference 500 fabric reinforcement in cavity of cavity walls	m2	466	
Carried to Collection				
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GROUND FLOOR LEVEL				
Bill No. 2				
CONCRETE, FORMWORK AND REINFORCEMENT				

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GROUND FLOOR LEVEL

Bill No. 2

CONCRETE, FORMWORK AND REINFORCEMENT

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GROUND FLOOR LEVEL

Bill No. 2

CONCRETE, FORMWORK AND REINFORCEMENT

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Item No		Quantity	Rate	Amount
	BILL NO. 3			
	<u>MASONRY</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 116			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Sizes in descriptions</u>			
	Where sizes in descriptions are given in brick units, "one brick" shall represent the length and "half brick" the width of a brick			
	<u>Hollow walls etc</u>			
	Descriptions of hollow walls shall be deemed to include leaving every fifth perpendicular of the bottom course of the external skin open as a weep hole.			
	<u>FOUNDATIONS (PROVISIONAL)</u>			
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>			
1	Half brick walls	m2	109	
2	One brick walls	m2	126	
3	280mm Hollow walls of two half brick skins including wire ties	m2	101	
4	345mm Hollow walls of two half brick skins including wire ties	m2	82	
	<u>SUPERSTRUCTURE</u>			
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>			
5	One brick walls	m2	1,299	
6	280mm Hollow walls of two half brick skins including wire ties	m2	1,386	
	Carried to Collection			R
	Section No. 3 GROUND FLOOR LEVEL Bill No. 3 MASONRY			

7	345mm Hollow walls of two half brick skins including wire ties	m2	406		
	<u>Brickwork of NFP bricks in class II mortar</u>				
8	Half brick walls	m2	1,006		
9	One brick walls	m2	868		
	<u>BRICKWORK SUNDRIES</u>				
10	Splayed mortar fillet one course high in 50mm cavity	m	326		
11	Closing 50mm cavity of hollow wall vertically with brickwork one brick wide	m	214		
12	Closing 50mm cavity of hollow wall horizontally with brickwork one brick wide	m	555		
	<u>Brickwork reinforcement</u>				
13	75mm Wide reinforcement built in horizontally in foundations (Provisional)	m	6,556		
14	75mm Wide reinforcement built in horizontally	m	9,676		
15	150mm Wide reinforcement built in horizontally in foundations (Provisional)	m	1,637		
16	150mm Wide reinforcement built in horizontally	m	5,530		
	<u>Prestressed fabricated lintels</u>				
17	110 x 75mm Lintels in lengths not exceeding 3m	m	399		
18	110 x 75mm Lintels in lengths exceeding 3m and not exceeding 4.5m	m	13		
19	150 x 75mm Lintels in lengths not exceeding 3m	m	180		
20	150 x 75mm Lintels in lengths exceeding 3m and not exceeding 4.5m	m	4		
	<u>FACE BRICKWORK</u>				
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MASONRY

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GROUND FLOOR LEVEL

Bill No. 3

MASONRY

Item No	Quantity	Rate	Amount
<u>BILL No. 4</u>			
<u>WATERPROOFING</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 120			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Waterproofing</u>			
Waterproofing of roofs, basements, etc shall be laid under a ten year guarantee. Waterproofing to roofs shall be laid to even laps to outlets etc with necessary ridges, hips and valleys. Descriptions of sheet or membrane waterproofing shall be deemed to include additional labour to turn-ups and turn-downs			
<u>DAMP-PROOFING OF WALLS AND FLOORS</u>			
<u>One layer of 375 micron "Consol Plastics Brikgrip DPC" or similar and approved embossed damp proof course</u>			
1	In walls	m2	312
<u>One layer of 250 micron "Consol Plastics Gunplas USB Green" or similar and approved waterproof sheeting sealed at laps with "Gunplas Pressure Sensitive Tape" or similar and approved</u>			
2	Under surface base	m2	723
<u>JOINT SEALANTS ETC</u>			
<u>"Sikaflex Tank N" or similar and approved concrete grey polyurethane sealing compound including backing cord, bond breaker, primer, etc</u>			
3	12 x 12mm in expansion joints in slabs, between beams, etc	m	126
<u>WATERPROOFING TO ROOFS, BASEMENTS, ETC</u>			
Carried to Collection			R
Section No. 3 GROUND FLOOR LEVEL Bill No. 4 WATERPROOFING			

One layer Derbigum SP4 or similar and approved waterproofing membrane with 75mm side laps and 100mm end laps sealed to primed surfaces to falls and cross falls by "torch-fusion" including protection of 50mm thick layer clean 19.25mm crushed stone on Interdek or similar approved separation layer. Waterproofing to be installed by an approved contractor in accordance with the manufacturer's instructions under a ten year guarantee

4	On screed to falls and cross falls (screed elsewhere measured)	m ²	678
5	Additional membrane 200mm girth at internal angles including 35mm radius rounded cove	m	660
6	Additional membrane at 150mm diameter outlet	No	22

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GROUND FLOOR LEVEL
Bill No. 4
WATERPROOFING

Section No. 3

GROUND FLOOR LEVEL

Bill No. 4

WATERPROOFING

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GROUND FLOOR LEVEL

Bill No. 4

WATERPROOFING

Item No			Quantity	Rate	Amount
	<u>BILL No. 5</u>				
	<u>ROOF COVERINGS ETC</u>				
	<u>WORK GROUP</u>				
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 124				
	<u>PROFIED METAL SHEETING AND ACCESSORIES</u>				
	<u>Safintra Roofing 0.5mm thick double interlocking concealed fix SAFLOK 700 profile Colorplus AZ100 ("Thunderstorm" finish outside and "Pebble Grey" finish inside) or similar and approved roof sheeting in single lengths, fixed to steel purlins (elsewhere measured) in accordance with the manufacturer's instructions</u>				
1	Roof covering with pitch not exceeding 25 degrees	m ²	2,074		
2	Apex flashing 462mm girth	m	200		
3	Gorge flashing 462mm girth	m	333		
4	Headwall flashing 308mm girth	m	144		
5	Sidewall flashing 308mm girth	m	15		
6	Counter flashing 154mm girth	m	159		
	<u>ROOF INSULATION</u>				
	<u>"Sisalation FR 405" or similar and approved fire retardant light industrial grade double sided reflective foil laminate reinforced aluminium foil bonded insulation</u>				
7	Insulation laid taut over steel rafters (at approximately 4 000mm centres) and fixed concurrent with purlins, etc	m ²	2,074		
	<u>ALUMINIUM FLASHINGS, LININGS, COPINGS, ETC (WORK GROUP 125) (PROVISIONAL)</u>				
Carried to Collection				20	
Section No. 3 GROUND FLOOR FVFL Bill No. 5 ROOF COVERINGS					

0.6mm "Saftal" or similar and approved aluminium sheet

8	Cover flashing 300mm girth	m	8
9	Cover flashing 400mm girth	m	19
10	Cover flashing 550mm girth	m	21
11	Cover flashing 675mm girth	m	30

Carried to Collection

Section No. 3
GROUND FLOOR LEVEL
Bill No. 5
ROOF COVERINGS

2

Item No	Quantity	Rate	Amount
<u>BILL No. 6</u>			
<u>CARPENTRY AND JOINERY</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 126			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Joinery</u>			
Descriptions of frames shall be deemed to include frames, transoms, mullions, rails, etc			
Descriptions of hardwood joinery shall be deemed to include pelleting of bolt holes			
<u>Fixing</u>			
Items described as "nailed" shall be deemed to be fixed with hardened steel nails or shot pins to brickwork or concrete			
<u>FLOORS ETC</u>			
<u>MOSO Bamboo X-treme 1x4 T&G decking boards or similar and approved made from compressed, thermally treated bamboo strips (colour chocolate) installed strictly in accordance with the manufacturer's instructions</u>			
1	Decking of 18mm tongued and grooved high density boarding (product code BO-POR-18-96-PP) on concrete floor (concrete floor elsewhere measured)	m ²	15
<u>SKIRTINGS</u>			
<u>Wrought meranti</u>			
2	22 x 69mm Bullnosed skirting nailed	m	1,592
3	22 x 69mm Bullnose skirting stepped over heads and nsets nailed	m	9
<u>DOORS ETC</u>			
Carried to Collection			R
Section No. 3 GROUND FLOOR LEVEL Bill No. 6 CARPENTRY AND JOINERY			

	<u>Semi-solid flush doors with 3.2mm standard hardboard covering finished with "Novalam Oxide Stucco" finish on both sides and 8mm concealed meranti edges</u>				
4	40mm Door 600 x 2032mm high	No	20		
	<u>"Grapedoor" Custom Made Wooden Doors or similar and approved hung to timber frames</u>				
5	40mm Kiasat Horizontal Wide Slatted double door size 1511 x 2032mm high with rebated meeting edges	No	6		
	<u>"Lotus Amoretti" or similar and approved solid flush back doors hung to steel frames</u>				
6	40mm Internal Horizontal B13 door 913 x 2032mm high	No	93		
7	40mm Internal Horizontal custom made door 1000 x 2032mm high	No	8		
8	Extra over door for 450 x 600mm opening for louvre panel (elsewhere measured)	No	22		
	<u>"Cubicle Solutions" or similar and approved 12mm Compact High Pressure Laminate modular frameless system toilet doors (one flat colour) with end panels face-fixed to inside of brickwork including grade 304 stainless steel brackets, hat and coat hook, indicator bolt and rise and fall butt auto open hinges, strictly in accordance with the manufacturer's instructions</u>				
9	Door for opening size 900 x 2125mm high	No	24		
	<u>FRAMED FRAMES ETC</u>				
	<u>Wrought kiasat</u>				
10	69 x 108mm Rebated frames plugged	m	138		
	<u>CILLS</u>				
	<u>Wrought meranti</u>				
11	32 x 160mm Cill with double bull-nosed front edge plugged	m	98		
	<u>BEADS, ARCHITRAVES, ETC</u>				
Carried to Collection				R	
Section No. 3 GROUND FLOOR LEVEL Bill No. 6 CARPENTRY AND JOINERY					

	<u>Wrought kiasat</u>				
12	18 x 96mm Splayed and angle rounded architraves plugged	m	67		
	<u>Wrought meranti</u>				
13	19mm Quadrant beads	m	118		
	<u>WALL PANELLING IN WAITING AREA</u>				
	<u>Wrought softwood</u>				
14	38 x 114mm Wall bearers plugged	m	15		
15	Panelling of 60mm thick x average 65mm wide vertical slats in "barcode" design, fixed through 30mm diameter steel bar (steel bar elsewhere measured) at 385mm centres	m2	5		
	<u>Wrought meranti timber boards</u>				
16	18mm Matching wall panelling 215mm high and in 2400mm widths plugged to brickwork	m2	8		
	<u>ACOUSTIC PANELLING</u>				
	<u>40mm Acoustic box wall panels by "Acoustic Walling Solutions" or similar approved fixed to brickwork strictly in accordance with the manufacturer's instruction</u>				
17	Vulcan fabric covered acoustic wall panels comprising of 47.5kg semi rigid energylite batts with a wooden frame	m2	194		
	<u>JOINERY SUNDRIES</u>				
	<u>Wrought meranti</u>				
18	Slatted seats of 32 x 70mm twice angle rounded slats at 100mm centres screwed through steel including holes	m2	2		
	<u>Everite autocement</u>				
19	15mm Thick x 225mm Wide Horizontal planks with high density plain finish countersunk screwed to steel sub-structure (steel sub-structure elsewhere measured)	m	217		
	<u>FURNITURE, FITTINGS, ETC</u>				
	Carried to Collection			R	
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	GROUND FLOOR LEVEL				
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	CARPENTRY AND JOINERY				

"Cubicle Solutions" Product Code CSL/CHPL/304/3 Locker or similar and approved with 8mm white Compact High Pressure Laminate carcass and 12mm charcoal Compact High Pressure Laminate doors including standard ironmongery (code GSSH/E112), D shaped keep (code CSLJ/LK/3) for individual padlocks (no locking mechanism), lock cover plate and handle (code CSLJ/LH/9) and 2mm Rowmark brushed aluminium oval numbering discs, strictly in accordance with the manufacturer's instructions

20 Locker size overall 300 x 450 x 1900mm high (1800mm locker and 100mm plinth)

No

2

"Obbligato" seating / furniture range or similar and approved placed in position as directed

21 B007 "X" bench size 1 800 x 450 x 450mm high with stainless steel support manufactured of kiasat timber

No

8

22 B011 Union square bench size 1 800 x 450 x 450mm high manufactured of kiasat timber

No

3

23 B011 Union square bench and planter combination size 1 800 x 450 x 450mm high overall manufactured of kiasat timber

No

4

24 Custom made bench and planter combination size 3 000 x 450 x 450mm high overall manufactured of kiasat timber

No

2

NOTICE BOARDS, WRITING BOARDS, ETC

"Vitrex System 2000 Pin Boards" or similar and approved with standard Flortime Premier (colour Misty) pinning material surface beaded all around with a natural anodised aluminium channel surround mitred at the corners, fixed in position to plastered brickwork strictly in accordance with the manufacturer's instructions

25 Board size 700 x 700mm high

No

3

26 Board size 1 500 x 1 200mm high

No

41

27 Board size 2 000 x 1 200mm high

No

1

28 Board size 2 400 x 1 200mm high

No

1

Carried to Collection

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CARPENTRY AND JOINERY

	<u>"Vitrex System 2000" standard model 2200 vitreous enamel wall mounted white board or similar and approved complete with integral anodised aluminium pen rail and fixing components, fixed in position to plastered brickwork strictly in accordance with the manufacturer's instructions</u>				
29	White board size 1 500 x 1 200mm high (Code 2207)	No	35		
30	White board size 2 000 x 1 200mm high (Code 2217)	No	1		
31	White board size 2 400 x 1 200mm high (Code 2209)	No	1		
32	Purpose made white board size 600 x 450mm high	No	16		
	<u>"Parrot Products" or similar and approved pinning display case (colour grey) with two 4mm fingered grooved toughened glass sliding doors, aluminium frame with reinforced plastic corners, security lock with two keys built into the door frame and mounting brackets, fixed in position to plastered brickwork strictly in accordance with the manufacturer's instructions</u>				
33	Pinning display case size 1 500 x 1 200mm high	No	12		
	<u>JOINERY FITTINGS</u>				
	<u>General</u>				
	The following subboard fittings have been measured as complete units i.e. the components of the units have not been separately measured. The descriptions, therefore, of such units shall be deemed to include all components, assembling, housing, notching, gluing, blocking, planing on and screwing with countersunk screws, edge strips, decorative plastic finish, glass, ironmongery, metalwork, paint or varnish finishes, etc.				
	The references given in the descriptions are to the respective types of fittings detailed on the architect's drawings as referred to in the various descriptions and annexed to these bills of quantities/accompanying these bills of quantities for tender purposes.				
	<u>Court room magistrate benches, seating benches, lectern tables, etc as per Architect's drawings numbers 600 REV A and 601 REV A accompanying these bills of quantities for tender purposes</u>				
34	Floor mounted hardwood seating bench 2750mm long	No	1		
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	Section No. 3 GROUND FLOOR LEVEL Bill No. 6 CARPENTRY AND JOINERY				

35	Floor mounted hardwood seating bench 3650mm long	No	2		
36	Floor mounted hardwood seating bench 5000mm long	No	2		
37	Floor mounted hardwood seating bench 4805mm long	No	2		
38	Floor mounted hardwood seating bench 6250mm long	No	1		
39	Floor mounted hardwood seating bench 5500mm long	No	1		
40	Floor mounted hardwood lectern table size 2000 x 720mm wide	No	1		
41	Floor mounted hardwood lectern table size 1500 x 720mm wide	No	1		
42	Floor mounted hardwood lectern table size 3750 x 720mm wide	No	1		
43	Floor mounted hardwood lectern table size 4000 x 720mm wide	No	1		
44	Floor mounted hardwood L-shaped lectern table size 4500 x 720mm wide overall	No	1		
45	Floor mounted hardwood L-shaped lectern table size 6000 x 720mm wide overall	No	1		
46	Floor mounted hardwood witness dock and seating size 1000 x 1200mm	No	4		
47	Floor mounted hardwood magistrate's bench size 4200 x 755mm wide	No	1		
48	Floor mounted hardwood magistrate's bench size 5000 x 755mm wide	No	1		
49	Floor mounted hardwood magistrate's bench size 6000 x 755mm wide	No	1		
	<u>Kitchen cupboards as per Architect's drawing number 604 REV A accompanying these bills of quantities for tender purposes</u>				
50	Wall cupboard 2370 x 340 x 700mm high with top, sides, bottom, divisions, shelves, back and three hinged doors	No	1		
Carried to Collection					R
Section No. 3 GROUND FLOOR LEVEL Bill No. 6 CARPENTRY AND JOINERY					

51	Combination floor and sink cupboard 2115 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and three hinged doors and dividing framework (sink elsewhere measured)	No	1	
52	Combination floor and sink cupboard 2370 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and three hinged doors, dividing framework and four drawers (sink elsewhere measured)	No	1	
53	Floor cupboard 3930 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back, five hinged doors, dividing framework and eight drawers	No	1	
<u>Kiosk cupboards as per Architect's drawing number 605 REV A accompanying these bills of quantities for tender purposes</u>				
54	Wall cupboard 1800 x 340 x 700mm high with top, sides, bottom, divisions, shelves, back and three hinged doors	No	1	
55	Combination floor and sink cupboard 1800 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and three hinged doors and dividing framework (sink elsewhere measured)	No	1	
<u>Cloak room cupboards as per Architect's drawing number 605 REV A accompanying these bills of quantities for tender purposes</u>				
56	Wall cupboard 2175 x 340 x 700mm high with top, sides, bottom, divisions, shelves, back, open shelving and three hinged doors	No	1	
57	Combination floor and sink cupboard 2175 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and three hinged doors, four drawers and dividing framework (sink elsewhere measured)	No	1	
<u>Cleaner store cupboards as per Architect's drawing number 606 REV A accompanying these bills of quantities for tender purposes</u>				
58	Wall cupboard 1755 x 340 x 700mm high with top, sides, bottom, divisions, shelves, back, open shelving and two hinged doors	No	1	
59	Combination floor and sink cupboard 1755 x 600 x 900mm high with top, sides, bottom, divisions, shelves, back and two hinged doors, four drawers and dividing framework (sink elsewhere measured)	No	1	
Carried to Collection				R
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CARPENTRY AND JOINERY				

Magistrate offices cupboards as per Architect's drawing number 612 REV A accompanying these bills of quantities for tender purposes

60 Wall cupboard 1135 x 568 x 2100mm high with top, sides, bottom, divisions, shelves back and two hinged doors

No

3

61 Wall mounted locker 3155 x 450 x 2125mm high comprising 40 individual lockers with tops, sides, bottoms, divisions auto return hinged doors with D-shaped keep for padlocks, door handles, etc

No

1

Cash hall shelving units as per Architect's drawing number 613 REV A accompanying these bills of quantities for tender purposes

62 12mm Medium density fibreboard with "French Walnut" textured finish free standing shelving unit 700 x 300 x 666mm high overall comprising of four equal size open shelves with top, sides, bottom and 3mm high impact PVC edging

No

3

Library shelving units as per Architect's drawing number 615 REV A accompanying these bills of quantities for tender purposes

63 32mm Medium density fibreboard with "French Walnut" textured finish wall mounted shelving unit 1126 x 354 x 2654mm high overall comprising of six equal size open shelves with top, sides, bottom, 150mm plinth, 160mm top rail, 12mm medium density fibreboard back and 3mm high impact PVC edging to all exposed edges

No

1

64 32mm Medium density fibreboard with "French Walnut" textured finish wall mounted shelving unit 1860 x 354 x 2654mm high overall comprising of six equal size open shelves with top, sides, bottom, 150mm plinth, 160mm top rail, 12mm medium density fibreboard back and 3mm high impact PVC edging to all exposed edges

No

6

65 32mm Medium density fibreboard with "French Walnut" textured finish combination wall and floor mounted T-shaped shelving unit with one leg 2480 x 354 x 906mm high overall and other leg 1600 x 622 x 906mm high overall, comprising of two equal size open shelves with top, sides, bottom, 150mm plinth, 160mm top rail, 12mm medium density fibreboard back and 3mm high impact PVC edging to all exposed edges

No

1

66 2500mm High hardwood ladder with 76 x 152mm side rails and five 200 x 400 x 25mm steps

No

1

Carried to Collection

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Section No. 3
GROUND FLOOR LEVEL
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CARPENTRY AND JOINERY

Clark of civil court office top and under counter cupboards and drawers as per Architect's drawing number 617 REV A accompanying these bills of quantities for tender purposes

67	"Thunder Eez' Quartz" square edged counter top or similar and approved with 3mm high impact PVC edging size 36'0 x 900 x 20mm thick on supporting under counter cupboard unit (under counter cupboard unit elsewhere measured)	No	1
68	"Novolam Oxyde Stucco Finish" or similar and approved square edged counter top hinged hatch with 3mm high impact PVC edging size 1000 x 900 x 32mm thick	No	1
69	Combination under counter floor cupboard ("Novolam Oxyde Stucco" finished) and drawers (Novolam French Walnut Textured" finished) unit 3610 x 900 x 1050mm high overall with top, sides, bottom, back, shelves, four hinged doors, eight drawers and framework including 3mm high density PVC edging to all exposed edges	No	1
70	"Novolam Oxyde Stucco Finish" square edged slats size 50 x 16mm thick to back of combination under counter cupboard and drawer unit (cupboard and drawer unit elsewhere measured)	m	5.8

Cash hall counter top and under counter cupboards and drawers as per Architect's drawing number 613 REV A accompanying these bills of quantities for tender purposes

71	Irregular shaped "Thunder Eez' Quartz" square edged counter top or similar and approved with 3mm high impact PVC edging size 5840 x 1425mm wide overall x 20mm thick countersunk fixed to top of 110mm brick wall (brick wall elsewhere measured) and supporting under counter cupboard units (under counter cupboard units elsewhere measured) including four 450 x 450 x 120mm deep recessed slots formed in top of counter for four bulk cash / document transfer trays (bulk cash / document transfer trays elsewhere measured)	No	1
72	Combination under counter floor cupboard and drawer unit 700 x 970 x 1100mm high with top, sides, bottom, divisions, shelves, back and two hinged doors, twelve drawers and dividing framework, including "French Walnut Textured" finish to all door and drawer fronts and 3mm high density PVC edging to all exposed edges	No	3

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	<u>Security rooms counter top and under counter cupboards and drawers as per Architect's drawing number 618 REV A accompanying those bills of quantities for tender purposes</u>				
73	"Thunder Eezi Quarts" square edged counter top or similar and approved with 3mm high impact PVC edging size 3585 x 600 x 20mm thick on and including two heavy duty shelf brackets and supporting under counter cupboard unit (under counter cupboard unit elsewhere measured)	No	1		
74	L-shaped "Thunder Eezi Quarts" square edged counter top or similar and approved with 3mm high impact PVC edging size 4690 x 600mm wide overall x 20mm thick on and including two heavy duty shelf brackets and supporting under counter cupboard units (under counter cupboard units elsewhere measured)	No	1		
75	L-shaped "Thunder Eezi Quarts" square edged counter top or similar and approved with 3mm high impact PVC edging size 6454 x 600mm wide overall x 20mm thick on and including two heavy duty shelf brackets and supporting under counter cupboard units (under counter cupboard units elsewhere measured)	No	1		
76	"Novolam French Walnut Textured" finished wall mounted main distribution cupboard 600 x 250 x 730mm high with top, sides, bottom, back, one hinged door and framework including 3mm high density PVC edging to all exposed edges	No	1		
77	"Novolam Oxyde Stucco" finished under counter floor cupboard 600 x 600 x 730mm high with top, sides, bottom, one shelf, back, one hinged door and framework including 3mm high density PVC edging to all exposed edges	No	1		
78	"Novolam French Walnut Textured" finished under counter floor drawer unit 600 x 600 x 730mm high with top, sides, bottom, back, three drawers and framework, including 3mm high density PVC edging to all exposed edges	No	1		
79	Combination under counter floor cupboard ("Novolam Oxyde Stucco" finished) and drawers ("Novolam French Walnut Textured" finished) unit 1200 x 600 x 730mm high overall with top, sides, bottom, one shelf, back, one hinged door, three drawers and framework including 3mm high density PVC edging to all exposed edges	No	2		
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80	Combination under counter floor cupboard ("Novolam Oxyle Stucco" finished) and drawers (Novolam French Walnut Textured" finished) unit 1978 x 600 x 730mm high overall with top, sides, bottom, two shelves, back, two hinged doors, three drawers and framework including 3mm high density PVC edging to all exposed edges	No	1
<u>Integrated justice office counter tops as per Architect's drawing number 607 REV A accompanying these bills of quantities for tender purposes</u>			
81	"Eezi Quarts" square edged counter top or similar and approved size 1551 x 710 x 20mm thick on and including two rectangular shaped frames size 1551 x 300mm wide comprising of 25 x 25 x 3mm thick galvanised mild steel angle sections welded together and fixed to brickwork	No	3
82	"Eezi Quarts" square edged downstand or similar and approved size 180 x 20mm thick at front edge of counter	m	9
<u>Mothara room WC counter top as per Architect's drawing number 607 REV A accompanying these bills of quantities for tender purposes</u>			
83	"Eezi Quarts" square edged counter top or similar and approved size 1135 x 600 x 20mm thick on and including rectangular shaped frame size 1135 x 300mm wide with one 300mm long intermediate rail, comprising of 25 x 25 x 3mm thick galvanised mild steel angle sections welded together and fixed to brickwork	No	1
84	"Eezi Quarts" square edged upstand or similar and approved size 100 x 20mm thick at back and sides of counter fixed to brickwork	m	2
85	"Eezi Quarts" square edged upstand and downstand or similar and approved size 230 x 20mm thick overall at front edge of counter	m	1
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Male and female WC vanity counter tops as per Architect's drawing number 607 REV A accompanying these bills of quantities for tender purposes

- 86 "Eezi Quarts" vanity counter top or similar and approved square edged size 1910 x 600 x 20mm thick on and including rectangular shaped frame size 1910 x 600mm wide with one 600mm long intermediate rail, comprising of 25 x 25 x 3mm thick galvanised mild steel angle sections welded together and fixed to brickwork, including cut-outs in vanity counter top for two wash hand basins (wash hand basins elsewhere measured)

No

1

- 87 "Eezi Quarts" square edged vanity counter top or similar and approved size 2210 x 600 x 20mm thick on and including rectangular shaped frame size 2210 x 600mm wide with one 600mm long intermediate rail, comprising of 25 x 25 x 3mm thick galvanised mild steel angle sections welded together and fixed to brickwork, including cut-outs in vanity counter top for two wash hand basins (wash hand basins elsewhere measured)

No

3

- 88 "Eezi Quarts" square edged upstand or similar and approved size 100 x 20mm thick at back and one side of counter fixed to brickwork

m

11

- 89 "Eezi Quarts" square edged upstand and downstand or similar and approved size 230 x 20mm thick overall at front edge of counter

m

11

Clerk of court office glazed shelving cabinets as per Architect's drawing number 614 REV A accompanying these bills of quantities for tender purposes

- 90 18mm Medium density fibreboard shelving cabinet 1878 x 332 x 2860mm high overall comprising of four equal size hinged glazed cabinet doors with "Novolam Oxyde Stucco" finish to frames, six equal spaced rows of shelving, top, bottom, back and sides with "French Walnut Textured" finish, 150mm "Novolam Oxyde Stucco" finish plinth and top rails, including 6mm obscure safety glass to doors, 3mm high Impact PVC edging to exposed edges, hidden shelf supports and pins, timber bearers, etc

No

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91	16mm Medium density fibreboard shelving cabinet 1415 x 332 x 2860mm high overall comprising of three equal size hinged glazed cabinet doors with "Novolam Oxyde Stucco" finish to frames, six equal spaced rows of shelving, top, bottom, back and sides with "French Walnut Textured" finish. 150mm "Novolam Oxyde Stucco" finish plinth and top rails, including 6mm obscure safety glass to doors, 3mm high impact PVC edging to exposed edges, hidden shelf supports and pins, timber bearers, etc.	No	1	
92	16mm Medium density fibreboard shelving cabinet 2801 x 332 x 2860mm high overall comprising of six equal size hinged glazed cabinet doors with "Novolam Oxyde Stucco" finish to frames, six equal spaced rows of shelving, top, bottom, back and sides with "French Walnut Textured" finish. 150mm "Novolam Oxyde Stucco" finish plinth and top rails, including 6mm obscure safety glass to doors, 3mm high impact PVC edging to exposed edges, hidden shelf supports and pins, timber bearers, etc.	No	5	
93	16mm Medium density fibreboard shelving cabinet 3262 x 332 x 2860mm high overall comprising of seven equal size hinged glazed cabinet doors with "Novolam Oxyde Stucco" finish to frames, six equal spaced rows of shelving, top, bottom, back and sides with "French Walnut Textured" finish. 150mm "Novolam Oxyde Stucco" finish plinth and top rails, including 6mm obscure safety glass to doors, 3mm high impact PVC edging to exposed edges, hidden shelf supports and pins, timber bearers, etc.	No	1	
<u>VENETIAN BLINDS</u>				
<u>"House of Supreme" or similar and approved wood venetian blind with 50mm wide UV resistant Dura-Coated horizontal slats and with hand controlled lift and tilt cords and stainless steel links with safety clutches, fixed in position to plastered reveal of opening strictly in accordance with the manufacturer's instructions</u>				
94	Venetian blind for window size 900 x 1 200mm high	No	4	
95	Venetian blind for window size 1 800 x 600mm high	No	9	
96	Venetian blind for window size 1 800 x 1 200mm high	No	25	
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97	Venetian blind for window size 2 100 x 600mm high	No	5		
	<u>ROLLER BLINDS</u>				
	<u>"BLIND DESIGNS" or similar and approved blackout fabric linear valance reveal fix roller blind with wooden top valance and stainless steel chain operated side control, fixed in position to plastered reveal of opening strictly in accordance with the manufacturer's instructions</u>				
98	Roller blind for window size 1 800 x 1 200mm high	No	1		
99	Roller blind for window size 1 800 x 600mm high	No	1		
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GROUND FLOOR LEVEL

Bill No. 6

CARPENTRY AND JOINERY

Item No		Quantity	Rate	Amount
	<u>BILL No. 7</u>			
	<u>CEILINGS, PARTITIONS AND ACCESS FLOORING</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 129			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Descriptions:</u>			
	Items described as "nailed" shall be deemed to be fixed with hardened steel nails or pins or shot pinned to brickwork or concrete			
	Items described as "plugged" shall be deemed to include screwing to fibre, plastic or metal plugs at not exceeding 800mm centres, and where described as "bolted" the bolts have been given elsewhere			
	<u>CEILINGS ETC</u>			
	<u>Sawn softwood</u>			
1	32 x 152mm Ceiling joists	m	30	
	<u>NAILED UP CEILINGS</u>			
	<u>4mm "Everite Nutec" or similar and approved fibre-gement boards with H-type pressed steel jointing strips</u>			
2	Ceilings including 38 x 38mm sawn softwood bracing at 450mm centres in both directions	m2	16	
3	Extra over ceiling for opening for 75mm diameter downlighter (Provisional)	No	6	
4	Extra over ceiling for opening for 600 x 1200mm light fitting (Provisional)	No	3	
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	Bill No. 7			
	CEILINGS, PARTITIONS AND ACCESS FLOORING			

"Everite Nutee" Nu-Doric Plain 75 or similar and approved polystyrene cove cornice fixed to wall and ceiling using Nucornice Adhesive or similar and approved adhesive

5	75mm Cove cornice	m	23

SUSPENDED CEILINGS

Proprietary suspended ceilings

OWAcoustic Freestyle L Baffle size 1200 x 600 x 40mm Class A fibreglass floating baffle units with square edges, white fleece-covered and suspended with OWConstruct Baffle Rope Fixation set with a positive fix or similar and approved, all in accordance with the manufacturer's instructions

6	Ceilings suspended not exceeding 1m below concrete soffits	m2	323

7	Sloping ceilings suspended not exceeding 1m below soffit of raking steel roof lattice trusses	m2	233

OWAcoustic Briliante A Premium biologically absorbable mineral wool white fleece finished ceiling tiles size 1200 x 600 x 15mm with square-edge finished edges, laid on OWConstruct S3 exposed demountable T24 suspension system with galvanised tees, cross tees and hangers or similar and approved, all in accordance with the manufacturer's instructions

8	Ceilings suspended not exceeding 1m below steel roof trusses	m2	1,336

9	Sloping soffit and side of horizontal bulkheads, size 1000 x 750mm deep, suspended not exceeding 1m below soffit of raking steel lattice trusses	m	114

10	Extra over ceiling for opening for 600 x 1200mm light fitting (Provisional)	No	220

11	Extra over ceiling for 450 x 450mm opening for ventilation/air conditioning diffuser (Provisional)	No	160

OWConstruct shadowline W-trim or similar and approved cornices to suspended ceilings

12	Cornices plugged	m	1,055

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Bill No. 7

CEILINGS, PARTITIONS AND ACCESS FLOORING

Item No		Quantity	Rate	Amount
	<u>BILL No. 8</u>			
	<u>FLOOR COVERINGS, PLASTIC LININGS, ETC</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 130			
	<u>FLOOR COVERINGS</u>			
	<u>3.2mm Thick "EQ Surfaces Classic" non-laminated single-ply recycled rubber floor sheeting, colour "Raiders of The Lost Architect", or similar and approved, including 3 coats of approved sealer, laid on a "Polyflor" or similar and approved adhesive on concrete screed (screed elsewhere measured), all in accordance with the manufacturer's specifications and instructions</u>			
1	On floors	m2	769	
2	On treads and risers of stairs	m2	19	
	<u>2.5mm Thick "Expona Commercial Wood PUR" luxury vinyl planks, colour "Antique Oak", or similar and approved, laid on a "Polyflor" or similar and approved adhesive, on concrete screed (screed elsewhere measured), all in accordance with the manufacturer's specifications and instructions</u>			
3	On floors	m2	1,164	
4	On treads and risers of stairs	m2	11	
	<u>"Easigrass" 30mm Kensington two-tone green extra thick high resilience C-shaped support yarn artificial grass or similar and approved laid loose on unfinished concrete</u>			
5	On floors	m2	15	
	<u>NOSINGS, ETC</u>			
	<u>"Trim Aluminium" or similar and approved</u>			
6	Stair nosing with black infill (Code: APRN371 N.S. 08) fixed to substrate with an approved adhesive	m	147	
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	FLOOR COVERINGS, WALL LININGS, ETC			

WALL LININGS

2mm "Gradus SureProtect Endure®" vinyl sheeting (SPE20 sheet) with standard corner guard, silicone sealed colour-matched vertical joints and "SPEUFT" finishing option, or similar and approved, strictly in accordance with the manufacturer's instructions

7	On walls	m2	105

KICK PLATES, PUSH PLATES, ETC

2mm "Polyflor SureProtect Endure®" vinyl sheeting (SPE20 sheet) and "SPEUFT" finishing option, or similar and approved, fixed strictly in accordance with the manufacturer's instructions

8	813 x 700mm High Push / kick plates on face of timber doors	No	8

POLISH, SEALERS, ETC

9	Two coats wax polish on vinyl flooring	m2	1,175

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Bill No. 8
FLOOR COVERINGS, WALL LININGS, ETC

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 GROUND FLOOR LEVEL
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 FLOOR COVERINGS, WALL LININGS, ETC

Item No		Quantity	Rate	Amount
	<u>BILL No. 9</u>			
	<u>IRONMONGERY</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 132			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Catalogue numbers and finishes to Ironmongery</u>			
	Where applicable catalogue numbers and finishes to ironmongery are indicated, refer to "ASSA ABLOY" standard catalogue or similar and approved			
	<u>HINGES, BOLTS, ETC</u>			
1	100mm Brass hinge with nylon washers	No	35	
2	ALB208 150AS ART 208C91 150mm Flush bolt	No	7	
3	ALB208 300AS 300mm Flush bolt	No	5	
4	47651A5 Union facility Indicator bolt	No	2	
5	SS2016SS Bathroom deadbolt	No	15	
6	J-B82T-SIL Single panic bolt T-bar 900mm	No	1	
	<u>LOCKS</u>			
7	L-2215-78SS/SIL Union mortice sash lock	No	86	
8	L-21315 76SS Union 323 cylinder deadlock	No	14	
9	2X815/TNP 815/831 WC privacy cylinder lock	No	8	
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10	CY110MKF533105N Euro single cylinder lock (MK)	No	7		
11	CY110MKF033335N Euro double cylinder lock (MK)	No	85		
12	CY110MKE733335N Euro turn cylinder lock (MK)	No	1		
13	E-2109-78SS Euro profile cylinder deadlock	No	1		
<u>HANDLES</u>					
14	SS6163-0GSS Handle on blank plate	No	171		
15	FFP65X50SS Flush finger pull	No	7		
16	PHD-CF-300-22SS Union pull handle flange fixed	No	1		
17	SS5D152X304-06 Union 22mm diameter tubular pull hand	No	5		
18	SS5D152X304I-05 22mm Diameter tubular pull handle on 152 x 304mm plate	No	8		
19	SS5D152X304R-05 22mm Diameter tubular pull handle on 152 x 304mm plate	No	8		
20	SS5305-05SS Escutcheon on rose profile	No	14		
21	SS5004-73SS Bathroom escutcheon on rose	No	15		
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22	2700SS Union rebate set	No	2		
23	8852SC Dust proof strike	No	6		
24	2915SC Union rebate set	No	5		
25	FD461-DC500 Mechanical cam action co-ordinator	No	1		
<u>PUSH PLATES AND KICKING PLATES</u>					
26	SS5023 05 304W Blank push plate 152 x 304mm	No	9		
27	SS5089-200W Kick plate 200 x 800mm	No	28		
<u>DOOR CLOSERS</u>					
28	DC500 Cam action closer EN-4 SIL	No	17		
<u>LETTERS, NAMEPLATES, ETC</u>					
29	SS5066-0655E17 Cleaner mop and bucket sign	No	2		
30	SS5066-0655F07 Tea kitchen sign	No	2		
31	SS5066-0655E19 Union Infant sign	No	1		
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32	SS5066-06SSE14 Paraplegic toilet sign	No	2		
33	SS5066-06SSE10 Male indicator sign	No	3		
34	SS5066-06SSE11 Female indicator sign	No	3		
	<u>15mm Thick x 75mm wide grade 304 stainless steel individual cut lettering with brushed finish pin-fixed to brickwork</u>				
35	250mm High "arial font" lettering	No	43		
	<u>Grade 304 stainless steel signage / push plate with brushed finish fixed to timber door with stainless steel fixing screws</u>				
36	365 x 1563mm overall x 1.2mm Thick female ablution cut-out sign / push plate fixed with 8 stainless steel screws (2 no cut-outs in total per sign)	No	3		
37	365 x 1565mm overall x 1.2mm Thick male ablution cut-out sign / push plate fixed with 8 stainless steel screws (2 no cut-outs in total per sign)	No	3		
38	814 x 1565mm overall x 1.2mm Thick cleaners room cut-out sign / push plate fixed with 21 stainless steel screws (3 no cut-outs in total per sign)	No	1		
39	935 x 1510mm overall x 1.2mm Thick mothers room cut-out sign / push plate fixed with 22 stainless steel screws (4 no cut-outs in total per sign)	No	1		
40	1000 x 1803mm overall x 1.2mm Thick paraplegic wc cut-out sign / push plate fixed with 18 stainless steel screws (2 no cut-outs in total per sign)	No	2		
	<u>"Vista Systems" or similar and approved signage, etc fixed with double sided mirror tape</u>				
41	155mm x 60mm x 10.8mm Model WFL2 door number (wall frame V60 x 150mm)	No	145		
42	305.2mm x 101mm x 15.7mm Model WFL19 door identification sign (wall frame TWCT00 x 400mm)	No	132		
43	305.5mm x 205mm x 44.4mm Model WBSB14 projecting identification sign (projecting sign SUS150 x 360mm)	No	32		
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44	156.5mm x 151mm x 46mm Model NCPV102 projecting toilet sign (projecting sign SUS150 x 150mm)	No	9		
45	151mm x 155mm x 21.8mm Model WFP30 wall mounted toilet sign (wall frame TWC150 x 150mm)	No	21		
46	644mm x 312mm x 33mm Model NCPV87 suspended directional sign (suspended sign 3x TWC105 x 640mm)	No	4		
47	1017.3mm x 3013mm x 183mm Model NCPV83 non-illuminated identification pylon (pylon VBS1000 x 3000mm)	No	2		
48	818.5mm x 1863mm x 157mm Model NCPV87 directional pylon (pylon VBS800 x 1850)	No	1		
	<u>"Bright Star Lighting" or similar and approved</u>				
49	110 x 110mm x 30mm WB310 GREEN LED wall bracket exit sign, including 1W LED light	No	4		
	<u>SUNDRIES</u>				
50	870015S Floor door stop satin stainless steel	No	98		
51	RH7024 APT 500B30 patent screws and nuts	No	162		
52	3580255S Hat and coat hook with rubber	No	24		
	<u>"Italtile" or similar and approved</u>				
53	Aston polished stainless steel door mounted robe hook (SKU: DMAST08)	No	3		
54	Aston polished stainless steel wall mounted towel ring (SKU: DMAST03)	No	3		
55	Zack Lines polished stainless steel wall mounted toilet paper holder size 147 x 30 x 152mm (SKU: JEZKLI40031)	No	3		
56	Zack Lines polished stainless steel wall mounted liquid soap dispenser size 110 x 40 x 157mm (SKU: JEZKLI40031)	No	3		
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	<u>"Cubicle Solutions" or similar and approved</u>				
57	Satin finish stainless steel wall mounted 3-roll toilet roll holder	No	21		
58	Grade 304 Stainless steel wall mounted soap dispenser	No	12		
59	Grade 304 Stainless steel wall mounted paper towel dispenser	No	15		
	<u>"Franke" or similar and approved</u>				
60	Satin finish stainless steel HF2400HF1 (1.2mm) wall mounted sensor operated hands free hand dryer size 280 x 207 x 245mm high (SKU 4537)	No	2		
61	Satin finish stainless steel RODX605 (0.8mm) wall mounted waste bin size 355 x 168 x 450mm high (SKU 7262)	No	15		
62	Satin finish stainless steel RODX811 (0.8mm) wall mounted sanitary towel disposal and waste bin size 200 x 165 x 205mm high (SKU:7773)	No	11		
63	CNTXBR stainless steel cistern back grab rail with Franke Fine Grip surface (Code 359912) size 750 x 280mm plugged and screwed to brickwork with stainless steel screws in accordance with the manufacturer's instructions	No	2		
64	CNTX700A stainless steel angle bar rail with Franke Fine Grip surface (Code 359877) size 256 x 618 x 95mm deep plugged and screwed to brickwork with stainless steel screws in accordance with the manufacturer's instructions	No	2		
	<u>Kirk Marketing or similar and approved</u>				
65	4 250 x 1250 x 12mm Charcoal vinyl walk-off door mat (Code: KRK-MMWLM.12CH) laid loose in mat surround	No	2		
	<u>FloorworX Coral3® Welcome polyamide fiber-based entrance matting systems manufactured in accordance with EN1401, or similar and approved, with sheet cut and joined as per manufacturer's instructions and fixed in position with FloorworX No. 71 contact adhesive, or similar and approved adhesive</u>				
66	1 200 x 800 x 9mm Silver Shadow (Colour Code: 3201) door mat fixed in mat surround	No	2		
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SHELVES ETC (PROVISIONAL)

"Premium Steel" or similar and approved heavy duty wall mounted steel shelving with standard epoxy powder coated finish, all in accordance with the manufacturer's specifications and instructions (refer to Architect's drawing number 608 REV A accompanying these bills of quantities for tender purposes)

67	Shelving unit size 914 x 2134mm high overall with 6 shelves 914mm wide x 457mm deep per shelf, including 229mm high basefoot	No	60
68	Shelving unit size 914 x 2134mm high overall with 6 shelves 914mm wide x 533mm deep per shelf, including 229mm high basefoot	No	53
69	Shelving unit size 914 x 2134mm high overall with 6 shelves 914mm wide x 610mm deep per shelf, including 229mm high basefoot	No	20

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IRONMONGERY

Welded Irregular shaped roof frame structures with flat section bearer, gusset and connection plates and L-section cleats with two legs of frame bolted to concrete or brickwork at clerestory level approximately 6m high above floor level (for Roof number reference as indicated below, refer to Structural Engineer's drawing number S200/1 accompanying these bills of quantities for tender purposes)

1	2 No mono pitched roof frames of 203 x 133mm x 15kg/m I-section rafters and sides (legs), the frame 10.583 x 5.454m high extreme (Roof 11)	t	0.91
2	2 No mono pitched roof frames of 203 x 133mm x 15kg/m I-section rafters and sides (legs), the frame 8.588 x 5.101m high extreme (Roof 8)	t	0.78
3	2 No mono pitched roof frames of 203 x 133mm x 15kg/m I-section rafters and sides (legs), the frame 8.585 x 4.901m high extreme (Roof 9)	t	0.78
4	3 No mono pitched roof frames of 203 x 133mm x 15kg/m I-section rafters and sides (legs), the frame 6.708 x 4.789m high extreme (Roof 10)	t	1.07

Welded roof trusses of angle section rails, struts, braces, cleats, etc and flat section bearer, gusset and connection plates bolted to concrete (for Truss Type reference as indicated below, refer to Structural Engineer's drawings numbers S200/2 - 18 accompanying these bills of quantities for tender purposes)

5	5 No monopitched trusses 12.586 x 2.032m high extreme (Truss Type 1A)	L	1.48
6	4 No monopitched trusses 12.587 x 1.982m high extreme (Trusses Type 1B & 1C)	t	1.17
7	6 No monopitched trusses 12.445 x 0.996m high extreme (Truss Type 3)	L	2.63
8	2 No monopitched trusses 11.117 x 1.774m high extreme (Truss Type 1D)	L	0.48
9	3 No monopitched trusses 8.544 x 1.967m high extreme (Truss Type 12)	L	0.88
10	5 No monopitched trusses 6.296 x 1.097m high extreme (Truss Type 2B)	L	0.70

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Section No. 3
GROUND FLOOR LEVEL
Bill No. 10
STRUCTURAL STEELWORK

11	1 No monopitched truss 4.465 x 0.838m high extreme (Truss Type 2A)	t	0.09		
12	3 No lattice trusses 11.592 x 0.952m high extreme (Truss Type 7A)	t	2.41		
13	3 No lattice trusses 11.268 x 0.505m high extreme (Truss Type 4)	t	1.01		
14	3 No lattice trusses 10.480 x 0.505m high extreme (Truss Type 5)	t	0.96		
15	1 No lattice trusses 10.240 x 0.892m high extreme (Truss Type 7H)	t	0.31		
16	1 No lattice trusses 10.143 x 0.877m high extreme (Truss Type 7G)	t	0.31		
17	5 No lattice trusses 8.929 x 1.426m high extreme (Truss Type 7B)	t	1.12		
18	2 No lattice trusses 8.836 x 0.505m high extreme (Truss Type 6)	t	0.45		
19	1 No lattice trusses 8.141 x 0.772m high extreme (Truss Type 7C)	t	0.18		
20	2 No lattice trusses 7.727 x 1.386m high extreme (Truss Type 7D)	t	0.34		
21	1 No lattice trusses 5.900 x 0.654m high extreme (Truss Type 7F)	t	0.13		
22	1 No lattice trusses 5.825 x 0.882m high extreme (Truss Type 7J)	t	0.14		
23	1 No lattice trusses 3.205 x 0.947m high extreme (Truss Type 7E)	t	0.08		
<u>Bolts to trusses etc</u>					
24	High tensile bolts	t	0.18		
25	15mm Diameter galvanised grade 4.8 epoxied threaded L-shaped anchor bolt 580mm girth embedded in Sika Anchor Fix-3x in top of concrete beam or column	No	114		
26	16mm Diameter galvanised grade 4.8 epoxied threaded bar 330mm girth embedded in Sika Anchor Fix-3x in side of concrete beam or column	No	267		
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27	M6 x 25mm U-bolt	No	37	
	<u>PURLINS, GIRTS, BRACING, ETC</u>			
	<u>Purlins and girts bolted to steel</u>			
28	Lipped channel section purlins	t	7.49	
	<u>Welded bracing etc with flat section connection plates bolted to steel</u>			
29	Square hollow section bracing	t	1.74	
30	Angle section bracing	t	1.56	
31	Round bracing rods, sag rods, etc with threaded ends	t	0.85	
	<u>STEEL FLOORS, STAIRS, ETC</u>			
	<u>Welded and bolted fire escape stairs from ground floor level to lower ground floor level with channel section columns, angle and flat section bearer, gusset and connection plates</u>			
32	178 x 54mm x 15kg/m channel section columns	t	0.06	
33	178 x 54mm x 15kg/m channel section slingers	t	0.49	
34	178 x 54mm x 15kg/m channel section bearers	t	0.02	
35	70 x 70 x 8mm angle section bearers	t	0.59	
36	6mm "Vastrap" or similar and approved plate treads 310 x 1 300mm long	t	0.40	
37	6mm "Vastrap" or similar and approved plate landing 1 510 x 1 250mm long	t	0.09	
38	6mm "Vastrap" or similar and approved plate landing 1 140 x 1 220mm long	t	0.07	
39	16mm Diameter galvanized grade 4.8 epoxied threaded bar 330mm girth embedded in "Sika Anchor Fix-3x" or similar and approved in top of concrete base, column or beam	No	5	
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40	16mm Diameter galvanised grade 4.8 epoxied threaded bar 280mm girth embedded in "Sika Anchor Fix-3x" or sim and approved to side of concrete beam or column	No	9	
	<u>Welded and bolted access stairs from lower ground floor level to ground floor level with channel section columns, angle and flat section bearer, gusset and connection plates</u>			
41	178 x 54mm x 15kg/m channel section columns	t	0.09	
42	178 x 54mm x 15kg/m channel section stringers	t	0.35	
43	70 x 70 x 8mm angle section bearers	t	0.46	
44	70 x 70 x 8mm angle section bracing	t	0.04	
45	6mm "Vastrap" or similar and approved plate reads 310 x 1 300mm long	t	0.29	
46	6mm "Vastrap" or similar and approved plate landing 1 530 x 1 150mm long	t	0.08	
47	6mm "Vastrap" or similar and approved plate landing 2 250 x 1 400mm long	t	0.08	
48	6mm "Vastrap" or similar and approved plate landing 1 100 x 1 500mm long	t	0.07	
49	16mm Diameter galvanised grade 4.8 epoxied threaded bar 330mm girth embedded in "Sika Anchor Fix-3x" or sim and approved in top of concrete base, column or beam	No	8	
50	16mm Diameter galvanised grade 4.8 epoxied threaded bar 280mm girth embedded in "Sika Anchor Fix-3x" or sim and approved to side of concrete beam or column	No	3	
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GROUND FLOOR LEVEL

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STRUCTURAL STEELWORK

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	<u>BILL No. 11</u>			
	<u>METALWORK</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 136			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>Descriptions</u>			
	Descriptions of bolts shall be deemed to include nuts and washers			
	Descriptions of expansion anchors and bolts and chemical anchors and bolts shall be deemed to include nuts, washers and mortices in brickwork or concrete			
	Metalwork described as "holed for bolt(s)" shall be deemed to exclude the bolts unless otherwise described			
	The effective fixing length of expansion and chemical expansion bolts is the thickness of the material being fixed to the concrete or masonry surface			
	<u>Aluminum windows, doors, shopfronts, etc</u>			
	All rates to include for brush pile to all horizontal openings sections of doors and shopfronts, aluminium angles / mild steel angles at thresholds (and reveals where necessary) to doors opening onto patios, decks, balconies, etc for dressing over waterproofing (waterproofing elsewhere measured)			
	Windows, doors and shopfronts to have rubber gasket around frames and are to be sealed internally and externally with an approved sealer between the brickwork / concrete and the aluminium frame			
	<u>STEEL HANDRAILS, BALUSTRADES, ETC</u>			
	<u>Welded balustrading to stairs, ramps and balconies</u>			
1	75 x 75 x 2.5mm Hollow section continuous handrails	kg	631	
2	50 x 10mm Flat section continuous bottom rails	kg	451	
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3	20 x 3mm Flat section balusters	kg	152
4	35 x 3mm Flat section balusters	kg	89
5	40 x 3mm Flat section balusters	kg	305
6	45 x 3mm Flat section balusters	kg	228
7	50 x 3mm Flat section balusters	kg	128
8	60 x 3mm Flat section balusters	kg	152
9	100 x 3mm Flat section balusters	kg	762
10	16mm Chemical expansion bolt with an effective fixing length of 10mm	No	180
11	Bolts	kg	37

SUNDRY STEELWORK

Sheet steel

12	3mm Thick powder coated sheet steel plugged to brickwork	m2	2

Solid round bars

13	30mm Diameter round bar fixed to timber wall bearer (timber wall bearer elsewhere measured) with metal 'saddles' at 300mm centres	m	15

Vertical tubing to brickwork

14	60 x 60 x 2.5mm x 4.35kg/m Square tubing	kg	220
15	Hole through 2.5mm steel for bolt	No	202
16	10mm Diameter expansion bolt with an effective fixing length of 60mm	No	101

Columns

17	60 x 180 x 3.5mm x 12.47kg/m Rectangular tube column	kg	168
18	Hole through 5mm steel for bolt	No	24
19	10mm Diameter expansion bolt with an effective fixing length of 5mm	No	24

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	<u>Welded bearers to slatted benches</u>				
20	Triangular shaped bracket formed of 80 x 40 x 2.5mm hollow section 780mm girth mitred and welded at angles and four times holed for bolts	No	9		
21	Extra over bracket for shaped closed end	No	18		
22	16mm Chemical expansion bolt with an effective fixing length of 55mm	No	18		
	<u>Welded cat-ladder 750mm wide and 7 580mm high to roof level</u>				
23	Welded cat-ladder 750mm wide and 7 580mm high to roof level formed of 70 x 12mm flat section stringers, 50 x 8mm flat section cage hoops and verticals and 24mm diameter rungs 450mm long at approximately 300mm centres including flat and angle section connections	Kg	394		
24	16mm Diameter galvanised grade 4.8 epoxied threaded bar 330mm girth embedded in "Sika Anchor Fix-3x" or sim and approved in top of concrete base, column or beam	No	2		
25	16mm Diameter galvanised grade 4.8 epoxied threaded bar 280mm girth embedded in "Sika Anchor Fix-3x" or sim and approved to side of concrete beam or column	No	44		
	<u>SUNDRY ALUMINIUM WORK</u>				
	<u>"Trellidor" or similar and approved polycarbonate burglar bars including patented bronze anodised aluminium frame fixed (tamper-proof fixing) to brickwork or concrete reveal of window opening, strictly in accordance with the manufacturer's instructions</u>				
26	Burglar bars for window opening size 800 x 600mm high	No	21		
27	Burglar bars for window opening size 900 x 1 200mm high	No	6		
28	Burglar bars for window opening size 1 800 x 600mm high	No	10		
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29	Burglar bars for window opening size 1 800 x 1 200mm high	No	28		
30	Burglar bars for window opening size 2 100 x 600mm high	No	5		
31	Burglar bars for door opening size 900 x 2 125mm high	No	1		
	<u>"Garret" portable heavy duty aluminium walk-through metal detector including optional 30-hour backup battery pack, optional desktop remote control with zone indication and with CMA interface module and optional networking to manage individual or groups of walk-through and perform statistical analysis of through-put</u>				
32	PD 6500i (International Code : 1168424) Enhanced Pinpoint Walk-Through Metal Detector	No	1		
	<u>NATURAL ANODISED ALUMINIUM LOUVRE UNITS</u>				
33	Double frame fixed louvre unit size 450 x 600mm high with horizontal blades fixed in opening of door including silicone sealant all round on both sides	No	22		
	<u>STAINLESS STEELWORK</u>				
	<u>"Euro Steel" stainless steel grade 316 (ASTM A276) or similar and approved stair handrails with polished finish fixed to brickwork or concrete with stainless steel mounting plates at 1200mm centres, strictly in accordance with the manufacturer's instructions</u>				
34	75 x 75 x 2.5mm Hollow section continuous handrails	m	5		
35	Extra over handrails for flat closed end	No	4		
36	Extra over handrail for mitred L-intersection	No	4		
	<u>"Architectural Armour" or similar and approved grade finish mounted in a in II mounted strictly in accordance with instructions</u>				
37	Combination bulk cash and document transfer tray in counter top opening size 330 x 380mm	No	4		
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MLTALWORK					

38	Standard bulk transfer unit with electric interlock in wall opening size 390 x 485mm (Provisional) <u>"Turnstar" or similar and approved full height turnstile with grade 304 brushed stainless steel finish mounted to concrete floor strictly in accordance with the manufacturer's instructions</u>	No	1	
39	'Triumph 4 Single' turnstile size 1 400 x 2 125mm high with mechanically controlled uni-directional rotation by means of key override, restrictor tubes for increased security and 180° rotation setting for extra walkthrough space <u>"Koala Kare Products" or similar and approved horizontal wall mounted grade 304 satin stainless steel finish baby changing station mounted to brickwork strictly in accordance with the manufacturer's instructions</u>	No	2	
40	Baby changing station model KB110-SSWM <u>"Obbligato" standard D Range 3CR12 utility grade stainless steel planters or similar approved with satin finish placed in position as directed</u>	No	1	
41	D400 planter	No	8	
42	D600 planter	No	7	
43	D700 planter	No	7	
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WELDED STEEL SCREENS, GATES, ETC

- 44 Double gate size 1800 x 2125mm high overall, each leaf of 50 x 50 x 2.5mm hollow section frame, with 10mm thick x 150mm wide horizontal fibre board planks countersunk screwed to frame on one side for the full height of the leaf and each leaf fitted with a pair of suitable hinges welded to 200 x 200 x 10mm thick plate, bolted to wall with and including four 12mm diameter expansion bolts per hinge and with 12mm diameter x 250mm long drop bolt with metal keep in concrete and nasp and staple welded on

No

4

- 45 Double gate size 2 920 x 2 925mm high overall, each leaf of 32mm diameter x 2mm thick round hollow section frame divided into 4 x equal horizontal panels, with 3.15mm diameter BRC Class A lightly galvanised wire mesh (Reference 189G) welded on to each panel and each leaf hung to 32mm diameter x 2mm thick round hollow section post 2 925mm long with 150 x 150 x 10mm thick base plate welded on to post, bolted to concrete floor with and including four 12mm diameter expansion bolts per post and each leaf fitted with 3 x suitable hinges welded to 200 x 200 x 10mm thick plate, bolted to post and with 12mm diameter x 250mm long drop bolt with metal keep in concrete and nasp and staple welded on

No

1

PRESSED STEEL DOOR FRAMES**1.2mm Rebated frames suitable for half brick walls**

- 46 Frame for door 813 x 2032mm high
- 47 Frame for door 1000 x 2032mm high
- 48 Frame for double door 1511 x 2032mm high

No

37

No

1

No

1

1.6mm Rebated frames suitable for one brick walls

- 49 Frame for door 813 x 2032mm high
- 50 Frame for door 1000 x 2032mm high
- 51 Frame for double door 1511 x 2032mm high

No

55

No

7

No

4

1.6mm Rebated frames suitable for 280mm cavity walls

- 52 Frame for door 813 x 2032mm high

No

1

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Bill No. 1
METALWORK

53	Frame for double door 1511 x 2032mm high	No	1	
<u>ALUMINIUM WINDOWS, DOORS, SHOPFRONTS, ETC</u>				
<u>Epoxy powder coated (colour charcoal) aluminium windows, doors, frames and shopfronts including glazing, etc strictly in accordance with relevant AMSA and SANS standards and performance criteria, plugged to brickwork or concrete, as per architect's drawings numbers 800 REV D, 801 REV D and 802 REV D accompanying these bills of quantities for tender purposes (door ironmongery elsewhere measured)</u>				
54	Window size 600 x 600mm high (W1)	No	24	
55	Window size 600 x 1 200mm high (W5)	No	2	
56	Window size 600 x 1 200mm high (W2)	No	10	
57	Window size 1 500 x 600mm high (W3)	No	10	
58	Window size 1 500 x 1 200mm high (W6)	No	28	
59	Window size 2 100 x 600mm high (W4)	No	3	
60	Fixed pane window size 1 550 x 1 300mm high (W14)	No	4	
61	Fixed pane window size 2 275 x 1 075mm high (W16)	No	3	
62	Composite fixed pane window size 4 200 x 1 075mm high (W15)	No	2	
63	Sliding window size 1 800 x 1 200mm high (W17)	No	2	
64	Composite sliding and fixed pane window size 4 500 x 1 210mm high (W18)	No	1	
65	Composite sliding and fixed pane window size 5 940 x 1 785mm high overall (W19)	No	1	
66	Clerestory window size 4 680 x 1 205mm high overall (W8)	No	1	
67	Clerestory window size 4 680 x 1 207mm high overall (W11)	No	1	
68	Clerestory window size 6 535 x 1 535mm high overall (W9)	No	1	
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69	Clerestory window size 5 535 x 1 355mm high overall (W12)	No	1	
70	Clerestory window size 5 655 x 1 848mm high overall (W10)	No	1	
71	Clerestory window size 5 655 x 1 848mm high overall (W13)	No	1	
72	Door size 900 x 2 125mm high (D7)	No	1	
73	Double door size 1 830 x 2 125mm high (D6)	No	1	
74	Glazed shopfront size 5 810 x 5 730mm high (S2)	No	1	
75	Glazed shopfront comprising of double door with sidelights and fanlight size 2 420 x 3 025mm high overall (S1)	No	2	
<u>LOUVRE UNITS</u>				
<u>Custom made rectangular shaped "Safintra" branded SFL4 Colorplus AZ150 ("Thunderstorm" finish outside only) or similar and approved fixed louvre unit mounted in a metal surround frame into brickwork, including flashings, etc strictly in accordance with the manufacturer's instructions</u>				
76	Louvre unit for 1 800 x 1 200mm high opening through 280mm cavity wall	No	4	
<u>ALUMINIUM ROLLER SHUTTERS ETC</u>				
<u>"Doors Galore" or similar and approved aluminium glazed roller shutters fixed to brickwork or concrete</u>				
77	Electrically operated powder coated "Alu-View" roller shutter with 6.38 laminated frosted safety glass for opening size 3.5 x 1.7m high	No	1	
<u>STEEL STRONGROOM DOORS, VENTILATORS, ETC</u>				
<u>"Chubb safes" or similar approved strongroom doors etc suitable for 345mm walls fixed to brickwork or concrete</u>				
78	"Category 1" strongroom door and frame for opening size 850 x 1930mm high	No	5	
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STEEL CELL DOORS

79	Standard SAPS solid steel door (cell door and frame) Type T2 size 1016 x 2020mm High overall suitable for 230mm brick wall (refer to Departmental Specification 371)	No	2
80	Standard SAPS steel grille gate (cell door grille gate and frame) Type T3 size 1016 x 2020mm High overall suitable for 230mm brick wall (refer to Departmental Specification 371)	No	2

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GROUND FLOOR LEVEL

Bill No. 11

METALWORK

Item No		Quantity	Rate	Amount
	<u>BILL No. 12</u>			
	<u>PLASTERING</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 142			
	<u>SCREEDS</u>			
	<u>Screeds on concrete</u>			
1	20mm Thick on floors and landings	m2	1,930	
2	Average 25mm thick on floors to falls and currents	m2	679	
3	20mm Thick on narrow widths	m2	35	
	<u>Prepare and apply Flowtex HT heavy duty hand troweled epoxy screed, including Flowprime primer, Scatter coat and two coats Flowshield Sealcoat, or similar and approved epoxy screed, all in accordance with manufacturer's detailed instructions on concrete</u>			
4	7mm Thick on floors and landings	m2	139	
5	7mm Thick on narrow widths	m2	2	
	<u>GRANOLITHIC</u>			
	<u>Untinted granolithic on concrete</u>			
6	15mm Thick on top of seating benches	m2	3	
7	15mm Thick on narrow widths	m2	1	
	<u>INTERNAL PLASTER</u>			
	<u>Cement plaster on brickwork</u>			
8	On walls	m2	8,354	
9	On narrow widths	m2	251	
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	Section No. 13 GROUND FLOOR LEVEL Bill No. 12 PLASTERING			

EXTERNAL PLASTER

10 On walls

m2

57

**CORNER PROTECTORS, DIVIDING STRIPS,
ETC**11 1,5mm Thick x 25 x 25mm stainless steel grade 304
satin chrome finish corner protector 1 200mm long fixed
to brickwork or concrete with approved adhesive

No

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PLASTER:NC

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PLASTERING

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GROUND FLOOR LEVEL

Bill No. 12

PLASTERING

Item No	Quantity	Rate	Amount
BILL No. 13			
<u>TILING</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 144			
<u>SUPPLEMENTARY PREAMBLES</u>			
<u>Descriptions</u>			
Unless described as "fixed with adhesive to plaster (plaster elsewhere)" descriptions of tiling on brick or concrete walls, columns, etc shall be deemed to include 1:4 cement plaster backing and descriptions of tiling on concrete floors etc shall be deemed to include 1:3 plaster bedding			
<u>WALL TILING</u>			
<u>75 x 300mm Union or similar approved white glass tiles fixed with high strength grey cementitious based adhesive to plaster (plaster elsewhere) with 3mm continuous flush joints in both directions</u>			
1	On walls	m2	535
2	On walls in isolated panels, splashbacks, etc	m2	10
3	On narrow widths	m2	9
4	Fair exposed cutting and fitting around pipe not exceeding 150mm internal diameter	No	42
<u>SUNDRIES</u>			
<u>"HOMELUX" or similar and approved</u>			
5	8mm Stainless steel effect straight edge metal tile trim	m	70
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Item No		Quantity	Rate	Amount
	<u>BILL No. 14</u>			
	<u>INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 146			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>"Polycop" polypropylene pipes:</u>			
	Polypropylene pipes 54mm diameter and under shall be seamless copper coloured class 18 pipes jointed with "Fast-fuse" heat welded thermoplastic or brass compression fittings as designed for use with copper pipes as stated			
	Pipes shall be firmly fixed to walls etc with coloured nylon snap-in pipe clips with provision for accommodating thermal movement and jointed and fixed strictly in accordance with the manufacturer's instructions			
	All pipe diameters are nominal external			
	<u>"Polylink" polypropylene pipes:</u>			
	Polypropylene pipes 63mm diameter and over shall be class 12 pipes jointed with cast iron "Supracamp" running joints			
	Fusion welded bends, once or twice mitred as necessary, and tees shall be factory manufactured			
	Fusion welded bends and tees shall include jointing to pipes with PVC rubber ring double Z joint couplers			
	Branch tees shall include flanged and bolted joints to "Polycop" branch pipes in addition and for brass compression male iron to copper straight couplers			
	Reducers shall include jointing to pipes with PVC rubber ring double Z joint couplers and reducers shall be of sufficient overall length to accommodate same			
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	Section No. 3 GROUND FLOOR LEVEL Bill No. 14 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)			

All pipes shall be jointed and fixed strictly in accordance with the manufacturer's instructions

All pipe diameters are nominal external

uPVC pipes and fittings:

Soil, waste and vent pipes and fittings shall be solvent welded jointed

uPVC pressure pipes and fittings:

Pipes for water supply shall be of the class stated

Pipes of 40mm diameter and smaller shall be plain ended with solvent welded uPVC loose sockets and fittings

Pipes of 50mm diameter and greater shall have sockets and spigots with push in type integral rubber ring joints. Bends shall be uPVC and all other fittings shall be cast iron, all with similar push-in type joints

Pipes for water supply shall be of the class stated

Pipes of 40mm diameter and smaller shall be plain ended with solvent welded uPVC loose sockets and fittings

Pipes of 50mm diameter and greater shall have sockets and spigots with push in type integral rubber ring joints. Bends shall be uPVC and all other fittings shall be cast iron, all with similar pushing type joints

Copper pipes:

Pipes shall be hard drawn and half-hard pipes of the class stated. Class 0 (thin walled hard drawn) pipes shall not be bent. Class 1 (thin walled half-hard), class 2 (half-hard) and class 3 (heavy walled half-hard) pipes shall only be bent with benders with inner and outer formers. Fittings to copper waste, vent and anti-siphon pipes, capillary solder fittings and compression fittings shall be "Gobra Watertech" type or similar and approved. Capillary solder fittings shall comply with ISO 2016. Only compression fittings shall be used in walls or in ground

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GROUND FLOOR LEVEL
Bill No. 14
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

Fixing of pipes

Unless specifically otherwise stated, descriptions of pipes shall be deemed to include fixing to walls etc, casting in, building in or suspending not exceeding 1m below suspension level

Reducing fittings

Where fittings have reducing ends or branches they are described as "reducing". In the case of pipes with diameters not exceeding 60mm only the largest end or branch size is given. Should the contractor wish to use other fittings and bushes or reducers he may do so on the understanding that no claim in this regard will be entertained. In the case of pipes with diameters exceeding 60mm all sizes are given and no claim for extra bushes, reducers, etc will be entertained

Wire grating

Descriptions of gutter outlets etc shall be deemed to include wire balloon gratings

Descriptions of gutter outlets etc shall be deemed to include wire balloon gratings

Exposed concrete surfaces

Exposed surfaces of concrete stormwater channels, cover slabs, inspection eye marker slabs, gully tops, cleaning eye tops, catch-pits, inspection chambers, etc shall be finished smooth with plaster

Excavations

No claim for rock excavation will be entertained unless the contractor has previously notified the quantity surveyor thereof prior to backfilling

"Soft rock" and "hard rock" shall be as defined in "Earthworks"

Laying, backfilling, bedding, etc of pipes

Pipes shall be laid and bedded and trenches shall be carefully backfilled in accordance with manufacturers' instructions

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GROUND FLOOR LEVEL.
B11 No. 14
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

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Where no manufacturers' instructions exist pipes shall be laid in accordance with clauses 5.1 and 5.2 of each of the following:

SABS 1200 L : Medium-pressure pipelines
LD : Sewers
LE : Stormwater drainage

Pipe trenches etc shall be backfilled in accordance with clauses 3, 5.5, 5.6, 5.7 and 7 of SABS 1200 DB Earthworks (Pipe trenches)

Pipes shall be bedded in accordance with clauses 3.1 to 3.4.1, 5.1 to 5.3 and 7 of SABS 1200 LB : Bedding (Pipes).

Unless otherwise described bedding of rigid pipes shall be class B bedding

Flush pans

Flush pans shall have straight or side outlets and "P" or "S" traps as necessary

Stainless steel basins, sinks, wash troughs, urinals, etc.

Units shall have standard aprons on all exposed edges and tiling keys against walls where applicable

Waste unions

Descriptions of waste unions shall be deemed to include rubber or vulcanite plugs and chains fixed to fittings

Valves, etc

Descriptions of valves etc shall be deemed to include flanged or screwed connections to piping, reducers, supports etc

Sealant to sanitary fittings

Prices for sanitary fittings fixed to walls or abutting walls, drop-in sinks / basins, etc shall include for silicone sealing compound against walls or around fittings

Coding and Marking

All pipes are to be colour coded in accordance with the SABS specifications and all are to be provided with Stainless Steel or Galvanised Steel Name Tags

Carried to Collection

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Section No. 3
GROUND FLOOR (FVE)
Bill No. 14
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

Steel sectional water tanks

Tanks shall comply with SABS CKS 114

As-built drawings

The contractor shall prepare an updated set of as-built drawings. At completion of the contract the contractor shall hand these drawings to the principal agent for reproducing onto the originals for handing over to the employer

RAINWATER DISPOSAL**0.58mm Galvanised sheet iron**

1	150 x 150mm Eaves gutters with beaded front edge	m	56
2	Extra over eaves gutter for stopped end	No	6
3	Extra over eaves gutter for outlet for 125 x 125mm rainwater pipe	No	8
4	125 x 125mm Eaves gutters with beaded front edge	m	42
5	Extra over eaves gutter for stopped end	No	2
6	Extra over eaves gutter for outlet for 125 x 125mm rainwater pipe	No	4
7	100 x 100mm Eaves gutters with beaded front edge	m	67
8	Extra over eaves gutter for stopped end	No	16
9	Extra over eaves gutter for outlet for 75 x 75mm rainwater pipe	No	8
10	Extra over eaves gutter for outlet for 100 x 75mm rainwater pipe	No	8
11	75 x 75mm Eaves gutters with beaded front edge	m	7
12	Extra over eaves gutter for stopped end	No	2
13	Extra over eaves gutter for outlet for 75 x 75mm rainwater pipe	No	2
14	125 x 125mm Rainwater pipes	m	71
15	Extra over rainwater pipe for bend	No	12

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Section No. 3
GROUND FLOOR LEVEL
Bill No. 14
INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

16	Extra over rainwater pipe for shoe	No	12	
17	100 x 75mm Rainwater pipes	m	16	
18	Extra over rainwater pipe for bend	No	8	
19	Extra over rainwater pipe for shoe	No	8	
20	75 x 75mm Rainwater pipes	m	38	
21	Extra over rainwater pipe for bend	No	10	
22	Extra over rainwater pipe for shoe	No	10	
	<u>Galvanised steel pipes</u>			
23	150m Pipes	m	98	
24	150mm Pipes suspended not exceeding 4m below suspension level	m	30	
	<u>Extra over galvanised steel pipes for steel fittings</u>			
25	150mm 90 degrees elbow	No	25	
	<u>"Fullbore" cast iron outlets</u>			
26	150mm x 180 degrees full flow vertical outlet	No	22	
	<u>SANITARY FITTINGS (WORK GROUP 148)</u>			
	<u>"Franko" or similar and approved</u>			
27	1.2mm Grade 304 18/10 stainless steel SAPSDIF combination wash hand basin and drinking fountain (Code 2520011) size 370 x 490 x 125mm with 40mm concealed waste outlet, self-closing bib tap at the top, the unit fitted with fixing lugs and secured in 125mm deep recess in brickwork	No	1	
28	1.2mm Grade 304 18/10 stainless steel HDS heavy duty security type wash hand basin (Code 2520008) size 390 x 322 x 340mm, manufactured with a pressed bowl size 360 x 280 x 140mm deep, complete with a pressed perforated waste outlet, 50mm diameter x 250mm long stainless steel outlet pipe, four 8mm diameter x 250mm long galvanised mild steel threaded rods for fixing the basin to brickwork, including "Wa.cro" or similar and approved 155LWS metering basin valve and BRD/5 basin spout	No	2	
	Carried to Collection			R
	Section No. 3 GROUND FLOOR LEVEL Bill No. 14 INTERNAL P. LIVING AND DRAINAGE (PROVISIONAL)			

29	1.2mm Grade 304 18/10 stainless steel Cascade Model CDX 811 drop in sink (Code 18900032) size 925 x 500mm, manufactured with a single end bowl size 343 x 410 x 169mm deep, complete with a 90mm waste outlet fitting and Spazi F1 plumbing kit (Code 1120008)	No	3	
30	1.2mm Grade 304 18/10 stainless steel Model SHX347 wall mounted wash trough (Code 2560003) size 500 x 450 x 240mm deep with pressed bowl, slanted ribbed front, radiused corners, including 40mm diameter waste outlet, stainless steel fixing brackets (Code 2120014) fixed to brickwork with anchor bolts	No	2	
31	1.2mm Grade 304 18/10 polished stainless steel Model CMFX592 wall mounted back entry standard pan (Code 2540137) with wall fixing plate, fixed to brickwork with anchor bolts in accordance with the manufacturer's instructions, including Geberit Alpha Concealed Cistern in-wall dual flushing system (Art.no. 105.179.00.1) with bright chrome plated Alpha15 actuator plate, all in accordance with the manufacturer's instructions	No	1	
32	0.9mm Grade 304 18/10 polished stainless steel Model TL101 flat back wall mounted trough urinal (Code 2540065-001) size 1830 x 300 x 810mm high with concealed sarge pipe and 22mm inlet chrome plated conex fitting for connecting to urinal flush valve (CB101 valve and Cobra FL15-1 CPstraight urinal tail pipe) and 10mm chrome plated left hand waste outlet, including tiling keys to sides and back walls, vermin proof bitumatic sound deadened material at back between brickwork and fitting, etc all in accordance with the manufacturer's instructions	No	1	
	<u>"Vaal" or similar and approved</u>			
33	Jade Art drop in basin (Code 702603WH) size 635 x 485mm with centre chain stay hole	No	11	
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34	Daisy vitreous china semi-rectangular wall mounted basin size 510 x 400mm (Code 700803WH) with three semi-punched tapholes, integral overflow and chain stay hole through the centre semi-punched taphole, bolted to wall with two 10mm bolts (Code 84487000). Including Classic floor mounted pedestal (Code 715000WH)	No	4	
35	Rounded Tucany vitreous china wall mounted basin size 580 x 415mm (Code 700803WH) with three semi-punched tapholes, integral overflow and chain stay hole through the centre semi-punched taphole, bolted to wall with two 10mm bolts (Code 84487000)	No	3	
36	Junior low level 104 degrees outlet wash down pan (Code 751301) complete including lid, filaments and junior jazz seat	No	1	
37	Daisy Elite semi close coupled 90 degree outlet open rim wc suite (Code 751400) and matching 9 litre cistern (Code 71150) complete with lid, filaments, flush pipe elbow and thermoseal soft-close seat	No	17	
38	Entice top dual flush close coupled wc suite complete (Code 772603) with lid, filaments and thermoseal seat	No	3	
39	Pearl semi close coupled paraplegic wc suite complete (Code 730050) with lid, filaments and purpose made side flush lever	No	2	
40	Lavatera wall hung urinal (Code 705400WH) complete with back inlet and waste outlet, 38mm chrome plated domical grating, spreader (20mm diameter thread), flush pipe and two hanger brackets	No	1	
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Section No. 3 GROUND FLOOR LEVEL Unit No. 14 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)				

	<u>"Zip Hydroboil" or similar and approved</u>		
41	318 x 150 x 450mm High 5 litre stainless steel wall mounted water heater (Code 2610009) including two way tap control, SK3 drip tray with brackets and connection to 15mm cold water supply	No	1
	<u>WASTE UNIONS ETC (WORK GROUP 148)</u>		
	<u>"On Tap" or similar and approved</u>		
42	32 x 75mm Chrome plated slotted clicker basin waste (GIO-BW202S)	No	18
	<u>TRAPS ETC (WORK GROUP 148)</u>		
	<u>uPVC</u>		
43	40mm Deep seal "P" or "S" trap	No	10
	<u>"Cobra Watertech" or similar and approved</u>		
44	40mm CP Bottle trap	No	18
	<u>TAPS, VALVES, ETC (WORK GROUP 148)</u>		
	<u>"On Tap" or similar and approved</u>		
45	10mm Benkier or similar and approved chromium plated angle regulating valve (Code GIO-5188-AV)	No	21
	<u>"Cobra" or similar and approved</u>		
46	15mm Star chrome plated extended bib tap	No	4
47	15mm Elbow action chrome plated cold water pillar tap (Code NM-SC2-21B)	No	2
48	Karoo range single lever raised plain mixer (KO-951R) with cast fixed spout, plug, chain and stay, basin waste, mounting kit, angle valves and 400mm long flexible inlets (Code 292CA)		
		No	14
	Carried to Collection		
	Section No. 3 GROUND FLOOR LEVEL Bill No. 14 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)		

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49 Karoo range single lever sink mixer (KO-979) with overarm swivel spout and 400mm long flexible inlets (Code 2920A)

No 3

SANITARY PLUMBING (WORK GROUP 146)

uPVC pipes

50 40mm Pipes m 140

51 110mm Pipes m 55

52 40mm Pipes suspended not exceeding 1m below suspension level m 40

53 110mm Pipes suspended not exceeding 1m below suspension level m 65

54 110mm Pipes laid in and including trenches not exceeding 1m deep m 50

Extra over uPVC pipes for fittings

55 40mm Bend No 70

56 40mm Junction No 32

57 40mm Double junction No 10

58 40mm Access bend No 35

59 40mm Access junction No 16

60 110mm End cap No 4

61 110mm ABC cleaning eye in end of pipe No 4

62 110mm Bend No 55

63 110mm Junction No 15

64 110mm Double junction No 5

65 110mm Par. connector No 25

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66	110mm Bent pan connector	No	7		
67	110mm Access bent pan connector	No	4		
68	110mm Access pipe	No	4		
69	110mm Access bend	No	4		
70	110mm Access junction	No	5		
71	110mm "GJ Two-way" vent valve	No	8		
	<u>Sundries</u>				
72	Testing waste pipe system		Item		
	<u>WATER SUPPLIES (WORK GROUP 148)</u>				
	<u>"Polycup" polypropylene pipes with brass compression fittings</u>				
73	20mm Pipes	m	335		
74	25mm Pipes	m	230		
75	25mm Pipes laid in and including trenches	m	110		
	<u>Extra over "Polycup" polypropylene pipes for brass compression fittings</u>				
76	20mm Fittings	No	235		
77	25mm Fittings	No	180		
	<u>Copper overflow and service pipes</u>				
78	22mm Overflow pipe 500mm girth twice bent	No	32		
79	22mm Service pipe 1000mm girth	No	33		
	<u>Sundries</u>				
80	450 x 450mm Cast iron stopcock box including brick chamber below not exceeding 750mm deep internally	No	6		
81	Testing water supply pipe system		Item		
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INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)					

FIRE INSTALLATION

Note : Fire installation to comply with the "SABS 0287"
unless described otherwise

FIRE APPLIANCES (WORK GROUP 148)**"Chubb" or similar approved**

82	SABS approved fire hose reel assembly complete with 30m rubber hose, fire hose reel jacket, chromium plated stop cock, shut-off nozzle, pressure gauge and wall bracket, complete	No	12
83	5kg Carbon dioxide fire extinguisher including standard backing board painted red, fixing, etc	No	12
84	9kg Carbon dioxide fire extinguisher including standard backing board painted red, fixing, etc	No	6

**WATER SUPPLIES TO FIRE APPLIANCES -
HDPE PIPING (WORK GROUP 148)****HDPE or similar approved Class 10 pipes and fittings with welded joints**

85	50mm Pipes laid under surface beds including trenches not exceeding 1000mm deep	m	75

Extra over HDPE or similar approved Class 10 pipes and fittings

86	50mm 90 degree bend	No	9
87	50mm 45 degree bend	No	6
88	50mm Reducer	No	5
89	50mm End Cap	No	4

Sundries

90	Testing fire water pipe system	Item	

**WATER SUPPLIES TO FIRE APPLIANCES -
STEEL PIPING (WORK GROUP 173)**

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GROUND FLOOR LEVEL
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INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

	<u>"Black Steel" SABS 62 or similar approved - Medium Pressure pipes</u>				
	Rates for black steel piping to include for degreasing, preparing and painting with one coat self-etching primer, one coat universal undercoat and two coats fire-red enamel paint				
91	25mm Pipes	m	1/5		
92	32mm Pipes	m	95		
	<u>Extra over steel pipes for steel fittings</u>				
93	25mm Bends	No	30		
94	25mm Tee	No	12		
95	25mm Reducer	No	12		
96	25mm Union	No	12		
97	32mm Tee	No	15		
98	32mm Bends	No	15		
99	32mm Reducer	No	15		
	<u>Painting</u>				
100	Paint exposed pipes not exceeding 100mm diameter red	m	160		
	<u>Sundries</u>				
101	Testing fire water pipe system		Item		
	<u>HOLES ETC (WORK GROUP 148)</u>				
	<u>Core drilling hole not exceeding 50mm diameter</u>				
102	200mm Thick reinforced concrete slab, beam, wall, etc.	No	18		
	<u>Core drilling hole exceeding 50mm and not exceeding 100mm diameter</u>				
103	200mm Thick reinforced concrete slab, beam, wall, etc.	No	15		
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	Section No. 3 GROUND FLOOR LEVEL Bill No. 14 INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)				

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GROUND FLOOR LEVEL

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INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

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GROUND FLOOR LEVEL

Bill No. 14

INTERNAL PLUMBING AND DRAINAGE (PROVISIONAL)

Item No		Quantity	Rate	Amount
	<u>BILL No. 15</u>			
	<u>GLAZING</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 15C			
	<u>MIRRORS, ETC</u>			
	<u>6mm Silvered float glass copper backed mirrors with polished edges holed for and fixed with brass mirror screws with foam backing strip all round plugged to brickwork or concrete</u>			
1	Mirror 450 x 700mm high with 4 screws	No	6	
	<u>6.38mm Glass PVC film backed mirrors with 10 mm bevelled and polished edges on 12mm thick block board backing with both items holed for and fixed with chromium plated dome capped mirror screws with rubber buffers to plugs in brickwork or concrete including LED low voltage white light low electrical consumption strip fixed to top and sides of block board</u>			
2	Mirror 1 000 x 1 800mm high with 8 screws (Provisional)	No	4	
3	Mirror 1 500 x 600mm high with 6 screws (Provisional)	No	2	
4	Mirror 1 800 x 600mm high with 8 screws (Provisional)	No	2	
5	Mirror 2 000 x 600mm high with 8 screws (Provisional)	No	4	
6	Mirror 3 000 x 600mm high with 12 screws (Provisional)	No	2	
	<u>"Roca Luna" or similar and approved mirrors plugged to brickwork or concrete strictly in accordance with the manufacturer's instructions</u>			
7	Mirror 800 x 900mm high reference code 8121 7000	No	2	
	Carried Forward to Summary of Section No. 3		R	
	Section No. 3 GROUND FLOOR LEVEL Bill No. 15 GLAZING			

Item No		Quantity	Rate	Amount
	<u>BILL No. 16</u>			
	<u>PAINTWORK</u>			
	<u>WORK GROUP</u>			
	Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 152			
	<u>PAINTWORK ETC TO NEW WORK</u>			
	<u>ON FLOATED PLASTER</u>			
	<u>Prepare and apply Kwartz Fill to surface cracks, one coat PlasterSeal primer and two coats TruVelvet paint or similar and approved</u>			
1	On internal walls	m2	8,033	
	<u>Prepare and apply Kwartz Fill to surface cracks, one coat PlasterSeal primer and two coats EnviroSilk paint or similar and approved</u>			
2	On external walls	m2	57	
	<u>ON SMOOTH CONCRETE</u>			
	<u>Prepare and apply Sikagard®-703 W or similar and approved water repellent impregnation emulsion strictly in accordance with the manufacturer's instructions</u>			
3	On walls	m2	36	
4	On columns	m2	73	
5	On ceilings and beams	m2	1,577	
	<u>ON FIBRE-CEMENT</u>			
	<u>One coat bonding liquid, one coat primer and two coats Pure Acrylic PVA paint or similar and approved</u>			
6	On ceilings	m2	18	
7	On horizontal planks to gate (both sides measured)	m2	31	
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	GROUND FLOOR LEVEL			
	Bill No. 16			
	PAINTWORK			

8	On horizontal planks to west elevation (both sides measured)	m2	104	
<u>ON METAL</u>				
<u>Prepare and apply one undercoat and two coats gloss enamel paint on steel</u>				
9	On gates, grilles, burglar screens, balustrades, etc (both sides measured over the full flat area)	m2	213	
10	On rails, bars, pipes, etc not exceeding 300 mm girth	m	58	
<u>One coat Stancor Carboclad 938 red oxide primer (75 micrometers DFT) as base coat (applied in workshop), one coat Stancor Carboclad 938 HB grey (75 micrometers DFT) intermediate coat and two finishing coats Stancor Carboclad 938 (40 micrometers DFT) paint or similar and approved on structural steel</u>				
11	On members of lattice trusses	m2	328	
12	On members of roof trusses	m2	320	
13	On columns and rafter beams of irregular shaped roof frame structures	m2	123	
14	On lipac channel purlins	m2	282	
15	On members of staircases	m2	116	
16	On members of cat ladders	m2	11	
17	On bracing members, sag rails, etc	m2	161	
<u>Prepare and apply two coats Dulux Grip undercoats and three coats Dulux Pearglo waterbased finishing coats or similar and approved on steel</u>				
18	On door frames	m2	163	
19	On record room, cell room and strongroom doors and frames	m2	9	
20	On gates, grilles, burglar screens, balustrades, etc (both sides measured over the full flat area)	m2	57	
21	On rectangular columns	m2	6	
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Section No. 3 GROUND FLOOR (FVF) Bill No. 15 PAINTWORK				

	<u>Prepare and wash down with Plascon Agwasolve degreaser, apply one coat Plasconafe 1A primer (50 to 80 micrometers DFT) and two coats Plascon Metalcare water based enamel paint (25 to 30 micrometers DFT) or similar and approved on galvanised steel</u>			
22	On rails, bars, pipes, etc	m2	41	
23	On eaves gutters	m2	62	
24	On rails, bars, pipes, etc not exceeding 300 mm girth	m	173	
25	On eaves gutters not exceeding 300 mm girth	m	147	
	<u>ON WOOD</u>			
	<u>Two coats wood primer</u>			
26	On backs of frames, linings, etc not exceeding 300mm wide	m	109	
	<u>Prepare and apply three coats Woodoc 5 Indoor Polywax Sealer (clear) with added Woodoc Stain Concentrate (meranti shade) or similar and approved as per the manufacturer's instructions</u>			
27	On doors	m2	391	
28	On door frames etc	m2	19	
	<u>Prepare and apply one coat sanding sealer and two coats clear varnish on wood</u>			
29	On skirtings, rails, etc not exceeding 300mm	m	1,699	
	<u>Prepare and apply one coat sanding sealer and two coats polyurethane varnish on wood</u>			
30	On open slatted seats of 32 x 70mm slats at 100mm centres (both sides measured over the full flat area)	m2	4	
31	On slatted wall panelling of 60mm thick x average 65mm wide vertical slats in "barcode" design (measured over the full flat area)	m2	5	
32	On hardwood wall panelling	m2	8	
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GROUND FLOOR LEVEL

Bill No. 16

PAINTWORK

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GROUND FLOOR LEVEL

Bill No. 16

PAINTWORK

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GROUND FLOOR LEVEL				
<u>SECTION SUMMARY - GROUND FLOOR LEVEL</u>				
Bill No		Page No	Amount	
1	EARTHWORKS (PROVISIONAL)	102		
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Item No	Quantity	Rate	Amount
<u>BILL No. 1</u>			
<u>ELECTRICAL INSTALLATION</u>			
<u>(PROVISIONAL)</u>			
<u>WORK GROUP</u>			
Unless otherwise stated the WORK GROUP for this Bill to be WORK GROUP 162			
1	Amount brought forward from document : "PART C5" - Electrical Installation Project Specification and Bills of Quantities accompanying these bills of quantities for tender purposes	Item	
Carried to Final Summary			H
Section No. 4			
ELECTRICAL INSTALLATION (PROVISIONAL.)			
Bill No. 1			
ELECTRICAL INSTALLATION			

Item No		Quantity	Rate	Amount
	<u>BILL No. 1</u>			
	<u>GENERAL SITE WORKS, RETAINING STRUCTURES, PAVINGS, FENCING, ETC - ALL TRADES (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	WORK GROUPS for this Bill as indicated			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>General note</u>			
	For SUPPLEMENTARY PREAMBLES applicable to the various trades, refer to SECTION 2 or SECTION 3 of the document			
	<u>SITE CLEARANCE ETC (WORK GROUP 104)</u>			
	<u>Site clearance</u>			
1	Digging up and removing rubbish, debris, vegetation, hedges, shrubs and trees not exceeding 200mm girth, bush, etc	m2	6,084	
	<u>BULK EXCAVATION, FILLING, ETC (WORK GROUP 104)</u>			
	<u>Excavation in earth for basement</u>			
2	Exceeding 2m and not exceeding 4m deep	m3	10,200	
	<u>Extra over bulk excavation in earth for excavation in</u>			
3	Soft rock	m3	2,000	
4	Hard rock	m3	1,000	
	<u>Extra over all excavations for carting away</u>			
5	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	7,650	
	<u>Risk of collapse of excavations</u>			
6	Sides of bulk excavations exceeding 1.5m deep	m2	708	
	Carried to Collection			R
	Section No. 5 EXTERNAL WORKS (PROVISIONAL) Bill No. 1 GENERAL SITE WORKS, RETAINING STRUCTURES, P			

	<u>Keeping excavations free of water</u>				
7	Keeping excavations free of all water other than subterranean water		Item		
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>				
	<u>Excavation in earth not exceeding 2m deep</u>				
8	Trenches	m3	106		
9	Holes	m3	29		
	<u>Back excavation of vertical sides of excavation in earth for working space including backfilling compacted to 98% Mod AASHTO density</u>				
10	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	106		
	<u>Extra over trench and hole excavations in earth for excavation in</u>				
11	Soft rock	m3	22		
12	Hard rock	m3	11		
	<u>Extra over back excavation in earth for working space for excavation in soft rock</u>				
13	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	9		
	<u>Extra over back excavation in earth for working space for excavation in hard rock</u>				
14	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	4		
	<u>Extra over all excavations for carting away</u>				
15	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	88		
	Carried to Collection			R	
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) B'll No. 1 GENERAL SITE WORKS, RETAINING STRUCTURES, P				

	<u>25MPa/19mm concrete</u>			
25	Bases	m3	7	
26	Columns in foundations	m3	1	
27	Columns	m3	6	
	<u>TEST BLOCKS (WORK GROUP 110)</u>			
28	Making and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	5	
	<u>ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK GROUP 111)</u>			
29	Bases	m2	28	
30	Rectangular columns in foundations	m2	20	
31	Rectangular columns	m2	65	
	<u>REINFORCEMENT (WORK GROUP 114)</u>			
	<u>Mild steel reinforcement to structural concrete work</u>			
32	8mm Diameter bars	l	0.30	
	<u>High tensile steel reinforcement to structural concrete work</u>			
33	12mm Diameter bars	l	0.70	
34	10mm Diameter bars	l	0.50	
	<u>BRICKWORK IN FOUNDATIONS (WORK GROUP 116)</u>			
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>			
35	One brick walls	m2	53	
	<u>BRICKWORK IN SUPERSTRUCTURE (WORK GROUP 116)</u>			
	<u>Brickwork of NFP bricks in class II mortar</u>			
36	One brick walls	m2	171	
	Carried to Collection			
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 1 GENERAL SITE WORKS, RETAINING STRUCTURES, E			

BRICKWORK SUNDRIES (WORK GROUP 116)

Expansion joints with "Jointex" or similar and approved softboard between vertical concrete and brick surfaces

37	10mm Joints not exceeding 300mm wide	m	240

Brickwork reinforcement

38	150mm Wide reinforcement built in horizontally in foundations	m	642

39	150mm Wide reinforcement built in horizontally in superstructure	m	428

FACE BRICKWORK (WORK GROUP 116)

Corobrik Titanium Gun Metal Gray Satin Texture or similar and approved face bricks pointed with recessed horizontal and vertical joints

40	Extra over brickwork for face brickwork in foundations	m2	12

41	Extra over brickwork for face brickwork in superstructure	m2	342

INTERLOCKING BLOCK RETAINING STRUCTURES (WORK GROUP 104)

"Loffelstein" or similar and approved precast concrete interlocking planter blocks finished smooth on exposed surfaces

42	Retaining structure with stepped face and curves as required to suit 60 degree slopes of L500 blocks size 500 x 450 x 170mm high type interlocking planter blocks laid with horizontal bed joints including backfilling with earth obtained from the excavations and filling the blocks with garden soil lightly tamped as the work proceeds	m2	300

43	Retaining structure circular on plan with stepped face and curves as required to suit 60 degree slopes of L600 blocks size 500 x 450 x 170mm high type interlocking planter blocks laid with horizontal bed joints including backfilling with earth obtained from the excavations and filling the blocks with garden soil lightly tamped as the work proceeds	m2	120

GEOSYNTHETIC REINFORCING PLASTIC SQUARE MESH NETTING (WORK GROUP 104)

Carried to Collection

R

Section No. 8
EXTERNAL WORKS (PROVISIONAL)
BJI No. 1
GENERAL SITE WORKS, RETAINING STRUCTURES, P

	<u>20 x 1.2mm Thick mesh netting with 150mm laps</u>				
44	Horizontally in position between different layers of compacted filling behind retaining structure	m2	1.680		
	<u>PAVING (WORK GROUP 116)</u>				
	<u>Paving of 60 x 60 x 80mm thick interlocking precast concrete (25 MPa) paving blocks on 20mm thick river sand bed with sand swept into joints including preparation of ground or filling</u>				
45	Paving in herringbone pattern to falls	m2	1,223		
46	Extra for forming 1200 x 150mm deep extreme open segmental channel in top of paving including necessary excavation, lifting, etc	m	125		
47	Extra for forming 7 500 X 7 000 x 350mm high extreme storm water diversion hump in top of paving including necessary additional filling compaction, etc	m	-		
48	300 mm Wide x 250mm high 30MPa concrete edge strip including necessary excavation, backfilling, formwork, etc	m	134		
49	Kerb (SABS 927 fig 3) 150 x 300mm high paving edge with bullnose finish to one top end along length on and including 300 x 50mm thick 30MPa unreinforced concrete bedding and 150 x 150 x 300mm 30MPa unreinforced concrete haunching at back of each joint, including necessary excavation, backfilling, jointing, pointing, etc	m	201		
50	Kerb (SABS 927 fig 3) 150 x 300mm high paving edge circular on plan not exceeding 4m radius with bullnose finish to one top end along length on and including 300 x 50mm thick 30MPa unreinforced concrete bedding and 150 x 150 x 300mm 30MPa unreinforced concrete haunching at back of each joint, including necessary excavation, backfilling, jointing, pointing, etc	m	24		
	<u>Paving of 100 x 100 x 60mm Smartstone Cosmopolitan Cobble smooth concrete cobblestone paving bricks or similar and approved with butt joints on 20mm thick river sand bed with sand and cement mixture swept into joints and hoed down including preparation of ground or filling</u>				
51	Paving in stretcher bond to falls	m2	863		
Carried to Collection					R
Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 1 GENERAL SITE WORKS, RETAINING STRUCTURES, P					

52	Extra for forming 1200 x 150mm deep extreme open segmental channel in top of paving including necessary excavation, filling, etc	m	85		
53	Extra for forming 7 500 X 7 000 x 350mm high extreme storm water diversion hump in top of paving including necessary additional: filling, compaction, etc	m	1		
54	300mm Wide x 250mm high 30MPa concrete edge strip including necessary excavation, backfilling, formwork, etc	m	404		
<u>WELDED STEEL FENCING, GATES, ETC</u> <u>(WORK GROUP 135)</u>					
<u>"Clearva Invisible Wall" galvanised perimeter security barrier fence system manufactured by COCHRANE STEEL or similar and approved, with "polymetic 6000" finishing coat (colour anthracite grey), comprising of 85mm posts tapering to 45mm with a depth of 85mm on 400 x 400 x 600mm 15MPa mass concrete bases, 3,305m wide x 2.1m high panels with 600mm "underlay" secured to the lower edge and 100mm toughened steel "shark tooth" spike fixed with anti-vandal bolts at 150mm centres to top edge, all strictly in accordance with the manufacturer's instructions</u>					
55	Fence system 2.1m high	m	246		
56	Extra over fence system for swing double entrance gate size 1.8 x 2.1m high	No	3		
57	Extra over fence system for single leaf sliding gate size 8 x 2.1m high including guide rail complete	No	1		
58	100mm toughened steel "shark tooth" spike fixed with anti-vandal bolts at 150mm centres to top of brick wall	m	58		
Carried to Collection				R	
Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 1 GENERAL SITE WORKS, RETAINING STRUCTURES, P					

"Turnstar" or similar and approved Velocity Raptor automatic tyre spike industrial vehicle barrier with swildrive installed strictly in accordance with the manufacturer's instructions

59 Vehicle barrier with 304 grade stainless steel cabinet with 4m octagonal barrier arm and 4m recessed spike barrier complete with integrated LED light strip, diffuser and red reflective tape, combined logic and loop detector, bolted to 500 x 500 x 400mm deep concrete base and connected to 220V single phase power supply

No

2

Carried to Collection

R

Section No. 8
EXTERNAL WORKS (PROVISIONAL)
Bill No. 1
GENERAL SITE WORKS, RETAINING STRUCTURES, P

Section No. 6

EXTERNAL WORKS (PROVISIONAL)

Bill No. 1

GENERAL SITE WORKS, RETAINING STRUCTURES, PAVINGS, FENCING, ETC (

COLLECTION

	Page No	Amount
Total Brought Forward from Page No.	191	
	192	
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	196	
	197	
	198	

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Section No. 6

EXTERNAL WORKS (PROVISIONAL)

Bill No. 1

GENERAL SITE WORKS, RETAINING STRUCTURES, P

Item No		Quantity	Rate	Amount
	<u>BILL No. 2</u>			
	<u>SITE CONSUMPTION WATER AND FIRE WATER SUPPLY AND RETICULATION (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	WORK GROUPS for this Bill as indicated			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>General note</u>			
	For SUPPLEMENTARY PREAMBLES applicable to the various trades, refer to SECTION 2 or SECTION 3 of the document			
	uPVC piping measured in this section to be joint with Z-lock method as per Engineer's drawings and instructions			
	<u>SITE CONSUMPTION WATER SUPPLY AND RETICULATION (WORK GROUP 148)</u>			
	<u>Class 9 uPVC pressure pipes</u>			
1	50mm Pipes vertically or ramped (no excavation)	m	15	
2	50mm Pipes laid in and including trenches not exceeding 1m deep	m	365	
	<u>Extra over Class 9 uPVC pipes for fittings</u>			
3	50mm 45 degree bend	No	4	
4	50mm 90 degree bend	No	13	
5	50mm T-junction	No	5	
6	Flange adapter 50mm uPVC pipe to 50mm galvanised pipe	No	4	
	<u>Galvanised steel pipes</u>			
7	50mm Pipes	m	65	
8	50mm Pipes laid in and including trenches not exceeding 1m deep	m	15	
	Carried to Collection		R	
	Section No. 6			
	EXTERNAL WORKS (PROVISIONAL)			
	Bill No. 2			
	SITE CONSUMPTION WATER AND FIRE WATER SUPPLY			

<u>Extra over galvanised steel pipes for steel fittings</u>				
9	50mm 45 Degree bend	No	4	
10	50mm 90 Degree bend	No	8	
11	50mm Tee junction	No	2	
<u>Sundries</u>				
12	Unreinforced concrete 25 MPa in irregular shaped thrust blocks behind inspection chamber drop inlet piping including extra excavation, formwork, etc	m3	10	
<u>Testing</u>				
13	Testing consumption water supply system		Item	
<u>VALVES, PUMPS, ETC TO CONSUMPTION WATER SUPPLY (WORK GROUP 170)</u>				
<u>Pump sets, valves, etc (Refer to Civil Engineer's drawings number C208 REV B accompanying these bills of quantities for tender purposes)</u>				
Descriptions of pumps shall be deemed to include connections to water and electrical supply and/or discharge points, vibration isolation mountings, insulation, concrete plinths as indicated on drawings, pressure gauges, etc				
14	Supply, installation and commissioning of electric consumption water supply pump in steel cage, valves etc complete with all connections, fittings, etc in accordance with manufacturer's instructions and specification (electrical motor control elsewhere measured)	No	1	
<u>CONSUMPTION WATER STORAGE TANKS (WORK GROUP 170)</u>				
Carried to Collection			R	
Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 2 SITE CONSUMPTION WATER AND FIRE WATER SUPP				

	<u>"Bralthewalle" sectional steel or similar and approved elevated water tank including structural steel stand on suitable reinforced concrete foundations as per manufacturer's specification and instructions (Refer to Civil Engineer's drawings number C208 REV B accompanying these bills of quantities for tender purposes)</u>				
15	Rectangular shaped sealed sectional steel elevated water tank with approximate volume of 21 000 litres with flanged inlet and outlets, drainage point, 50mm diameter valve in chamber, non-return valve, pressure release valves, completely assembled on and including structural steel frame with all connections, rubber insertions, nuts, bolts, washers, etc in accordance with manufacturer's specifications and instructions	No	1		
	<u>THE FOLLOWING IN WATER METER CHAMBER (WORK GROUPS AS INDICATED)</u>				
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>				
	<u>Excavation in earth not exceeding 2m deep</u>				
16	Water meter chamber	m3	17		
	<u>Extra over trench and hole excavations in earth for excavation in</u>				
17	Soft rock	m3	5		
18	Hard rock	m3	2		
	<u>Extra over all excavations for carting away</u>				
19	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	11		
	<u>Risk of collapse of excavations</u>				
20	Sides of trench and hole excavations exceeding 1,5m deep	m2	22		
	<u>Keeping excavations free of water</u>				
21	Keeping excavations free of all water other than subterranean water		Item		
	Carried to Collection			R	
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 2 \$ TC CONSUMPTION WATER AND FIRE WATER SUPP				

<u>Compaction of surfaces</u>					
22	Compaction of ground surface under floors etc including scarifying for a depth of 150mm, breaking down oversize material, adding suitable material where necessary and compacting to 93% Mod AASHTO density	m2	10		
<u>Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 98% Mod AASHTO density</u>					
23	Backfilling to trenches, holes, etc	m3	7		
<u>Prescribed density tests on filling</u>					
24	"Modified AASHTO Density" test	No	2		
<u>UNREINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES</u>					
<u>1:6 Soilcrete mix</u>					
25	Surface blinding under water meter chamber base	m3	2		
<u>REINFORCED CONCRETE (WORK GROUP 110)</u>					
<u>25MPa/19mm concrete</u>					
26	Sides and bottom of water meter chamber	m3	3		
<u>TEST BLOCKS (WORK GROUP 110)</u>					
27	Making and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	2		
<u>CONCRETE SUNDRIES (WORK GROUP 110)</u>					
<u>Finishing top surfaces of concrete smooth with a steel trowel</u>					
28	Top surfaces of concrete water meter chamber base and top slab	m2	6		
<u>ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK GROUP 111)</u>					
29	Outer face of pump station valve chamber sides	m2	11		
Carried to Collection					
Section No. 6					
EXTERNAL WORKS (PROVISIONAL)					
Bill No. 2					
SITE CONSUMPTION WATER AND FIRE WATER SUPP					

SMOOTH FORMWORK (DEGREE OF ACCURACY 1) (WORK GROUP 111)

Smooth formwork to sides

30	Inner face of pump station valve chamber sides	m2	10

Boxing in smooth formwork to form

31	50 x 60mm Horizontal rebate along top edge	m	8

MOVEMENT JOINTS ETC (WORK GROUP 110)

"Neoprene" or similar and approved packing strip between horizontal concrete and steel surfaces

32	5mm Joints not exceeding 300mm wide	m	8

REINFORCEMENT (WORK GROUP 114)

Fabric reinforcement

33	Mesh reference 254 fabric reinforcement in concrete surface beds, slabs, etc	m2	15

SUNDRY STEELWORK (WORK GROUP 136)

Water meter chamber lid, etc

34	Hinged water meter chamber lid size 1800 x 2150 comprising of 4.5mm thick non-slip floor plate welded to 50 x 50 x 8mm angle section frame all round, including 16mm diameter x 350mm long twice band handle fitted through 2 x holes in lid, three 20mm diameter x 150mm long bullet hinges welded on and 10mm chain fixed to lid and bearers (bearers elsewhere measured) to keep lid open at 135 degree angle	No	1

35	50 x 50 x 8mm Angle section bearers with 50 x 3mm thick x 75mm long flat section fishtail lugs welded on at 1000mm centres, including embedding in edge of concrete with Sikka AnchorFix-3x	kg	54

36	12mm Chemical expansion bolt with an effective fixing length of 8mm	No	8

WATER METER CHAMBER PIPING, ETC (WORK GROUP 148)

Carried to Collection

2

Section No. 6
EXTERNAL WORKS (PROVISIONAL)
Bill No. 2
SITE CONSUMPTION WATER AND FIRE WATER SUPP

	<u>Piping and fittings schedule for water meter chamber (piping and fittings to be hot dipped galvanised mild steel)</u>				
37	50mm Pipe 160mm long flanged one side	No	1		
38	50mm Pipe 400mm long flanged one side	No	1		
39	50mm Pipe 700mm long	No	1		
40	50mm Water meter	No	1		
41	50mm Valve	No	2		
42	50mm VJ coupling	No	1		
43	Flange adapter fitting for fitting 50mm galvanised pipe to 50mm uPVC pipe	No	2		
	<u>THE FOLLOWING IN WATER SERVICES CHAMBER (WORK GROUPS AS INDICATED)</u>				
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>				
	<u>Excavation in earth not exceeding 2m deep</u>				
44	Water services chamber	m3	13		
	<u>Extra over trench and hole excavations in earth for excavation in</u>				
45	Soft rock	m3	1		
46	Hard rock	m3	1		
	<u>Extra over all excavations for carting away</u>				
47	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	8		
	<u>Risk of collapse of excavations</u>				
48	Sides of trench and hole excavations exceeding 1.5m deep	m2	19		
	<u>Keeping excavations free of water</u>				
49	Keeping excavations free of all water other than subterranean water			Item	
	Carried to Collection				R
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 2 SITE CONSUMPTION WATER AND FIRE WATER SUPPLY				

	<u>Compaction of surfaces</u>				
50	Compaction of ground surface under floors etc including scarifying for a depth of 150mm, breaking down oversize material, adding suitable material where necessary and compacting to 98% Mod AASHTO density	m2	7		
	<u>Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 98% Mod AASHTO density</u>				
51	Backfilling to trenches, holes, etc	m3	5		
	<u>Prescribed density tests on filling</u>				
52	"Modified AASHTO Density" test	No	2		
	<u>UNREINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES</u>				
	<u>1:3 Soilcrete mix</u>				
53	Surface blinding under water services chamber base	m3	2		
	<u>REINFORCED CONCRETE (WORK GROUP 110)</u>				
	<u>25%Pa/19mm concrete</u>				
54	Sides and bottom of water services chamber	m3	4		
	<u>TEST BLOCKS (WORK GROUP 110)</u>				
55	Making and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	2		
	<u>CONCRETE SUNDRIES (WORK GROUP 110)</u>				
	<u>Finishing top surfaces of concrete smooth with a steel trowel</u>				
56	Top surfaces of concrete water meter chamber base and top slab	m2	4		
	<u>ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK ROUP 111)</u>				
57	Outer face of pump station valve chamber sides	m2	13		
Carried to Collection					R
Section No. 8 EXTERNAL WORKS (PROVISIONAL) Bill No. 2 SITE CONSUMPTION WATER AND FIRE WATER SUPP					

SMOOTH FORMWORK (DEGREE OF ACCURACY II) (WORK GROUP 111)**Smooth formwork to sides**

58 Inner face of pump station valve chamber sides m² 11

Boxing in smooth formwork to form

59 60 x 60mm Horizontal rebate along top edge m 8

MOVEMENT JOINTS ETC (WORK GROUP 110)**"Neoprene" or similar and approved packing strip between horizontal concrete and steel surfaces**

60 5mm Joints not exceeding 300mm wide m 8

REINFORCEMENT (WORK GROUP 114)**Fabric reinforcement**

61 Mesh reference 254 fabric reinforcement in concrete surface beds, slabs, etc m² 17

SCAFFOLD STEELWORK (WORK GROUP 136)**Water services chamber lid, etc**

62 Hinged water services chamber lid size 2'00 x 2'053 comprising of 4.5mm thick non-slip floor plate welded to 50 x 50 x 8mm angle section frame all round, including 16mm diameter x 350mm long twice bend handle fitted through 2 x holes in lid, three 20mm diameter x 150mm long bullet hinges welded on and 10mm chain fixed to lid and bearers (bearers elsewhere measured) to keep lid open at 135 degree angle No 1

63 60 x 60 x 8mm Angle section bearers with 50 x 3mm thick x 75mm long flat section fish tail lugs welded on at 1000mm centres, including embedding in edge of concrete with Sika AnchorFix-3x kg 8

54 12mm Chemical expansion bolt with an effective fixing length of 8mm No 8

WATER SERVICES CHAMBER PIPING, ETC (WORK GROUP 148)

Carried to Collection

22

Section No. 6
EXTERNAL WORKS (PROVISIONAL)
Bill No. 2
SITE CONSUMPTION WATER AND FIRE WATER SUPPLY

Piping and fittings schedule for water services chamber (piping and fittings to be hot dipped galvanneal mild steel)

65	50mm Pipe 200mm long flanged one side	No	2
66	50mm Pipe 300mm long flanged one side	No	1
67	50mm Pipe 320mm long flanged both sides	No	3
68	50mm Pipe 400mm long flanged one side	No	3
69	50mm T piece 320mm long with 80mm long off take	No	2
70	50mm Valve	No	1
71	50mm Check valve one way flow	No	1
72	50mm VJ coupling	No	3
73	Flange adapter fitting for fitting 50mm galvanised pipe to 50mm uPVC pipe	No	3

SITE FIRE WATER SUPPLY AND RETICULATION (WORK GROUP 148)

Class 9 uPVC pressure pipes

74	50mm Pipes vertically or ramped (no excavation)	m	12
75	50mm Pipes laid in and including trenches not exceeding 1m deep	m	85
76	75mm Pipes vertically or ramped (no excavation)	m	15
77	75mm Pipes laid in and including trenches not exceeding 1m deep	m	325

Extra over Class 9 uPVC pipes for fittings

78	50mm 45 Degree bend	No	2
79	50mm 90 Degree bend	No	4
80	50mm Flange adaptor	No	4
81	75mm 45 degree bend	No	5
82	75mm 90 degree bend	No	4

Carried to Collection

Section No. 6
EXTERNAL WORKS (PROVISIONAL)
Bill No. 2
SITE CONSUMPTION WATER AND FIRE WATER SUPP

83	75mm T-junction	No	2	
84	Flange adapter 50mm uPVC pipe to 75mm uPVC pipe	No	3	
	<u>Fire hydrant</u>			
85	Smooth or shutter finished reinforced concrete 25 MPa fire hydrant pedestal size 400 x 400mm at base tapering to octagonal shaped top size 440 x 340mm overall x 1700mm high, cast around 75mm HDPE vertical pipe including necessary excavations not exceeding 1000mm deep, backfilling and compacting, formwork, 4 x 1700mm long 12mm diameter reinforcing bars and two coats of paint to exposed surfaces	No	4	
86	Cast iron right angled shielded fire hydrant as per SABS 1128-2 / SANS 1128-2	No	4	
87	1"0 x 63 HDPE reducer and brass reducer and transition coupler with brass male thread and brass reducer bush to suit fire hydrant	No	4	
	<u>Sundries</u>			
88	Unreinforced concrete 25 MPa in irregular shaped thrust blocks behind inspection chamber drop inlet piping including extra excavation, formwork, etc	m3	5	
	<u>Testing</u>			
89	Testing fire water supply system		Item	
	<u>VALVES, PUMPS, ETC TO FIRE WATER SUPPLY (WORK GROUP 170)</u>			
	<u>Pump sets, valves, etc (Refer to Civil Engineer's drawings numbers C206 REV D and C207 REV D accompanying these bills of quantities for tender purposes)</u>			
	Descriptions of pumps shall be deemed to include connections to water and electrical supply and/or discharge points, vibration isolation mountings, insulation, concrete plinths as indicated on drawings, pressure gauges, etc			
90	Supply, installation and commissioning of electric fire water supply pump complete with all connections, fittings, etc in accordance with manufacturer's instructions and specification (electrical motor control elsewhere measured)	No	1	
	Carried to Collection			
	Section No. 8			
	EXTERNAL WORKS (PROVISIONAL)			
	Bill No. 2			
	SITE CONSUMPTION WATER AND FIRE WATER SUPP			

FIRE WATER STORAGE TANK (WORK GROUP 170)

"Bridgwater" sectional steel or similar approved water tanks in accordance with the manufacturer's instructions and specifications (Refer to Civil Engineer's drawings numbers C206 REV D and C207 REV D accompanying these bills of quantities for tender purposes)

91	Irregular shaped sealed sectional steel water tank with approximate volume of 220 000 litres with flanged inlet and outlets, drainage point, gate valve, non-return valve, pressure release valves, etc in accordance with the indicated piping schedule, completely assembled on steel sub-structure (steel sub-structure elsewhere measured) with and including all connections, rubber insertions, nuts, bolts, washers, etc in accordance with engineer's specifications and drawings and manufacturer's instructions	No	1

Piping and fittings schedule for fire water storage tank (piping and fittings to be hot dipped galvanised mild steel)

92	50mm 90 Degree bend	No	4
93	50mm Pipe 597mm long	No	1
94	50mm Pipe 1065mm long	No	1
95	50mm Pipe 2521mm long	No	1
96	80mm 90 Degree bend	No	5
97	80mm Pipe 320mm long	No	1
98	80mm Pipe 360mm long	No	1
99	80mm Pipe 410mm long	No	1
100	80mm Pipe 1600mm long	No	1
101	80mm Isolating valve	No	1
102	Flange adapter fitting for fitting 80mm galvanised pipe to 75mm uPVC pipe	No	2
103	Flange adapter fitting for 50mm diameter tank inlet	No	1
104	Flange adapter fitting for tank suction outlet	No	1

Carried to Collection

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Section No. 6
EXTERNAL WORKS (PROVISIONAL)
Bill No. 7
SITE CONSUMPTION WATER AND FIRE WATER SUPP

Item No		Quantity	Rate	Amount
	<u>BILL No. 3</u>			
	<u>SITE STORM WATER RETICULATION (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	WORK GROUPS for this Bill as indicated			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>General note</u>			
	For SUPPLEMENTARY PREAMBLES applicable to the various trades, refer to SECTION 2 or SECTION 3 of the document			
	<u>STORM WATER DRAINAGE (WORK GROUP 146)</u>			
	<u>uPVC Class 34D pipes or similar approved pipes</u>			
1	110mm Sump chamber suction pipe	m	3	
2	110mm Pipes vertically or ramped to cleaning eyes etc (no excavation)	m	10	
3	110mm Pipes laid in and including trenches not exceeding 1m deep	m	20	
	<u>Extra over uPVC pipes for fittings</u>			
4	110mm Bend	No	5	
5	110mm In-line check valve	No	1	
	<u>Cast iron covers</u>			
6	1 000 x 850mm heavy duty water tight pump station chamber cover and frame	No	1	
7	Lifting-key for manhole cover	No	1	
	Carried to Collection			20
	Section No. 6			
	EXTERNAL WORKS (PROVISIONAL)			
	Bill No. 3			
	SITE STORM WATER RETICULATION			

	<u>Sundries</u>				
8	Unreinforced concrete 15 MPa in thrust blocks in trenches at bends, tees, etc, including extra excavation, formwork, etc	m ³	1		
9	Cutting through side of existing precast concrete kerb for opening for 110mm diameter discharge pipe	No	1		
	<u>Testing</u>				
10	Testing stormwater drainage system		Item		
	<u>STORM WATER DISCHARGE PUMP, ETC (WORK GROUP 170)</u>				
	<u>Pump sets, valves, etc (Refer to Civil Engineer's drawing number C403 REV C accompanying these bills of quantities for tender purposes)</u>				
	Descriptions of pumps shall be deemed to include connections to piping and electrical supply and/or discharge points, vibration isolation mountings, insulation, concrete plinths as indicated on drawings, pressure gauges, etc				
11	Supply, installation and commissioning of electric storm water discharge pump, valves, etc complete with all connections, fittings, etc in accordance with manufacturer's instructions and specification (electrical motor control elsewhere measured)	No	1		
	<u>THE FOLLOWING IN STORM WATER DRAINAGE CHANNEL, STORM WATER SUMP CHAMBER AND PUMP STATION CHAMBER (WORK GROUPS AS INDICATED)</u>				
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>				
	<u>Excavation in earth not exceeding 2m deep</u>				
12	Drainage channel	m ³	16		
13	Sump and pump station chamber	m ³	4		
	Carried to Collection			R	
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 3 SITE STORM WATER RETICULATION				

	<u>Back excavation of vertical sides of excavation in earth for working space including backfilling compacted to 98% Mod AASHTO density</u>				
14	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	59		
	<u>Extra over trench and hole excavations in earth for excavation in</u>				
15	Soft rock	m3	3		
16	Hard rock	m3	1		
	<u>Extra over back excavation in earth for working space for excavation in soft rock</u>				
17	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	6		
	<u>Extra over back excavation in earth for working space for excavation in hard rock</u>				
18	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	2		
	<u>Extra over all excavations for carting away</u>				
19	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	20		
	<u>Risk of collapse of excavations</u>				
20	Sides of trench and hole excavations not exceeding 1.5m deep	m2	59		
	<u>Keeping excavations free of water</u>				
21	Keeping excavations free of all water other than subterranean water		Item		
	<u>Compaction of surfaces</u>				
22	Compaction of ground surface under floors etc including scar lying for a depth of 150mm, breaking down oversize material, adding suitable material where necessary and compacting to 93% Mod AASHTO density	m2	55		
Carried to Collection				R	
Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 3 SITE STORM WATER RETICULATION					

	<u>Prescribed density tests on filling</u>			
23	"Modified AASHTO Density" test	No	6	
	<u>UNREINFORCED CONCRETE (WORK GROUP 110)</u>			
	<u>25MPa/18mm concrete</u>			
24	Sides and bottom of drainage channel	m3	11	
25	Sides and bottom of pump station chamber	m3	1	
	<u>REINFORCED CONCRETE (WORK GROUP 110)</u>			
	<u>25MPa/18mm concrete</u>			
26	Sides and bottom of storm water sump chamber	m3	2	
	<u>TEST BLOCKS (WORK GROUP 110)</u>			
27	Making and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	6	
	<u>CONCRETE SUNDRIES (WORK GROUP 110)</u>			
	<u>Finishing top surfaces of concrete smooth with a steel trowel</u>			
28	Top surfaces of concrete storm water sump chamber and pump station chamber base slabs	m2	3	
29	Top surfaces of concrete drainage canal base slab to falls	m2	53	
	<u>ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK GROUP 111)</u>			
30	Outer face of storm water sump chamber and pump station chamber walls	m2	11	
31	Edges, risers, ends and reveals not exceeding 300mm high or wide	m	9	
32	Edges exceeding 300mm high	m2	47	
	<u>SMOOTH FORMWORK (DEGREE OF ACCURACY II) (WORK GROUP 111)</u>			
	Carried to Collection			R
	Section No. 3			
	EXTERNAL WORKS (PROVISIONAL)			
	Bill No. 3			
	SITE STORM WATER RETICULATION			

	<u>Smooth formwork to sides</u>				
33	Inner face of storm water surge chamber and pump station chamber walls	m ²	11		
34	Edges, risers, ends and reveals not exceeding 300mm high or wide	m	151		
	<u>Boxing in smooth formwork to form</u>				
35	40 x 40mm Horizontal rebate along top edge	m	157		
	<u>MOVEMENT JOINTS ETC (WORK GROUP 110)</u>				
	<u>"Jointex" or similar and approved expansion joints between vertical concrete surfaces</u>				
36	12mm Joints not exceeding 300mm high	m	33		
	<u>REINFORCEMENT (WORK GROUP 114)</u>				
	<u>Fabric reinforcement</u>				
37	Mesh reference 254 fabric reinforcement in concrete surface beds, slabs, etc	m ²	9		
	<u>SUNDRY STEELWORK (WORK GROUP 136)</u>				
	<u>Drainage channel gratings, etc</u>				
38	25 x 4.5mm Mentis RS40 or similar end approved grating with banded edges and non-slip dimples laid loose in framing (framing elsewhere measured)	kg	947		
39	40 x 40 x 6mm Angle section bearers with 50 x 3mm thick x 75mm long flat section fishtail lugs welded on at 1000mm centres, including embedding in edge of concrete surface bed with Sika AnchorFix-5x	kg	476		
	Carried to Collection			R	
	Section No. 6 EXTERNAL WORKS (PROV(S)IONAL) Bill No. 3 SITE STORM WATER RECOLLECTION				

Item No		Quantity	Rate	Amount
	<u>BILL No. 4</u>			
	<u>SITE SEWER AND WASTE RETICULATION</u> <u>(PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	WORK GROUPS for this Bill as indicated			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>General note</u>			
	For SUPPLEMENTARY PREAMBLES applicable to the various trades, refer to SECTION 2 or SECTION 3 of the document			
	<u>SEWER AND WASTE DRAINAGE (WORK GROUP 146)</u>			
	<u>uPVC Class 9 pipes or similar approved pipes</u>			
1	110mm Pipes vertically or rammed to cleaning eyes etc (no excavation)	m	7	
2	110mm Pipes laid in and including trenches not exceeding 1000mm deep	m	18	
	<u>uPVC Class 34 pipes or similar approved pipes</u>			
3	110mm Sump chamber suction pipe	m	7	
4	110mm Pipes vertically to gulleys etc (no excavation)	m	25	
5	110mm Pipes laid in and including trenches not exceeding 1000mm deep	m	178	
6	110mm Pipes laid in and including trenches exceeding 1000mm and not exceeding 2000mm deep	m	119	
7	110mm Pipes laid in and including trenches exceeding 2000mm and not exceeding 3000mm deep	m	70	
	<u>Extra over uPVC Class 9 or similar approved pipes for fittings</u>			
8	110mm 90 degree Bend	No	5	
	Carried to Collection			R
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 4 SITE SEWER AND WASTE RETICULATION			

9	110mm flange adaptor	No	1	
	<u>Extra over uPVC Class 34 or similar approved pipes for fittings</u>			
10	110mm 90 degree bend	No	54	
11	110mm for 22.5 degree bend	No	5	
12	110mm for 45 degree bend	No	23	
13	110mm 22.5 degree Junction	No	5	
14	110mm 45 degree Junction	No	19	
16	110mm 90 degree 4-way junction	No	13	
16	110mm Rodding eye	No	23	
17	110mm End Cap	No	23	
	<u>Gulleys, etc</u>			
18	110mm UPVC dished gully assembly with approved hinged grating not exceeding 750mm deep and joint to uPVC pipes including bedding in concrete	No	23	
	<u>Precast concrete circular sewer sump chamber (covers elsewhere measured)</u>			
19	Sewer sump chamber 2000mm diameter exceeding 3750mm and not exceeding 3500mm deep internally	No	1	
	<u>Precast concrete circular inspection chambers (covers elsewhere measured)</u>			
20	Inspection chamber 1184mm diameter exceeding 750mm and not exceeding 1000mm deep internally	No	2	
21	Inspection chamber 1184mm diameter exceeding 1000mm and not exceeding 1250mm deep internally	No	1	
22	Inspection chamber 1184mm diameter exceeding 1000mm and not exceeding 1250mm deep internally in position in existing round sewer line in existing road surface, including necessary additional excavations, backfilling, making good road surface, etc	No	1	
23	Inspection chamber 1184mm diameter exceeding 1500mm and not exceeding 1750mm deep internally	No	4	
	Carried to Collection			R
	Section No. 6			
	EXTERNAL WORKS (PROVISIONAL)			
	Bill No. 4			
	SITE SEWER AND WASTE RETICULATION			

24	Inspection chamber 1164mm diameter exceeding 1750mm and not exceeding 2000mm deep internally	No	1		
25	Inspection chamber 1164mm diameter exceeding 2250mm and not exceeding 2500mm deep internally	No	1		
	<u>Purpose made concrete pipe drop inlet inspection chambers (covers elsewhere measured) (Refer to Civil Engineer's drawing number C302 REV C accompanying these bills of quantities for tender purposes)</u>				
26	Inspection chamber 1000mm diameter tapering to 750mm diameter at top exceeding 3500mm and not exceeding 3750mm deep internally	No	2		
27	Inspection chamber 1000mm diameter and exceeding 2000mm and not exceeding 3000mm deep internally, complete as per engineer's drawing H349739/00/00/501/201 rev.B	No	3		
	<u>Gratings, covers, etc</u>				
28	550mm Diameter Type 4 (SABS 558) cast iron manhole cover and frame	No	2		
29	550mm Diameter Type 2A (SABS 558) heavy duty cast iron manhole cover and frame	No	10		
30	Lifting-key for manhole cover (handed to employer)	No	2		
	<u>Sundries</u>				
31	Unreinforced concrete 25 MPa in irregular shaped thrust blocks behind inspection chamber drop inlet piping including extra excavation, formwork, etc	m3	4		
	<u>Testing</u>				
32	Testing sewer drainage system		Item		
	<u>SEWER AND WASTE DISCHARGE PUMP, ETC (WORK GROUP 170)</u>				
	Carried to Collection				
	Section No. 6				
	EXTERNAL WORKS (PROVISIONAL)				
	Bill No. 4				
	SITE SEWER AND WASTE RETICULATION				

	<u>Pump sets, valves, etc</u>			
33	Supply, installation and commissioning of Sulzer AS 0530 0350 Hz 3 kilowatt (400W) electric sewage and waste water pump or similar and approved with 142mm vortex impeller complete with all connections, fittings, etc in accordance with manufacturer's instructions and specification (electrical motor control elsewhere measured)	No	2	
34	Supply, installation and commissioning of Mufin Munster Model 30304T-B100 In-Line Configuration or similar and approved sewage grinder including suitable 2.2kW electric motor complete with all connections, fittings, etc in accordance with manufacturer's instructions and specification (electrical motor control elsewhere measured)	No	1	
35	Marley Pipe Systems or similar and approved 110mm sewer non-return valve	No	1	
36	Inclodon or similar and approved 110mm socketed GI IFC TOP R&V gate valve	No	2	
37	Marley or similar and approved 110 x 5" flanged adaptor product code 520.11L	No	2	
	<u>THE FOLLOWING IN PUMP STATION VALVE CHAMBER (WORK GROUPS AS INDICATED)</u>			
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>			
	<u>Excavation in earth not exceeding 2m deep</u>			
38	Pump station valve chamber	m3	6	
	<u>Back excavation of vertical sides of excavation in earth for working space including backfilling compacted to 98% Mod AASHTO density</u>			
39	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls are 300mm away from excavated face	m2	12	
	<u>Extra over trench and hole excavations in earth for excavation in</u>			
40	Soft rock	m3	1	
41	Hard rock	m3	1	
	Carried to Collection			
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 4 SITE SEWER AND WASTE RETICULATION			

	<u>Extra over back excavation in earth for working space for excavation in soft rock</u>				
42	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	1		
	<u>Extra over back excavation in earth for working space for excavation in hard rock</u>				
43	Exceeding 500mm and not exceeding 1.5m deep for placing and removing formwork to walls etc 300mm away from excavated face	m2	1		
	<u>Extra over all excavations for carting away</u>				
44	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	6		
	<u>Risk of collapse of excavations</u>				
45	Sides of trench and hole excavations not exceeding 1.5m deep	m2	12		
	<u>Keeping excavations free of water</u>				
46	Keeping excavations free of all water other than subterranean water			Item	
	<u>Compaction of surfaces</u>				
47	Compaction of ground surface under floors etc including scarifying for a depth of 150mm, breaking down oversize material, adding suitable material where necessary and compacting to 93% Mod AASHTO density	m2	4		
	<u>Prescribed density tests on filling</u>				
48	"Modified AASHTO Density" test	No	1		
	<u>REINFORCED CONCRETE (WORK GROUP 110)</u>				
	<u>25MPa/19mm concrete</u>				
49	Sides and bottom of pump station valve chamber	m3	3		
	<u>TEST BLOCKS (WORK GROUP 110)</u>				
50	Making and testing 150 x 150 x 150mm concrete strength test cube (Provisional)	No	1		
	Carried to Collection			R	
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 4 SITE SEWER AND WASTE RETICULATION				

CONCRETE SUNDRIES (WORK GROUP 110)**Finished top surfaces of concrete smooth with a steel trowel**

- 51 Top surfaces of concrete pump station valve chamber base slab

m2

4

ROUGH FORMWORK (DEGREE OF ACCURACY III) (WORK GROUP 111)

- 52 Outer face of pump station valve chamber sides

m2

12

SMOOTH FORMWORK (DEGREE OF ACCURACY II) (WORK GROUP 111)**Smooth formwork to sides**

- 53 Inner face of pump station valve chamber sides

m2

10

Boxing in smooth formwork to form

- 54 60 x 60mm horizontal rebate along top edge

m

8

MOVEMENT JOINTS ETC (WORK GROUP 110)**"Neoprene" or similar and approved packing strip between horizontal concrete and steel surfaces**

- 55 Smm joints not exceeding 300mm wide

m

6

REINFORCEMENT (WORK GROUP 114)**Fabric reinforcement**

- 56 Mesh reference 254 fabric reinforcement in concrete surface beds, slabs, etc

m2

16

SUNDRY STEELWORK (WORK GROUP 136)**Drainage channel gratings, etc**

- 57 Hinged valve box lid size 2000 x 2000 comprising of 4 5mm thick non-slip floor plate welded to 50 x 50 x 8mm angle section frame all round, including 18mm diameter x 350mm long twice bend handle fitted through 2 x holes in lid, three 20mm diameter x 150mm long bolted hinges welded on and 10mm chain fixed to lid and bearers (bearers elsewhere measured) to keep lid open at 135 degree angle

No

1

Carried to Collection

R

Section No. 6

EXTERNAL WORKS (PROVISIONAL)

Bill No. 4

SITE SEWER AND WASTE RETICULATION

58	60 x 60 x 6mm Angle section bearers with 50 x 3mm thick x 75mm long flat section fishtail lugs welded on at 1000mm centres, including embedding in edge of concrete with Sika Anchorfix 3x	kg	57		
59	12mm Chemical expansion bolt with an effective fixing length of 8mm	No	8		
Carried to Collection				R	
Section No. 6					
EXTERNAL WORKS (PROVISIONAL)					
Bill No. 4					
SITE SEWER AND WASTE RETICULATION					

Section No. 6

EXTERNAL WORKS (PROVISIONAL)

Bill No. 4

SITE SEWER AND WASTE RETICULATION

COLLECTION

Total Brought Forward from Page No.

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Amount

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Section No. 6

EXTERNAL WORKS (PROVISIONAL)

Bill No. 4

SITE SEWER AND WASTE RETICULATION

Item No		Quantity	Rate	Amount
	<u>BILL No. 5</u>			
	<u>GUARDHOUSE AND STAFF ENTRANCE - ALL TRADES (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	WORK GROUPS for this Bill as indicated			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>General note</u>			
	For SUPPLEMENTARY PREAMBLES applicable to the various trades, refer to SECTION 2 or SECTION 3 of the document			
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>			
	<u>Excavation in earth not exceeding 2m deep</u>			
1	Trenches	m3	17	
	<u>Extra over trench and hole excavations in earth for excavation in</u>			
2	Soft rock	m3	2	
3	Hard rock	m3	1	
	<u>Extra over all excavations for carting away</u>			
4	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	7	
	<u>Risk of collapse of excavations</u>			
5	Sides of trench and hole excavations not exceeding 1,5m deep	m2	49	
	<u>Keeping excavations free of water</u>			
6	Keeping excavations free of all water other than subterranean water	Item		
	Carried to Collection			R
	Section No. 5 EXTERNAL WORKS (PROVISIONAL) Bill No. 5 GUARDHOUSE AND STAFF ENTRANCE			

	<u>Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 98% Mod AASHTO density</u>				
7	Backfilling to trenches, holes, etc	m3	10		
	<u>UNREINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES (WORK GROUP 110)</u>				
	<u>25MPa/19mm concrete</u>				
8	Strip footings	m3	4		
9	Surface beds cast in panels on waterproofing	m3	1		
	<u>BRICKWORK IN FOUNDATIONS (WORK GROUP 116)</u>				
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>				
10	Half brick walls	m2	2		
11	One brick walls	m2	23		
	<u>BRICKWORK IN SUPERSTRUCTURE (WORK GROUP 116)</u>				
	<u>Brickwork of NFP bricks in class II mortar</u>				
12	Half brick walls	m2	4		
13	One brick walls	m2	54		
	<u>BRICKWORK SUNDRIES (WORK GROUP 116)</u>				
	<u>Brickwork reinforcement</u>				
14	75mm Wide reinforcement built in horizontally in foundations (Provisional)	m	25		
15	75mm Wide reinforcement built in horizontally	m	13		
16	150mm Wide reinforcement built in horizontally in foundations (Provisional)	m	270		
17	150mm Wide reinforcement built in horizontally	m	135		
	Carried to Collection			R	
	Section No. 6				
	EXTERNAL WORKS (PROVISIONAL)				
	Bill No. 5				
	GUARDHOUSE AND STAFF ENTRANCE				

	<u>Prestressed fabricated lintels</u>				
18	110 x 75mm Lintels in lengths not exceeding 3m	m	1		
19	150 x 75mm Lintels in lengths not exceeding 3m	m	7		
	<u>FACE BRICKWORK (WORK GROUP 116)</u>				
	<u>Corobrik Titanium Gun Metal Grey Satin Texture or similar and approved face bricks pointed with recessed horizontal and vertical joints</u>				
20	Extra over brickwork for face brickwork in foundations	m2	2		
21	Extra over brickwork for face brickwork in superstructure	m2	42		
	<u>DAMP-PROOFING OF WALLS AND FLOORS (WORK GROUP 120)</u>				
	<u>One layer of 375 micron "Consol Plastics Brikrup DPC" or similar and approved embossed damp proof course</u>				
22	In walls	m2	11		
	<u>One layer of 250 micron "Consol Plastics Gunplas USB Green" or similar and approved waterproof sheeting sealed at laps with "Gunplas Pressure Sensitive Tape" or similar and approved tape</u>				
23	Under surface beds	m2	8		
	<u>PROFILED METAL SHEETING AND ACCESSORIES (WORK GROUP 124)</u>				
	<u>Safintra 0.5mm thick double interlocking concealed fix SAFLOK 700 profile Colomplus AZ100 ("Thunderstorm" finish outside and "Pebble Grey" finish inside) roof sheeting in single lengths, as manufactured by Safintra Roofing, or similar and approved, fixed to timber purlins (elsewhere measured) in accordance with the manufacturer's instructions</u>				
24	Roof covering with pitch not exceeding 25 degrees	m2	10		
25	Headwall flashing 305mm girth	m	3		
26	Sidewall flashing 305mm girth	m	6		
	Carried to Collection			R	
	Section No. 6				
	EXTERNAL WORKS (PROVISIONAL)				
	Bill No. 5				
	GUARDHOUSE AND STAFF ENTRANCE				

27	Counter flashing 154mm glrth	m	9	
<u>ROOF INSULATION (WORK GROUP 124)</u>				
<u>"Sisalation FR 405" or similar and approved fire retardant light industrial grade double sided reflective foil laminate reinforced aluminium foil bonded insulation</u>				
28	Insulation laid taut over timber rafters (at approximately 500mm centres) and fixed concurrent with purlins, etc	m2	10	
<u>WALL PANELS (WORK GROUP 126)</u>				
<u>MOSO Bamboo X-treme 1x4 T&G decking boards, or similar and approved, made from compressed, thermally treated bamboo strips (colour chocolate) installed strictly in accordance with the manufacturer's instructions</u>				
29	Decking of 18mm tongued and grooved high density boarding (product code BO-POR-18-36-PP) fixed to face of brick wall (brick wall elsewhere measured)	m2	11	
<u>ROOF JOINERY (WORK GROUP 126)</u>				
<u>Sawn softwood</u>				
30	38 x 75mm Purlins	m	50	
31	38 x 114mm Roof beams	m	17	
<u>SKIRTINGS (WORK GROUP 126)</u>				
<u>Wrought meranti</u>				
32	22 x 69mm Bullnose skirting nailed	m	14	
<u>DOORS ETC (WORK GROUP 126)</u>				
<u>"Lotus Amoretti" or similar and approved solid flush back doors hung to steel frames</u>				
33	40mm Internal Horizontal 813 door 813 x 2032mm high	No	1	
34	Extra over door for 450 x 600mm opening for louvre panel (elsewhere measured)	No	1	
<u>CILLS (WORK GROUP 126)</u>				
Carried to Collection				R
Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bt No. 5 GUARDHOUSE AND STAFF ENTRANCE				

	<u>Wrought meranti</u>				
35	32 x 160mm Cill with double bullnosed front edge plugged	m	5		
	<u>NAILED UP CEILINGS (WORK GROUP 129)</u>				
	<u>4mm "Everite Nutec" fibre-cement boards with H-type pressed steel jointing strips</u>				
36	Ceilings including 38 x 38mm sawn softwood bracing at 450mm centres in both directions	m2	7		
37	Extra over ceiling for opening for 75mm diameter downlighter (Provisional)	No	1		
38	Extra over ceiling for opening for 600 x 1 200mm light fitting (Provisional)	No	1		
	<u>"Everite Nutec" Nu-Done Plain 75 polystyrene cove cornice or similar and approved fixed to wall and ceiling using Nucorice Adhesive or similar and approved adhesive</u>				
39	75mm Coved cornices	m	17		
	<u>FLOOR COVERINGS (WORK GROUP 130)</u>				
	<u>2.5mm Thick "Expona Commercial Wood PUR" luxury vinyl planks, colour "Antique Oak", or similar and approved, laid on a "Polyflor" or similar approved adhesive on concrete screed (screed elsewhere measured), all in accordance with the manufacturer's specifications and instructions</u>				
40	On floors	m2	7		
	<u>POLISH, SEALERS, ETC (WORK GROUP 130)</u>				
41	Two coats wax polish on vinyl flooring	m2	7		
	<u>IRONMONGERY (WORK GROUP 132)</u>				
	<u>Where applicable catalogue numbers and finishes to ironmongery are indicated, refer to "ASSA ABLOY" standard catalogue or similar and approved</u>				
42	37651A5 Union facility indicator bolt	No	1		
Carried to Collection					
Section No. 6					
EXTERNAL WORKS (PROVISIONAL)					
Bill No. 5					
GUARDHOUSE AND STAFF ENTRANCE					

43	SS2016SS Bathroom deadbolt	No	1		
44	SS6163-06SS Handle on blank plate	No	2		
45	SS5305-05SS Escutcheon on rose profile	No	1		
46	SS5004-73SS Bathroom escutcheon on rose	No	1		
47	870015S Floor door step satin stainless steel	No	1		
48	SS8025SS Hat and coat hook with rubber	No	1		
	<u>15mm Thick x 75mm wide grade 304 stainless steel individual cut lettering with brushed finish pin-fixed to brickwork</u>				
49	250mm High "arial font" lettering	No	28		
	<u>SUNDRY ALUMINIUM WORK (WORK GROUP 138)</u>				
	<u>"Trellidor" or similar and approved polycarbonate burglar bars including patented bronze anodised aluminium frame fixed (tamper-proof fixing) to brickwork or concrete reveal of window opening, strictly in accordance with the manufacturer's instructions</u>				
50	Burglar bars for window opening size 600 x 600 mm High	No	1		
51	Burglar bars for window opening size 900 x 1 200mm high	No	2		
52	Burglar bars for window opening size 1 800 x 1 200mm high	No	1		
	Carried to Collection			R	
	Section No. 8				
	EXTERNAL WORKS (PROVISIONAL)				
	Bill No. 5				
	GUARDHOUSE AND STAFF ENTRANCE				

**NATURAL ANODISED ALUMINIUM LOUVRE
UNITS (WORK GROUP 136)**

- 53 Double frame fixed louver unit size 450 x 800mm high
with horizontal blades fixed in opening of door including
silicone sealant all round on both sides

No 1

**PRESSED STEEL DOOR FRAMES (WORK
GROUP 136)**

1.2mm Rebated frames suitable for half brick walls

- 54 Frame for door 6'3 x 2032mm high

No 1

SCREEDS (WORK GROUP 142)

Screeds on concrete

- 55 20 mm Thick on floors and landings

m2 7

INTERNAL PLASTER (WORK GROUP 142)

Cement plaster on brickwork

- 56 On walls

m2 34

- 57 On narrow widths

m2 2

EXTERNAL PLASTER (WORK GROUP 142)

- 58 On walls

m2 40

- 59 On narrow widths

m2 5

WALL TILING (WORK GROUP 144)

**75 x 300mm Union or similar and approved white
glass tiles fixed with high strength grey
cementitious based adhesive to plaster (plaster
elsewhere) with 3mm continuous flush joints in both
directions**

- 60 On walls in isolated panels, splashbacks, etc

m2 0.7

"HOMELUX" or similar approved

- 61 6mm Stainless steel effect straight edge metal tile trim

m 2

SANITARY FITTINGS (WORK GROUP 148)

Carried to Collection

Section No. 6

EXTERNAL WORKS (PROVISIONAL)

Bill No. 5

GUARDHOUSE AND STAFF ENTRANCE

<u>"Franke" or similar and approved</u>					
62	1.2mm Grade 304 1 8/10 stainless steel I.D.S heavy duty security type wash hand basin (Code 2520008) size 380 x 322 x 340mm, manufactured with a pressed bowl size 360 x 280 x 140mm deep, complete with a pressed perforated waste outlet, 50mm diameter x 250mm long stainless steel outlet pipe, four 8mm diameter x 250mm long galvanised mild steel threaded rods for fixing the basin to brickwork, including "Walcro" or similar and approved 155UW5 metering basin valve and BBD/15 basin spout	No	1		
<u>"Vaal" or similar and approved</u>					
63	Galay Elite semi close coupled 90 degree outlet open rim wc suite (Code 751400) and matching 9 litre cistern (Code 71180) complete with lid, fittings, flush pipe elbow and thermostet soft-close seat	No	1		
<u>TRAPS ETC (WORK GROUP 146)</u>					
<u>uPVC</u>					
64	40mm Deep seal "P" or "S" trap	No	1		
<u>SANITARY PLUMBING (WORK GROUP 146)</u>					
<u>uPVC pipes</u>					
65	40mm Pipes	m	8		
66	110mm Pipes	m	5		
67	110mm Pipes laid in and including trenches not exceeding 1m deep	m	3		
<u>Extra over uPVC pipes for fittings</u>					
68	40mm Bend	No	3		
69	40mm Access bend	No	1		
70	110mm Bend	No	2		
71	110mm Junction	No	1		
72	110mm Access bowl pan connector	No	1		
73	110mm "GI Two-way" vent valve	No	1		
Carried to Collection				R	
Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 5 GUARDHOUSE AND STAFF ENTRANCE					

[illegible]

PAINTWORK ON FLOATED PLASTER (WORK GROUP 152)

Prepare and apply Kwartz Fill to surface cracks, one coat PlasterSeal primer and two coats TruVelvet paint or similar and approved

85 On internal walls m2 36

Prepare and apply Kwartz Fill to surface cracks, one coat PlasterSeal primer and two coats EnviroSilk paint or similar and approved

88 On external walls m2 45

PAINTWORK ON FIBRE-CEMENT (WORK GROUP 152)

One coat bonding liquid, one coat primer and two coats Pure Acrylic PVA paint or similar and approved

87 On ceilings m2 7

PAINTWORK ON METAL (WORK GROUP 152)

Prepare and apply two coats Dulux Grip undercoats and three coats Dulux Pearglo waterbased finishing coats or similar and approved on steel

88 On door frames m2 1

PAINTWORK ON WOOD (WORK GROUP 152)

Prepare and apply three coats Woodoc 5 Indoor Polywax Sealer (clear) with added Woodoc Stain Concentrate (meranti shade), or similar and approved, as per the manufacturer's instructions

89 On doors m2 6

Prepare and apply one coat sanding sealer and two coats clear varnish on wood

90 On skirtings, rails, etc not exceeding 300mm m 19

Carried to Collection

R.

Section No. 5
EXTERNAL WORKS (PROVISIONAL)
Bill No. 5
GUARDHOUSE AND STAFF ENTRANCE

Item No		Quantity	Rate	Amount
	<u>BILL No. 6</u>			
	<u>REFUSE AREA - ALL TRADES</u> <u>(PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	WORK GROUPS for this Bill as indicated			
	<u>SUPPLEMENTARY PREAMBLES</u>			
	<u>General note</u>			
	For SUPPLEMENTARY PREAMBLES applicable to the various trades, refer to SECTION 2 or SECTION 3 of the document			
	<u>EXCAVATION, FILLING, ETC OTHER THAN BULK (WORK GROUP 104)</u>			
	<u>Excavation in earth not exceeding 2m deep</u>			
1	Trenches	m3	15	
	<u>Extra over trench and hole excavations in earth for excavation in</u>			
2	Soft rock	m3	1	
3	Hard rock	m3	0.3	
	<u>Extra over all excavations for carting away</u>			
4	Surplus material from excavations and/or stock piles on site to a dumping site to be located by the contractor	m3	6	
	<u>Risk of collapse of excavations</u>			
5	Sides of trench and hole excavations not exceeding 1.5m deep	m2	42	
	<u>Keeping excavations free of water</u>			
6	Keeping excavations free of all water other than subterranean water	Item		
	Carried to Collection		R	
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 5 REFUSE AREA			

	<u>Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 98% Mod AASHTO density</u>		
7	Backfilling to trenches, holes, etc	m3	9
	<u>UNREINFORCED CONCRETE CAST AGAINST EXCAVATED SURFACES (WORK GROUP 110)</u>		
	<u>25MPa/19mm concrete</u>		
8	Skip footings	m3	4
9	Surface beds cast in panels on waterproofing	m3	2
	<u>Finishing top surfaces of concrete smooth with a power float</u>		
10	Surface beds, slabs, etc to falls and currents	m2	25
	<u>BRICKWORK IN FOUNDATIONS (WORK GROUP 116)</u>		
	<u>Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar</u>		
11	One brick walls	m2	21
	<u>BRICKWORK IN SUPERSTRUCTURE (WORK GROUP 116)</u>		
	<u>Brickwork of NFP bricks in class II mortar</u>		
12	One brick walls	m2	41
	<u>BRICKWORK SUNDRIES (WORK GROUP 116)</u>		
	<u>Brickwork reinforcement</u>		
13	150mm Wide reinforcement built in horizontally in foundations (Provisional)	m	254
14	150mm Wide reinforcement built in horizontally	m	108
	<u>FACE BRICKWORK (WORK GROUP 116)</u>		

Carried to Collection

Section No. 6
EXTERNAL WORKS (PROVISIONAL)
Bill No. 6
REFUSE AREA

	<u>Corobrik Titanium Gun Metal Grey Salin Texture or similar and approved face bricks pointed with recessed horizontal and vertical joints</u>				
15	Extra over brickwork for face brickwork in foundations	m2	4		
16	Extra over brickwork for face brickwork in superstructure	m2	85		
17	Extra over brickwork for brick-on-edge header course band	m	106		
	<u>DAMP-PROOFING OF WALLS AND FLOORS</u> <u>(WORK GROUP 120)</u>				
	<u>One layer of 375 micron "Consol Plastics Briqrip DPC" or similar and approved embossed damp proof course</u>				
18	In walls	m2	5		
	<u>One layer of 250 micron "Consol Plastics Gunplas USB Green" or similar and approved waterproof sheeting sealed at laps with "Gunplas Pressure Sensitive Tape" or similar and approved tape</u>				
19	Under surface beds	m2	25		
	<u>WELDED STEEL SCREENS, GATES, ETC</u> <u>(WORK GROUP 136)</u>				
20	Double gate size 1800 x 2125mm high overall, each leaf of 50 x 50 x 2.5mm hollow section frame, with 10mm thick x 150mm wide horizontal fibre board planks countersunk screwed to frame on one side for the full height of the leaf and each leaf fitted with a pair of suitable hinges welded to 200 x 200 x 10mm thick plate, bolted to wall with and including four 12mm diameter expansion bolts per hinge and with 12mm diameter x 250mm long drop bolt with metal keep in concrete and hasp and staple welded on	No	1		
21	"COCHRANE STEEL" or similar and approved 100mm. toughened steel "shark tooth" spike fixed with anti-vandal bolts at 150mm centres to top of brick wall	m	21		
	<u>TAPS, VALVES, ETC (WORK GROUP 148)</u>				
	<u>"Cobra" or similar and approved</u>				
22	20mm Brass oilcock with hose union	No	1		
	Carried to Collection			R	
	Section No. 6 EXTERNAL WORKS (PROVISIONAL) Bill No. 6 REFUSE AREA				

WATER SUPPLIES (WORK GROUP 148)"Polycop" polypropylene pipes with brass compression fittings

23	20mm Pipes	m	3		
24	25mm Pipes	m	2		
25	25mm Pipes laid in and including trenches	m	1		

Extra over "Polycop" polypropylene pipes for brass compression fittings

26	20mm Fittings	No	4		
27	25mm Fittings	No	4		

Sundries

28	450 x 450 mm Cast iron stopcock box including brick chamber below not exceeding 750mm deep internally	No	1		
29	Testing water supply pipe system	Item			

PAINTWORK ON FIBRE-CEMENT (WORK GROUP 152)One coat bonding liquid, one coat primer and two coats Pure Acrylic PVA paint or similar and approved

30	On horizontal planks to gate (both sides measured)	m2	8		

PAINTWORK ON METAL (WORK GROUP 152)Prepare and apply two coats Dulux Grip undercoats and three coats Dulux Pearloid waterbased finishing coats or similar and approved on steel

31	On gates, gates, burglar screens, balustrades, etc (both sides measured over the full flat area)	m2	8		

Carried to Collection

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Section No. 6
EXTERNAL WORKS (PROVISIONAL)
Bill No. 6
REFUSE AREA

Section No. 6

EXTERNAL WORKS (PROVISIONAL)

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REFUSE AREA

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EXTERNAL WORKS (PROVISIONAL)

Bill No. 6

REFUSE AREA

EXTERNAL WORKS (PROVISIONAL)

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1	GENERAL SITE WORKS, RETAINING STRUCTURES, PAVINGS, FENCING, ETC (PROVISIONAL)
2	SITE CONSUMPTION WATER AND FIRE WATER SUPPLY AND RETICULATION
3	SITE STORM WATER RETICULATION
4	SITE SEWER AND WASTE RETICULATION
5	GUARDHOUSE AND STAFF ENTRANCE
6	REFUSE AREA

199

211

217

225

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Carried to Final Summary

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EXTERNAL WORKS (PROVISIONAL)

Item No		Quantity	Rate	Amount
	<u>BILL No. 1</u>			
	<u>NDPW CONTRACT PARTICIPATION GOALS AND CIDB BUILD PROGRAMME (PROVISIONAL)</u>			
	<u>WORK GROUP</u>			
	This Bill will not be subjected to any Contract Price Adjustment Provisions			
	<u>NOTE TO TENDERERS</u>			
	As CPGs may not provide any bidder a competitive advantage, provisions and fixed percentages for profit and attendance have been provided.			
	<u>CONTRACT PARTICIPATION GOALS - FOR THE CALCULATION OF THESE GOALS, REFER ALSO TO DOCUMENT IN PART C7 : NDPWI CONTRACT PARTICIPATION GOALS AND CIDB BUILD PROGRAMME IMPLEMENTATION GUIDE</u>			
	<u>MINIMUM TARGETED LOCAL BUILDING MATERIAL SUPPLIERS</u>			
	Provision is made for the Minimum Targeted Local Building Material Suppliers CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.0.2. Materials to the value of R500 000.00 (Five Hundred Thousand Rand) should be purchase from local suppliers as defined in the CPG specification in terms of locality, based on determination by the PQS taking into account specific project variables			
1	Allowance for monitoring and monthly reporting on material purchased from Local Building Material Suppliers by main contractor and subcontractors	%	5.00	
2	Add for profit all inclusive of associated costs to the contractor for implementation	%	5.00	
3	Add for attendance all inclusive of associated costs to the contractor for implementation.	%	5.00	
	Carried to Collection			
	Section No. 7 NDPW CONTRACT PARTICIPATION GOALS AND CIDB Bill No. 1 NDPW CONTRACT PARTICIPATION GOALS AND CIDB			

MINIMUM TARGETED LOCAL LABOUR SKILLS DEVELOPMENT

- 4 Provision is made for the Minimum Targeted Local Labour Skills Development CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.3

Item

380,000.00

- 5 Allowance for the cost for a suitably qualified and experienced training service provider appointed by the main contractor including monitoring and monthly reporting

%

5.00

- 6 Add for profit all inclusive of associated costs to the contractor for implementation,

%

5.00

- 7 Add for attendance all inclusive of associated costs to the contractor for implementation,

%

5.00

MINIMUM TARGETED ENTERPRISE DEVELOPMENT

Provision of 0.5% (Five Percent) of the tender value is made for Minimum Targeted Enterprise Development CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.4.

- 8 Allowance is for the appointment of training coordinator, mentor, training service providers and training of the beneficiary enterprises including monitoring and monthly reporting

%

5.00

- 9 Add for profit all inclusive of associated costs to the contractor for implementation,

%

5.00

- 10 Add for attendance all inclusive of associated costs to the contractor for implementation,

%

5.00

MINIMUM TARGETED SKILLS DEVELOPMENT GOALS

- 11 Provision is made for the Minimum Targeted Skills Development CPG in the execution of this project as described in PG-01.2 (EC) SCOPE OF WORKS C3.6.5.

Item

480,000.00

Carried to Collection

R

Section No. 7

NDPWI CONTRACT PARTICIPATION GOALS AND CDB

Bill No. 1

NDPWI CONTRACT PARTICIPATION GOALS AND CDB

12	Allowance is for the appointment of a suitably qualified person to manage the requirements as per the document mentioned above and will include inter alia the following : • stipends payable to the beneficiaries • appointment of training coordinator • appointment of mentor (where applicable) • appointment of training service providers • other additional costs as per table 3 of the Standard • monitoring and monthly reporting, etc	%	5.00
13	Add for profit all inclusive of associated costs to the contractor for implementation.	%	5.00
14	Add for attendance all inclusive of associated costs to the contractor for implementation.	%	5.00

MINIMUM TARGETED LABOUR INTENSIVE WORK

Provision is made for the Minimum Targeted Labour Intensive Work CPG in the execution of this project as described in PG-C1.2 (EC) SCOPE OF WORKS C3.6.7. Allow for Labour Intensive Work to the value of R2 660 000.00 (Two Million Six Hundred and Sixty Thousand Rand) as defined in the CPG specification in terms of locality, based on determination by the PQS taking into account specific project variables.

15	Allowance for monitoring and monthly reporting on labour intensive work by main contractor and subcontractors	%	5.00
16	Add for profit all inclusive of associated costs to the contractor for implementation.	%	5.00
17	Add for attendance all inclusive of associated costs to the contractor for implementation	%	5.00

Carried to Collection

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Section No. 7
 NDPWI CONTRACT PARTICIPATION GOALS AND CIGS
 Bill No. 1
 NDPWI CONTRACT PARTICIPATION GOALS AND CIGS

Section No. 7

NDPWI CONTRACT PARTICIPATION GOALS AND CDBG BUILD PROGRAMME (PR

Bill No. 1

NDPWI CONTRACT PARTICIPATION GOALS AND CDBG BUILD PROGRAMME

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Section No. 7

NDPWI CONTRACT PARTICIPATION GOALS AND CDBG

Bill No. 1

NDPWI CONTRACT PARTICIPATION GOALS AND CDBG

Item No		Quantity	Rate	Amount
	<u>BILL No. 1</u>			
	<u>PROVISIONAL SUMS</u>			
	<u>PROVISIONAL SUMS</u>			
	The following provisional sums are to be used as directed by the Department of Public Works and Infrastructure and omitted in whole or in part if not required.			
	<u>PROVISION OF FIBRE INTERNET CONNECTION</u>			
1	Provide the sum of R2 875 000.00 (Two Million Eight Hundred and Seventy Five Thousand Rand) for the fibre internet connection	Item		2,875,000.00
2	Add for profit if required	%		
3	Add for attendance if required	%		
	<u>COMMUNITY LIASON OFFICER (CLO)</u>			
4	Provide the sum of R275 000.00 (Two Hundred And Seventy Six Thousand Rand) for the community liaison officer for the construction period of 24 months	Item		275,000.00
5	Add for profit if required	%		
6	Add for attendance if required	%		
	<u>CLERK OF WORKS</u>			
7	Provide the sum of R835 000.00 (Eight Hundred and Five Thousand Rand) for the clerk of works for the construction period of 24 months	Item		835,000.00
8	Add for profit if required	%		
9	Add for attendance if required	%		
	Carried to Collection		R	
	Section No. 8 PROVISIONAL SUMS Bill No. 1 PROVISIONAL SUMS			

LOCAL AUTHORITY CONNECTION FEES

10 Provide the sum of R92 000.00 (Ninety Two Thousand Rand) for local authority connection fees to be paid by the contractor and recovered from the employer

11 Add for profit if required

12 Add for attendance if required

ELECTRICAL INSTALLATION - ADDITIONAL PROVISIONS

13 Provide the sum of R155 250.00 (One Hundred and Fifty Five Thousand Two Hundred and Fifty Rand) for additional provisions in connection with the electrical installation

14 Add for profit if required

15 Add for attendance if required

Carried to Collection

Section No. 8
PROVISIONAL SUMS
Bill No. 1
PROVISIONAL SUMS

Item 92,000.00

%

%

Item 155,250.00

%

%

R

Section No. 8

PROVISIONAL SUMS

Bill No. 1

PROVISIONAL SUMS

COLLECTION

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PROVISIONAL SUMS

Bill No. 1

PROVISIONAL SUMS

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	Sub Total excluding VAT		R
	Add VAT @ 16%		R
	Carried to Form of Offer and Acceptance		R

PART C5
ELECTRICAL INSTALLATION

DEPARTMENT OF PUBLIC WORKS

JAN KEMPDORP MAGISTRATE COURT

On

C/O PIET RETIEF AND ARBEID STREET
JAN KEMPSDORP, NORTHERN CAPE
ELECTRICAL TENDER DOCUMENT



public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

ARCHITECT

The Creative Axis Architects
34 Dauphine Street
Bayswater
Bloemfontein



ELECTRICAL ENGINEERS

ZUTARI SOUTH AFRICA PTY LTD
Hydro Park 135 Pres Reitz Avenue
Bloemfontein
9301



111607

APRIL 2021

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- **Section 4: MCC Installation**
- **Final Summary**

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**ELECTRICAL INSTALLATION
BILLS OF QUANTITIES**

SECTION No. 1
PRELIMINARIES

SECTION No. 1 PRELIMINARIES						
ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
1	NOTE The pricing of this section to be included with the Project Bill of Quantities (Refer Section No. 2 - Preliminaries)	sum	-			R -
	Carried to Final Summary					R -

SECTION No. 2
MW & STANDBY POWER INSTALLATION

SECTION No. 2
MV & STANDBY POWER INSTALLATION

ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
2	MV Installation					
2.1	Nalenik Upgrade for Jira Zangpoap Municipality to supply connection	sum	1			
2.2	Add percentage for profit and attendance	%	10%			
2.3	11kV XLPE Copper Cable Table 19	m	100			
2.4	600kVA Miniature Substation Complete with earth mat and P/Inch	ea	1			
2.5	Earth grid for Main sub	ea	1			
2.6	STANDBY GENERATOR					
2.6.1	Supply and install 500 kVA Standby Generator as specified including Drive	nos	1			
2.6.2	Earth grid for Generator	sqm	1			
2.7	CABLE BLEEVES					
2.7.1	Supply and install 110mm diameter PVC sleeve with draw wires	m	220			
2.7.2	Supply and install 50mm diameter PVC sleeve with draw wires	m	50			
2.8	PVC DANGER TAPE					
2.8.1	Supply and install of PVC danger tape above the cables as specified:	m	100			
2.9	MANHOLES					
2.9.1	Supply and install 600 x 600mm Manholes with non-ocable lids	ea	2			
Carried to Final Summary						R -

SECTION No. 3
LY BUILDING INSTALLATION

SECTION No. 3
LV BUILDING INSTALLATION

ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
3.1	NEW LV DISTRIBUTION BOARDS Supply and installation of the following new distribution boards complete with switching gear and equipment as specified. Refer to single line diagrams and specification.					
3.1.1	Distribution Board - Main	EA	1			
3.1.2	Distribution Board - A	EA	1			
3.1.3	Distribution Board - B	EA	1			
3.1.4	Distribution Board - C	EA	1			
3.1.5	Distribution Board - D	EA	1			
3.1.6	Distribution Board - E	EA	1			
3.1.7	Distribution Board - F	EA	1			
3.2	LABELLING OF DISTRIBUTION BOARDS Supply and install labels in black with white background for all equipment. Letters to be at least 20mm high.	Item	1			
3.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
3.3.1	500mm ² x 4 Core Cu PVC SWA PVC Cable	m	260			
3.3.2	240mm ² x 4 Core Cu PVC SWA PVC Cable	m	200			
3.3.3	185mm ² x 4 Core Cu PVC SWA PVC Cable	m	50			
3.3.4	150mm ² x 4 Core Cu PVC SWA PVC Cable	m	90			
3.3.5	120mm ² x 4 Core Cu PVC SWA PVC Cable	m	-			
3.3.6	50mm ² x 4 Core Cu PVC SWA PVC Cable	m	80			
3.3.7	35mm ² x 4 Core Cu PVC SWA PVC Cable	m	1			
3.3.8	25mm ² x 4 Core Cu PVC SWA PVC Cable	m	160			
3.3.9	16mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
3.3.10	10mm ² x 4 Core Cu PVC SWA PVC Cable	m	110			
3.3.11	4mm ² x 3 Core Cu PVC SWA PVC Cable	m	120			
3.3.12	150mm ² Bare Copper Earth	m	510			
3.3.13	95mm ² Bare Copper Earth	m	30			
3.3.14	35mm ² Bare Copper Earth	m	90			
3.3.15	16mm ² Bare Copper Earth	m	160			
3.3.16	10mm ² Bare Copper Earth	m	180			
3.3.17	6mm ² Bare Copper Earth	m	110			
Carried to Summary of Section No. 3					R	-

3.3.19	Trenching (600 mm deep x 300 mm wide), including back filling	m	100			
3.4	LIGHTING INSTALLATION Supply and installation of the following luminaires					
3.4.1	B1	ea	74			
3.4.2	B2	ea	21			
3.4.3	B3	ea	41			
3.4.4	B4	ea	4			
3.4.5	B5	ea	4			
3.4.6	D1	ea	82			
3.4.7	D2	ea	5			
3.4.8	D3	ea	5			
3.4.9	J2	ea	18			
3.4.10	R1	ea	19			
3.4.11	F4	ea	143			
3.4.12	A1- inclusive of 4.5m High Fibre Glass poles (4m mounting height)	ea	33			
3.4.13	A2	ea	37			
3.4.14	Supply and install 5 Amp. Non-switch sockets for final connections to light fittings	ea	525			
3.4.15	Supply and install 5 Amp. Plug caps complete with 3 meter 2.5mm ² x 3 core Galvne cord for final connections to light fittings	ea	525			
3.4.16	Supply and install 2.5mm ² Red PVC covered stranded copper wire	m	17325			
3.4.17	Supply and install 2.5mm ² Black PVC covered stranded copper wire	m	17325			
3.4.18	Supply and install 2.5mm ² Bare stranded copper wire	m	17325			
3.4.19	Supply and install 16 Ampere single lever one way flush mounted light switches complete with cover plate and screws	ea	52			
3.4.20	Supply and install 16 Ampere single lever two way flush mounted light switches complete with cover plate and screws	ea	33			
3.4.21	Supply and install 16 Ampere single lever three way flush mounted light switches complete with cover plate and screws	ea	2			
3.4.22	Supply and install 10 Ampere single lever one way dimmable flush mounted light switches complete with cover plate and screws	ea	4			
	Carried to Summary of Section No. 3					R

3.4.23	Supply and install 16 Ampere two lever two way flush mounted light switches complete with cover plate and screws	ea	5			
3.4.24	Supply and install 16 Ampere two lever one way flush mounted light switches complete with cover plate and screws	ea	4			
3.4.25	Supply and install 10 Ampere Single Load 360° PIR Occupancy Sensor light switches complete with all accessories	ea	31			
3.4.26	Supply and install 16 Ampere photo electric relays (Photo cells)	ea	7			
3.4.27	Supply and install 20 mm diameter Boral steel conduit in concrete complete with sockets, locknuts and saddles terminated in wall boxes and round boxes	m	660			
3.4.28	Supply and install 20 mm diameter Boral steel conduit in brick complete with sockets, locknuts and saddles terminated in wall boxes and round boxes	m	660			
3.4.29	Supply and install 20 mm diameter Boral steel conduit laid to roof trusses complete with sockets, locknuts and saddles terminated in galvanized trunking and round boxes	m	660			
3.4.30	Supply and install 60mm diameter Boral steel conduit round boxes in concrete	ea	100			
3.4.31	Supply and install 60mm diameter Boral steel conduit round boxes in brick	ea	100			
3.4.32	Supply and install 100mm x 50mm x 50mm galvanized wall boxes	ea	120			
3.4.33	Chasing in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	250			
3.5	16 AMPERE SOCKET OUTLETS					
3.5.1	External weather proof power outlets IP65 box	ea	6			
3.5.2	Dual flush mounted switched socket outlet	ea	87			
3.5.3	Single flush mounted dedicated switched socket outlet	ea	2			
3.5.4	Dual flush mounted dedicated switched socket outlet	ea	3			
3.5.5	Supply and install 2-line Floor Box in concrete complete with accessories and cover plate	ea	6			
3.5.6	Supply and install Castrol multi-unit 4-line wall boxes	ea	57			
3.5.7	Data port outlet	ea	100			
3.5.8	Supply and install 20 mm diameter Boral steel conduit chased in brick complete with sockets, locknuts and saddles terminated in wall boxes and trunking	m	300			
	Carried to Summary of Section No. 3					R

3.5.9	Supply and install 100mm x 100mm x 50mm galvanized wall boxes	ea	87			
3.5.10	Chasing in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	300			
3.5.11	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	9333			
3.5.12	Supply and install 2.5mm ² Bare stranded copper wire	m	4500			
3.5.13	Supply and install 2.5mm ² green and yellow PVC covered stranded copper wire	m	4500			
3.6	BOOM GATES (ROLLER DOORS)					
3.6.1	Supply and install 40 Ampere double pole flush mounted isolator	ea	2			
3.6.2	Supply and install 25 mm diameter Bosa steel conduit complete with sockets in ground	m	100			
3.6.3	Supply and install 25 mm diameter Bosa steel conduit complete with sockets, locknuts and saddles terminated in wall boxes or back	m	100			
3.6.4	Supply and install 4mm ² Red and Black PVC covered stranded copper wire	m	500			
3.6.5	Supply and install 2.5mm ² Bare stranded copper wire	m	150			
3.7	AIR-CONDITIONING OUTLET POINTS					
3.7.1	Supply and install 20 Ampere double pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	110			
3.7.2	Supply and install 20 Ampere triple pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	15			
3.7.3	Supply and install 25 mm diameter Bosa steel conduit complete with sockets in concrete	m	800			
3.7.4	Supply and install 25 mm diameter Bosa steel conduit complete with sockets, locknuts and saddles terminated in wall boxes or back	m	800			
3.7.5	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	10000			
3.7.6	Supply and install 2.5mm ² Bare stranded copper wire	m	5000			
3.7.7	Final connector to outdoor and indoor unit including conductors, flexible conduit, adapters and auxiliary material as required by supplier of air conditioning unit	item	102			
3.7.8	Supply and install O-Line Wire Mesh (75mm x 100mm) in ceiling void complete with elbows, tees, intersections, bolts and nuts	m	200			
	Carried to Summary of Section No. 3					R

3.7	AIR-CONDITIONING OUTLET PORTS					
3.7.1	Supply and install 20 Ampere double pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	110			
3.7.2	Supply and install 20 Ampere triple pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	15			
3.7.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	m	500			
3.7.4	Supply and install 20 mm diameter Boral steel conduit complete with sockets, tees and end caps terminated in wall boxes in brick	m	500			
3.7.5	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	10000			
3.7.6	Supply and install 2.5mm ² Blue stranded copper wire	m	5000			
3.7.7	Final connection to outdoor and indoor unit including conductors, flexible conduit, adaptors and ancillary material as required by supplier of air conditioning units	item	102			
3.7.8	Supply and install O-Line Wire Mesh (75mm x 100mm) in ceiling void complete with elbows, tees, intersections, bolts and nuts	m	300			
3.8	LIGHTNING PROTECTION Lightning protection installation complete as specified and indicated on the drawings. The installation must be done by specialist contractor.					
3.8.1	16mm diameter copper bar earth electrode installed with length of 1200mm long	ea	9			
3.8.2	25mm ² PVC insulated copper stranded conductors	m	100			
3.8.3	25mm diameter Boral steel conduit in brick	m	120			
3.8.4	Test Points	ea	9			
3.8.5	8mm diameter aluminium conductor	m	500			
3.9	WIREMESH, TRUNKING AND TRAYS FOR ELECTRICAL, DATA AND FIRE PROTECTION SYSTEMS					
3.9.1	Supply and install O-Line Wire Mesh (75mm x 100mm) in ceiling void complete with elbows, tees, intersections, bolts and nuts as indicated on drawing	m	250			
Carried to Summary of Section No. 3						R

2.5.2	Supply and install O-Line P3200 (76mm x 51mm) galvanized trunking complete with hangers, elbows, tees, intersections, cover plates, bolts and nuts as indicated on drawing	m	800			
3.5.3	Supply and install O-Line P9000 (127mm x 76mm) galvanized trunking complete with hangers, elbows, tees, intersections, cover plates, bolts and nuts as indicated on drawing	m	850			
3.1	CABLE MARKINGS					
3.10.1	Cable markings as specified in specification	ea	10			
3.11	TESTS					
3.11.1	All relevant tests as specified	item	1			
3.12	SCAFFOLDING					
3.12.1	Provision for the erecting and maintaining of scaffolding	item	1			
3.13	SAFETY SIGNS, NOTICES AND EQUIPMENT					
3.13.1	Supply and install all signs, notices and equipment as required by the Occupational and Safety Act (as amended)	Sum	1			
3.14	TURNSTILE & XRAY SCANNER					
3.14.1	Supply and install 20 Ampere double pole industrial surface mounted isolator in ceiling void	ea	3			
3.14.2	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	m	30			
3.14.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	10			
3.14.4	Chasing in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	20			
3.14.5	Supply and install 6mm ² Red and Black PVC covered stranded copper wire	m	70			
3.14.6	Supply and install 4.0mm ² Blue stranded copper wire	m	30			
3.14.8	Final connection to luminaire	ea	3			
3.15	ACCESS CONTROL					
3.15.1	Supply and install 20 Ampere double pole industrial surface mounted isolator in ceiling void	ea	3			
3.15.2	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	ea	150			
3.15.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	90			
	Carried to Summary of Section No. 3					R

3.15.4	Supply and install 6.0mm ² Red and Black PVC covered stranded copper wire	m	350			
3.15.5	Supply and install 4.0mm ² Bare stranded copper wire	m	180			
3.15.6	Final connection to power supply	ea	3			
3.16	FIRE PANEL					
3.16.1	Supply and install 30 Ampere double pole flush mounted isolator in brick	ea	2			
3.16.2	Supply and install 60mm diameter PVC conduit round boxes in concrete	ea	120			
3.16.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	m	60			
3.16.4	Supply and install 20 mm diameter Boral steel conduit complete with sockets, elbows and saddles terminated in wall boxes in brick	m	30			
3.15.5	Supply and install 6.0mm ² Red and Black PVC covered stranded copper wire	m	120			
3.15.6	Supply and install 4.0mm ² Bare stranded copper wire	m	60			
3.16.7	Supply and install 100mm x 100mm x 50mm galvanised x4 boxes	ea	2			
3.16.8	Cheering in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	20			
3.16.9	Final connection to fire panel	ea	2			
3.17	GENERAL EARTHING					
3.17.1	General earthing for all the buildings as specified	item	1			
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SECTION No. 4
MCC INSTALLATION

SECTION No. 4						
MCC INSTALLATION						
ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
4.1	Fire Fighting Water Supply					
4.1.1	Supply and install weatherproof MCC with VSD starter for 15KW 380V pump, pump will stop and start using pressure control.	ea	1			
4.1.2	Supply and install steel stand for above mentioned MCC	ea	1			
4.1.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
4.1.3.1	6mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
4.1.3.2	4mm ² Bare Copper Earth	m	100			
4.2	Domestic Water Supply					
4.2.1	Supply and install weatherproof MCC with VSD starter for 3KW 400V pump, pump will stop and start using pressure control.	ea	1			
4.2.2	Supply and install steel stand for above mentioned MCC	ea	1			
4.2.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
4.2.3.1	4mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
4.2.3.2	2.5mm ² Bare Copper Earth	m	100			
4.3	Sewer Pump Station					
4.3.1	Supply and install weatherproof MCC with 2x VSD starters for two 3KW 400V pumps, pumps will stop and start using level control.	ea	1			
4.3.2	Supply and install steel stand for above mentioned MCC	ea	1			
4.3.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
4.3.3.1	4mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
4.3.3.2	2.5mm ² Bare Copper Earth	m	100			
4.4	Stormwater Pump					
4.4.1	Supply and install weatherproof MCC with VSD starter for 1.5KW 400V pump, pump will stop and start using level control	ea	1			
4.4.2	Supply and install steel stand for above mentioned MCC	ea	1			
Carried to Summary of Section No. 4						R

4.4.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc					
4.4.3.1	4mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
4.4.3.2	2.5mm ² Bare Copper Earth	m	160			
4.5	CONTROL AND INSTRUMENTATION CABLING Allow for all the costs and expenses in connection with the design, manufacture, painting, testing, supplying, delivery, offloading, storage and Site installation of the following materials and equipment: Cu/PVC Insulated/PVC Bedded/SWA/PVC Sheathed 600/1000V multicore control cables with stranded conductors. Cable fixed by cable tray, drawn into sleeves or laid into bundles					
4.5.1	15mm ² x 7 core communication cable	m	300			
4.5.2	75mm ² x 3 core supply cable	m	300			
Carried to Summary of Section No. 4						R

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TOTAL CARRIED TO FINAL SUMMARY	R -

FINAL SUMMARY

**JAN KEMPODOP MAGISTRATE OFFICE- ELECTRICAL INSTALLATION
FINAL SUMMARY**

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Section No. 3 – LV Building Installation page 10	R -
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TOTAL (EXCL VAT) CARRIED TO PROJECT BILL OF QUANTITIES (SECTION No. 4 : ELECTRICAL INSTALLATION)	R -

**ELECTRICAL INSTALLATION
SPECIFICATIONS**

DEPARTMENT OF PUBLIC WORKS

JAN KEMPDORP MAGISTRATE COURT

On
C/O PIET RETIEF AND ARBEID STREET
JAN KEMPSDORP, NORTHERN CAPE
ELECTRICAL TENDER DOCUMENT



public works

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APRIL 2021

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PART 1: GENERAL SPECIFICATIONS

1.1 SCOPE

Application

This document specifies the standard requirements for the design, installation, testing and commissioning of electrical installations operating on voltages up to 1000 volt ac.

The primary intention of this specification is to ensure the provision of an electrical installation which has been properly designed and constructed to ensure safe reliable operation and to facilitate safe inspection, testing and maintenance.

General

The following definitions are used in this Specification:

- The term 'Telemetry Station' shall include both Master Control Station(s) and Remote Terminal Unit(s);
- The term "Employer" shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person;
- The term "Contractor" shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.
- The term "Engineer" shall mean the person appointed by the Employer to act as the Engineer for the purposes of the contract.

Electrical System Characteristics

- The design of the installation shall comply with SANS 10142-1.
- The design of the installation shall consider the following supply characteristics:
 - (i) Voltage, frequency and number of phases;
 - (ii) Maximum prospective short circuit current (phase to phase and phase to neutral);
 - (iii) Type of system, e.g. TN-S, TN-C-S;
 - (iv) Maximum earth loop impedance of the earth fault path external to the installation;
 - (v) Type and rating of the cut-out or switch device
 - (vi) Load capability of the supply source, particularly the effects on the supply voltage of the starting of new equipment and any fault contributions from new equipment.

The installation protective devices shall be correctly co-ordinated with the installation and with respect to existing installations. Discrimination studies shall be performed to validate the co-ordination of the installation.

- All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and working space for such activities. Similarly, the positioning of equipment shall not impede access to, or working space at non-electrical equipment and services for operation and maintenance activities.

The installation shall be suitable for access and use by electrically unskilled persons.

- Where additions or alterations to an existing installation are to be performed, the rating and condition of existing equipment, including that associated with the supply, shall be verified to confirm its suitability to carry any additional load. The earthing and equipotential bonding arrangements shall also be verified. No addition or alteration shall have an adverse effect on the existing installation.

Installation Performance Requirements

- The installation shall be suitable for its intended duty with respect to the electrical supply, distribution and load requirements.
- The installation shall be suitable for the environmental conditions, particularly with respect to corrosion resistance and ingress protection.
- The installation shall be suitable for its intended location, particularly with respect to the mechanical properties and impact strength of the components parts.
- The installation shall be compatible with existing equipment, plant, machinery and services.
- The installation, including its circuit arrangements, shall satisfy the operational and functional requirements of the Employer and be readily and easily maintained throughout its operating life.
- Unless otherwise specified in the Particular Specification, the minimum operating life of the installation shall be 20 years.

1.2 STANDARDS

Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site specific requirements will be found in the Particular Specification and its accompanying Data Sheets, which shall be read in conjunction with this Specification.

The design, construction, installation, inspection, testing and commissioning of the installation shall comply with all relevant Statutory Regulations, and the latest editions (current at the time of Tender) of all relevant South African National Standards.

The decreasing order of precedence of these requirements shall be as follows:

- Statutory requirements,
- Employer's requirements,
- Data Sheets,
- Particular Specification,
- Standard Drawings,
- This Specification,
- National and international standards.
- Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.
- The Manufacturer of Assemblies to form part of the electrical installation shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the Assembly.

Regulations, Specifications and Standards

The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:

- (b) Occupational Health and Safety Act (Act 85 of 1993);
 - (c) Construction Regulations 2014 issued in terms of Section 43 of the Act;
 - (d) Local Fire Regulations; and
 - (e) Regulations of the Local Supply Authority.
- and the latest editions (current at the time of Tender) of all relevant SANS, British Standards and International Standards, including:

The installation shall also comply with:

- (f) This Specification including all Data Sheets; and
- (g) Any documentation issued by, or on behalf of, the Employer in respect of the installation.

The Contractor shall operate an approved, auditable quality assurance procedure covering the design, construction, and inspection and testing of the installation.

Compliance with Specification

Standard Specifications

The included Zutari standard specifications are based on SANS standards which in turn refers to predominantly IEC standards. These include;

- Engineering Standard SPE-EE-0001, Introduction to Standard Specification
- Engineering Standard SPE-EE-0002, Inspection, Testing and Commission
- Engineering Standard SPE-EE-0004, Preliminary and General Specification
- Engineering Standard SPE-EE-0010, LV Switchgear & Control Gear Assemblies
- Engineering Standard SPE-EE-0011, LV Cables
- Engineering Standard SPE-EE-0012, Cable Support Systems
- Engineering Standard SPE-EE-0013, Wiring and outlets
- Engineering Standard SPE-EE-0014, Lighting
- Engineering Standard SPE-EE-0015, Street and Area Lighting
- Engineering Standard SPE-EE-0020, MV & LV Earthing
- Engineering Standard SPE-EE-0021, Lightning Protection for Structures
- Engineering Standard SPE-EE-0042, Trenching and Excavation

Technical Datasheets

Detailed technical information of the equipment required is specified in the attached technical datasheets. These sheets form part of the technical/returnable documents and must be completed in full. These include:

Schedule no.	Ref	Description	Attached Y/N
SHEET 1	Magistrate Court	LOW VOLTAGE CABLE	Y
SHEET 2	Magistrate Court	CIRCUIT BREAKERS	Y
SHEET 3	Magistrate Court	MINIATURE SUBSTATION	Y

Drawings

Drawings are listed in section 1.8

Order of precedence

In case of any contradiction between the technical specifications, technical datasheets and drawings, the order of precedence shall be:

- Project Specification (this document).
- Zutari Technical data sheets
- Tender drawings & schedules
- Zutari standard specifications

Equipment and Material Supplied

All equipment and material supplied shall be:

- Completely new
- Components to be of the same manufacturer
- In compliance with the technical specifications and/or drawings and/or schedules
- Guaranteed for a minimum period of twelve months (this period commences after issuing practical completion certificate)

Scope of Works

This specification covers the works required for the supply, delivery and installation (including testing and commissioning) of the LV equipment and material for the electrical works of the project.

LV Installation

The works shall consist of:

- Cable management system (cable and wire support) for the various electrical & electronic services
- LV Cable reticulation, including the supply and termination of the main cable
- Small power installation, including manufacturing of LV Panels (DBs)
- Artificial lighting installation, including aerial lights
- Installation of Lightning protection system

Physical and Climatic Site Conditions

With reference to the detailed site location below and the site plan under the drawings section, it is the contractors responsibility to confirm the physical and climatic site conditions from the applicable weather bureau.

Location

Refer to contractual documents for detailed location data.



Figure 1: Location map

Electrical System Operating Parameters

The operating conditions of the electrical network to which the complete electrical installation shall connect, is specified in Table 1.

Table 1: Electrical System Operating Parameters

No.	Description	Unit	Value
1.	System Voltage:		
	Nominal	kV	11 (±6%)
	Minimum	kV	10.34
	Maximum	kV	11.66
2.	3 Phase System Fault Level	kA	Contractor to source information from Supply Authority. Forecast for increased network capacity for 20 years minimum
3.	Earth Fault level	A	Contractor to source information from the Supply Authority
4.	Frequency	Hz	50
5.	Phase Rotation (Standard / Non-Standard) and (Clockwise / Anti-clockwise)	-	RYB (Anti-clockwise)
6.	Earthing Method (Direct / Indirect)	11kV	Indirect
		415V	Direct, TN-S
7.	Insulator Creepage Distance		
	Low Polluted Atmosphere	16 mm/kV	n/a
	Moderate Polluted Atmosphere	20 mm/kV	n/a
	High Polluted Atmosphere	25 mm/kV	Yes
	Very high Polluted Atmosphere	31 mm/kV	n/a

1.3 COMPONENTS AND EQUIPMENT

General

All equipment and components shall be suitable for their operating environment, particularly with respect to the following:

- (h) The degree of ingress protection against dust and moisture (IP rating)
- (i) The corrosion resistance of the materials of construction; and
- (j) Mechanical properties (especially impact strength).

Power Outlets

Commercial Socket Outlets

- (a) All socket outlets with switches shall fully comply with SANS 164 and SANS 60669-1.
Units for flush mounting shall be suitable for a 100 x 100 x 50 mm deep flush wall box. Surface mounted patterns shall be housed in heavy pressed steel boxes. Shutters shall be provided.
All socket outlets with switches shall be continuously rated at 16A and shall be suitable for operation on a 250V, 50 Hz, ac system.
Cover plates shall have beveled edges which overlap the box.

Industrial Socket Outlets

- (a) The plugs, couplers and socket outlets shall conform to the requirements of SANS 1239.
Where pilot connections are required, they shall disconnect before the main phase connectors disconnect.
3-Phase Socket Outlets
30A, 400V socket outlets shall be five pole (Three phase, one neutral and one earth), coloured red, incorporating isolation mechanically interlocked with the plug.
The equipment enclosures shall be IP55 to SANS 60529.
All welding plug and socket outlets shall be 3-phase, plus neutral, plus earth.
Single Phase Outlets
16 A, 230 V socket outlets shall be two pole and earth, incorporating isolation mechanically interlocked with the plug.

Local Isolators

- (a) Local isolator shall be selected from the following:
Isolator in accordance with SANS 60947-3, complete with additional late-make, early-break auxiliary contacts as required;
Plug and socket assembly to SANS 60309-1 and SANS 60309-2, incorporating isolation mechanically interlocked with the plug; or
Plug and socket assembly to SANS 60309-1 incorporating a de-contactor arrangement or additional late-make early-break auxiliary contacts.
Moulded case Isolators shall be of the double pole ON-LOAD type and approved by Engineer.

Heavy duty metal clad isolators must be approved by Engineer. Toggles shall be interlocked with the covers.

To distinguish the switches from circuit breakers the operating handles of isolators shall have a distinctive colour and where called for in the Particular Specification the switch shall be clearly and indelibly labelled "ISOLATOR".

The local isolator shall be pad-lockable in the "off" position.

Lighting and Accessories

Luminaires

- (a) Luminaires shall comply with SANS 60606 (relevant parts).

Luminaires shall be supplied with lamps of a type suitable for the luminaire design.

Control Gear and Enclosures

- (a) Control gear shall be fully compatible (both physically and electrically) with the type of lamp and luminaire with which it is intended to be used.

High frequency, electronic control gear shall be used for tubular (double capped) and compact (single capped) fluorescent lamps and if appropriate for discharge lamps.

The temperature rating of the control gear shall be appropriate to its operating environment.

If the control gear is not integral to the lamp or housed within the luminaire, it shall be housed within a suitable enclosure.

Switches

- (a) Flush mounted switches

Flush mounted switches shall comply with SANS 60669-1 and shall bear the SABS mark. All flush mounted switches shall be suitable for mounting in 100 x 50 x 50 mm galvanised steel or PVC wall boxes unless otherwise specified in the Particular Specification.

The switch mechanism shall be of the tumbler operated micro-gap type with silent operation and shall be rated for 16 A at 250 V and 50 Hz.

Switches shall have protected terminals for safe wiring. Multi-lever switches shall be constructed so as to enable individual defective switches to be removed and replaced without having to remove the remaining switches.

The mounting holes provided on the yoke strap shall be slotted to allow for easy alignment. A brass earthing terminal shall furthermore be provided on the yoke to ensure the positive earthing of the switch assembly.

Switches with pilot light indication

Flush mounted switches with pilot light indication shall comply with the relevant parts of SANS 60669-1 and shall bear the SANS mark.

Switches with pilot light indication shall be suitable for mounting in 100 x 50 x 50 mm galvanised steel wall boxes.

The switch shall be rated at 16 A at 250 V and 50 Hz. A red indication lamp shall form an integral part of the switch lever and shall light-up when the switch is in the on position.

Cover plates for switches

Cover plates for flush mounted switches shall have levelled edges which overlap the wall box in order to conceal all wall imperfections.

Surface mounted switches

Surface mounted switches shall comply with SANS 60669-1 and shall bear the SANS mark.

Surface mounted switches shall consist of single or multiple switches, not exceeding four and shall be mounted in a pressed steel box of heavy duty construction.

The switch mechanism shall be of the tumbler operated micro-gap type with silent operation and shall be rated for 16 A at 250 V and 50 Hz.

A brass earthing terminal shall furthermore be provided on the switch construction to ensure the positive earthing of the switch assembly and enclosure.

The covers of surface mounted switches shall have toggle protectors.

Watertight Switches

Watertight switches shall consist of 10A switches on porcelain bases in cast iron or aluminium alloy housing. Contacts must be of heavy duty brass construction and a quick acting spring mechanism shall be fitted. A rigid operating knob shall be clearly marked to indicate the "ON" and "OFF" positions. Conduit entry shall be provided through a tapped hole. The complete unit shall be watertight.

Photo-Electric daylight switches

The unit shall comprise a photo-cell, thermal actuator and change-over switch. The cover of the unit shall be manufactured from a tough, durable material providing protection against tampering. The cover shall have good weathering properties. It shall be ultra violet resistant and shall not deteriorate when exposed to sunlight for prolonged periods.

The units shall be capable of operating in dusty conditions between -5°C and $+55^{\circ}\text{C}$.

The units shall be designed to withstand damage by either stone-throwers or hail. If the units do not possess this quality, separate wire screens shall be provided for this purpose.

All parts shall be treated to be corrosion-proof.

The operation level shall be factory preset for "ON" at a light level of approximately 54 lux and "OFF" at approximately 100 lux. Voltage variations shall not affect the operational levels.

A time delay of not less than 15 s shall be provided to prevent the unit from functioning due to lighting or other short period changes in illumination.

The unit shall be effectively safeguarded against voltage surges by means of a suitable surge protector which shall preferably form an integral part of the unit.

The unit shall be of the wall mounting type and shall be supplied complete with a suitable bracket.

The change over switch shall be capable of switching 12 A alternating current at 230 volts.

Area Lighting

Floodlight Luminaires

- (a) The luminaires shall be of the totally enclosed weatherproof type complete with a high-pressure sodium discharge lamp with integral mounted igniter and control gear unless otherwise specified.

The housing shall be robustly constructed of die cast LM6 aluminium alloy or other corrosion proof and UV resistance material and be effectively sealed against the ingress of moisture and dust, etc. The front glass cover shall be constructed from heat resistant armoured glass having retaining clips, fasteners, etc., manufactured from stainless or ferritic steel. The fitting shall incorporate a protector scale to allow for the correct and accurate adjustment of the downward to vertical aiming angle.

The internal wiring shall be by means of high temperature grade silicone rubber insulated high quality flexible stranded cables not subject to deterioration. The low voltage wiring

shall not be less than 660 volt grade and in the case of high voltage wiring the continuous voltage grade must be suitable for the open circuit voltage of the ballast.

The section in which the capacitor, igniter, choke gear and terminals, etc., are located shall be accessible to provide ease of maintenance. The section shall be complete with earthing terminal and 660 volts insulated line connector block. Capacitors shall be metal clad, totally enclosed type complete with sealed in cable tails. Capacitors shall be manufactured fully in accordance with SANS 51048 and be capable of improving the overall p.f. to at least 0.95 and be fitted with safety discharged resistors. Chokes shall be of the totally encapsulated type having terminal blocks for ease of maintenance. The electronic ignition device shall be of the three wire type operating on the superimposed pulse principle. The circuitry shall be such that should a lamp fail the ignition shall not continue pulsing.

The lampholder and cap shall be porcelain, having silver plated metal parts being of the GES type and able to withstand the high starting voltage. The lampholder shall incorporate a spring wire type supporting device at the end of the lamp opposite the cap.

Poles

- (a) Poles shall be of the round cross-section tapered type with a mounting height of the luminaires as specified in the Particular Specification. The poles shall be of glass filament wound manufactured and shall be smooth, tapered and seamless.

The pole tops shall be provided with multiple luminaire assembly, two-way, three-way or four-way, of diameter to suit the luminaire's offered.

At a height of 1 000 mm above ground level an opening 250 mm high by 80 mm wide, shall be provided. A gland plate to take up to 3 cables, 6,3 A/5 kA MCB, a terminal block and an earth stud shall be installed on a mounting plate in this opening. A shaped weatherproof coverplate, manufactured from the same material as the pole shall be provided to cover the opening. The coverplate shall provide total protection of IP55 to SANS 476. The coverplate shall be fastened into place by means of Allen key type countersunk screws.

The internal wiring between the luminaire and terminal block shall be by means of two 1,5 mm² PVC insulated conductors and a 1,5 mm² bare copper earth conductor. The terminal block shall be suitable for the incoming cables and the internal wiring 1,5 mm² conductors specified.

Luminaire mounting carriage

- (a) The luminaire mounting carriage shall be constructed from galvanized mild steel and shall be provided with all the necessary brackets for the mounting of the luminaires, control gear and terminal boxes.

The carriage shall be designed to carry the weight of the luminaires and associated equipment.

Ballasts should replace the missing luminaires to reassure that the weight is uniformly spread over the luminaire mounting carriage.

Electrical connection to the luminaires

- (a) The connection to the luminaires shall be by means of a suitable rated multiconductor trailing cable. The cable shall have numbered cores with one green/yellow earth core. The cable shall be terminated in an adequately sized terminal box mounted on the luminaire mounting carriage from which the connections to the individual luminaires and ancillary equipment shall be taken. The cable shall be provided with an approved tension sock at the point of suspension.

Telephone and Accessories

Telephone distribution board

- (a) The board shall comprise of a steel tray, architrave frame and hinged doors.

The tray shall be constructed from corrosion resistant mild sheet steel having a minimum thickness of 1.6 mm. Bracing gussets with slots shall be provide on the four corners. Expanded metal shall be spot welded in position on the back of the tray.

Sufficient 25 mm diameter knock-outs shall be provided on the top and bottom sides of the tray.

The architrave frame shall be constructed from 1.2 mm thick sheet steel with square edges. The architrave frame shall form a overlapping 25 mm border around the tray and shall be fixed to the tray in such a manner as to allow for adjustment for the inequalities in the wall finish.

A 20 mm thick soft timber panel of fine grade pine to SANS 1783 without knots shall be installed inside the main telephone distribution board and shall cover the entire back of the distribution board. Clipboard or similar timber or other materials are not acceptable for use as back-boards.

The doors shall be constructed from 1.2 mm sheet steel, reinforced to ensure rigidity. The doors shall be flush mounted in architrave frames. Door catches shall be constructed of chromium plated brass and shall be installed flush with the door. Built-in locks shall be provided when specified in the Particular Specification.

The main telephone distribution board shall be of the dimensions and type as specified in the Particular Specification.

The main telephone distribution shall normally be intended for indoor use but however when specified to the contrary in the Particular Specification or on the drawings, a weatherproof, outdoor type board shall be provided. All outdoor boards shall be equipped with a drip overhang and shall be normally intended for surface mounting.

The boards shall be finished with a high quality undercoat and two final coats of off-white colour paint unless specified to the contrary in the Particular Specification.

Wall and column mounted telephone outlet points

- (a) Outlet points shall, unless specified to the contrary in the Particular Specification, consist of a 100 x 100 x 50 conduit box flush mounted and complete with a blank cover plate to match the cover plates of switched socket outlets and light switches.

INSTALLATION OF COMPONENT AND EQUIPMENT

General

Final positions of equipment shall be agreed on site, prior to installation.

All equipment shall be securely mounted using proprietary fixtures and fittings.

The method of equipment installation shall not adversely affect the function or structural integrity of the structure to which the equipment is attached.

Equipment terminals and covers shall be readily and safely accessible after installation.

The method of equipment installation shall not adversely affect the IP rating of the equipment.

Unless otherwise specified in the Particular Specification, cable access to all plantfield mounted equipment shall be bottom entry.

Framework and Brackets

- (a) Unless otherwise approved in the Particular Specification, site-fabricated framework and brackets shall not be used:

Framework and brackets shall be positioned so as not to adversely effect the removal and replacement of equipment.

Only proprietary accessories (fittings and brackets etc.) shall be used.

Where it is necessary to modify on site any pre-fabricated galvanised mild steel framework, the cut edges shall be dressed and treated immediately with an approved cold galvanising paint to prevent corrosion.

Fasteners securing equipment to framework and brackets shall be independent of those securing framework and brackets to walls and floors.

Positioning of Equipment

- (a) Equipment shall be positioned with due regard to the aesthetics of the installation.

Where a group comprises a number of items at different mounting heights, with not more than one item at any one height, then all items shall be sited on a common vertical centre line.

Where a group comprises a number of items mounted at the same height, then all items shall be sited on a common horizontal centre line.

Where a group comprises a number of different sized items they shall be arranged with the largest item at one end of the group and a progressive reduction in size of the remaining items.

Where a group comprises a number of items at different mounting heights with more than one item at any height, then a common vertical centre line shall be established and the items arranged on, or symmetrically about, this centre line.

Where a group comprises a number of items at the same mounting height with more than one item at the same position, then a common horizontal centre line shall be established and the items arranged on, or symmetrically about, this centre line.

Mounting height of Components

Except otherwise specified, mounting heights shall be as follows:

Distribution boards	:	top frame 2000 mm above finished floor level
Switches		underside 1400 mm above finished floor level
Socket outlets		underside 300 mm above finished floor level
Telephone outlets	:	underside 300 mm above finished floor level

All distribution boards, switches and socket outlets shall be of the flush mounted type except where stated otherwise.

Installation of Socket Outlets

- (a) Socket outlets and power outlets shall be installed in the positions as indicated on the drawings.

The Contractor shall only commence with the installation of power outlets in the conduit outlets allowed therefore after the plasterer and painter have completed their work in the vicinity of the outlet;

Unless otherwise specified socket outlets shall be installed at the following heights above finished floor level, measured to the underside of the outlet:

300 mm above finished floor levels for general applications; and 200 mm above work top levels in kitchens.

Connections to geysers

- (a) Each geyser shall be connected to a separate circuit with a separate earth conductor.

The conduit from the distribution board shall terminate in a 100 x 100 x 50 mm outlet box within 1 metre of the geyser. A suitably rated double pole isolator shall be installed in the outlet box. A flexible conduit shall be installed between the isolator and the geyser.

Connections to heaters, fans and air conditioners

- (a) A suitably rated double pole isolator shall be supplied and installed within 1 metre of heaters, fans and air conditioners. Where the equipment is out of reach the isolator shall be installed 1,5 metres above floor level. Flexible cords of sufficient rating may be used for the final connection to the equipment.

Where control units are to be installed the units shall be installed 1,5 metres above floor level.

Installation of Lighting and Accessories

General

- (a) The lighting installation shall be designed on the basis of lowest life cycle costs, considering factors such as power consumption, the service lives and replacement costs of components (lamps, control gear and luminaires etc.) and maintenance requirements.

The electrical subcontractor shall only commence with the installation of light fittings after the paintwork in the vicinity of the fitting is complete and dry. Care shall be taken to ensure that ceiling boards and paintwork is not damaged during the installation of light fittings.

The type of light fittings to be used are indicated and specified on both the relevant drawings as well as in the Particular Specifications.

Positions of light fittings

The mounting positions of light fittings are indicated on the relevant drawings and shall be verified on site.

Mounting heights of light switches

Light switches shall be installed 1,4 metres above finished floor level unless specified to the contrary.

Mounting of light fittings

- (a) Incandescent surface mounted fittings shall be screwed to the ceiling by means of at least two 4 mm diameter electroplated self tapping screws. On concrete, plastered and brick surfaces good quality plastic expansion plugs shall be used and on suspended and mull

ceilings a solid timber backing strip of at least 40 x 40 mm timber shall be supplied and installed between supports and the screws fixed to these backing strips.

Surface mounted fluorescent fittings will be firmly mounted to ensure close contact with the ceiling over the entire length of the fitting. On concrete slabs the fittings shall be mounted by means of two screws into the ceiling conduit box as well as two round headed 4 mm x 30 mm electroplate self tapping screws and plastic expansion plugs, one at either end. On suspended ceilings the fittings shall be similarly mounted but timber backing strips of at least 40 x 40 x 450 mm shall be placed in position on top of the ceiling board and the end screws secured to these strips to spread the load.

Installation of Area Lighting

General

The contractor shall set out the positions of the masts and poles and the cable route as indicated on the drawings.

Poles

(a) Excavations

The holes for poles shall be excavated to the following depths:

Mounting Height	Depth of excavation
$1.5 < \text{Mounting Height} < 7.5$	1m
$7.5 < \text{Mounting Height} < 10.5$	1.8m
$\text{Mounting Height} > 10.5\text{m}$	2m

The holes for poles shall have minimum dimensions of 1 metre by 0.5 metres.

Once the poles have been erected and aligned the excavations shall be backfilled and compacted in layers of 150 mm to 95% MOD AASTHO using material free of stones, vegetation, etc.

Where the soil is sandy, loose or marshy, the poles shall be planted in a 12:1 sand/cement mixture.

Planting of Poles

The steel and glass filament wound polyester poles shall be fitted with a base plate that shall be securely bolted with hook bolts before the pole is planted.

The contractor shall ensure that the poles are not strained or damaged in any way during the erecting thereof.

The structures shall be vertical to a tolerance of 0.5% at the top of the pole after erection.

The streetlight poles shall be planted with the luminaire outreach extended in the direction of the roadway and so that the outreach arm is perpendicular to the centre line of the road, except if otherwise specified by the Engineer.

Under no circumstances shall poles be shortened to create the impression that they have been planted to the correct depth.

Installation of Telephone and Accessories

General

The electrical subcontractor shall only supply and install all materials required for the provision of telephone distribution wireways and outlets as indicated on the relevant drawings. The telephone cabling installation shall be undertaken by others.

Main telephone distribution board

- (a) The main telephone distribution board shall be flush mounted in the wall in the position indicated on the relevant drawing. The mounting height for the board is specified in the Particular Specification.

All conduits and sleeves to telephone outlets or sub-distribution boards in the buildings or elsewhere on the site as well as the main incoming sleeves shall terminate at the main telephone distribution board as shown on the relevant drawing.

Separation of services

- (a) Ways provided for telephone or other related services shall under no circumstances be used for any other purpose.

Power cables, conductors and accessories shall be installed at a minimum distance of 300 mm away from the routes reserved for telecommunication cables.

Conduits and other channels shall be installed in such a way as to avoid telephone cables from crossing power cables.

Telephone outlets

- (a) Telephone outlets in walls shall comprise of 100 mm x 100 mm x 50 mm deep wall boxes which shall be flush mounted in the wall, in the position shown on the relevant drawing, with the underside 200 mm above the finished floor level. The wall box shall be fitted with an ivory coloured blank coverplate.

All outlet boxes shall align up neatly with adjacent socket outlet wall boxes.

Telephone outlets in floors fitted with floorducting shall be of the same type as the floor outlets for power socket outlets and shall normally be provided in the same outlet box.

Telephone outlets in power skirting shall be provided in the positions shown on the relevant drawing and the electrical subcontractor need only provide a separate short length cover plate at these positions. The cover plate for the fixing of the telephone outlet shall not exceed 250 mm in length and shall be secured in such a manner that adjacent coverplate sections may be removed without disturbing the telephone outlet.

1.4 LOW VOLTAGE CABLES

General

Cables shall be manufactured strictly in accordance with the requirements of SANS 1507.

Cables shall be delivered within 12 months of manufacture and shall be delivered to site on cable drums or coiled with protective wrappings.

Cables shall be delivered, stored and handled in accordance with the manufacturer's instructions. Where the performance of the cable is likely to be adversely affected by the ingress of moisture, it shall be adequately sealed at either end.

The end protruding from the drum shall be protected against mechanical damage.

Cable selection and sizing should comply with SANS 10142-1.

Cables shall have copper conductors to SANS 1411-1. Cores of cross sectional area greater than 1.5 mm² shall be stranded or flexible.

Where neutral conductors are provided, they shall be of the same cross sectional area as the associated phase conductor.

Types of Low Voltage Cables

PILC/PVC and PILC/SWA/PVC

- (a) Paper insulated lead covered cables shall not be used in low voltage installations, except where specified.

Cables shall comply with SANS 97.

Multicore cables shall have a single wire armour.

PVC/AWA/PVC and PVC/SWA/PVC

- (a) Cables shall comply with SANS 1507-3 and be rated at 600/1000V.

Single core cables shall have aluminium wire armour.

Multicore cables comprising five conductors and above, shall have each core individually coloured or coloured white with black numerals.

XLPE/AWA/PVC/PVC and XLPE/SWA/PVC/PVC

- (a) Cables shall comply with SANS 1507-4 and be rated at 600/1000V.

Single core cables shall have aluminium wire armour.

PVC/PVC

Cables shall comply with SANS 1507-3 and be rated at 600/1000V.

XLPE/PVC

- (a) Cables shall comply with SANS 1507-3 and SANS 1507-4, and be rated at 600/1000V.

Single Core PVC

- (a) Cables shall comply with SANS 1507-2 and be rated at 600/1000V.
The insulation shall be phase coloured and where used in single phase systems, line cables shall be red, neutral cables black and earth cables yellow and green.

Flat Twin and Earth PVC

- (a) Copper conductors shall comply with SANS 1411-1, PVC insulated to SANS 1411-2, laid up with a bare copper earth continuity conductor between them, with PVC bedding to SANS 1411-2.
Cables shall be rated at 300/500V.

Earth continuity conductors

- (a) Earth continuity conductors shall comprise of stranded copper conductors of cross-section indicated in the Particular Specification.
A single earth conductor may be used where two or more cables run together, providing the earth conductor cross-sectional area is based on the largest size cable in the run.

Cable Accessories

Concrete protective slabs and cable markers

- (a) Concrete cable markers shall be placed at a minimum of 50 m intervals, changes in trench direction and at road crossings.

Concrete protective slabs shall have the following dimensions:

Length	1 000mm
Width	350 mm
Thickness	50 mm

The slabs shall be constructed of 20 MPa concrete and each slab shall be reinforced with one longitudinal and three transverse mild steel rod of minimum diameter 8 mm. The slabs shall be manufactured in such a way that the slabs interlock with each other thus avoiding shifting of the slabs after installation.

1.5 INSTALLATION OF CABLES

General

The cable installation shall comply with the requirements of SANS 10142-1.

Cables shall be installed strictly in accordance with the cable routes drawing.

Cable installed in groups shall run in straight lines and not cross over each other.

Cables installed above ground shall, as far as possible, run parallel with the lines of building construction.

Cables buried below ground shall, as far as possible, follow features of the site such as roadways and building lines.

Cables and their support systems shall not be fixed to protective barriers, guards or direct to guard-rails.

Cables shall be installed strictly according to the manufacturers requirements pertaining to:

Maximum tensile or compressive stresses (e.g. due to pinching or squashing)

Minimum bending radii;

Temperature of installation; and

Operating environment.

No joints shall be allowed in the low-voltage cables without the prior approval of the Engineer.

Proprietary cable support systems shall be used.

Unarmoured cables shall only be used where there is no risk of mechanical damage.

The open end of all cable sleeves and opening in building structures specifically provided for the passage of cables (including unused openings) shall be sealed after cable installation to prevent the ingress of harmful or flammable gases, liquid, smoke, fire and vermin.

Separation of Cables

(a) Cables shall be classified as follows:

	AC	DC
High Voltage	>1000	>1500
Low voltage (power, control, small power and lighting)	50–1000 Vrms	120–1500 V
Extra-low voltage (signal/instrument, data transmission and telecommunication)	< 50 Vrms	< 120 V

Unless otherwise specified in the Particular Specification, or by the cable manufacturer, or for reasons of electromagnetic compatibility, the minimum separation distance between cables of different classification shall be according to the following table.

Separation (mm)	Extra Low Voltage	Low Voltage	Other Services (Above Ground)	Other Services (Below Ground)
Extra Low Voltage	-	300	150	500
Low Voltage	300	-	150	500
High Voltage Cables	500	300	300	500

Other Services (Above Ground)	150	150	-	-
Other Services (Below Ground)	500	500	-	-
Note:				
The above figures need not to apply to the short lengths of cables near the equipment to which the cable are connected				

Cables of different classifications shall not be installed in the same duct.

The figures specified in the table above do not apply to cables that are installed in separate metal enclosures and/or cables on cable support systems (cable trays/ladders) that are separated with metal partitions.

When cables have to cross, it shall be done at right angles.

Trenches

General

- (a) The proposed trench route shall be surveyed for the presence of underground cables and/or services before digging commences.

The site shall be preserved as far as possible. Only the minimum of trees, shrubs, rocks, etc shall be removed and cleared for the cable route.

Where surplus material has to be disposed of, the Contractor shall dump the material in the area provided by him. It shall be done at the cost of the Contractor.

Excavation

- (a) The cable trench shall be excavated along the routes indicated on the relevant drawings

The trench shall be absolutely straight.

If any obstacle or interference should be encountered which may require alterations to the trench or routes, such alterations shall receive prior written approval of the Engineer.

Where not specified the trench shall be deep enough so that the top layer of LV cables is buried a minimum of 600 mm below final ground levels.

The Contractor shall excavate by hand where he cannot excavate by means of machines due to limited access and the proximity of other services.

The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clean up the bottom of the trenches after he has completed the required excavation.

The Contractor shall remove all sharp projections, which could damage the cable where the trench is excavated through rocky formations, and shall remove all loose rocks, material, etc from the bottom of the trench.

No excavated material shall be left closer than 300 mm from the side of the excavation.

Once the excavations for cable trenches have been completed, the Contractor shall give the Engineer one working day notice to inspect the trench and to be present when the measurements are made. No inspections shall be undertaken on Saturdays, Sundays and public holidays.

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed.

Installation of Cables Directly in Ground

(a) Sand bed and sand bed cover for cables

A sand bed layer of soft soil shall be installed and levelled at the bottom of each trench after the trench has been approved by the Engineer, and prior to cable laying.

If the excavated material is not suitable for the sand bed layer then suitable soil shall be imported for this purpose. The cost thereof shall be included in the price for the excavation, unless otherwise specified.

The minimum thickness of the sand bed layer is 50 mm.

If the soil for the sand bed and sand cover has to be sifted, a sieve with holes not larger than 5 mm shall be used.

The cable shall, after the completion of the trench, be laid with the minimum of delay so that the trench can be backfilled.

The sand bed cover for LV cables shall be 150 mm thick, of similar soil and shall be placed directly after the cable(s) has been inspected.

Only one cable shall be laid at a time and the Contractor shall take precautions that the cables which are already installed are not damaged.

Laying of cables

Cable rollers shall be used when cables are drawn into trenches. The cable rollers shall be placed so that the cable does not touch the bottom or the sides of the trench.

If the Contractor intends using a winch to draw the cable into the trench, a cable stocking shall be used or the draw wires shall be soldered to the cable so that the tension is exerted on all the cores, lead sheath and/or steel wire armouring at the same time.

The maximum tension on a cable during laying operations shall not exceed the value specified by the manufacturer.

Sufficient lengths of cable shall be left at the beginning and end of the cable routes to allow for the termination of the cables. The Contractor shall take the necessary precautions to protect the cable ends until they are terminated. The cable ends shall be sealed by means of lead or heatshrink sealing caps to ensure that the cable is waterproof.

Where cables are drawn through sleeves, care shall be taken that they are not kinked or excessively bent.

The Contractor shall keep accurate records of each length of cable laid. The following information shall be recorded:

- Cable drum number
- Size of cable
- Laid from where to where
- Length of cable
- Date laid

The Contractor shall be liable for the repair of the cable due to the faulty manufacture of the cable, should this information not be recorded directly after the cable has been laid.

The Engineer shall inspect all cable trenches before backfilling to ensure that the laying of cables complies with the specification.

Where a cable crosses over other services, the cable shall not be installed at a depth less than 600 mm below ground level and if this is not possible the cable shall be installed underneath the other service and shall be protected in the prescribed manner by means of concrete slabs. The depth of the cable shall be maintained for one metre on either side of the crossing.

If it is not possible to cross over or underneath a service in the prescribed manner, the matter shall be referred to the Engineer for a decision.

The following minimum clearances shall be maintained between electrical cables and other services.

	Vertical	Horizontal
GPO Cables	300 mm	300 mm
Water pipes	300 mm	300 mm
Sewer pipes	300 mm	800 mm
Storm water pipes	300 mm	600 mm
LV cables on same route	100mm	One cable diameter of larger cable

Backfilling of trenches

When the cable has been laid, inspected and approved and the sand bed cover has been installed, the trench shall be backfilled with soil containing not more than 40% rock or shale which shall be able to pass through a 100 mm sieve and which is approved by the Engineer. Where more than 40%, but less than 70% rock occurs, the Contractor shall replace the rock with imported soil. However, should more than 70% rock occur then all the backfilling material shall be imported.

The Contractor may import further stone-free material to the site or sieve the excavated material for sand bedding and cover but payment shall only be compensated for the actual quantity of imported material required as determined by the Engineer. The quantity of imported material required shall be calculated from the nominal trench width.

The excavated material shall be backfilled in layers of 150 mm and shall be well compacted and consolidated to 90% MOD AASHTO. Where necessary the Engineer may require that a mechanical vibrator be used for compacting the trench.

The Contractor shall maintain the completed sections of the cable trench in a proper safe condition for the duration of the contract. The Contractor shall refill and compact the trench where subsidence occurs.

After completion of the work the route of the cable shall be neatly finished off and cleared. All stones bigger than 25 mm as well as all loose organic material and rubble shall be removed.

Electrical warning tape shall be installed on all cable routes (LV and HV) at 150 mm above the top cable layer. Where a cable route exceeds 600 mm in width multiple warning tapes shall be run in such a way that the space between adjacent warning tapes does not exceed 150 mm.

Installation of concrete slabs and cable markers

Where cables cross other services such as water pipes, sewage pipes and other cables or where the chance exists that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs. The slabs shall protect the cable for a distance of 500 mm on either side of the crossing.

Proprietary cable markers shall be placed at a minimum of 50m intervals, changes in trench direction and at road and other service crossings. The markers shall be buried in the ground directly over the cable with the top protruding 50 mm above the finished ground level.

Cable Sleeves

General

- (a) The sleeves shall be PVC, or alternative sleeve complying with this specification.
The sleeves shall be with a minimum wall thickness of 5 mm and mass not exceeding 45 kg per sleeve length.

Method of Laying

- (a) The sleeves must be installed strictly in accordance with the relevant drawings to facilitate future location of the sleeves.

Sufficient sleeves shall be installed to provide spare capacity of 20%. Under roadways, sufficient sleeves shall be installed to provide spare capacity of 50% subject to a minimum of 2 ducts.

The distance between sleeves shall be not less than 50 mm where more than one sleeve is installed.

The maximum angle of a single bend in a sleeve shall be

45°, when all cables has a diameter less than 25 mm; or

22.5°, where any cable has a diameter greater than 35 mm.

All bends shall be the long radius type.

When installed beneath roads there shall be a minimum of 750 mm of cover above the crown of the sleeve and the sleeve shall be extended to 1.5 m on either side of the road surface.

Where sleeves are installed during the road construction, the sleeve positions shall be marked with the letter "E" cut or casted into the concrete of the kerb.

The sleeves shall be bedded on to a 50 mm layer of sifted sand. A 50 mm sand cover shall be backfilled over the sleeves and thoroughly compacted.

The depth of cover in soft ground shall be a minimum of 500 mm above the crown of the duct.

The sleeves shall be laid straight without kinks.

Joints shall be carried out with suitable couplings to prevent movement between pipe ends.

After installation all foreign matter in the pipe shall be cleared with a mandril.

The sleeves shall be sealed with PVC plugs to prevent the entry of sand before backfilling.

The necessary precautions during further construction activities shall be made to prevent damage to the sleeves.

All sleeves shall be left with an 8 mm diameter nylon draw wire in place, anchored at each end.

Bore and Jointing

- (a) The bore shall be accurate, smooth and without surface cracks and the inside edges shall be edged or rounded.

The edging or rounding shall be such that no ridge is formed when two sleeves are joined and with the edges of the jointed sleeves up to 5 mm apart.

A suitable slip collar or other simple device to maintain the 5 mm spacing after the installation of the sleeves, shall be provided.

All joints and changes in direction of the sleeve system shall be achieved by the use of proprietary bends and accessories made of the same material of the sleeves.

The joints shall be flexible enough and have enough play to allow for a 5° adjustment in adjacent pipe lengths during installation or in the case of subsequent subsidence of the ground.

The joints need not be watertight but shall stop sand and other materials entering the sleeves.

Cable Trays, Ladders

Cable Trays

- (a) All cable trays shall, unless specified otherwise, be heavy duty cable tray standard pattern by O-line or equal.

Metal cable trays shall be manufactured from perforated rolled steel. Metal trays manufactured to the following standards shall be used:

Less than 150mm wide	- 1,2mm minimum thickness with 12mm minimum return.
150mm to 450mm	- 1,2mm minimum thickness with 19mm minimum return.
Above 450mm (Heavy duty)	- 2,5mm minimum thickness with 76mm return

The cable tray edges are to be turned up on both sides to improve rigidity but where necessary the sides of the tray are to be reinforced with galvanised steel angle minimum 25mm x 25mm x 3mm with 25mm x 3mm cross braces at 500mm centres.

The upstands of trays up to 450mm wide shall not be perforated and the top of the upstand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

Both standard electrical duty and heavy duty trays shall be hot-dip galvanised after perforation and bending of the edges.

Cable trays shall be sized to provide a spare capacity of 20%.

Cable Ladders

- (a) Metal cable ladders shall consist of 120mm high side rails of 2mm minimum thickness and be similar or equal to O-line. Cross pieces shall be spaced at maximum intervals of 300mm. Where cables of 10mm² or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm.

Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring upon the prior approval of the Engineer.

Cable ladders shall be sized to provide a spare capacity of 20%.

Cable trays shall be used to support cables which would sag excessively across runs.

Cable Tray and Ladder Connections

- (a) Cable tray and ladder connections shall be of proprietary manufacture and of the same source as the linear sections that they connect.

The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected.

The radius of all bends shall be the minimum. The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded.

Sharp angles shall be 45° mitred.

Installation of Cable Trays and Ladders

- (a) Spacing between ladder/tray tiers shall be a minimum of 300mm.

Fixing materials shall be compatible with ladder/tray materials and resist corrosion.

Where practicable, cuts in trays shall not pass through perforations.

Cable trays shall be mounted with a minimum air gap of 25 mm between the underside of the tray and the mounting surface.

Installation of Cables on Cable Trays and Ladders

- (a) Cables shall be supported to avoid damage during installation, prior to dressing and fixing. Depending on the overall diameter, single cables and groups shall be secured according to the following:

	Overall Diameter
Nylon UV Protected Cable Ties	<35mm
Proprietary cable clamps	>35mm

In outdoor applications, where the installation may be subject to ultra-violet light, PVC covered aluminium tape shall be used in preference to nylon cable ties.

Cables installed in groups shall be installed in a straight line and not cross over each other. Cables shall not be installed in more than two layers, comprising a maximum size group size of 7.

Where cables leave the cable tray it shall be formed or covered with PVC to ensure a smooth surface for the cable to exit.

Where single core cables are installed in trefoil formation, trefoil cable clamps shall be used.

Conduit

Plain-end metallic conduit and accessories

- (a) Plain-end conduit shall be manufactured from mild steel having a minimum wall thickness of 0,9 mm and shall comply with SANS 60614.

Bending and setting of plain-end conduit shall be undertaken using the correct bending apparatus as recommended by the manufacturer of the conduit.

Galvanised conduits shall be hot-dipped on both the internal and external surfaces, in accordance with SANS 121.

All plain-end metallic conduit accessories shall be of malleable cast iron or pressed steel, and shall comply with SANS 60614.

PVC conduit and accessories

- (a) PVC conduit shall comply with SANS 950 and shall bear the SANS mark.

PVC conduit shall be constructed from rigid PVC. PVC conduit shall be white in colour and shall be non-inflammable. The minimum softening temperature shall be at 75 °C.

All PVC conduit accessories shall be fully in accordance with SANS 950 and shall bear the SABS mark.

Flexible conduit

- (a) Flexible steel conduit and adaptors shall comply with IEC 60086 where applicable. Flexible steel conduit shall be of a galvanised steel construction which is not required to be

waterproof, but shall be vermin proof and suitable for protection of cables against mechanical damage.

In moist or damp areas flexible steel conduit shall be of the plastic sheathed galvanised steel type.

Flexible polypropylene tubing shall only be fastened to PVC conduit installations.

Conduit Accessories

(a) Earth clamps

Earth clamps shall comprise of copper strips having a minimum thickness of 1 mm and shall not be less than 12 mm wide. Earth clamps shall be provided complete with a 25 mm x 4 mm brass bolt, washer and nut and shall be constructed so that the clip can be firmly attached to the conduit without the need for any additional packing.

Flush mounted PVC wall boxes

Flush mounted PVC wall boxes shall be manufactured from rigid PVC and shall be white in colour. All PVC wall boxes shall comply with SANS 950.

The boxes shall be provided with the necessary mounting lugs to suite the units for which the box is intended. Mounting lugs shall be drilled at 82,5 mm centres and shall be provided with no 6 J.B.C. screw threads.

The boxes shall be of approximately the same physical dimensions as those specified for steel wall boxes above and shall have 20 mm knock outs.

Facilities shall be provided for the fixing of earth terminals to the box.

Round group-type PVC boxes.

The boxes shall be similar in shape to those specified in 'Round group-type steel boxes' and shall have spouts which are to be reinforced with webs.

The cover screw pillars shall be provided with tapped brass inserts and provision shall be made for a brass earthing terminal adjacent to one or both of the pillars.

PVC round box covers shall be of PVC and shall be secured by means brass screws at 50 mm centres.

The boxes shall be fully in accordance with SANS 950.

Draw wires

All draw wires for unused conduits shall be of galvanized steel wire having a minimum diameter of 1,6 mm or nylon.

Conduit installation

(a) General

The conduit installation shall conform to par 6.5 of SANS 10142-1.

Spacebar saddles shall be used to keep clear mounting surfaces.

The conduit system shall be mechanically continuous, secure and retrievable.

All unused, screwed entries shall be filled with a blanking plug. Female PVC bushes shall be fitted to all free ends.

Conduits shall not be used to support the weight of fittings etc, except where specifically designed to do so. Conduit boxes supporting luminaires or accessory boxes shall be fixed to the structure of the building independently of the conduit.

Sufficient conduit and drawing boxes shall be provided to facilitate cable installation. In general, no more than 2 bends or offsets or one coupling shall be permitted without a conduit draw box.

Steel conduit shall not be relied upon for earth continuity

All PVC conduit shall be installed in accordance with Appendix C, SANS 950.

Draw boxes should be as far as possible be placed out of sight and shall be indicated on the "as built" drawings.

The edge of flush mounted outlet boxes shall not be deeper than 10 mm from the final surface. Spacer springs shall be used under covers where necessary.

Oversize cover plates shall be provided on all flush mounted round conduit boxes, where required. Surface mounted boxes shall be provided with standard size cover plate.

Flexible conduit

In installations where the equipment has to be moved frequently to enable adjustment during normal operation for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors on equipment, for stove connections and where otherwise required, flexible conduit shall be used for the final connection to the equipment.

Flexible conduit shall be connected to the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2 m of the junction and if the flexible conduit can easily be rewired.

Flexible conduit shall consist of metal reinforced plastic conduit or PVC covered metal conduit with an internal diameter of at least 15 mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured from either brass or mild steel plated with zinc or cadmium.

Installation in concrete

In order not to delay building operations, the electrical subcontractor shall ensure that all conduits and accessories which are to be cast in concrete are placed in position in good time. The electrical contractor or his representative shall be in attendance when the concrete is cast.

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep type. In columns where flush mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

Elbows for conduits of 32 mm diameter and smaller and sharp bends will not be allowed in concrete slabs.

Draw boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate. The cover plate shall be secured by means of brass screws.

All conduits shall be installed as close as possible to the neutral axis of concrete beams, slabs and columns. The conduits shall be rigidly secured to the reinforcing to prevent movement towards the surface of the concrete.

All conduits, draw boxes etc. shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Draw boxes and outlet boxes shall preferably be secured by means of a bolt and nut installed from the back of the box through the shuttering. Fixing lugs may also be used to screw the boxes to the shuttering where off-shutter finishes are required. Where floor glass shuttering is used by the builder, the equipment shall be fixed to the steel only and no holes shall be drilled or made in shuttering. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

As far as possible, conduits shall not be installed across expansion joints. Where this is unavoidable a conduit expansion joint shall be provided. The expansion joint shall consist of two draw boxes with an interlinking flexible conduit connection. The draw box shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest to the joint. The free end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box. The circuit conduit passing through the sleeve shall be terminated 40 mm inside the draw box and in the case of metallic conduit, the conduit end shall be fitted with a brass bush. The gap between the sleeve and the conduit at the joint shall be sealed with "Prestley Tac-Tac" or equal sealing compound, to prevent the ingress of wet cement. The

other end of the circuit conduit shall be secured to the draw box by means of a standard bushed adapter for other PVC types. The cover plates shall be installed before the ceiling is painted. Where a number of conduits are installed in parallel they shall cross the expansion joint of the structure via a single draw box. A number of draw boxes adjacent to each other will not be allowed.

The installation of conduits in floor screed shall be kept to a minimum. Where conduits are installed in screed, the top of the conduit shall be at least 20 mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2,0 m. The electrical contractor shall ensure that conduits are not visible above the screed where the conduits leave the screed.

All draw boxes, conduits, etc, which are installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occurred during the installation of the conduits, or any lost draw boxes, or blocked conduits shall be immediately reported to the Engineer immediately.

Where it is necessary to cut or drill holes in the concrete structure, prior permission shall be obtained from the Engineer in writing.

Installation in brickwork

Recessed conduits and accessories installed in brickwork shall be built-in. In order not to delay building operations the electrical contractor shall ensure that all conduits and accessories which are to be built-in are placed in position in good time.

Any conduit draw boxes, outlet boxes etc, which have been damaged, lost or omitted, shall immediately be reported to the Engineer.

Surface and roof space installations

All conduits shall be installed horizontally or vertically as determined by the route. The electrical contractor shall take all measures to ensure a neat installation.

Conduits shall be firmly secured by means of saddles and screws and in accordance with SANS 10142, par. 5.1.2(b). Conduits shall be secured within 150 mm before and after each 90° bend.

Only approved plugging materials such as fibre plugs or plastic plugs, etc, and round head screws shall be used when fixing saddles, switches, plugs etc, to walls. Wood plugs are not acceptable nor should plugs be installed in joints in brick walls.

Chasing and builder's work

Except where otherwise specified the builder or principal contractor shall be responsible for building in of conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes. The electrical contractor shall notify the builder of his requirements and the responsibility lies with the Contractor to ensure that all the builder's work is clearly indicated or marked where necessary and provided in accordance with his requirements.

Electrical materials to be built in must be supplied, placed and fixed in position by the electrical contractor when required to do so by the builder or principal contractor. The electrical contractor shall also ensure that these materials are installed in the correct positions.

Unless specifically stated to the contrary in the Particular Specification all flush mounted conduits, accessories, switchboard trays, bonding trays etc, shall be built-in and no chasing shall be allowed.

Installation of Cables in Conduit

- (a) The cable installation in the conduit shall conform to par 6.5.5 of SANS 10142-1 and other parts where applicable.

Conduit shall be deburred and swabbed prior to cables being pulled in.

DC shall be installed in separate conduits.

PART C5
ELECTRICAL INSTALLATION

DEPARTMENT OF PUBLIC WORKS

**JAN KEMPDORP MAGISTRATE
COURT**

On
C/O PIET RETIEF AND ARBEID STREET
JAN KEMPSDORP, NORTHERN CAPE
ELECTRICAL TENDER DOCUMENT



public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

ARCHITECT

The Creative Axis Architects
34 Dauphine Street
Bayswater
Bloemfontein



ELECTRICAL ENGINEERS

ZUTARI SOUTH AFRICA PTY LTD
Hydro Park 135 Pres Reitz Avenue
Bloemfontein
9301



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**ELECTRICAL INSTALLATION
BILLS OF QUANTITIES**

SECTION No. 1
PRELIMINARIES

SECTION No. 1 PRELIMINARIES						
ITEM#	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
1	NOTE The pricing of this section to be included with the Project Bill of Quantities (Refer Section No. 1 Preliminaries)	sum	1			R -
	Carried to Final Summary					R -

SECTION No. 2
MV/ & STANDBY POWER INSTALLATION

SECTION No. 2						
MV & STANDBY POWER INSTALLATION						
ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
2	MV Installation					
2.1	Network Upgrade for Jan Kumpcorp Municipality to supply connection	sum	1			
2.2	Add percentage for profit and attendance	%	10%			
2.3	11kV XLPE Copper Cable Table 19	m	100			
2.4	800KVA Miniature Substation Complete with earth mat and Hinch	ea	1			
2.5	Earth grid for Mini sub	ea	1			
2.6	STANDBY GENERATOR					
2.6.1	Supply and install 200 KVA Standby Generator as specified including Diesel	Item	1			
2.6.2	Earth grid for Generator	ea	1			
2.7	CABLE SLEEVES					
2.7.1	Supply and install 110mm diameter PVC sleeve with draw wires	m	220			
2.7.2	Supply and install 50mm diameter PVC sleeve with draw wires	m	50			
2.8	PVC DANGER TAPE					
2.8.1	Supply and install of PVC danger tape above the cables as specified:	m	100			
2.9	MANHOLES					
2.9.1	Supply and install 600 x 600mm Manholes with non locable lids	ea	2			
Carried to Final Summary					R	-

SECTION No. 3
LV BUILDING INSTALLATION

SECTION No. 3						
LV BUILDING INSTALLATION						
ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
3.1	NEW LV DISTRIBUTION BOARDS Supply and installation of the following new distribution boards complete with switchgear and equipment as specified. Refer to single line diagrams and specifications.					
3.1.1	Distribution Board - Main	ea	1			
3.1.2	Distribution Board - A	ea	1			
3.1.3	Distribution Board - B	ea	1			
3.1.4	Distribution Board - C	ea	1			
3.1.5	Distribution Board - D	ea	1			
3.1.6	Distribution Board - E	ea	1			
3.1.7	Distribution Board - F	ea	1			
3.2	LABELING OF DISTRIBUTION BOARDS Supply and install labels in black with white background for all equipment. Letters to be at least 20mm high.					
3.2.1		Item	1			
3.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
3.3.1	300mm ² x 4 Core Cu PVC SWA PVC Cable	m	250			
3.3.2	240mm ² x 4 Core Cu PVC SWA PVC Cable	m	200			
3.3.3	185mm ² x 4 Core Cu PVC SWA PVC Cable	m	50			
3.3.4	150mm ² x 4 Core Cu PVC SWA PVC Cable	m	90			
3.3.5	120mm ² x 4 Core Cu PVC SWA PVC Cable	m	1			
3.3.6	95mm ² x 4 Core Cu PVC SWA PVC Cable	m	90			
3.3.7	85mm ² x 4 Core Cu PVC SWA PVC Cable	m	1			
3.3.8	75mm ² x 4 Core Cu PVC SWA PVC Cable	m	150			
3.3.9	60mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
3.3.10	50mm ² x 4 Core Cu PVC SWA PVC Cable	m	110			
3.3.11	40mm ² x 3 Core Cu PVC SWA PVC Cable	m	120			
3.3.12	150mm ² Bare Copper Earth	m	510			
3.3.13	95mm ² Bare Copper Earth	m	30			
3.3.14	35mm ² Bare Copper Earth	m	50			
3.3.15	16mm ² Bare Copper Earth	m	160			
3.3.16	10mm ² Bare Copper Earth	m	180			
3.3.17	6mm ² Bare Copper Earth	m	110			
Carried to Summary of Section No. 3						R

3.3.19	Tie clasp (500 mm deep x 300 mm wide) including back filling	m	1.00			
3.4	LIGHTING INSTALLATION Supply and installation of the following luminaires.					
3.4.1	B1	ea	74			
3.4.2	B2	ea	21			
3.4.3	B3	ea	41			
3.4.4	B4	ea	4			
3.4.5	B5	ea	4			
3.4.6	D1	ea	32			
3.4.7	D2	ea	51			
3.4.8	D3	ea	9			
3.4.9	D7	ea	18			
3.4.10	R1	ea	19			
3.4.11	R2	ea	142			
3.4.12	A1 - inclusive of 4.5m high Fibre Glass poles (including height)	ea	22			
3.4.13	A2	ea	37			
3.4.14	Supply and install 5 Amp. Non-switch sockets for final connections to light fittings	ea	526			
3.4.15	Supply and install 5 Amp. Plug tops complete with 3 meter 2.5mm ² x 3 core Cabletye cord for final connections to light fittings	ea	526			
3.4.16	Supply and install 2.5mm ² Red PVC covered stranded copper wire	m	17325			
3.4.17	Supply and install 2.5mm ² Black PVC covered stranded copper wire	m	17325			
3.4.18	Supply and install 2.5mm ² Blue stranded copper wire	m	17325			
3.4.19	Supply and install 16 Ampere single lever one way flush mounted light switches complete with cover plate and screws	ea	97			
3.4.20	Supply and install 16 Ampere single lever two way flush mounted light switches complete with cover plate and screws	ea	33			
3.4.21	Supply and install 16 Ampere single lever three way flush mounted light switches complete with cover plate and screws	ea	2			
3.4.22	Supply and install 16 Ampere single lever one way dimmable flush mounted light switches complete with cover plate and screws	ea	4			
	Carried to Summary of Section No. 3					R

3.4.23	Supply and install 16 Ampere two lever two way flush mounted light switches complete with cover plate and screws	ea	5			
3.4.24	Supply and install 16 Ampere two lever one way flush mounted light switches complete with cover plate and screws	ea	4			
3.4.25	Supply and install 16 Ampere Single Load 352° PIR Occupancy Sensor light switches complete with all accessories	ea	34			
3.4.26	Supply and install 16 Ampere photo electric relays (Photo cells)	ea	7			
3.4.27	Supply and install 20 mm diameter Boral steel conduit in concrete complete with sockets, locknuts and saddles terminated in wall boxes and round boxes	m	660			
3.4.28	Supply and install 20 mm diameter Boral steel conduit in brick complete with sockets, locknuts and saddles terminated in wall boxes and round boxes	m	660			
3.4.29	Supply and install 20 mm diameter Boral steel conduit fixed in red bricks complete with sockets, locknuts and saddles terminated in galvanneal trunking and round boxes	m	660			
3.4.30	Supply and install 60mm diameter Boral steel conduit round boxes in concrete	ea	100			
3.4.31	Supply and install 60mm diameter Boral steel conduit round boxes in brick	ea	100			
3.4.32	Supply and install 100mm x 50mm x 50mm galvanneal wall boxes	ea	120			
3.4.33	Chasing in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	250			
3.5	16 AMPERE SOCKET OUTLETS					
3.5.1	External weather proof power outlet IP55 box	ea	6			
3.5.2	Dual flush mounted switched socket outlet	ea	87			
3.5.3	Single flush mounted dedicated switched socket outlet	ea	3			
3.5.4	Dual flush mounted dedicated switched socket outlet	ea	3			
3.5.5	Supply and install O-Line Floor Box in concrete complete with accessories and cover plate	ea	9			
3.5.6	Supply and install Cathcon multi-port 14mm wall boxes	ea	31			
3.5.7	Data point outlet	ea	100			
3.5.8	Supply and install 20 mm diameter Boral steel conduit chased in brick complete with sockets, locknuts and saddles terminated in wall boxes and trunking	m	200			
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3.5.9	Supply and install 100mm x 100mm x 53mm galvanized wall boxes	ea	67			
3.5.10	Casing in of conduit in brick wall including filling, top chasing with plaster cement and finishing off to match existing plaster work	m	900			
3.5.11	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	6000			
3.5.12	Supply and install 2.5mm ² Bare stranded copper wire	m	4500			
3.5.13	Supply and install 2.5mm ² green and yellow PVC covered stranded copper wire	m	4500			
3.6	BOOM GATES (ROLLER DOORS)					
3.6.1	Supply and install 20 Ampere double pole flush mounted isolator	ea	1			
3.6.2	Supply and install 25 mm diameter Eosol steel conduit complete with sockets in ground	m	100			
3.6.3	Supply and install 25 mm diameter Eosol steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	100			
3.6.4	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	300			
3.6.5	Supply and install 2.5mm ² Bare stranded copper wire	m	150			
3.7	AIR-CONDITIONING OUTLET POINTS					
3.7.1	Supply and install 20 Ampere double pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	110			
3.7.2	Supply and install 20 Ampere triple pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	15			
3.7.3	Supply and install 20 mm diameter Eosol steel conduit complete with sockets in concrete	m	800			
3.7.4	Supply and install 20 mm diameter Eosol steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	800			
3.7.5	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	10000			
3.7.6	Supply and install 2.5mm ² Bare stranded copper wire	m	5000			
3.7.7	Final connection to outdoor and indoor unit including conductors, flexible conduit, adaptors and ancillary material as required by supplier of air conditioning units	item	102			
3.7.8	Supply and install O Line Wire Mesh (75mm x 100mm) in ceiling void complete with elbows, tees intersections, hobs and nuts	m	300			
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3.7	AIR-CONDITIONING OUTLET PORTS					
3.7.1	Supply and install 20 Ampere double pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	110			
3.7.2	Supply and install 20 Ampere triple pole enclosed surface mounted isolator with pad lockable red/yellow handle Adjacent to outdoor unit	ea	15			
3.7.3	Supply and install 20 mm diameter Bessel steel conduit complete with sockets in canopy	m	500			
3.7.4	Supply and install 20 mm diameter Bessel steel conduit complete with sockets, locknuts and gaskets terminated in well boxes in rack	m	800			
3.7.5	Supply and install 4.0mm ² Red and Black PVC covered stranded copper wire	m	10000			
3.7.6	Supply and install 2.5mm ² Bare stranded copper wire	m	5000			
3.7.7	Flue connection to outdoor and indoor unit including conductors, flexible conduit, adaptors and auxiliary materials as required by supplier of air conditioning units	item	102			
3.7.8	Supply and install U-Line Wire Mesh (75mm x 100mm) in ceiling void complete with elbows, tees, intersections, hots and nuts	m	900			
3.8	LIGHTING PROTECTION Lighting protection installation complete as specified are indicated on the drawings. The installation must be done by specialist contractor.					
3.8.1	16mm diameter copper bar earth electrode installed with length of 1200mm long	ea	9			
3.8.2	50mm ² PVC insulated copper stranded conductors	m	100			
3.8.3	25mm diameter Bessel steel conduit in trunk	m	120			
3.8.4	Test Points	ea	9			
3.8.5	8mm diameter aluminium conductor	m	600			
3.9	WIREMESH, TRUNKING AND TRAYS FOR ELECTRICAL, DATA AND FIRE PROTECTION SYSTEMS					
3.9.1	Supply and install U-Line Wire Mesh (75mm x 100mm) in ceiling void complete with elbows, tees, intersections, hots and nuts as indicated on drawing	m	250			
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2.9.2	Supply and install O-Line PB200 (76mm x 51mm) galvanized trunking complete with hangers, elbows, tees, intersections, cover plates, bolts and nuts as indicated on drawing	m	600			
2.9.3	Supply and install O-Line P9000 (127mm x 76mm) galvanized trunking complete with hangers, elbows, tees, intersections, cover plates, bolts and nuts as indicated on drawing	m	550			
3.1	CABLE MARKINGS					
3.10.1	Cable markings as specified in specification	ea	10			
3.11	TESTS					
3.11.1	All relevant tests as specified	item	1			
3.12	SCAFFOLDING					
3.12.1	Provision for the erecting and maintaining of scaffolding	item	1			
3.13	SAFETY SIGNS, NOTICES AND EQUIPMENT					
3.13.1	Supply and install all signs, notices and equipment as required by the Occupational and Safety Act (as amended)	Sum	-			
3.14	TURNSTILE & XRAY SCANNER					
3.14.1	Supply and install 20 Ampere double pole industrial surface mounted switch in ceiling void	ea	3			
3.14.2	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	m	30			
3.14.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	13			
3.14.4	Chasing in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	20			
3.14.5	Supply and install 6mm ² Red and Black PVC covered stranded copper wire	m	70			
3.14.6	Supply and install 4.0mm ² Bare stranded copper wire	m	35			
3.14.6	Final connection to turnstile	ea	3			
3.15	ACCESS CONTROL					
3.15.1	Supply and install 20 Ampere double pole industrial surface mounted switch in ceiling void	ea	9			
3.15.2	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	ea	150			
3.15.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	95			
	Carried to Summary of Section No. 3					R -

3.15.4	Supply and install 6.0mm ² Red and Black PVC covered stranded copper wire	m	60			
3.15.5	Supply and install 4.0mm ² Blue stranded copper wire	m	100			
3.15.6	Final connection to power supply	ea	1			
3.16	FIRE PANEL					
3.16.1	Supply and install 30 Ampere double pole flush mounted isolator in brick	ea	2			
3.16.2	Supply and install 60mm diameter PVC conduit round boxes in concrete	ea	120			
3.16.3	Supply and install 20 mm diameter Boral steel conduit complete with sockets in concrete	m	60			
3.16.4	Supply and install 20 mm diameter Boral steel conduit complete with sockets, locknuts and saddles terminated in wall boxes in brick	m	30			
3.16.5	Supply and install 6.0mm ² Red and Black PVC covered stranded copper wire	m	130			
3.16.6	Supply and install 4.0mm ² Blue stranded copper wire	m	60			
3.16.7	Supply and install 100mm x 100mm x 20mm galvanized wall boxes	ea	2			
3.16.8	Chasing in of conduit in brick wall including filling up chasing with plaster cement and finishing off to match existing plaster work	m	20			
3.16.9	Final connection to fire panel	ea	2			
3.17	GENERAL EARTHING					
3.17.1	General earthing for all the buildings as specified	Item	1			
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SECTION No. 4
MCC INSTALLATION

SECTION No. 4 MCC INSTALLATION						
ITEM	DESCRIPTION	UNIT	QTY	MATERIAL	LABOUR	TOTAL
4.1	Fire Fighting Water Supply					
4.1.1	Supply and install weatherproof MCC with VSD starter for 15KW 380V pump, pump will stop and start using pressure control.	ea	1			
4.1.2	Supply and install steel stand for above mentioned MCC	ea	1			
4.1.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
4.1.3.1	6mm ² x 4 Core CU PVC SWA PVC Cable	m	140			
4.1.3.2	4mm ² Bare Copper Earth	m	100			
4.2	Domestic Water Supply					
4.2.1	Supply and install weatherproof MCC with VSD starter for 1.5KW 400V pump, pump will stop and start using pressure control.	ea	1			
4.2.2	Supply and install steel stand for above mentioned MCC	ea	1			
4.2.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
4.2.3.1	6mm ² x 4 Core CU PVC SWA PVC Cable	m	100			
4.2.3.2	2.5mm ² Bare Copper Earth	m	100			
4.3	Sewer Pump Station					
4.3.1	Supply and install weatherproof MCC with 2x VSD starters for two 3KW 400V pumps, pumps will stop and start using level control.	ea	1			
4.3.2	Supply and install steel stand for above mentioned MCC	ea	1			
4.3.3	DISTRIBUTION CABLES Supply and install the following cables complete with terminations etc.					
4.3.3.1	4mm ² x 4 Core CU PVC SWA PVC Cable	m	100			
4.3.3.2	2.5mm ² Bare Copper Earth	m	100			
4.4	Stormwater Pump					
4.4.1	Supply and install weatherproof MCC with VSD starter for 1.5KW 400V pump, pump will stop and start using level control.	ea	1			
4.4.2	Supply and install steel stand for above mentioned MCC	ea	1			
	Carried to Summary of Section No. 4					R

4.4.3	DISTRIBUTION CABLES Supply and install the following cables compatible with telephones etc.					
4.4.3.1	4mm ² x 4 Core Cu PVC SWA PVC Cable	m	100			
4.4.3.2	2.5mm ² Bare Copper Earth	m	100			
4.5	CONTROL AND INSTRUMENTATION CABLEING Allow for all the costs and expenses in connection with the design, manufacture, painting, testing, supplying, delivery, offloading, storage and Site installation of the following materials and equipment: Oil/PVC Insulated PVC Bedded SWA/PVC Sheathed 600/1000V multicore control cables with stranded conductors. Cable fixed to cable tray drawn into sleeves or laid into trenches.					
4.5.1	1.5mm ² x 7 core control cable	m	300			
4.5.2	4.5mm ² x 3 core supply cable	m	200			
Carried to Summary of Section No. 4					R	-

<u>SUMMARY SECTION No. 4</u>	<u>AMOUNT</u>
Total page no. 11	R .
Total page no. 12	R .
TOTAL CARRIED TO FINAL SUMMARY	R -

FINAL SUMMARY

JAN KEMPDRP MAGISTRATE OFFICE: ELECTRICAL INSTALLATION	
FINAL SUMMARY	
	AMOUNT
Section No. 1 – Preliminaries page 1	R -
Section No. 2 – MV & Standby Power Installation page 2	R -
Section No. 3 – LV Building Installation page 10	R -
Section No. 4 – MCC Installation page 13	R -
TOTAL (EXCL VAT) CARRIED TO PROJECT BILLS OF QUANTITIES (SECTION No. 4 : ELECTRICAL INSTALLATION)	R -

**ELECTRICAL INSTALLATION
SPECIFICATION**

DEPARTMENT OF PUBLIC WORKS

**JAN KEMPDORP MAGISTRATE
COURT**

On

C/O PIET RETIEF AND ARBEID STREET
JAN KEMPSDORP, NORTHERN CAPE
ELECTRICAL TENDER DOCUMENT



public works

Department:
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REPUBLIC OF SOUTH AFRICA

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PART 1: GENERAL SPECIFICATIONS

1.1 SCOPE

Application

This document specifies the standard requirements for the design, installation, testing and commissioning of electrical installations operating on voltages up to 1000 volt ac.

The primary intention of this specification is to ensure the provision of an electrical installation which has been properly designed and constructed to ensure safe reliable operation and to facilitate safe inspection, testing and maintenance.

General

The following definitions are used in this Specification:

- The term 'Telemetry Station' shall include both Master Control Station(s) and Remote Terminal Unit(s);
- The term "Employer" shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person;
- The term "Contractor" shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.
- The term "Engineer" shall mean the person appointed by the Employer to act as the Engineer for the purposes of the contract.

Electrical System Characteristics

- The design of the installation shall comply with SANS 10142-1.
- The design of the installation shall consider the following supply characteristics:
 - (i) Voltage, frequency and number of phases;
 - (ii) Maximum prospective short circuit current (phase to phase and phase to neutral);
 - (iii) Type of system, e.g. TN-S, TN-C-S;
 - (iv) Maximum earth loop impedance of the earth fault path external to the installation;
 - (v) Type and rating of the cut-out or switch device
 - (vi) Load capability of the supply source, particularly the effects on the supply voltage of the starting of new equipment and any fault contributions from new equipment.

The installation protective devices shall be correctly co-ordinated within the installation and with respect to existing installations. Discrimination studies shall be performed to validate the co-ordination of the installation.

- All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and working space for such activities. Similarly, the positioning of equipment shall not impede access to, or working space at, non electrical equipment and services for operation and maintenance activities.
- The installation shall be suitable for access and use by electrically unskilled persons.
- Where additions or alterations to an existing installation are to be performed, the rating and condition of existing equipment, including that associated with the supply, shall be verified to confirm its suitability to carry any additional load. The earthing and equipotential bonding arrangements shall also be verified. No addition or alteration shall have an adverse effect on the existing installation.

Installation Performance Requirements

- The installation shall be suitable for its intended duty with respect to the electrical supply distribution and load requirements.
- The installation shall be suitable for the environmental conditions, particularly with respect to corrosion resistance and ingress protection.
- The installation shall be suitable for its intended location, particularly with respect to the mechanical properties and impact strength of the components parts.
- The installation shall be compatible with existing equipment, plant, machinery and services.
- The installation, including its circuit arrangements, shall satisfy the operational and functional requirements of the Employer and be readily and easily maintained throughout its operating life.
- Unless otherwise specified in the Particular Specification, the minimum operating life of the installation shall be 20 years.

1.2 STANDARDS

Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site specific requirements will be found in the Particular Specification and its accompanying Data Sheets, which shall be read in conjunction with this Specification.

The design, construction, installation, inspection, testing and commissioning of the Installation shall comply with all relevant Statutory Regulations, and the latest editions (current at the time of Tender) of all relevant South African National Standards.

The decreasing order of precedence of these requirements shall be as follows:

- Statutory requirements,
- Employer's requirements,
- Data Sheets,
- Particular Specification,
- Standard Drawings,
- This Specification,
- National and international standards.
- Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.
- The Manufacturer of Assemblies to form part of the electrical installation shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the Assembly.

Regulations, Specifications and Standards

The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:

- (b) Occupational Health and Safety Act (Act 85 of 1993);
- (c) Construction Regulations 2014 issued in terms of Section 43 of the Act;
- (d) Local Fire Regulations; and
- (e) Regulations of the Local Supply Authority.

and the latest editions (current at the time of Tender) of all relevant SANS, British Standards and International Standards, including:

The installation shall also comply with:

- (f) This Specification including all Data Sheets; and
- (g) Any documentation issued by, or on behalf of, the Employer in respect of the Installation.

The Contractor shall operate an approved, auditable quality assurance procedure covering the design, construction, and inspection and testing of the installation.

Compliance with Specification

Standard Specifications

The included Zutar standard specifications are based on SANS standards which in turn refers to predominantly IEC standards. These include:

- Engineering Standard SPE-EE-0001, Introduction to Standard Specification
- Engineering Standard SPE-EE-0002, Inspection, Testing and Commission.
- Engineering Standard SPE-EE-0004, Preliminary and General Specification
- Engineering Standard SPE-EE-0010, LV Switchgear & Control Gear Assemblies
- Engineering Standard SPE-EE-0011, LV Cables
- Engineering Standard SPE-EE-0012, Cable Support Systems
- Engineering Standard SPE-EE-0013, Wiring and outlets
- Engineering Standard SPE-EE-0014, Lighting
- Engineering Standard SPE-EE-0015, Street and Area Lighting
- Engineering Standard SPE-EE-0020, MV & LV Earthing
- Engineering Standard SPE-EE-0021, Lightning Protection for Structures
- Engineering Standard SPE-EE-0042, Trenching and Excavation

Technical Datasheets

Detail technical information of the equipment required is specified in the attached technical datasheets. These sheets form part of the technical returnable documents and must be completed in full. These include:

Schedule no.	Ref.	Description	Attached Y/N
SHEET 1	Magistrate Court	LOW VOLTAGE CABLE	Y
SHEET 2	Magistrate Court	CIRCUIT BREAKERS	Y
SHEET 3	Magistrate Court	MINIATURE SUBSTATION	Y

Drawings

Drawings are listed in section 1.5

Order of precedence

In case of any contradiction between the technical specifications, technical datasheets and drawings; the order of precedence shall be:

- Project Specification (this document)
- Zutar Technical data sheets
- Tender drawings & schedules
- Zutar standard specifications

Equipment and Material Supplied

All equipment and material supplied shall be:

- Completely new
- Components to be of the same manufacturer
- In compliance with the technical specifications and/or drawings and/or schedules
- Guaranteed for a minimum period of twelve months (this period commences after issuing practical completion certificate)

Scope of Works

This specification covers the works required for the supply, delivery and installation (including testing and commissioning) of the LV equipment and material for the electrical works of the project.

LV Installation

The works shall consist of:

- Cable management system (cable and wire support) for the various electrical & electronic services
- LV Cable reticulation, including the supply and termination of the main cable
- Small power installation, including manufacturing of LV Panels (DBs)
- Artificial lighting installation, including aerial lights
- Installation of Lightning protection system

Physical and Climatic Site Conditions

With reference to the detailed site location below and the site plan under the drawings section, it is the contractors responsibility to confirm the physical and climatic site conditions from the applicable weather bureau.

Location

Refer to contractual documents for detailed location data.



Figure 1: Location map

Electrical System Operating Parameters

The operating conditions of the electrical network to which the complete electrical installation shall connect, is specified in Table 1.

Table 1: Electrical System Operating Parameters

No.	Description	Unit	Value
1.	System Voltage:		
	Nominal	kV	11 (±8%)
	Minimum	kV	10.34
	Maximum	kV	11.66
2.	3 Phase System Fault Level	kA	Contractor to source information from Supply Authority. Forecast for increased network capacity for 20 years minimum
3.	Earth Fault level	A	Contractor to source information from the Supply Authority
4.	Frequency	Hz	50
5.	Phase Rotation (Standard / Non-Standard) and (Clockwise / Anti-clockwise)	-	RYB (Anti-clockwise)
6.	Earthing Method (Direct / Indirect)	11kV	Indirect
		415V	Direct, TN-S
7.	Insulator Creepage Distance		
	Low Polluted Atmosphere	16 mm/kV	n/a
	Moderate Polluted Atmosphere	20 mm/kV	n/a
	High Polluted Atmosphere	25 mm/kV	Yes
	Very high Polluted Atmosphere	31 mm/kV	n/a

1.3 COMPONENTS AND EQUIPMENT

General

All equipment and components shall be suitable for their operating environment, particularly with respect to the following:

- (h) The degree of ingress protection against dust and moisture (IP rating)
- (i) The corrosion resistance of the materials of construction; and
- (j) Mechanical properties (especially impact strength).

Power Outlets

Commercial Socket Outlets

- (a) All socket outlets with switches shall fully comply with SANS 164 and SANS 60669-1.
Units for flush mounting shall be suitable for a 100 x 100 x 50 mm deep flush wall box. Surface mounted patterns shall be housed in heavy pressed steel boxes. Shutters shall be provided.
All socket outlets with switches shall be continuously rated at 16A and shall be suitable for operation on a 250V, 50 Hz, ac system.
Cover plates shall have beveled edges which overlap the box.

Industrial Socket Outlets

- (a) The plugs, couplers and socket outlets shall conform to the requirements of SANS 1239.
Where pilot connections are required, they shall disconnect before the main phase connectors disconnect.
3-Phase Socket Outlets
30A, 400V socket outlets shall be five pole (Three phase, one neutral and one earth), coloured red, incorporating isolation mechanically interlocked with the plug.
The equipment enclosures shall be IP55 to SANS 60529.
All welding plug and socket outlets shall be 3-phase, plus neutral, plus earth.
Single Phase Outlets
16 A, 230 V socket outlets shall be two pole and earth, incorporating isolation mechanically interlocked with the plug.

Local Isolators

- (a) Local isolator shall be selected from the following:
Isolator in accordance with SANS 60947-3, complete with additional late-make, early-break auxiliary contacts as required;
Plug and socket assembly to SANS 60309-1 and SANS 60309-2, incorporating isolation mechanically interlocked with the plug; or
Plug and socket assembly to SANS 60309-1 incorporating a de-contact arrangement or additional late-make early-break auxiliary contacts.
Moulded case isolators shall be of the double pole ON-LOAD type and approved by Engineer.

Heavy duty metal clad Isolators must be approved by Engineer. Toggles shall be interlocked with the covers.

To distinguish the switches from circuit breakers the operating handles of isolators shall have a distinctive colour and where called for in the Particular Specification the switch shall be clearly and indelibly labelled "ISOLATOR".

The local isolator shall be pad-lockable in the "off" position.

Lighting and Accessories

Luminaires

- (a) Luminaires shall comply with SANS 60568 (relevant parts).

Luminaires shall be supplied with lamps of a type suitable for the luminaire design.

Control Gear and Enclosures

- (a) Control gear shall be fully compatible (both physically and electrically) with the type of lamp and luminaire with which it is intended to be used.

High frequency, electronic control gear shall be used for tubular (double ended) and compact (single ended) fluorescent lamps and if appropriate for discharge lamps.

The temperature rating of the control gear shall be appropriate to its operating environment.

If the control gear is not integral to the lamp or housed within the luminaire, it shall be housed within a suitable enclosure.

Switches

- (a) Flush mounted switches

Flush mounted switches shall comply with SANS 60869-1 and shall bear the SABS mark.

All flush mounted switches shall be suitable for mounting in 100 x 50 x 50 mm galvanised steel or PVC wall boxes unless otherwise specified in the Particular Specification.

The switch mechanism shall be of the lumper operated micro-gap type with silent operation and shall be rated for 16 A at 250 V and 50 Hz.

Switches shall have protected terminals for safe wiring. Multi-lever switches shall be constructed so as to enable individual defective switches to be removed and replaced without having to remove the remaining switches.

The mounting holes provided on the yoke strap shall be slotted to allow for easy alignment. A brass earthing terminal shall furthermore be provided on the yoke to ensure the positive earthing of the switch assembly.

Switches with pilot light indication

Flush mounted switches with pilot light indication shall comply with the relevant parts of SANS 60869-1 and shall bear the SABS mark.

Switches with pilot light indication shall be suitable for mounting in 100 x 50 x 50 mm galvanised steel wall boxes.

The switch shall be rated at 16 A at 250 V and 50 Hz. A red indication lamp shall form an integral part of the switch lever and shall light-up when the switch is in the on position.

Cover plates for switches

Cover plates for flush mounted switches shall have levelled edges which overlap the wall box in order to conceal all wall imperfections.

Surface mounted switches

Surface mounted switches shall comply with SANS 50669-1 and shall bear the SANS mark.

Surface mounted switches shall consist of single or multiple switches, not exceeding four and shall be mounted in a pressed steel box of heavy duty construction.

The switch mechanism shall be of the rubber operated micro-gap type with silent operation and shall be rated for 16 A at 250 V and 50 Hz.

A brass earthing terminal shall furthermore be provided on the switch construction to ensure the positive earthing of the switch assembly and enclosure.

The covers of surface mounted switches shall have toggle protectors.

Waterlight Switches

Waterlight switches shall consist of 10A switches on porcelain bases in cast iron or aluminium alloy housing. Contacts must be of heavy duty brass construction and a quick acting spring mechanism shall be fitted. A rigid operating knob shall be clearly marked to indicate the "ON" and "OFF" positions. Conduit entry shall be provided through a tapped hole. The complete unit shall be watertight.

Photo-Electric daylight switches

The unit shall comprise a photo-cell, thermal actuator and change-over switch. The cover of the unit shall be manufactured from a tough, durable material providing protection against tampering. The cover shall have good weathering properties. It shall be ultra violet resistant and shall not deteriorate when exposed to sunlight for prolonged periods.

The units shall be capable of operating in dusty conditions between -5°C and +55°C.

The units shall be designed to withstand damage by either stone-throwers or hail. If the units do not possess this quality, separate wire screens shall be provided for this purpose.

All parts shall be treated to be corrosion-proof.

The operation level shall be factory preset for "ON" at a light level of approximately 54 lux and "OFF" at approximately 108 lux. Voltage variations shall not affect the operational levels.

A time delay of not less than 15 s shall be provided to prevent the unit from functioning due to lightning or other short period changes in illumination.

The unit shall be effectively safeguarded against voltage surges by means of a suitable surge protector which shall preferably form an integral part of the unit.

The unit shall be of the wall mounting type and shall be supplied complete with a suitable bracket.

The change over switch shall be capable of switching 10 A alternating current at 230 volts.

Area Lighting

Floodlight Luminaires

- (a) The luminaires shall be of the totally enclosed weatherproof type complete with a high-pressure sodium discharge lamp with integral mounted igniter and control gear unless otherwise specified.

The housing shall be robustly constructed of die cast LM6 aluminium alloy or other corrosion proof and UV resistance material and be effectively sealed against the ingress of moisture and dust, etc. The front glass cover shall be constructed from heat resistant armoured glass having retaining clips, fasteners, etc., manufactured from stainless or ferritic steel. The fitting shall incorporate a protractor scale to allow for the correct and accurate adjustment of the downward to vertical aiming angle.

The internal wiring shall be by means of high temperature grade silicone rubber insulated high quality flexible stranded cables not subject to deterioration. The low voltage wiring

shall not be less than 660 volt grade and in the case of high voltage wiring the continuous voltage grade must be suitable for the open circuit voltage of the ballast.

The section in which the capacitor, igniter, choke gear and terminals, etc., are located shall be accessible to provide ease of maintenance. The section shall be complete with earthing terminal and 660 volts insulated line connector block. Capacitors shall be metal clad, totally enclosed type complete with sealed in cap's tails. Capacitors shall be manufactured fully in accordance with SANS 61048 and be capable of improving the overall p.f. to at least 0,95 and be fitted with safety discharged resistors. Chokes shall be of the totally encapsulated type having terminal blocks for ease of maintenance. The electronic ignition device shall be of the three wire type operating on the superposed pulse principle. The circuitry shall be such that should a lamp fail the ignition shall not continue pulsing.

The lampholder end cap shall be porcelain, having silver plated metal parts being of the GCS type and able to withstand the high starting voltage. The lampholder shall incorporate a spring wire type supporting device at the end of the lamp opposite the cap.

Poles

- (a) Poles shall be of the round cross-section tapered type with a mounting height of the luminaires as specified in the Particular Specification. The poles shall be of glass filament wound manufactured and shall be smooth, tapered and seamless.

The pole base shall be provided with multiple luminaire assembly, two-way, three-way or four-way, of diameter to suit the Luminaires offered.

At a height of 1 600 mm above ground level an opening 250 mm high by 80 mm wide, shall be provided. A gland plate to take up to 3 cables, 6,3 A/5 kA MCB, a terminal block and an earth stud shall be installed on a mounting plate in this opening. A shaped weatherproof coverplate, manufactured from the same material as the pole shall be provided to cover the opening. The coverplate shall provide total protection of IP55 to SANS 475. The coverplate shall be fastened into place by means of Allen key type countersunk screws.

The internal wiring between the luminaire and terminal block shall be by means of two 1,5 mm² PVC insulated conductors and a 1,5 mm² bare copper earth conductor. The terminal block shall be suitable for the incoming cables and the internal wiring 1,5 mm² conductors specified.

Luminaire mounting carriage

- (a) The luminaire mounting carriage shall be constructed from galvanized mild steel and shall be provided with all the necessary brackets for the mounting of the luminaires, control gear and terminal boxes.

The carriage shall be designed to carry the weight of the luminaires and associated equipment.

Ballasts should replace the missing luminaires to ensure that the weight is uniformly spread over the luminaire mounting carriage.

Electrical connection to the luminaires

- (a) The connection to the luminaires shall be by means of a suitable rated multicore trailing cable. The cable shall have numbered cores with one green/yellow earth core. The cable shall be terminated in an adequately sized terminal box mounted on the luminaire mounting carriage from which the connections to the individual luminaires and ancillary equipment shall be taken. The cable shall be provided with an approved tension sock at the point of suspension.

Telephone and Accessories

Telephone distribution board

- (a) The board shall comprise of a steel tray, architrave frame and hinged doors.

The tray shall be constructed from corrosion resistant mild steel steel having a minimum thickness of 1,6 mm. Bracing gussets with slots shall be provide on the four corners. Expanded metal shall be spot welded in position on the back of the tray.

Sufficient 25 mm diameter knock-outs shall be provided on the top and bottom sides of the tray.

The architrave frame shall be constructed from 1,2 mm thick sheet steel with square edges. The architrave frame shall form a overlapping 25 mm border around the tray and shall be fixed to the tray in such a manner as to allow for adjustment for the inequalities in the wall finish.

A 20 mm thick soft timber panel of fine grade pine to SANS 1783 without knots shall be installed inside the main telephone distribution board and shall cover the entire back of the distribution board. Clipboard or similar timber or other materials are not acceptable for use as back-boards.

The doors shall be constructed from 1,2 mm sheet steel, reinforced to ensure rigidity. The doors shall be flush mounted in architrave frames. Door catches shall be constructed of chromium plated brass and shall be installed flush with the door. Built-in locks shall be provided when specified in the Particular Specification.

The main telephone distribution board shall be of the dimensions and type as specified in the Particular Specification.

The main telephone distribution shall normally be intended for indoor use but however when specified to the contrary in the Particular Specification or on the drawings, a weatherproof, outdoor type board shall be provided. All outdoor boards shall be equipped with a drip overhang and shall be normally intended for surface mounting.

The boards shall be finished with a high quality undercoat and two final coats of off-white colour paint unless specified to the contrary in the Particular Specification.

Wall and column mounted telephone outlet points

- (a) Outlet points shall, unless specified to the contrary in the Particular Specification, consist of a 100 x 100 x 50 conduit box flush mounted and complete with a blank cover plate to match the cover plates of switched socket outlets and light switches.

INSTALLATION OF COMPONENT AND EQUIPMENT

General

Final positions of equipment shall be agreed on site, prior to installation.

All equipment shall be securely mounted using proprietary fixtures and fixings.

The method of equipment installation shall not adversely affect the function or structural integrity of the structure to which the equipment is attached.

Equipment terminals and covers shall be readily and safely accessible after installation.

The method of equipment installation shall not adversely affect the IP rating of the equipment.

Unless otherwise specified in the Particular Specification, cable access to all plantfield mounted equipment shall be bottom entry.

Framework and Brackets

- (a) Unless otherwise approved in the Particular Specification, site-fabricated framework and brackets shall not be used.

Framework and brackets shall be positioned so as not to adversely effect the removal and replacement of equipment.

Only proprietary accessories (fittings and brackets etc.) shall be used.

Where it is necessary to modify on site any pre-fabricated galvanised mild steel framework, the cut edges shall be dressed and treated immediately with an approved cold galvanising paint to prevent corrosion.

Fasteners securing equipment to framework and brackets shall be independent of those securing framework and brackets to walls and floors.

Positioning of Equipment

- (a) Equipment shall be positioned with due regard to the aesthetics of the installation.

Where a group comprises a number of items at different mounting heights, with not more than one item at any one height, then all items shall be lined on a common vertical centre line.

Where a group comprises a number of items mounted at the same height, then all items shall be lined on a common horizontal centre line.

Where a group comprises a number of different sized items they shall be arranged with the largest item at one end of the group and a progressive reduction in size of the remaining items.

Where a group comprises a number of items at different mounting heights with more than one item at any height, then a common vertical centre line shall be established and the items arranged on, or symmetrically about, this centre line.

Where a group comprises a number of items at the same mounting height with more than one item at the same position, then a common horizontal centre line shall be established and the items arranged on, or symmetrically about, this centre line.

Mounting height of Components

Except otherwise specified, mounting heights shall be as follows:

Distribution boards	top frame 2000 mm above finished floor level
Switches	underside 1400 mm above finished floor level
Socket outlets	underside 300 mm above finished floor level
Telephone outlets	underside 300 mm above finished floor level

All distribution boards, switches and socket outlets shall be of the flush mounted type except where stated otherwise.

Installation of Socket Outlets

- (a) Socket outlets and power outlets shall be installed in the positions as indicated on the drawings.

The Contractor shall only commence with the installation of power outlets in the conduit outlets allowed therefore after the plasterer and painter have completed their work in the vicinity of the outlet.

Unless otherwise specified socket outlets shall be installed at the following heights above finished floor level, measured to the underside of the outlet:

300 mm above finished floor levels for general applications; and 200 mm above work top levels in kitchens.

Connections to geysers

- (a) Each geyser shall be connected to a separate circuit with a separate earth conductor.

The conduit from the distribution board shall terminate in a 100 x 100 x 50 mm outlet box within 1 metre of the geyser. A suitably rated double pole isolator shall be installed in the outlet box. A flexible conduit shall be installed between the isolator and the geyser.

Connections to heaters, fans and air conditioners

- (a) A suitably rated double pole isolator shall be supplied and installed within 1 metre of heaters, fans and air conditioners. Where the equipment is out of reach the isolator shall be installed 1,5 metres above floor level. Flexible cords of sufficient rating may be used for the final connection to the equipment.

Where control units are to be installed the units shall be installed 1,5 metres above floor level.

Installation of Lighting and Accessories

General

- (a) The lighting installation shall be designed on the basis of lowest life cycle costs, considering factors such as power consumption, the service lives and replacement costs of components (lamps, control gear and luminaires etc.) and maintenance requirements.

The electrical subcontractor shall only commence with the installation of light fittings after the paintwork in the vicinity of the fitting is complete and dry. Care shall be taken to ensure that ceiling boards and paintwork is not damaged during the installation of light fittings.

The type of light fittings to be used are indicated and specified on both the relevant drawings as well as in the Particular Specifications.

Positions of light fittings

The mounting positions of light fittings are indicated on the relevant drawings and shall be verified on site.

Mounting heights of light switches

Light switches shall be installed 1,4 metres above finished floor level unless specified to the contrary.

Mounting of light fittings

- (a) Incandescent surface mounted fittings shall be screwed to the ceiling by means of at least two 4 mm diameter electroplated self tapping screws. On concrete, plastered and brick surfaces good quality plastic expansion plugs shall be used and on suspended and soft

ceilings a solid timber backing strip of at least 40 x 40 mm timber shall be supplied and installed between supports and the screws fixed to these backing strips.

Surface mounted fluorescent fittings will be firmly mounted to ensure close contact with the ceiling over the entire length of the fitting. On concrete slabs the fittings shall be mounted by means of two screws into the ceiling conduit box as well as two round headed 4 mm x 30 mm electroplated self tapping screws and plastic expansion plugs, one at either end. On suspended ceilings the fittings shall be similarly mounted but timber backing strips of at least 40 x 40 x 450 mm shall be placed in position on top of the ceiling board and the end screws secured to these strips to spread the load.

Installation of Area Lighting

General

The contractor shall set out the positions of the masts and poles and the cable route as indicated on the drawings.

Poles

(a) Excavations

The holes for poles shall be excavated to the following depths:

Mounting Height	Depth of excavation
5.5 < Mounting Height < 7.5	1m
7.5 < Mounting Height < 10.5	1.8m
Mounting Height > 10.5m	2m

The holes for poles shall have minimum dimensions of 1 metre by 0.5 metres.

Once the poles have been erected and aligned the excavations shall be backfilled and compacted in layers of 150 mm to 95% MOD AASTHO using material free of stones, vegetation, etc.

Where the soil is sandy, loose or marshy, the poles shall be planted in a 12:1 sand/cement mixture.

Planting of Poles

The steel and glass filament wound polyester poles shall be fitted with a base plate that shall be securely bolted with rock bolts before the pole is planted.

The contractor shall ensure that the poles are not strained or damaged in any way during the erecting thereof.

The structures shall be vertical to a tolerance of 0.5% at the top of the pole after erection.

The streetlight poles shall be planted with the luminaire outreach extended in the direction of the roadway and so that the outreach arm is perpendicular to the centre line of the road, except if otherwise specified by the Engineer.

Under no circumstances shall poles be shortened to create the impression that they have been planted to the correct depth.

Installation of Telephone and Accessories

General

The electrical subcontractor shall only supply and install all materials required for the provision of telephone distribution wireways and outlets as indicated on the relevant drawings. The telephone cabling installation shall be undertaken by others.

Main telephone distribution board

- (a) The main telephone distribution board shall be flush mounted in the wall in the position indicated on the relevant drawing. The mounting height for the board is specified in the Particular Specification.

All conduits and sleeves to telephone outlets or sub-distribution boards in the buildings or elsewhere on the site as well as the main incoming sleeves shall terminate at the main telephone distribution board as shown on the relevant drawing.

Separation of services

- (a) Wireways provided for telephone or other related services shall under no circumstances be used for any other purpose.

Power cables, conductors and accessories shall be installed at a minimum distance of 300 mm away from the routes reserved for telecommunication cables.

Conduits and other channels shall be installed in such a way as to avoid telephone cables from crossing power cables.

Telephone outlets

- (a) Telephone outlets in walls shall comprise of 100 mm x 100 mm x 50 mm deep wall boxes which shall be flush mounted in the wall, in the position shown on the relevant drawing, with the underside 300 mm above the finished floor level. The wall box shall be fitted with an ivory coloured blank coverplate.

All outlet boxes shall align up neatly with adjacent socket outlet wall boxes.

Telephone outlets in floors fitted with floorgrating shall be of the same type as the floor outlets for power socket outlets and shall normally be provided in the same outlet box.

Telephone outlets in power skirting shall be provided in the positions shown on the relevant drawing and the electrical subcontractor need only provide a separate short length cover plate at these positions. The cover plate for the fixing of the telephone outlet shall not exceed 250 mm in length and shall be secured in such a manner that adjacent coverplate sections may be removed without disturbing the telephone outlet.

1.4 LOW VOLTAGE CABLES

General

Cables shall be manufactured strictly in accordance with the requirements of SANS 1507.

Cables shall be delivered within 12 months of manufacture and shall be delivered to site on cable drums or coiled with protective wrappings.

Cables shall be delivered, stored and handled in accordance with the manufacturer's instructions. Where the performance of the cable is likely to be adversely affected by the ingress of moisture, it shall be adequately sealed at either end.

The end protruding from the drum shall be protected against mechanical damage.

Cable selection and sizing should comply with SANS 10142-1.

Cables shall have copper conductors to SANS 1411-1. Cores of cross sectional area greater than 1.5 mm² shall be stranded or flexible.

Where neutral conductors are provided, they shall be of the same cross sectional area as the associated phase conductor.

Types of Low Voltage Cables

PILC/PVC and PILC/SWA/PVC

- (a) Paper insulated lead covered cables shall not be used in low voltage installations, except where specified.

Cables shall comply with SANS 97.

Multicore cables shall have a single wire armour.

PVC/AWA/PVC and PVC/SWA/PVC

- (a) Cables shall comply with SANS 1507-3 and be rated at 600/1000V.

Single core cables shall have aluminium wire armour.

Multicore cables comprising five conductors and above, shall have each core individually coloured or coloured white with black numerals.

XLPE/AWA/PVC/PVC and XLPE/SWA/PVC/PVC

- (a) Cables shall comply with SANS 1507-4 and be rated at 600/1000V.

Single core cables shall have aluminium wire armour.

PVC/PVC

Cables shall comply with SANS 1507-3 and be rated at 600/1000V.

XLPE/PVC

- (a) Cables shall comply with SANS 1507-3 and SANS 1507-4, and be rated at 600/1000V.

Single Core PVC

- (a) Cables shall comply with SANS 1507-2 and be rated at 600/1000V.

The insulation shall be phase coloured and where used in single phase systems, line cables shall be red, neutral cables black and earth cables yellow and green.

Flat Twin and Earth PVC

- (a) Copper conductors shall comply with SANS 1411-1 PVC insulated to SANS 1411-2, laid up with a bare copper earth continuity conductor between them, with PVC bedding to SANS 1411-2.

Cables shall be rated at 300/500V.

Earth continuity conductors

- (a) Earth continuity conductors shall comprise of stranded copper conductors of cross-section indicated in the Particular Specification.

A single earth conductor may be used where two or more cables run together, providing the earth conductor cross-sectional area is based on the largest size cable in the run.

Cable Accessories

Concrete protective slabs and cable markers

- (a) Concrete cable markers shall be placed at a minimum of 50 m intervals, changes in trench direction and at road crossings.

Concrete protective slabs shall have the following dimensions.

Length	1 000mm
Width	350 mm
Thickness	50 mm

The slabs shall be constructed of 20 MPa concrete and each slab shall be reinforced with one longitudinal and three transverse mild steel rod of minimum diameter 6 mm. The slabs shall be manufactured in such a way that the slabs interlock with each other thus avoiding shifting of the slabs after installation.

1.5 INSTALLATION OF CABLES

General

The cable installation shall comply with the requirements of SANS 10142-1.

Cables shall be installed strictly in accordance with the cable routes drawing.

Cable installed in groups shall run in straight lines and not cross over each other.

Cables installed above ground shall, as far as possible, run parallel with the lines of building construction.

Cables buried below ground shall, as far as possible, follow features of the site such as roadways and building lines.

Cables and their support systems shall not be fixed to protective barriers, guards or direct to guard-rails.

Cables shall be installed strictly according to the manufacturers requirements pertaining to:

Maximum tensile or compressive stresses (e.g. due to pinching or squashing)

Minimum bending radii;

Temperature of installation; and

Operating environment.

No joints shall be allowed in the low-voltage cables without the prior approval of the Engineer.

Proprietary cable support systems shall be used.

Unarmoured cables shall only be used where there is no risk of mechanical damage.

The open end of all cable sleeves and opening in building structures specifically provided for the passage of cables (including unused openings) shall be sealed after cable installation to prevent the ingress of harmful or flammable gases, liquid, smoke, fire and vermin.

Separation of Cables

(a) Cables shall be classified as follows:

	AC	DC
High Voltage	>1000	>1500
Low voltage (power, control, small power and lighting)	50–1000 Vrms	120–1500 V
Extra-low voltage (signal/instrument, data transmission and telecommunication)	< 50 Vrms	< 120 V

Unless otherwise specified in the Particular Specification, or by the cable manufacturer, or for reasons of electromagnetic compatibility, the minimum separation distance between cables of different classification shall be according to the following table.

Separation (mm)	Extra Low Voltage	Low Voltage	Other Services (Above Ground)	Other Services (Below Ground)
Extra Low Voltage	-	300	150	500
Low Voltage	300	-	150	500
High Voltage Cables	500	300	300	500

Other Services (Above Ground)	150	150	-	-
Other Services (Below Ground)	500	500	-	-
Note: The above figures need not to apply to the short lengths of cables near the equipment to which the cable are connected				

Cables of different classifications shall not be installed in the same duct.

The figures specified in the table above do not apply to cables that are installed in separate metal enclosures and/or cables on cable support systems (cable trays/addors) that are separated with metal partitions.

When cables have to cross, it shall be done at right angles.

Trenches

General

- (a) The proposed trench route shall be surveyed for the presence of underground cables and/or services before digging commences.

The site shall be preserved as far as possible. Only the minimum of trees, shrubs, rocks, etc shall be removed and cleared for the cable route.

Where surplus material has to be disposed of, the Contractor shall dump the material in the area provided by him. It shall be done at the cost of the Contractor.

Excavation

- (a) The cable trench shall be excavated along the routes indicated on the relevant drawings.

The trench shall be absolutely straight.

If any obstacle or interference should be encountered which may require alterations to the trench or routes, such alterations shall receive prior written approval of the Engineer.

Where not specified the trench shall be deep enough so that the top layer of LV cables is buried a minimum of 600 mm below final ground levels.

The Contractor shall excavate by hand where he cannot excavate by means of machines due to limited access and the proximity of other services.

The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clean up the bottom of the trenches after he has completed the required excavation.

The Contractor shall remove all sharp projections, which could damage the cable where the trench is excavated through rocky formations, and shall remove all loose rocks, material, etc from the bottom of the trench.

No excavated material shall be left closer than 300 mm from the side of the excavation.

Once the excavations for cable trenches have been completed, the Contractor shall give the Engineer one working day notice to inspect the trench and to be present when the measurements are made. No inspections shall be undertaken on Saturdays, Sundays and public holidays.

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed.

Installation of Cables Directly In Ground

(a) **Sand bed and sand bed cover for cables**

A sand bed layer of soft sand shall be installed and levelled at the bottom of each trench after the trench has been approved by the Engineer, and prior to cable laying.

If the excavated material is not suitable for the sand bed layer then suitable soil shall be imported for this purpose. The cost thereof shall be included in the price for the excavation unless otherwise specified.

The minimum thickness of the sand bed layer is 50 mm.

If the soil for the sand bed and sand cover has to be sifted, a sieve with holes not larger than 6 mm shall be used.

The cable shall, after the completion of the trench, be laid with the minimum of delay so that the trench can be backfilled.

The sand bed cover for LV cables shall be 150 mm thick, of similar soil and shall be placed directly after the cable(s) has been inspected.

Only one cable shall be laid at a time and the Contractor shall take precautions that the cables which are already installed are not damaged.

Laying of cables

Cable rollers shall be used when cables are drawn into trenches. The cable rollers shall be placed so that the cable does not touch the bottom or the sides of the trench.

If the Contractor intends using a winch to draw the cable into the trench, a cable stocking shall be used or the draw wires shall be soldered to the cable so that the tension is exerted on all the cores, lead sheath and/or steel wire armouring at the same time.

The maximum tension on a cable during laying operations shall not exceed the value specified by the manufacturer.

Sufficient lengths of cable shall be left at the beginning and end of the cable routes to allow for the termination of the cables. The Contractor shall take the necessary precautions to protect the cable ends until they are terminated. The cable ends shall be sealed by means of lead or hotbitum sealing caps to ensure that the cable is waterproof.

Where cables are drawn through sleeves, care shall be taken that they are not kinked or excessively bent.

The Contractor shall keep accurate records of each length of cable laid. The following information shall be recorded:

- Cable drum number
- Size of cable
- Laid from where to where
- Length of cable
- Date laid

The Contractor shall be liable for the repair of the cable due to the faulty manufacture of the cable, should this information not be recorded directly after the cable has been laid.

The Engineer shall inspect all cable trenches before backfilling to ensure that the laying of cables complies with the specification.

Where a cable crosses over other services, the cable shall not be installed at a depth less than 600 mm below ground level and if this is not possible the cable shall be installed underneath the other service and shall be protected in the prescribed manner by means of concrete slabs. The depth of the cable shall be maintained for one metre on either side of the crossing.

If it is not possible to cross over or underneath a service in the prescribed manner, the matter shall be referred to the Engineer for a decision.

The following minimum clearances shall be maintained between electrical cables and other services:

	Vertical	Horizontal
GPO Cables	300 mm	300 mm
Water pipes	300 mm	300 mm
Sewer pipes	300 mm	800 mm
Storm water pipes	200 mm	600 mm
LV cables on same route	100mm	One cable diameter or larger cable

Backfilling of trenches

When the cable has been laid, inspected and approved and the sand bed cover has been installed, the trench shall be backfilled with soil containing not more than 40% rock or shale which shall be able to pass through a 100 mm sieve and which is approved by the Engineer. Where more than 40%, but less than 70% rock occurs, the Contractor shall replace the rock with imported soil. However, should more than 70% rock occur then all the backfilling material shall be imported.

The Contractor may import further stone-free material to the site or sieve the excavated material for sand bedding and cover but payment shall only be compensated for the actual quantity of imported material required as determined by the Engineer. The quantity of imported material required shall be calculated from the nominal trench width.

The excavated material shall be backfilled in layers of 150 mm and shall be well compacted and consolidated to 90% MOD AASHITO. Where necessary the Engineer may require that a mechanical vibrator be used for compacting the trench.

The Contractor shall maintain the completed sections of the cable trench in a proper safe condition for the duration of the contract. The Contractor shall refill and compact the trench where subsidence occurs.

After completion of the work the route of the cable shall be neatly finished off and cleared. All stones bigger than 25 mm as well as all loose organic material and rubble shall be removed.

Electrical warning tape shall be installed on all cable routes (LV and HV) at 150 mm above the top cable layer. Where a cable route exceeds 600 mm in width multiple warning tapes shall be run in such a way that the space between adjacent warning tapes does not exceed 150 mm.

Installation of concrete slabs and cable markers

Where cables cross other services such as water pipes, sewage pipes and other cables or where the chance exists that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs. The slabs shall protect the cable for a distance of 500 mm on either side of the crossing.

Proper cable markers shall be placed at a minimum of 50m intervals, changes in trench direction and at road and other service crossings. The markers shall be buried in the ground directly over the cable with the top protruding 50 mm above the finished ground level.

Cable Sleeves

General

- (a) The sleeves shall be PVC, or alternative sleeve complying with this specification. The sleeves shall be with a minimum wall thickness of 5 mm and mass not exceeding 45 kg per sleeve length.

Method of Laying

- (a) The sleeves must be installed strictly in accordance with the relevant drawings to facilitate future location of the sleeves.
- Sufficient sleeves shall be installed to provide spare capacity of 20%. Under roadways, sufficient sleeves shall be installed to provide spare capacity of 50% subject to a minimum of 2 ducts.
- The distance between sleeves shall be not less than 50 mm where more than one sleeve is installed.
- The maximum angle of a single bend in a sleeve shall be:
- 45°, where all cables has a diameter less than 35mm; or
- 22.5°, where any cable has a diameter greater than 35mm.
- All bends shall be the long radius type.
- When installed beneath roads there shall be a minimum of 750mm of cover above the crown of the sleeve and the sleeve shall be extended to 1,5 m on either side of the road surface.
- Where sleeves are installed during the road construction, the sleeve positions shall be marked with the letter "E" cut or casted into the concrete of the kerb.
- The sleeves shall be bedded on to a 50 mm layer of sifted sand. A 50 mm sand cover shall be backfilled over the sleeves and thoroughly compacted.
- The depth of cover in soft ground shall be a minimum of 500mm above the crown of the duct.
- The sleeves shall be laid straight without kinks.
- Joints shall be carried out with suitable couplings to prevent movement between pipe ends.
- After installation all foreign matter in the pipe shall be cleared with a mandril.
- The sleeves shall be sealed with PVC plugs to prevent the entry of sand before backfilling.
- The necessary precautions during further construction activities shall be made to prevent damage to the sleeves.
- All sleeves shall be left with and 3mm diameter nylon draw wire in place, anchored at each end.

Bore and Jointing

- (a) The bore shall be accurate, smooth and without surface cracks and the inside edges shall be edged or rounded.
- The edging or rounding shall be such that no ridge is formed when two sleeves are joined and with the edges of the jointed sleeves up to 5 mm apart.
- A suitable slip collar or other similar device to maintain the 5 mm spacing after the installation of the sleeves, shall be provided.
- All joints and changes in direction of the sleeve system shall be achieved by the use of proprietary bends and accessories made of the same material of the sleeves.
- The joints shall be flexible enough and have enough play to allow for a 5° adjustment in adjacent pipe lengths during installation or in the case of subsequent subsidence of the ground.
- The joints need not be watertight but shall stop sand and other materials entering the sleeves.

Cable Trays, Ladders

Cable Trays

- (A) All cable trays shall, unless specified otherwise, be heavy duty cable tray standard pattern by O-line or equal

Metal cable trays shall be manufactured from perforated rolled steel. Metal trays manufactured to the following standards shall be used:

Less than 150mm wide	-	1,2mm minimum thickness with 12mm minimum return.
150mm to 450mm	-	1,2mm minimum thickness with 19mm minimum return.
Above 450mm (Heavy duty)	-	2,5mm minimum thickness with 20mm return

The cable tray edges are to be turned up on both sides to improve rigidity but where necessary the sides of the tray are to be reinforced with galvanised steel angle minimum 25mm x 25mm x 3mm with 25mm x 3mm cross braces at 900mm centres

The upstands of trays up to 450mm wide shall not be perforated and the top of the upstand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

Both standard electrical duty and heavy duty trays shall be hot-dip galvanised after perforation and bending of the edges

Cable trays shall be sized to provide a spare capacity of 20%.

Cable Ladders

- (a) Metal cable ladders shall consist of 120mm high size rails of 2mm minimum thickness and be similar or equal to O-line. Cross pieces shall be spaced at maximum intervals of 300mm. Where cables of 10mm² or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm.

Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring upon the prior approval of the Engineer.

Cable ladders shall be sized to provide a spare capacity of 20%

Cable trays shall be used to support cables which would sag excessively across runs.

Cable Tray and Ladder Connections

- (a) Cable tray and ladder connections shall be of proprietary manufacture and of the same source as the linear sections that they connect.

The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected

The radius of all bends shall be 1m minimum. The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded.

Sharp angles shall be 45° mitered.

Installation of Cable Trays and Ladders

- (a) Spacing between ladder/tray runs shall be a minimum of 300mm.

Fixing materials shall be compatible with ladder/tray materials and resist corrosion.

Where practicable, cuts in trays shall not pass through perforations.

Cable trays shall be mounted with a minimum air gap of 25 mm between the underside of the tray and the mounting surface.

Installation of Cables on Cable Trays and Ladders

- (a) Cables shall be supported to avoid damage during installation, prior to dressing and fixing. Depending on the overall diameter, single cables and groups shall be secured according to the following:

	Overall Diameter
Nylon UV Protected Cable Ties	<35mm
Priority cable clamps	>35mm

In outdoor applications, where the installation may be subject to ultra-violet light, PVC covered aluminium tape shall be used in preference to nylon cable ties.

Cables installed in groups shall be installed in a straight line and not cross over each other. Cables shall not be installed in more than two layers, comprising a maximum size group size of 7.

Where cables leave the cable tray it shall be formed or covered with PVC to ensure a smooth surface for the cable to exit.

Where single core cables are installed in trefoil formation, trefoil cable clamps shall be used.

Conduit

Plain-end metallic conduit and accessories

- (a) Plain-end conduit shall be manufactured from mild steel having a minimum wall thickness of 0.9 mm and shall comply with SANS 50614.

Bending and setting of plain-end conduit shall be undertaken using the correct bending apparatus as recommended by the manufacturer of the conduit.

Galvanised conduits shall be hot-dipped on both the internal and external surfaces, in accordance with SANS 121.

All plain-end metallic conduit accessories shall be of malleable cast iron or pressed steel and shall comply with SANS 50614.

PVC conduit and accessories

- (a) PVC conduit shall comply with SANS 950 and shall bear the SANS mark.

PVC conduit shall be constructed from rigid PVC. PVC conduit shall be white in colour and shall be non-inflammable. The minimum softening temperature shall be at 75°C.

All PVC conduit accessories shall be fully in accordance with SANS 950 and shall bear the SANS mark.

Flexible conduit

- (a) Flexible steel conduit and adaptors shall comply with IEC 50086 where applicable. Flexible steel conduit shall be of a galvanised steel construction which is not required to be

waterproof, but shall be vermin proof and suitable for protection of cables against mechanical damage.

In moist or damp areas flexible steel conduit shall be of the plastic sheathed galvanised steel type.

Flexible polypropylene tubing shall only be fastened to PVC conduit installations.

Conduit Accessories

(a) Earth clamps

Earth clamps shall comprise of copper strips having a minimum thickness of 1 mm and shall not be less than 12 mm wide. Earth clamps shall be provided complete with a 25 mm x 4 mm brass bolt, washer and nut and shall be constructed so that the clip can be firmly attached to the conduit without the need for any additional backing.

Flush mounted PVC wall boxes

Flush mounted PVC wall boxes shall be manufactured from rigid PVC and shall be white in colour. All PVC wall boxes shall comply with SANS 950.

The boxes shall be provided with the necessary mounting lugs to suit the units for which the box is intended. Mounting lugs shall be drilled at 82,5 mm centres and shall be provided with no 8 L.H.C. screw threads.

The boxes shall be of approximately the same physical dimensions as those specified for steel wall boxes above and shall have 20 mm knock-outs.

Facilities shall be provided for the fixing of earth terminals to the box.

Round group-type PVC boxes.

The boxes shall be similar in shape to those specified in "Round group-type steel boxes" and shall have spouts which are to be reinforced with webs.

The cover screw pillars shall be provided with tapped brass inserts and provision shall be made for a brass earthing terminal adjacent to one or both of the pillars.

PVC round box covers shall be of PVC and shall be secured by means brass screws at 50 mm centres.

The boxes shall be fully in accordance with SANS 950.

Draw wires

All draw wires for unused conduits shall be of galvanised steel wire having a minimum diameter of 1,5 mm or nylon.

Conduit Installation

(b) General

The conduit installation shall conform in par 8.6 of SANS 10142-1

Spacebar saddles shall be used to keep clean insulating surfaces.

The conduit system shall be mechanically continuous, secure and rewirable.

All unused, screwed entries shall be fitted with a blanking plug. Female PVC bushes shall be fitted to all free ends.

Conduits shall not be used to support the weight of fittings etc. except where specifically designed to do so. Conduit boxes supporting luminaires or accessory boxes shall be fixed to the structure of the building independently of the conduit.

Sufficient conduit and drawing boxes shall be provided to facilitate cable installation. In general, no more than 2 bends or off-sets or one coupling shall be permitted without a conduit draw box.

Steel conduit shall not be relied upon for earth continuity.

All PVC conduit shall be installed in accordance with Appendix C, SANS 950.

Draw boxes should be as far as possible be placed out of sight and shall be indicated on the "as built" drawings.

The edge of flush mounted outlet boxes shall not be deeper than 10 mm from the final surface. Spacer springs shall be used under screws where necessary.

Oversize cover plates shall be provided on all flush mounted round conduit boxes, where required. Surface mounted boxes shall be provided with standard size cover plate.

Flexible conduit

In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors or equipment, for stove connections and where otherwise required, flexible conduit shall be used for the final connection to the equipment.

Flexible conduit shall be connected to the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2 m of the junction and if the flexible conduit can easily be rewired.

Flexible conduit shall consist of metal reinforced plastic conduit or PVC covered metal conduit with an internal diameter of at least 15 mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel constructions may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured from either brass or mild steel plated with zinc or cadmium.

Installation in concrete

In order not to delay building operations, the electrical subcontractor shall ensure that all conduits and accessories which are to be cast in concrete are placed in position in good time. The electrical contractor or his representative shall be in attendance when the concrete is cast.

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep type. In columns where flush mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

Elbows for conduits of 32 mm diameter and smaller and sharp bends will not be allowed in concrete slabs.

Draw boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate. The cover plate shall be secured by means of brass screws.

All conduits shall be installed as close as possible to the neutral axis of concrete beams, slabs and columns. The conduits shall be rigidly secured to the reinforcing to prevent movement towards the surface of the concrete.

All conduits, draw boxes etc. shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Draw boxes and outlet boxes shall preferably be secured by means of a bolt and nut installed from the back of the box through the shuttering. Fixing lugs may also be used to screw the boxes to the shuttering where off-shutter finishes are required. Where fibre glass shuttering is used by the builder, the equipment shall be fixed to the steel only and no holes shall be drilled or made in shuttering. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

As far as possible, conduits shall not be installed across expansion joints. Where this is unavoidable a conduit expansion joint shall be provided. The expansion joint shall consist of two draw boxes with an inter-linking flexible conduit connection. The draw box shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest to the joint. The one end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box. The circuit conduit passing through the sleeve shall be terminated 40 mm inside the draw box and in the case of metallic conduit, the conduit end shall be fitted with a brass bush. The gap between the sleeve and the conduit at the joint shall be sealed with "Pratley Tie-Tac" or equivalent sealing compound, to prevent the ingress of wet cement. The

other end of the circuit conduit shall be secured to the draw box by means of a standard bushed adaptor for other PVC types. The cover plates shall be installed before the ceiling is painted. Where a number of conduits are installed in parallel they shall cross the expansion joint of the structure via a single draw box. A number of draw boxes adjacent to each other will not be allowed.

The installation of conduits in floor screed shall be kept to a minimum. Where conduits are installed in screed, the top of the conduit shall be at least 20 mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2,0 m. The electrical contractor shall ensure that conduits are not visible above the screed where the conduits leave the screed.

All draw boxes, conduits, etc., which are installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occurred during the installation of the conduits, or any lost draw boxes, or blocked conduits shall be immediately reported to the Engineer immediately.

Where it is necessary to cut or drill holes in the concrete structure, prior permission shall be obtained from the Engineer in writing.

Installation in brickwork

Recessed conduits and accessories installed in brickwork shall be built-in. In order not to delay building operations the electrical contractor shall ensure that all conduits and accessories which are to be built-in are placed in position in good time.

Any conduit draw boxes, outlet boxes etc., which have been damaged, lost or omitted, shall immediately be reported to the Engineer.

Surface and roof space installations

All conduits shall be installed horizontally or vertically as determined by the route. The electrical contractor shall take all measures to ensure a neat installation.

Conduits shall be firmly secured by means of saddles and screws and in accordance with SANS 10142, par. 5.4.2(b). Conduits shall be secured within 150 mm before and after each 90° bend.

Only approved plugging materials such as fibre plugs or plastic plugs, etc, and round head screws shall be used when fixing saddles, switches, plugs etc. to walls. Wood plugs are not acceptable nor should plugs be installed in joints in brick walls.

Chasing and builder's work

Except where otherwise specified the builder or principal contractor shall be responsible for building in of conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes. The electrical contractor shall notify the builder of his requirements and the responsibility lies with the Contractor to ensure that all the builder's work is clearly indicated or marked where necessary and provided in accordance with his requirements.

Electrical materials to be built in must be supplied, placed and fixed in position by the electrical contractor when required to do so by the builder or principal contractor. The electrical contractor shall also ensure that these materials are installed in the correct positions.

Unless specifically stated to the contrary in the Particular Specification all flush mounted conduits, accessories, switchboard trays, bonding trays etc, shall be put in and no chasing shall be allowed.

Installation of Cables in Conduit

- 12) The cable installation in the conduit shall conform to par 6.5.6 of SANS 10142-1 and other parts where applicable.

Conduit shall be deburred and swabbed prior to cables being pulled in.

DC shall be installed in separate conduits.

- The entire conduit system shall be complete prior to installing cables.
- Circuits supplied from different distribution boards shall not be installed in the same conduit.
- Final sub-circuits shall not be installed in the same conduit as sub-mains circuits

Power Skirting

General

- This section covers the supply and installing of two or three compartment power skirting.

Construction

- (a) The power skirting and covers shall be installed in standard lengths as per manufacturer.
- The covers shall either snap on or shall be fixed by means of toggle or swivel nuts.
- Proprietary socket outlets that are compatible with the power skirting shall be used
- Proprietary internal and external bends and off sets of the same source shall be used.

Installation

- (a) Conduits for the circuit wiring to the power skirting shall be installed in the floorslabs and chased into the walls to terminate in flush conduit boxes behind the power skirting at the heights of the compartments for the telephone, power and other service compartments.
- The wiring shall pass through large diameter holes, suitably bushed, cut in the rear of the power skirting.
- Where power skirting is interrupted by doorways bridging conduits shall be installed for each of the service compartments.

Wiring inside wire-ways

General

- (a) The cables shall be installed in accordance with SANS 10142-1 and as specified in the Particular Specification.
- All unarmored conductors shall be installed in conduits, trunking or power skirting and such conductors shall not be exposed to possible mechanical damage.
- The contractor shall only commence with the wiring of the installation, or part thereof, after the complete conduit installation, or part thereof including the distribution board (rey supplying the circuits in that part of the installation, is complete.
- The contractor shall however ensure that the wiring of the electrical installation in the building is completed prior to the main contractor. The electrical subcontractor shall be responsible for the co-ordination of his proposed program for the wiring of the building with the main contractor's proposed painting program.
- Any debris or moisture inside of wire-ways shall be removed prior to the installation of conductors
- The cables shall be terminated by means of PVC glands fitted with a neoprene seal. The neoprene seal shall have a round opening for the round multicore cable and a rectangular shaped opening for the flat multicore cable.

Circuits

- (a) The circuits for the installation are indicated on the relevant drawings. The following are the maximum number of points normally connected to each type of circuit unless otherwise indicated on the drawings:

Light points per circuit	=	8
Socket outlets per circuit	=	4
Extraction fan, Air conditioner points per circuit	=	2
Stove points per circuit	=	1

The wiring of one circuit only will be allowed in a 20 mm diameter conduit, with the exception of the wiring from switch boards to fabricated sheet metal boxes located close to switchboards, in which case more than one circuit will be allowed. For larger conduit sizes the requirements of SANS 10142, par. 6.5.6, shall be met.

Looping and joints

A loop-in wiring system where conductors are looped from outlet to outlet shall be employed. Joints in conductors shall be avoided as far as possible but where it becomes unavoidable, joints will be accepted in cable channels only and not in conduits. Joints shall be soldered or shall alternatively consist of approved ferruling properly covered with the correct size heat-shrink sleeves. The use of PVC insulation tape is not acceptable.

Grouping of conductors

In cases where the conductors of more than one circuit are installed in the same wire-way, the conductors of each separate circuit, including the circuit earth continuity conductor, shall be grouped at intervals of at least one metre using plastic cable ties. The conductors of different circuits shall however remain separate in order to ensure that any given circuit may be withdrawn from the wire-way. Conductors entering distribution boards or control boards shall be grouped and bound by means of plastic cable bands. The use of PVC insulation tape for grouping conductors will not be accepted.

Pulling-through of conductors

The electrical subcontractor shall take utmost care whilst pulling conductors through conduit to ensure that the conductors are not kinked, twisted or strained in any manner. Care shall furthermore be taken to ensure that conductors do not come into contact with materials or surfaces that may damage or otherwise adversely affect the insulation and durability of the conductor.

Earth continuity conductors

Bare copper earth continuity conductors or green PVC insulated stranded copper earth continuity conductors, as specified in the Particular Specification, shall be used throughout the installation.

When earth continuity conductors are looped between earth terminals of equipment, the looped conductor ends shall be twisted together and then ferruled or soldered to ensure that a positive earth continuity is maintained when the conductors are removed from any earth terminal.

Where bare copper earth wires are specified for circuits installed in power skirting and floor ducting the electrical subcontractor shall provide a suitable length of PVC sleeving over the bare earth conductor where it passes behind or is connected to power outlets to ensure that such an earth conductor does not come into contact with any live parts.

Wiring inside vertical wireways

Conductors installed in vertical wireways shall be secured at intervals not exceeding 5 m to support the weight of the conductors. Approved clamps shall be supplied and installed in suitable draw-boxes for this purpose.

Conductor sizes

The conductor size for each circuit type is specified in the Particular Specification. In the event that a conductor size is not specified in the Particular Specification, the following minimum conductor sizes shall be used:

Circuit	Minimum Conductor (Size)	
	Phase (mm ²)	Earth (mm ²)
Lighting	2.5	2.5
Socket outlet	4	2.5
Stove	6	6
Bell	1.5	1.5
Clock	1.5	1.5
Air conditioner	4	2.5
Control Wiring	1.5	1.5

Single pole switches

Single pole switches shall be connected to the phase conductor and shall not be connected to the neutral conductor.

Three phase outlets

- (2) With the exception of three phase outlets, wiring to circuits connected to different phases shall not normally be present at lighting, switch or socket outlet boxes. Where this is unavoidable, barriers shall be provided between terminals or connections of the various phases and the box shall be suitably labelled internally to indicate the presence of three phase voltages.

A separate neutral conductor shall be installed together with each three phase circuit to outlets intended for equipment connection by means of isolators or sockets, irrespective of whether the particular equipment normally requires a neutral or not.

Glanding, Identification and Termination of Cables

Glanding

- (2) All metallic cable glands shall comply with SANS 1213 and PVC glands shall comply with SANS 950.

All gland shall be suitable for the type and size of cable being installed and the intended operating environment. Where cables could be subjected to a wet or damped environment,

water tight seals shall be fitted on inner/outer sheaths. All cable glands shall be fitted with an overall neoprene sealing sleeve.

Gland plates shall be a minimum of 2.0mm thick and shall maintain the IP rating of the enclosure.

Where a cable is glanded through a painted or otherwise coated metallic surface provision shall be made to ensure earth continuity between the gland and the enclosure.

Where single core power cables enter an enclosure, the glanding arrangement shall prevent circulating currents.

Glands shall be rigidly supported to ensure cable entry at 90° to the enclosure.

Identification

- (a) Cables shall be identified at both ends by a cable marker, similar or equal to Gratiplast. The reference character sizes shall not be less than 3mm high.

The colours of conductor PVC insulation shall comply with SANS 10142-1, par. 6.3.3. The colours of conductors for sub circuits shall as far as possible correspond with the colour of the supply phase.

The colours of conductors for the wiring of two-way and intermediate switches shall preferably differ from the colour of phase conductors.

Terminations

- (a) All of the strands forming the conductor shall be connected at the point of termination.

Terminal bodies and screws shall be constructed from non-corrosive metal encased in fire resistant, moulded plastic insulating bodies. No part of the terminal body or fastening screws shall project beyond the insulating material which shall afford suitable protection against accidental contact by personnel and against short circuits or tracking.

The terminal block and its associated mounting rail shall be constructed in such a manner as to ensure a firm and positive fastening of the terminal block to the rail. Terminal blocks shall be held in position by means of standard end clamps. It shall furthermore be possible to extend the terminal block by adding additional terminal blocks within the terminal sequence without having to disconnect or dismantle the terminal strip.

It shall be possible to inter mix terminals of various sizes, for different conductor sizes, whilst utilising the same mounting rail. Where smaller terminal blocks occur adjacent to larger terminal blocks, suitable shielding barriers shall be inserted to conceal the terminals that might otherwise be exposed.

The terminal bodies and clamping screws shall be so constructed as to ensure that conductors are not needed or covered when the clamping screws are tightened. Screws shall not come into direct contact with the conductors.

Each terminal block shall have provision for clip-in numbering or labelling strips to be installed, together with protective clear caps over the sheets.

The insulation of conductors shall only be removed over the portion of the conductors that enter the terminals of switches, socket-outlets or other equipment. When more than one conductor enters a terminal, the strands shall be securely twisted together. Under no circumstances shall any of the strands be removed to enable easier insertion of the conductors into terminals.

No more than two conductors shall be permitted to be fastened to any one terminal.

The electrical subcontractor shall take care to ensure that the copper strands are not kinked or damaged during the removal of the insulation.

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PVC insulated conductors shall not be used for the direct connection to equipment where the temperature exceeds 75°C, such as stoves, geysers, electric water heaters and high power incandescent lamps. Silicon coated or other approved conductors shall be used in such cases.

Terminals shall be sized and current rated to match the conductors that are connected to them.

1.6 EARTHING

General

All earthing bonding shall be performed in accordance with SANS 10142-1 & 10199-1.

It must not be assumed that any existing earthing system is satisfactory without investigation. If the existing earthing system is found to be insufficient it shall be rectified. Any new earthing system shall be compatible with the existing earthing system.

Where the installation includes provision of a new or replacement power transformer, a new earth electrode system shall be installed. This shall be connected to the consumer earth terminal which in turn shall be connected to the neutral point of the secondary winding, all of which shall form the primary node of the power system earth.

Earth Electrodes

General

- (a) An earth electrode system shall comply with SANS 1063 and shall be installed in accordance with SANS 10199

The earth electrode system shall consist of a number of interconnected earth rods, tapes or plates, buried or driven into the ground to provide a connection to 'Earth' with an effective earth resistance at the point of connection which is adequate for all protection and protective functions.

The maximum effective earth resistance shall be 10Ω. Where the protection and protective functions rely on overcurrent devices and the passage of current is via the earth electrodes, the maximum effective earth resistance shall be a lower value as required to ensure correct operation of the overcurrent devices. Where LV and HV earthing systems are interconnected, the maximum combined effective earth resistance shall be 1Ω.

The earth electrode system shall be designed and manufactured to withstand corrosion and accommodate any increase in earth resistance due to corrosion, soil drying or freezing over the life of the installation. Where necessary, approved soil conditioning agents may be used.

All component parts of the earth electrode system shall be proprietary items designed for use in earth electrode systems.

Types of Earth Electrode

- (a) Earth Rods

Earth rods shall be extensible, copper clad, high tensile steel rods. They shall be at least 16.0 mm (nominal) in diameter with hardened steel tips and driving caps. Individual rods shall be not more than 1.2 m long. The copper cladding shall be molecularly bonded to the steel and be not less than 0.25 mm thick.

Connections between individual rods shall be by screwed joints in accordance with one of the following:

The ends of the rods shall be externally threaded and be joined by a counterbored, threaded coupler designed to completely enclose the threaded section of the rod. The external threads shall be roll-formed with a minimum copper coating thickness of 0.05 mm at the root of the threads. Couplers shall be manufactured from high strength silicon or aluminium bronze alloy; or

The ends of the rods shall be internally threaded and joined by a screwed phosphor bronze dowel. A corrosion inhibiting paste shall be applied to the threads before assembly.

A single earth rod assembly shall be not more than 6 m long and the separation between adjacent earth rod positions shall be not less than 1.25 times the length of the longest earth rod assembly.

The absence of any buried services, down to the maximum driving depth, shall be established before penetration of the ground commences.

Rods shall be driven into virgin (i.e. not previously disturbed or backfilled) ground using a proprietary percussive hammer.

Earth Tapes

Earth tapes shall be manufactured from bare, annealed copper at least 25 mm wide x 3 mm thick. Tapes shall be installed in trenches at least 1 m below ground level. The minimum distance between adjacent runs of tape shall be 1 m.

Earth Plates

Earth plates shall be manufactured from copper and be either solid or of lattice type construction. The minimum dimensions of individual plates shall be 600 mm x 600 mm x 3 mm thick. Plates shall be buried vertically in the ground and the top of each plate shall be at least 1 m below ground level. The minimum distance between adjacent plates shall be 2.5 m.

Earth Conductors

- (a) Earth electrodes shall be interconnected using bare copper tape or conductors, sized according to the anticipated fault current. The final earthing conductor connecting the earth electrode system to the main earth terminal shall be a copper tape or stranded conductor and shall be sheathed in green/yellow PVC insulation.

Where copper tape is fixed to the building structure it shall be by means of purpose made 'solder-bar' saddles, not by drilling holes through the tape.

Earth conductors shall be installed so as to allow tests to be carried out on the earthing system whilst maintaining an effective earth resistance. This shall be achieved by disconnecting links at each test point.

Where the earthing system provides the earth reference for a transformer secondary winding, and more than one earth electrode is provided, the earth electrodes shall be divided into groups. A final earthing conductor for each group shall be separately brought to the electrical installation main earth terminal via bolted links at each end of the earth bar in order to facilitate inspection and testing without loss of the earthing facility.

Where a HV earthing system is connected to a LV earthing system, the size of the interconnecting conductor shall be not less than that of the main earth conductor on the LV side.

Consumer's Earth Terminal

- (a) The consumer's earth shall comply with par 6.1.1 of SANS 10142-1.

A consumer's earth terminal shall be provided for each installation. This shall be located in, or adjacent to, the main switchgear Assembly at the origin of the installation and shall be clearly labelled.

The consumer's earth terminal shall comprise a tinned, copper earth bar manufactured from hard drawn, high conductivity copper. The size of the bare, copper earth bar shall be 50 mm x 6 mm throughout its length.

The consumer's earth terminal shall be mounted via barrel insulators onto a galvanised channel and where not forming part of the main switchgear Assembly, shall be fixed on a wall between 300 mm and 600 mm above finished floor level.

The consumer's earth terminal shall be of sufficient length to accept the earthing conductor, main bonding conductors, circuit protective conductors, functional earthing conductors (if required) and lightning protection system bonding conductor (if any). Space for three additional spare terminals shall also be incorporated.

Connections to the consumer's earth terminal from the transformer frame, earth electrodes and main switchgear Assembly shall be provided with removable links to facilitate testing.

The consumer's earth terminal shall be connected to the mass of earth by one of the following methods:

TN-C-S system - connection to an earthing point which may be provided by the supplier of electricity and connected by them through the combined earth neutral conductors of their supply system to the earthed star point of the secondary winding of the supply transformer;

TN-S system - connection to an earthing point which may be provided by the supplier of electricity and connected by them through the sheath and armoring of their supply cables to the earthed star point of the secondary winding of the supply transformer; or

Note: In sub-clauses (a) and (b) above, it is possible that the supplier of electricity's earthing point and the consumer's earth terminal could be co-existent.

Where the electrical installation includes the provision of a power transformer, the primary mode of the power earthing system, comprising the neutral point of the secondary winding of the power transformer, shall be connected through a bolted link to the consumer's earth terminal. The consumer's earth terminal shall in turn be connected to the earth electrode system as specified.

Where a neutral to earth link is provided, any current measuring devices associated with current balance or earth leakage protection systems shall be positioned to ensure correct operation.

Where the main secondary connections of transformers involve single-core lead covered cables, bonding of the lead sheaths shall be strictly in accordance with manufacturers' instructions. Normally, sheaths shall be bonded at the transformer and left bare back and insulated at the switchboard.

Functional Earths

- (a) A functional earth is defined as a separate or clean earth typically for instrumentation, telemetry and intrinsically safe systems.

Where a functional earth is required, it shall comprise a dedicated earth network connected to a dedicated functional earth bar with a single connection to the consumer earth terminal at source. There shall be no other interconnection between the consumer earth terminal and functional earthing systems.

Cable screens, shields and drain wires, where they are separate from the CPC, shall be insulated with sleeving and be connected to the functional earth via insulated terminals. Equipment protective earths shall be connected in a strictly individual and radial manner to protective earth terminals, as shall equipment functional earths be connected to functional earth terminals. Equipment protective and functional earth terminals shall be separately connected back to the consumer earth terminal at the origin of the installation.

Joints and Connections

Joints

- (a) Joints in cables shall not be permitted. Joints in tapes shall be kept to a minimum.

Joints in tapes below ground level shall be achieved by exothermic welding. Above ground, joints in tapes shall be achieved by rivetting through drilled holes or by sweating. Joints serving as test points shall be bolted or clamped. Overlap of conductors shall be not less than 100 mm.

All contact surfaces shall be thoroughly cleaned and coated with an anti-corrosive electrical joining compound suitable for the conductor materials.

Bolts, screws, nuts, and washers shall be phosphor bronze. Rivets shall be copper. The minimum provision for joining tape shall be two M8 bolts or four 5 mm diameter rivets.

Connections

- (a) Connections shall be made:
- to most earthing terminals by phosphor bronze set screws and nuts; and
 - to earth rods by bronze, gun-metal, or copper clamps, with phosphor bronze bolts.
- Termination of cables shall be by lugs joined to the cable by an exothermic welding process, by crimping or by compression joints complying with SANS 61230.
- Where holes are drilled in copper tape for connection to items of plant, the effective cross sectional area of the connection shall be maintained.
- Surfaces of all equipment to which protective conductors are connected shall be clean, and free from paint and other non-conducting material. Surface preparation shall be removed at the point of contact, with the exception of galvanised or similar metallic preparations. Any surface preparations removed, shall be made good upon completion of the connection to preserve the life and purpose of both the surface and the protective conductor.

Protection

- (a) All joints, connections, and bare bonding exposed to the elements, or not contained inside switchgear enclosures or other electrical apparatus, shall be protected, immediately after making, with a suitable surface preparation. This preparation shall be easily removable without cleaning compounds, and shall not be harmful to personnel, or to the materials to which it is applied. It shall not impair electrical conductivity.
- Protective coatings shall be waterproof, inert, and tenacious. Acceptable materials are:
- solvent rathack thixotropic corrosion preventatives which form a film of melt petroleum wax;
 - fast drying durable rubberised sprayed coatings; and
 - heat shrink clear sheathings.

Earth Continuity Conductors

General

- (a) All earth continuity conductors above ground shall be identified by a green and yellow covering.
- The Cross sectional area of every protective earth conductor shall be sized in accordance with SANS 10142-1.

Bonding Conductors

- (a) General
- Bonding and bonding conductors shall comply with par 6.11 -13 of SANS 10142-1.
- Main Equipotential Bonding**
- Main equipotential bonding shall be provided for:
- all major items of process plant;
 - the metallic pipes of all incoming services (i.e. water, heating, gas etc);
 - structural steelwork; and
 - any lightning protection system.

All bonding carried out between the consumer's earth terminal and incoming services shall be at a point as close as possible to the point of entry of these services to the premises.

Additional bonding

Any extraneous conductive parts, i.e. any metalwork not forming part of the installation but which itself may have some connection with the mass of earth and which is in such a position that a person could make simultaneous contact between it and an exposed conductive part of the electrical installation, shall be bonded to the nearest exposed conductive part, unless it can be shown to be in otherwise good contact with the earthing system.

Supplementary bonding of a permanent and reliable nature shall be carried out to extraneous conductive parts in a manner which takes due consideration of subsequent maintenance activities.

Where the use of tapework or equipment with specialised, fully protective, non-conducting surface preparations cannot guarantee earth continuity, notably across flanged joints, then supplementary earth bonding conductors or purpose designed hardware ensuring continuity, shall be used.

Metallic cable and wiring support systems shall be bonded to all non-electrical services.

Miscellaneous

Metallic fencing, inclusive of access gates, in close proximity to overhead power cables or substations shall be adequately earthed, using flexible connections where necessary.

1.7 LABELS AND SAFETY SIGNS

General

Labels and safety signs shall be written in English and be unambiguous, durable and legible. Labels shall be attached directly or adjacent to the equipment to which they refer but not to trunking covers or other easily removable or transferable items.

Labels and safety signs shall be attached using an appropriate number of corrosion resistant, mechanical fixings.

The fixing of labels, safety signs and notices shall not affect the IP rating of the equipment.

Labels

- (a) All equipment shall be clearly identified by individual labels and if necessary, instruction plates shall be provided to define the correct operation of the equipment.

Identification labels for control gear, local isolators and emergency stop pushbuttons shall uniquely identify the equipment they serve.

Labels mounted on the outside of an enclosure shall be manufactured from laminated plastic, engraved so as to produce black letters on a white background. Labels mounted on the inside of an enclosure shall be to the same standard or may alternatively be printed using an approved proprietary system. Characters shall be upper case and for:

Labels mounted on the outside of an enclosure, be not less than 6 mm in height; and
Internal component labels, be not less than 3 mm in height.

Internal components shall be clearly identified by individual labels and have circuit designations which correlate with the installation drawings and documentation.

A typed circuit chart shall be permanently fixed inside each distribution board cover door or immediately adjacent to the distribution board. The chart shall be laid out in accordance with the physical arrangement of the protective devices, such that it is easy to relate the circuit chart details to the appropriate protective device.

Safety Signs

- (a) Standards symbols shall be used as far as possible.

Any hazard for which a standard symbol is not defined shall be identified by simple and appropriate symbols and/or wording.

Signs shall be provided to avoid danger to personnel and to provide compliance with statutory regulations. As a minimum, safety signs shall be fitted to removable covers over busbars and live connections and to doors of compartments containing:

Incoming supply cable termination points;

Incoming supply switching and isolation devices;

An internal switching and isolation device;

Motor starters incorporating capacitors;

More than one supply or multiple control circuits originating elsewhere;

Equipment located within a "safe area" but associated with certified apparatus located within a hazardous area; a sign shall also be fitted at the safe area cable termination rail;

Voltages exceeding 230 V, if such voltages would not be expected.

Self-adhesive, vinyl safety signs may be used if there is no requirement for a special legend and proprietary safety signs are available.

Notices

- (a) Access doors of all switchrooms, generator rooms etc. shall have a permanent warning notice indicating the voltages present within.

Each switchroom, generator room etc. shall contain a permanent notice containing instructions and illustrations of the correct procedure to be followed when dealing with cases of electric shock.

An electrical schematic, i.e. a black on white, non-fading print showing the schematic layout of the installed distribution system, shall be mounted adjacent to each main switchgear position.

1.8 DRAWINGS AND DOCUMENTATION

General

All drawings, information, and documentation shall be in English, and each item shall be identified with the Employer's name and project / scheme / contract reference title and numbers, the Employer's representative's name and reference numbers, and the Manufacturer's works / contract / order references. Drawings for acceptance shall be provided on A3 paper copies.

Drawings

Detailed "as-built" drawings shall be provided by the Contractor showing positions of the following.

Equipment (e.g. Light fittings, draw boxes, outlets etc.)

Wire-ways (e.g. trenches, conduit, cables ladder/trays, power skirting etc.)

Cable Routes

MAIN BUILDING

111607-0000-DRG-EE-001	LOWER FLOOR - LIGHTING LAYOUT
111607-0000-DRG-EE-002	LOWER FLOOR - SMALL POWER LAYOUT
111607-0000-DRG-EE-003	LOWER FLOOR - ISOLATOR LAYOUT
111607-0000-DRG-EE-004	LOWER FLOOR - WIREWAYS LAYOUT
111607-0000-DRG-EE-005	GROUND FLOOR - LIGHTING LAYOUT
111607-0000-DRG-EE-006	GROUND FLOOR - SMALL POWER LAYOUT
111607-0000-DRG-EE-007	GROUND FLOOR - ISOLATOR LAYOUT
111607-0000-DRG-EE-008	GROUND FLOOR - LIGHTNING PROTECTION LAYOUT
111607-0000-DRG-EE-009	GROUND FLOOR - WIREWAYS LAYOUT
111607-0000-DRG-EE-010	- DB LAYOUT
111607-0000-DRG-EE-011	- SINGLE LINE DIAGRAM SHEET 1 OF 3
111607-0000-DRG-EE-012	- SINGLE LINE DIAGRAM SHEET 2 OF 3
111607-0000-DRG-EE-013	- SINGLE LINE DIAGRAM SHEET 3 OF 3

Operating and Maintenance Manual

Three Operating Manuals, three Maintenance Manuals and three Certification copies shall be provided for all equipment supplied. The operating and maintenance manuals shall include at least the following:

A schedule of all components equipment in the installations with the following information shall be provided,

- (a) Manufacturers name and contact details
Circuit number (DB name, circuit breaker e.g. DB01=CB08)
Function (e.g. Switching lighting circuit DB03=L1)

A schedule of all the cables excluding house wiring with the following information

- (a) Manufacturers name and contact details

Circuit number (DB name, circuit breaker e.g. DB01=CR08)

Size

Installed length

Function (Feeding Submersible pump IW=SP=01)

Full description and details of design capacity and design criteria for each item of equipment and each product.

(a) Detailed description of the function of all operator controls,

Relevant reduced drawings - general arrangements, assemblies, electrical schematics and parts lists.

Procedures for fault finding.

Maintenance instructions for all components and including repair, overhaul, change-out and installation procedures

Inspection schedules

Spare part information

The Manual's format shall be of A4

1.9 TESTING AND COMMISSIONING

General

The installation shall be inspected and tested in accordance with SANS 10142-1

Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision for all inspection and testing activities.

The Contractor shall provide all necessary safety equipment and test instruments. All test instruments shall comply with SANS 61010 and be covered by a current test and calibration certificate.

The Contractor's safe working arrangements shall comply with the safety management systems and procedures prevailing on site. Where there may be a risk of injury to personnel, the Contractor shall submit a risk assessment and method statement for approval, prior to starting work.

Unless otherwise specified in the Particular Specification, all inspection and test results shall be recorded using proforma documentation (test certificates and schedules) complying with SANS 10142-1.

The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified in the Particular Specification, the period of notice for witness testing shall be 5 working days.

Where most of the inspection and testing activities are not witnessed, the Contractor shall allow for 10 % of the inspection and testing activities to be repeated for witness testing.

If there is a requirement for additional inspection and test activities to be performed as part of process commissioning, this shall be specified in the Particular Specification.

Unless otherwise agreed by the Employer, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.

Test Sequence

Inspections before Testing

- (a) Before testing, inspections shall be performed to verify:
 - All equipment and material is of the correct type and complies with applicable SANS and IEC standards;
 - All parts of the installation are correctly selected and erected;
 - No part of the installation is visibly damaged or otherwise defective;
 - The installation is suitable for the environmental conditions; and
 - The installation complies with this Specification.

Tests before supply is connected

- (a) On satisfactory completion of the inspections specified in 0 and before the supply is connected, the following tests shall be undertaken in the sequence listed:
 - Continuity of conductors;
 - Earthing conductor
 - Main bonding conductors

Circuit earth fault loop impedance, Z_s

Insulation resistance:

Site applied insulation, where applicable

Protection by separation of circuits, where applicable.

Protection by barriers or enclosures provided during erection, where applicable.

Insulation of non-conducting floors and walls, where applicable.

Polarity.

Earth electrode resistance, where applicable.

Tests after supply is connected

- (a) On satisfactory completion of the tests specified in Section D and after connection of the supply the following additional tests shall be performed in the sequence listed.

Re-check of polarity.

Phase rotation, unless otherwise ascertained.

Prospective fault current, where practicable.

Installation external earth fault loop impedance, Z_e .

Functional testing of residual current devices.

PART 2: ELECTRICAL INSTALLATION: PARTICULAR SPECIFICATION

2.1. GENERAL

General

- The electrical portion of the work shall comply with the Standard Specifications and the additional specifications attached to this document.
- The Particular Specification only contains additional projects specific information that is not contained in the Standard Specification.
- Detail technical information of the equipment specified can be found in the Technical Data Sheets.
- The Particular Specification sections relate to the Standard Specification as indicated in the headings.
- The Particular Specification covers the detailed information relevant to all buildings that form part of the project. The building related information however will be dealt with, measured and described, in the separate schedule of quantities for each building.

Electricity Supply

- (a) The municipality is the local supply authority responsible for power supply to Jan Kempdorp.
- (b) The Supply Voltage is at 11000V and the existing transformer supplying low voltage is 315kVA.

Coordination of Services and Work done by others

- (a) This contracts programme shall be co-ordinated with the appointed building contractor's programme and shall include allowance for adverse weather conditions, builders holidays and public holidays as specified in the conditions of contract.
- (b) The provisional programme for the project will be handed to the Contractor once the Contractor has been appointed.
- (c) This contract covers the electrical work related to the project.

Existing Works and Services

The Contractor is responsible for obtaining information regarding services and the existing works which may be affected by the new works. Before the Contractor commences with operations, he must discuss with and have the approval of the Project Manager concerned regarding the proposed methods for the safeguarding of any services and existing works he may encounter during construction. The cost of all precautionary measures, which may be necessary to ensure the safety of such services and existing works, as well as the protection of all persons, shall be for the account of the Contractor. Any alteration to services, which may be required, shall be carried out by the Authority concerned at the expense of the Contractor. The Contractor shall be held responsible for any damage, injury or accident caused as a result of his failure to take the necessary precautionary measures.

2.2 ELECTRICAL SCOPE

- The scope of the electrical installation work shall comprise the following:
- Removal of existing electrical installation.
- Low Voltage Cable Distribution.
- Electrical distribution boards; supply and installation.
- Area lighting installation.
- The supply and installation of artificial lighting circuits and luminaries.
- The supply and installation of small power outlet installation.
- The supply and installation of Standby power by means of 125kVA Standby Generator.
- No UPS installation.
- Smoke Detections System.
- Wiring channels and wire-ways; supply and install.
- Earthing and bonding; supply and install.
- Labelling.
- Site supervision.
- Commissioning and testing of the complete electrical installation.
- Production of "post construction" drawings and documentation
- Correction of defects in the Works in accordance with the requirements specified in the Contract Documents

The above list is not necessarily complete and is only intended to give the Contractor an overview of the works.

2.3. LV ELECTRICAL INSTALLATION

LV Cables

The contractor shall supply and completely install all electrical distribution cables as indicated on the drawings, and listed in the Schedule of Cables.

Tenderers must base their tender on the amounts of cable, including earth conductors, as indicated in the Bill of Quantities. During the course of the work the actual lengths will be measured on site and adjustments will be made to the quantities in the Bill of Quantities for payment purposes.

Tenderers must base their cost for trenching in pickable rock, soft rock and hard rock on the total quantities as indicated in the Bill of Quantities. The actual quantities, based on the dimensions as specified in the standard specifications for trenches for the applicable number of cables to be laid, will be measured on site during the course of the service and adjustments made to the quantities in the Bill of Quantities for payment purposes.

Payment for cable trenching having a greater volume than that specified for the purpose will not be considered except where extra excavations are necessary to by-pass obstacles such as water pipes, drains, large boulders etc. In all such instances the amount of the extra excavations must be agreed upon on site between the Engineer and the contractor.

Labeling of Electrical Cables

All cables shall be labeled at both ends of the cable, by means of a "Brother Tape label printer, covered with transparent heat shrink covering". This label shall indicate the size of the cable and earth conductor and DB to which it feeds, or feeds from; e.g. "50mm² x 4 Core Cable + 25 mm² Earth Conductor from DB GF- Feeding Sub-DB 1F in First Floor"

Schedule of cables

Supply and install the following low voltage distribution cables according to the routes as indicated on the relevant drawings.

All cables shall be supplied and installed according to the standards as specified in the Standard Specification.

All cable lengths specified are provisional and the contractor must measure the exact measurements on site before ordering any cables.

Item	From	To	Distance (m)	Cable size (4core mm ²)	Parallel Cables	BCEW (mm ²)
1	MINISUB	MAIN DB (NORMAL)	70	150	1	95
2	MAIN DB (NORMAL)	DB-A (NORMAL)	10	70	1	35
3	DB-A (NORMAL)	DB-B (NORMAL)	20	16	1	10
4	DB-A (NORMAL)	DB-C (NORMAL)	60	16	1	10
5	DB-A (NORMAL)	DB-D (NORMAL)	55	16	1	10
7	DB-A (NORMAL)	DB-E (NORMAL)	45	16	1	10
8	GENERATOR	MAIN DB (EMERGENCY)	10	95	1	50
9	MAIN DB (EMERGENCY)	DB-A (EMERGENCY)	15	35	1	25
10	DB-A (EMERGENCY)	DB-B (EMERGENCY)	20	10	1	6
11	DB-A (EMERGENCY)	DB-C (EMERGENCY)	60	10	1	6
12	DB-A (EMERGENCY)	DB-D (EMERGENCY)	55	25	1	16
13	DB-D (EMERGENCY)	DB-G (EMERGENCY)	50	6	1	4
14	DB-A (EMERGENCY)	DB-E (EMERGENCY)	45	16	1	10

Conduit and Wiring

Conduit and accessories in ceiling voids, cast in concrete and chased into brickwork shall be PVC.

Surface mounted conduit exposed to the weather shall be galvanised steel

All wall boxes shall be galvanised steel.

All conduits, regardless of the system employed, shall be installed strictly as described in the applicable paragraphs of the standard specification. Wiring of the installation shall be carried out as directed in this specification and the standard specification.

Conduit for general electrical circuits with wiring up to 4mm² shall be 20mm diameter.

Conduit for general electrical circuits with wiring 6mm² and higher shall be 25mm diameter.

Conduits for electronic services shall be 25mm diameter.

Note:

All switches and light fittings must be supplied with a permanent earth terminal for the connection of the earth wire.

Lugs held by switch fixing screws or self-tapping screws will not be acceptable.

Switch Socket Outlets

Supply, install and connect all switch socket outlets as specified and shown on the drawing(s).

Switch socket outlets will be installed flush in wall, or in power skirting, or in floor boxes as indicated on the drawings.

The dedicated switch socket outlets will be of the Red type (with flat earth pin in the 12 o'clock position).

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Normal switch socket outlets shall be wired with 2 x 4mm² PVC insulated copper conductors and 2,5mm² bare copper earth conductor and dedicated switch socket outlets with 2 x 4mm² PVC insulated copper conductors and 2,5mm² insulated copper earth conductor.

The socket outlets shall be similar or equal to the "CRABTREE TYPE" and of the double socket type.

The building also require socket outlets that shall be similar or equal to the two prong European type.

Light Switches

All light switches "CRABTREE" type shall be flush mounted 16A type with metal cover and earth terminal as specified, and be mounted in a 100 x 50 x 50mm galvanised flush wall box.

All motion sensors "SCHNEIDER" type shall be roof mounted angle load 360° dual technology occupancy sensor.

The wall boxes for the light switches shall be installed at a height of 1.4m AFFL to the middle of the wall box.

Light Fittings

The following is a list with a description of the luminaires and light fittings specified for the project.

LIGHT FITTING SCHEDULE

Light fittings and accessories shall be according to the Schedule of Light Fittings and shall be approved by the Engineer.

Important Note:

- All light fitting prices shall include lamps, and shall be priced as per the exact specifications indicated on the schedule and drawings.
- Any deviation from the specification shall first be approved by the client, engineer and architect, after the tender has been awarded.

The following is a list with a description of the luminaires and light fittings specified for the project.

TYPE		DESCRIPTION	QTY
F4	OFFICES, BOARD ROOMS, COURT ROOMS	4 X 36W RECESSED FLUORESCENT LIGHT FITTING	145
R1	HOLDING CELLS	2 X 36W SURFACE MOUNTED VANDAL-PROOF FLUORESCENT LIGHT FITTING	20
J2	PLANT ROOM	2 X 50W SURFACE MOUNTED CORROSION - RESISTANT FLUORESCENT LIGHT FITTING	16
A1	EXTERIOR	55W POST MOUNTED LED LIGHT FITTING	22
A2	STORE ROOM	2 X 55W FLUORESCENT CHANNEL LIGHT FITTING	35

B1	STAIRS	20W LED ROUND CEILING MOUNTED BULKHEAD LIGHT FITTING	75
B2	EXTERIOR	20W LED WALL MOUNTED BULKHEAD LIGHT FITTING	22
B3	EXTERIOR	20W LED ROUND CEILING MOUNTED BULKHEAD LIGHT FITTING (VANDAL PROOF)	42
B4	EXTERIOR	20W LED ROUND CEILING MOUNTED BULKHEAD LIGHT FITTING WITH BATTERY BACKUP(VANDAL PROOF)	5
B5	EXTERIOR	20W LED ROUND CEILING MOUNTED BULKHEAD LIGHT FITTING WITH BATTERY BACKUP.	2
D1	CORRIDORS	12W RECESSED LED DOWNLIGHTER	62
D2	BATHROOMS	12W LED CIRCULAR ALUMINIUM REFLECTOR DOWNLIGHT	51
D3	COVER	95 W SUSPENDED LED DISK LIGHT FITTING	10
M		MOTION SENSOR	40

Circuits and Wiring

Electrical circuits shall be arranged according to the indications on the drawings. Only one circuit shall be installed per conductor.

Wiring shall be done with general purpose PVC insulated copper wire. The following wiring sizes shall be used:

Item	Circuit Type	Circuit Breaker	L+N Wire	Earth Wire
1	Stoves	30A	6mm ²	4mm ²
2	Geysers	30A	4mm ²	2.5mm ²
3	Socket Outlet	20A	4mm ²	2.5mm ²
4	Lighting	10A	2.5mm ²	2.5mm ²

Power Outlet Points

Supply, install and connect all power outlet points as specified and shown on the drawings).

DESCRIPTION OF POWER POINTS

GEYSER INSTALLATION

Geysers will be installed as indicated on the drawings (by others). The final electrical connection shall be by the Electrical Sub-Contractor. Wire from distribution board wiring channel with 2 x 4mm² PVC conductors with 2.5mm² BCEW in 25mm Ø conduit. Provide local 30 A DP isolator adjacent to each geyser against the wall at 1800mm AFFL.

Care shall be taken to ensure that the geysers are filled with water before the power is switched on.

STOVE INSTALLATION

Stoves will be installed as indicated on the drawings (by others). The final electrical connection shall be by the Electrical Sub-Contractor. Wire from distribution board wiring channel with 6mm² PVC conductors with 4mm² RCFW in 25mm Ø conduit. Provide local 30 A MCB isolator adjacent to each stove against the wall at 1400mm AFFL.

FAN UNITS

Fan units form part of the air-conditioning contract and will be installed and commissioned by others.

Supply and install power points for these units in position as indicated on the drawings.

The circuits from the relevant switchboards shall consist of 2 x 2,5mm² PVC insulated stranded copper conductors and 1 x 1,5mm² green and yellow PVC insulated stranded copper earth conductor wired in 20mm diameter PVC conduit.

Each circuit shall terminate in a 30 Ampère double industrial surface mounted isolator in the ceiling void.

AIRCONDITIONING UNITS

Air-conditioning units does not form part of the air-conditioning contract and will be installed and commissioned by others.

Supply and install power points for these units in position as indicated on the drawings.

The circuits from the relevant switchboards shall consist of 2 x 4mm² PVC insulated stranded copper conductors and 1 x 2,5mm² green and yellow PVC insulated stranded copper earth conductor wired in PSCC galvanized trunking and 20mm diameter steel conduit.

Each circuit shall terminate in a 30 Ampère double pole industrial surface mounted isolator in the ceiling void.

AIRCONDITIONING PLANTS

The supply and installation of air-conditioning condensing units does not form part of the contract and will be installed and commissioned by others.

Supply and install power points for condensing units in position as indicated on the drawings.

The circuits from the relevant switchboards shall consist of 16mm² x 4 core PVC armoured cables and 1 x 10mm² copper earth conductor.

The circuit shall terminate in termination blocks of condensing units.

Wiring trays and conduit for Data, Telephone and Access Control

Supply and install the wiring trays and conduit for data network cabling in position as indicated on the drawings.

The wiring trays shall be flush mounted complete with cover plates and screws.

INTERCONNECTION SLEEVES

Supply and install 110mm diameter and 50mm diameter PVC interconnection sleeves between manholes and the relevant buildings complete with steel draw wires as indicated on the drawings.

Separate sleeves with different colours shall be installed for each of the following services:

TELEPHONE NETWORK	-	BLUE
DATA NETWORK	-	GREEN
SECURITY NETWORK	-	YELLOW

GALVANIZED WIRING MESH AND CABLE LADDERS

Supply and install galvanized wiring mesh and cable ladders as indicated on the drawings.

Wiring mesh and cable ladders shall be complete with bends, T-Pieces and 4-way sections in the ceiling void in the locations as shown on the drawings and all other accessories needed to complete the installation.

Wiring mesh and cable ladders supports shall be spaced to avoid sagging between supports.

The Contractor shall allow for the necessary brackets, clamps, bolts and nuts, hanger supports and materials to secure the trunking to the structure.

This Wiring Mesh will accommodate all the wiring and cables for the electronic services such as Data, Telephone, Fire, Access Control and Audio Visual.

Power Skirting

The electrical contractor shall be responsible for the supply and installation of all power skirting complete with corner pieces, end pieces, junction pieces, supply conduits, cover plates, power outlets and outlets for other services as specified and indicated on the drawings.

The top compartment shall be used for power wiring and switch socket outlets, whilst the bottom compartments shall be for telephone and other light current services including data.

If more than one circuit is installed in the same wire way, the conductors of each separate circuit including earth conductor shall be lapped at intervals of 1 m with PVC insulation tape.

Provision shall be made on the cover for the telephone and computer outlet points.

Standard 16 Amp 3-pin fused switch socket outlets 100 x 50 mm nominal size shall be supplied and installed in the position indicated on the drawing and as specified.

Adjoining skirting sections will be bonded and securely joined by means of fish plates fixed by pop-rivets to both adjoining sections. All adjoining sections shall be rectangular and shall but tightly. Covers shall fit tightly across the joints.

Where channels cross expansion joints in the structure, suitable expansion joints shall be provided in the channel by means of fish plate's pop-riveted or screwed to the channel on the one side of the expansion joint and bolting freely in the channel on the other side of the expansion joint.

The power skirting must comply with SABS 1197. The contractor must ensure that the power skirting is installed to the satisfaction of the Engineer before commencing with the wiring thereof.

The power skirting shall be approved and will be 3-channel type with a partitioning in the lower section to create the third channel.

The electrical subcontractor must allow for adjoining conduit to be installed in walls separating offices. As first and preferred option the subcontractor must install the conduit in the separating walls during construction thereof by the building contractor. The location and height above floor level must be co-ordinated so that the power skirting will cover the conduit totally and no wiring will be exposed. The second option is to drill holes through the separating walls as required after the walls have been built and to request the builder to do the necessary patching.

Installation above suspended Ceilings

In areas where suspended ceilings are installed it could be practical to install P9000 and G875 wiring channel in the ceiling void. In this instance the service outlets will consist of 65mm diameter round draw boxes installed in the ceiling void and linked to the galvanised wiring channel with 20mm OR 25mm diameter conduit that terminates properly on the channel. The wiring channel measured in the schedule of quantities will be used for this application if required and instructed accordingly on site. Because of the limitation on access above suspended ceilings the connection to luminaires will be by means of a 5A plug top on a cord cable to plug into a 5A unswitched socket outlet mounted on a 65mm diameter round draw box in close proximity to the luminaire.

Break Glass Outlet Points

As part of the Smoke detection system a number of break glass units will be required at strategic exit doors. For this reason the electrical contractor will be required to supply and install a number of break glass outlet points. The break glass outlet points will consist of flush mounted 100 x 100 x 50mm draw boxes and 20mm diameter conduit connected to the associated wiring channel in the ceiling space.

Data and Telephone and Access Control Installation

Data and telephone wireways and conduit will be installed by the contractor but the actual switches, routers and cables will be installed by the other suppliers. The electrical contractor will however assist these third party contractors to get access to the containment such as wiring channels and conduit to install the wiring by others.

Distribution Boards

Special Note:

The following shall be applicable to switchboards required for this service

The electrical contractor shall supply and install the distribution boards as indicated in the Distribution Board Schedule. All distribution boards shall comply with the standard specification and be approved by the Engineer

General information regarding the distribution boards

Construction:

All distribution boards shall be manufactured according to the detail specifications and drawings, and shall be inspected and approved by the Engineer before installation.

The Engineer shall first approve any other type of distribution board, which may be submitted as an alternative.

All busbars and lugs shall be insulated and wiring shall enter the switch gear from the back of the distribution board.

Quality specification and manufacturers:

All switchgear and equipment shall comply with the standard specification in the document.

Wiring:

The manufacturers shall internally wire all distribution boards.

Wiring between switchgear and busbars shall be done by means of PVC insulated stranded copper conductors, fixed to the busbars with copper lugs, and brass bolts.

Only colour coded wiring shall be accepted, e.g.: Red, yellow and blue for phases, and black for neutral

Wiring coloured by means of PVC insulated tape shall not be accepted.

Wiring shall be neatly strapped in a vertical and horizontal manner

All instrument and control wiring shall be 2.5mm² PVC insulated copper conductors, and shall be numbered for ease of tracing circuits.

Colour:

The colour of distribution boards shall be white and all painting shall be done in accordance with the standard specifications in this document.

Doors:

Where specified, doors shall be of the removable type.

Separate Compartments:

Where distribution boards have separate compartments, they shall be separated by means of a metal dividing section, and be equipped with individual removable circuit breaker covers.

Labelling:

All distribution boards shall be labelled in the following manner

Name of distribution board labelled in Mini-substation

Supply information and size of cable e.g.:

Feed from Mini-sub with 1 x 50mm² x 4 core Cu cable and 25mm² BCEW.

All circuit breakers shall be marked with an engraved type of label

(black letters on white background) and secured to the metal panel as specified in the Standard Specification.

Legend cards can be used for circuits of which the description is too long to fit below the circuit breaker.

Legend Cards

Legend cards covered by removable glass or 1.6mm transparent acrylic plastic shall be fitted to the inside of the door of the distribution board and circuits shall be noted on this legend card. Legend card layout and description for each DB shall be submitted to the Engineer for approval.

Main	:	Main Isolator Switch OR Local Isolator Switch (As case may be)
L1	:	Lights : Bedroom 1, Bedroom 2 & Kitchen,
P1	:	Plugs : Bedroom 1, Bedroom 2 & Kitchen,
ELUI	:	Earth leakage unit for plug circuits 1, 2 & 3.

SCHEDULE OF DISTRIBUTION BOARDS

Note: The distribution boards and all switchgear should be able to withstand a minimum fault current as indicated.

Supply and install new distribution boards complete with switchgear and bus bars in position as indicated on the drawing. The complete building installation will be on standby power. This all distribution boards will be "RED" coloured.

The following switchgear must be installed:

NEW MINIA TURE SUBSTATION TYPE: OUTDOOR WEATHER PROOF MINIMUM FAULT CURRENT: 10.16 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMPERE)	QTY
TRANSFORMER	DB MAIN (NORMAL)	3	300	1

GENERATOR TYPE: OUTDOOR WEATHER PROOF MINIMUM FAULT CURRENT: 8.32 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMPERE)	QTY
MAIN		3	180	1
	SURGE ARRESTERS	4		1
CHANGE OVER SWITCH		3	180	1
DISTRIBUTION	DB MAIN (EMERGENCY)	3	180	1

DISTRIBUTION BOARD DB - MAIN (EMERGENCY) TYPE: FLOOR STANDING MINIMUM FAULT CURRENT: 7.81 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMPERE)	QTY
MAIN		3	180	1
SUB MAIN	DISTRIBUTION BOARD ME	3	120	1
	SURGE ARRESTERS	4		1
LOCAL		3	60	1

DISTRIBUTION LIGHTS	1	10	15
SPARE	1	10	2
EARTH LEAKAGE	2	63	2
GENERAL PLUGS	1	20	7
SPARE PLUGS	1	20	1
DEDICATED PLUGS	1	20	1
DEDICATED PLUGS	1	10	1

DB- MAIN (NORMAL)
TYPE: FLOOR STANDING
MINIMUM FAULT CURRENT: 8.23 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP/RE)	QTY
MAIN		3	300	1
SUB-MAIN	DISTRIBUTION BOARD A	3	150	1
	DISTRIBUTION BOARD C/C	3	180	1
LOCAL		3	80	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	AIRCON	2	20	9
	AIRCON	3	80	1

DISTRIBUTION BOARD - DB-A (EMERGENCY)
TYPE: FLUSH MOUNTED
MINIMUM FAULT CURRENT: 7.20 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP/RE)	QTY
MAIN		3	120	1
SUB-MAIN	DISTRIBUTION BOARD - B	3	30	1
	DISTRIBUTION BOARD - C	3	80	1
	DISTRIBUTION BOARD - D	3	40	1
	DISTRIBUTION BOARD - E	3	30	1
	SURGE ARRESTERS	4		1
LOCAL MAIN	DISTRIBUTION BOARD - DB-A	3	80	1
DISTRIBUTION	LIGHTS	1	10	7
	SPARE	1	10	2
	EARTH LEAKAGE	2	63	2
	GENERAL PLUGS	1	20	7
	SPARE PLUG	1	20	1
	DEDICATED PLUGS	1	20	2
	AIRCON	1	20	1

DISTRIBUTION BOARD - DB A (NORMAL)
TYPE: FLUSH MOUNTED
MINIMUM FAULT CURRENT: 7.76 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		3	150	1
SUB-MAIN	DISTRIBUTION BOARD – B	3	30	1
	DISTRIBUTION BOARD – C	3	60	1
	DISTRIBUTION BOARD – D	3	40	1
	DISTRIBUTION BOARD – E	3	30	1
	SURGE ARRESTERS	4		1
LOCAL MAIN		3	60	1
DISTRIBUTION	AIRCON	2	20	9

DISTRIBUTION BOARD – DB-B (EMERGENCY)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 3.43 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		3	30	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	LIGHTS	1	10	7
	SPARE	1	10	2
	EARTH LEAKAGE	2	63	1
	GENERAL PLUGS	1	20	4
	DEDICATED PLUGS	1	20	1
	AIRCON	2	20	1

DISTRIBUTION BOARD – DB B (NORMAL)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 4.6 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		3	30	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	AIRCON	2	20	3

DISTRIBUTION BOARD – DB-C (EMERGENCY)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 1.59 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		3	40	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	LIGHTS	1	10	7
	SPARE	1	10	2

	EARTH LEAKAGE	2	63	2
	GENERAL PLUGS	1	20	8
	DEDICATED PLUGS	1	20	1

DISTRIBUTION BOARD – DB C (NORMAL)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 2.36 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMPERE)	QTY
MAIN		3	40	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	AIRCON	2	30	7

DISTRIBUTION BOARD – DB-D (EMERGENCY)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 2.43 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMPERE)	QTY
MAIN		3	80	1
SUB-MAIN	DISTRIBUTION BOARD – G	2	30	1
	SURGE ARRESTERS	4		1
LOCAL MAIN		3	60	1
DISTRIBUTION	LIGHTS	1	10	10
	SPARE	1	10	2
	EARTH LEAKAGE	2	63	3
	GENERAL PLUGS	1	20	12
	DEDICATED PLUGS	1	20	1
	DEDICATED PLUGS	1	10	5
	AIRCON	2	20	1

DISTRIBUTION BOARD – DB D (NORMAL)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 3.39 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMPERE)	QTY
MAIN		3	60	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	AIRCON	2	30	10

DISTRIBUTION BOARD – DB-E (EMERGENCY)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 2.00 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		3	40	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	LIGHTS	1	10	10
	PHOTOCELL BYPASS SWITCH		1	1
	CONTROL CONTACTOR		1	2
	SPARE	1	10	2
	EARTH LEAKAGE	2	63	2
	GENERAL PLUGS	1	20	6
	SPARE	1	20	2
	DEDICATED PLUGS	1	20	3

DISTRIBUTION BOARD – DB E (NORMAL)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 2.9 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		3	40	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	AIRCON	2	30	6

DISTRIBUTION BOARD – DB-G (EMERGENCY)

TYPE: FLUSH MOUNTED

MINIMUM FAULT CURRENT: 0.8 kA

SECTION	FEEDER	NUMBER OF POLES	RATING (AMP&RE)	QTY
MAIN		2	30	1
	SURGE ARRESTERS	4		1
DISTRIBUTION	LIGHTS	1	10	3
	PHOTOCELL BYPASS SWITCH		1	1
	CONTROL CONTACTOR		1	1
	AIRCON 2 & 4	1	30	2
	EARTH LEAKAGE	2	63	1
	GENERAL PLUGS	1	20	2

Provisional Cost Amounts

Provisional Cost Items have been included in the schedule of quantities. Should the client decide to make provision for the facilities described as Provisional Cost Items the electrical subcontractor will be instructed to procure and install such services or have it installed by a specialist subcontractor. In the schedule of quantities allowance has been made for tenderers to price their profit and attendance on the Provisional Cost Items if they want to do so. It is a prerequisite that tenderers shall quote the percentage at which the profit and attendance is tendered, because the exact price for the service will have to be determined by documentary proof and the profit and allowance calculated at the percentage as tendered for.

System Testing and Commissioning

The system testing shall be done in accordance with the Standard Specifications.

2.4. STANDBY GENERATOR INSTALLATION

SCOPE OF WORKS

The scope of this contract is for the supply, deliver, off-loading, and storage, installation, commissioning, testing and handing over of a 125kVA standby generator.

The onus is on the tenderer to ascertain any local conditions or peculiarities which might affect the contract, and which are not specified.

The backup generator shall comply with the latest Department of Public Works Specifications, which will be included in the tender document.

125kVA STANDBY GENERATOR

Supply, deliver, install and commission a new 125kVA standby generator complete in outdoor soundproof canopy.

The standby generator shall comply in all respects to the requirements as specified in the Standard Technical Specification for Standby generators.

SPECIFIC REQUIREMENTS

The specific requirements for the standby generator sets are as follows:

ENGINE REQUIREMENTS

ENGINE TYPE

Diesel fueled, warm starting water cooled, compression ignition, direct injection industrial type complying with BS 5514 part 1 – 5 as amended.

EXHAUST

An efficient residential type silencer shall be included.

OUTPUT

The output of the engine under the specified site conditions shall be the nett available output after allowance for all auxiliary equipment, including air filters, cooling fan, oil pump, battery-charging alternator, governor, etc. has been made. No turbo charged engines will be allowed.

The engine must have a run down time of at least 5 minutes at no load speed before shut down.

SPEED

The engine shall operate at a normal speed of 1500r/min only.

ALTERNATOR REQUIREMENTS

GENERAL

The alternator shall be brushless and shall comply with the relevant parts of BS 4999/5000.

CAPACITY

125 kVA GENERATOR

The output capacity of the alternator shall be 125kVA @ 0.8 p.f.

PHASES

The alternator shall be wired for 4-wire operation, each phase being brought out separately unto a terminal block.

VOLTAGE

Three-phase: 415 V
Single Phase: 230 V

BASE REQUIREMENTS

TYPE

The base shall be of the diesel tank incorporated type.

ANTI-VIBRATION MOUNTINGS

Anti-vibration mountings shall be provided between the base and alternator set.

SET REQUIREMENTS

The set shall be as specified in the Standard Technical Specification for Standby generators.

DIESEL TANK

125 KVA STANDBY GENERATOR

1000 Litre - A incorporated in base.

The diesel tank shall include the following:

Diesel level indicator

Electrically driven transfer pump

Alarms to operate when the diesel reserve drops to 30% of the tank capacity

Copper fitting as required, for connecting the tank to the engine

3m of flexible hose ended off in a bent metal pipe with a non-return valve to fill the tank,

3m of flexible hose ended off in a bent metal pipe with a non-return valve to fill the tank.

WATER JACKET HEATER

The standby generator sets shall include a water jacket heater element.

CONTROL-EQUIPMENT REQUIREMENTS

The following control equipment shall be supplied and installed:

PROGRAMMABLE LOGIC CONTROLLER

The control equipment shall be as specified in the Standard Technical Specification for Standby generators and the controller shall incorporate the following functions:

- Mains sensing
- Alternator output-voltage sensing
- Alternator over-frequency sensing
- Control of processor unit (self-diagnostics)
- Starter and control battery charger
- Test points shall be provided for fault-finding purposes
- Alarms/Status indications

AUTOMATIC VOLTAGE REGULATOR (AVR)

The AVR shall be mounted in the control cubicle.

MAIN VOLTAGE MONITORS

A mains voltage monitor shall be provided.

When the voltage of the incoming mains varies by more than $\pm 10\%$ from the normal voltage on any phase, the monitor shall signal that the incoming mains must be disconnected and the engine-starting sequence initiated.

Upon restoration of the incoming mains to within the voltage limits of $\pm 10\%$ of the normal voltage on all phases, the monitor shall signal that the load must be disconnected from the alternator and reconnected to the incoming mains.

If the alternator has been disconnected from the load as a result of the conditions set then, upon restoration of the incoming mains to within the voltage limits of $\pm 10\%$ on all phases, the monitor shall signal that the load must be reconnected to the incoming mains.

Should the incoming mains fail while the engine is running under control of the cooling-off timer the signal for the cooling-off timer and the starting sequence shall be cancelled after confirmation of the mains failure.

ALTERNATOR VOLTAGE MONITOR

When the output voltage of the alternator varies by more than $\pm 10\%$ on ANY phase, the monitor shall signal that the load to be disconnected from the alternator and the engine stopped.

FREQUENCY MONITOR

An over frequency monitor shall be provided which shall shut down the set if the frequency exceeds 52.5 Hz or drops below 47.5 Hz. It shall meet the requirements of class A1 governing. The monitor shall not detect harmonics.

TIMERS

INCOMING SUPPLY FAILURE TIMER

It is essential that incoming supply failures, occurring at short intervals, do not cause a series of starts and stops.

A timer adjustable from 1s to 10s is required.
The timer will usually be set to 3s.

The signal generated by the mains voltage monitor shall start the timer. If the duration of the signal is less than the setting on the timer, the signal is suppressed so that the switching and starting sequence is not initiated. However, if the duration of the signal is more than the setting on the timer, the signal shall be transmitted to initiate the switching and starting sequence.

INCOMING SUPPLY RESTORATION TIMER

It is essential that incoming supply restorations occurring at short intervals do not cause a series of stops and starts.

A timer adjustable from not less than 5 sec's to not more than 150 sec's is required.

The signal generated by the main-voltage monitor shall be timed, if the duration of the signal is less than 150 sec's, the signal is suppressed and the timer is reset. However, if the duration of the signal is more than 150 sec's, the signal shall be transmitted to initiate the switching sequence.¹

ALTERNATOR SUPPLY/INCOMING SUPPLY CHANGE-OVER TIMER

It is essential that the supply be disconnected from the load before the incoming supply is reconnected to the load.

A minimum time of 5 sec's is required with a maximum setting of 70 sec's for sets less than 90KVA. On receipt of the switching signal the alternator supply shall be disconnected from the load and the timer started. After 5 sec's the incoming supply shall be reconnected to the load.

ENGINE COOLING-OFF TIMER

After the load has been transferred to the incoming supply the engine shall run without load for a period to cool off and then stop.

A timer adjustable up to 5 min. is required.

REPEAT-START CONTROL

A repeat-start control is required so that in the event of the engine failing to start on the first start attempt, the starter motor shall be released and repeat the start attempt.

The repeat-start attempt shall be repeated twice.

The duration of each start attempt shall be 6 sec's with a period of 15 sec's between successive start attempts.

Should the engine fail to start after the third start attempt, the repeat start control shall transmit a signal for alarm purposes.

METERS

GENERAL

All meters shall be similar in appearance and shall be either of the digital or the analogue type. MDI.

Digital meters shall be of the seven-segment light emitting diode type.

The digits (numerals) shall be red, have a height of not less than 10 mm and be readable over an arc of 90°. The digital meters shall have an accuracy of 0,5% of the maximum range and shall have at least one decimal digit.

Analogue meters shall be of the square dial type with a 90° deflection.

The scale shall be linear and read from zero to as near as practically possible to 150% of the engine set's nominal rating, with the scale length not less than 85 mm.

Analogue meters shall have an accuracy of better than 1,5% of the full scale deflection. The dc volt and ammeters shall have a length of not less than 40mm.

In addition to the above, analogue meters shall comply with the requirements of BS 89 for panel-mounted industrial instruments.

AC AMMETERS

An AC ammeter and selector switch is required to read phase to phase and phase to neutral voltages.

A switch is required to switch the voltmeter to either the incoming mains supply or the alternator supply.

AC AMMETERS

An AC ammeter per phase (colour coded) is required to read the total current load supplied by the alternator, including dummy loads if fitted.

In case of analogue meters for currents up to 100A, direct reading meters may be used; for currents above 100A, current transformers shall be used.

The ammeters shall have a suppressed overload scale above the normal range and shall be of the maximum demand type (MDI).

In case of digital meters, additional MDI ammeters shall be fitted.

Where the charge - over circuitry forms part of the engine control panel, the am meters shall be wired accordingly.

DC VOLTMETER

A dc voltmeter, calibrated from 10V to 35V, is required (to monitor the starter) control battery voltage. The ammeter shall be calibrated from 0A to 10A.

FREQUENCY METER

A frequency meter, calibrated from 47Hz to 63Hz, is required.

A selector switch is required to switch the frequency meter to either the incoming mains supply or the alternator supply or off.

HOUR METER

An hour meter, capable of registering up to 9 999h is required.
The hour meter shall indicate engine running hours whether the set is loaded or not.

STARTER/CONTROL BATTERY CHARGER

A solid state mains battery charger in parallel with the engine driven generator is required to float and maintain the battery voltage between 2.33V and 2.30V per cell.

The charger shall be of the constant voltage type with automatic and inherent current limiting features.

The output of the charger shall be limited to 5A.

The input of the charger shall be connected to the incoming mains on the load side of the voltage sensing circuit breaker.

Sealed or encapsulated units are not acceptable.

A loss-of-charge current alarm shall be provided to indicate failure of the mains charger. This shall be a current monitor. A delay period of 1min must be allowed before the alarm is triggered.

When used as a mobile unit it shall be possible to power the battery charger from an external source. In the idle condition the battery shall be disconnected via an on/off switch. A label indicating BATTERY SWITCHED OFF/BATTERY AFGESKAKEL shall be provided.

ALARM/STATUS INDICATIONS

The following alarm/status indications, by means of high-intensity LEDs, shall be provided.

Temperature of engine cylinder coolant
Low oil pressure
Engine running (green LED)
30% diesel-fuel in service tank
Engine start failure
High/low alternator output voltage
Mains fail
Battery charger fails
Dunnage load in operation
Electric fan failure (when electric fan is fitted)
Emergency stop activated
Manual control (flashing red LED)
Over and under speed (frequency)

The alarm indicator shall be of the push-button-reset type.

All alarm/status indications shall be extended to a terminal strip to allow for remote control and monitoring.

CONTROL SELECTOR

A 4-position control-selector shall be provided to facilitate the following modes of operation:

OFF:	Diesel/alternator set switched off
MANUAL:	Diesel / alternator take load on mains failure
AUTO:	Diesel/alternator takes load on mains failure
TEST:	Mains bypassed. Diesel / alternator shall not take load

ALTERNATOR AND MAINS CIRCUIT-BREAKERS (ACB)

125 kVA STANDBY GENERATOR

Supply and install the following air circuit breaker to withstand a minimum fault of 15 kA in the control cubicle:

Alternator circuit breaker	-	180 Ampère triple pole
Mains circuit breaker	-	180 Ampère triple pole

EMERGENCY STOP-BUTTON

An emergency stop-button shall be positioned on the front panel of the control cubicle. When depressed the diesel/alternator shall immediately stop and the load shall be disconnected from the set.

The stop button shall be of the self-latching, twist release type. The stop button shall be red with a minimum diameter of 25mm. A label indicating its function shall be positioned directly above the stop button.

CHANGE-OVER CONTACTORS AND MAINS BYPASS SWITCH

GENERAL

125 kVA STANDBY GENERATOR

The change-over contactors (or motorized c/o breakers), standby switch and mains bypass switch shall be able to carry a load of at least 1000 Amperes and must be able to withstand a fault current of at least 15 kA.

The change-over contactors and bypass switch shall be mounted in the control cubicle.

CHANGE-OVER CONTACTORS

The change-over contactors shall be mechanically and electrically interlocked. A three-position bypass switch shall be provided.

The bypass switch shall provide the following functions:

-Automatic	:	Normal working position
-Bypassed	:	Incoming mains connected directly to the load with the alternator isolated
-Off	:	Incoming mains, alternator and load isolated

BATTERY

A battery suitable for continuous float charge operation at a maximum charge voltage of 27.6 for 24 volt systems and 13.8 for 12 volt systems shall be provided with the set.

The minimal voltage after the final start at 3 attempts shall not fall below 75% of nominal voltage.

Only maintenance free batteries will be considered. The battery offered shall be suitable to operate between 0°C - 45°C.

The life expectancy of the battery under the above operating conditions must be specified. However a minimum of 5 years is required.

The charger must be of the constant voltage type, pulse type chargers are not acceptable, suitable to charge the offered battery in accordance with the battery manufacturer's specification. The transformer shall have a capacity of not less than 120 V.A. and a D.C. rating of 7 amperes for 12 volt systems and 250 V.A. and a D.C. rating of 8 amperes for 24 volt systems.

DUMMY LOADS

The dummy loads shall be rated at 30% of the total kVA output rating of the diesel alternator supplied.

Automatic sensing shall be incorporated to switch the dummy loads in after a 5 - 10 min period once the actual load is less than 35% of the rated output of the alternator and shall be switched out when the actual load, excluding the dummy loads, is 40% or more.

The dummy loads shall be parallel to the output circuit after the ACB (Alternator circuit breaker). The dummy loads shall be positioned in a cooling.

HANDBOOKS AND DRAWINGS

The contractor shall supply the following handbooks and drawings. (In English).

- Engine and Alternator handbooks
- Service manual
- Spare parts manual
- Spare part list - indicating make, rating etc.

Control cubicle handbooks
Description (operating) manual
Fault-finding manual
Component lists - indicating make, rating etc.
Drawings
Wiring and schematic drawings showing detailed circuitry of the following

Engine
Alternator
AVR
Control cubicle
Interfacing between assemblies, sub-assemblies, components, etc.

Each wire, component, terminal, etc. shall be clearly annotated on the drawing for identification and maintenance purposes.

No drawing shall exceed A1 size. Each drawing shall be properly numbered, e.g.

- AB 001 Sheet 1
- AB 001 Sheet 2 etc.

Microfilms

Software (CD's): copies of all circuits required for maintenance purposes shall be provided per type of plant

Basis of provision

Handbooks and drawings shall be provided on the following basis:

Two copies of every handbook and of every drawing per plant (for Region use)

One copy of every handbook and of every drawing and software per type of plant (for Head Office use).

A separate schematic drawing shall be pasted inside the control cubicle behind a transparent plastic cover.

Unless handbooks and drawings are available at the time of final inspection certificate will not be issued.

The Engineer will take possession of all handbooks and drawings for delivery to the Client.

MAKER'S TEST

Every engine/alternator set and cubicle shall be tested as a unit at the maker's works

The test shall cover a period of at least 2 h. For the first hour the alternator shall be loaded to its full capacity at unity power factor. At the commencement of the second hour of the test, the alternator shall be subjected to an overload of 10%, which shall be maintained for 1 hour.

The set shall be capable of carrying this load without overheating of the engine or the alternator.

The following shall be recorded every 30 minutes throughout the test:

- Voltage across load
- Current through load
- Engine-head temperature
- Ambient air temperature

Any adjustment made to the set during the test run shall be recorded on the test sheet.

The supplier shall specifically certify that every set is capable of producing its full output without overheating of the alternator or the engine when operating under the following conditions:

- Altitude: 1440 m
- Ambient air temperature: 35°C
- Relative humidity: 40%

The above test results must be available at the time of final inspection, failing which an inspection certificate will not be issued.

SIGN WRITING, MARKINGS AND LABELING

SIGN WRITING

All meters, switches, indicators, lamps, etc. on the face of the cubicle shall be clearly sign written in Afrikaans and English as to purpose or function.

The cubicle shall be so constructed that the AC and DC components are screened from one another.

MARKINGS

An engraved riveted plate with the following inscription in letters not less than 16mm high, shall be mounted in a readily visible position on the front of the unit:

'DANGER-MAINS VOLTAGE'
'KOTSI MOTLAKASE'

The manufacturer's rating plate and the identification plate shall be mounted on the front of the unit.

LABELLING

All assemblies, sub-assemblies and components shall be clearly labelled for easy identification on the schematic circuit drawings and wiring diagrams.

SHIPPING AND PACKING

Each set must be transported as a unit. The supplier shall quote two prices, as follows:

A price for packing the equipment to withstand conveyance by road or rail including delivery to the site as indicated.

B Supply of the generator set.

NOTE:

The supplier shall be responsible for any damage arising from inadequate or careless packing.

DELIVERY

Delivery shall take place in accordance with the stipulations in the tender documents.

SIZE AND MASS

Tenderers shall state the approximate size and mass of a set without fuel, lubricant and water. The contractor must supply the fuel and lubricant after the unit is installed.

TECHNICAL ASSISTANCE

The supplier shall undertake to furnish such technical assistance and information as may be required by the engineer to overcome any difficulties that may be encountered in the operation of the set.

GUARANTEE

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The plant shall be guaranteed against faulty material, faulty design and poor workmanship, fair wear and tear excluded.

The guarantee shall be for a period of twelve months after date of delivery.

The availability of all components shall be guaranteed for a min. period of 10 years.

TECHNICAL SCHEDULE OF INFORMATION

The following must be completed in full. Failure to do so will invalidate the tender and the offer will be rejected.

No equivalents shall be accepted.

Delete which are not applicable, i.e. N/A.

SECTION A

ENGINE	MAKE	MODEL	ASPIRATION	1000 HRS CONT. STANDBY SITE OUTPUT (Kw)	DERATING @ 1800 M	COOLING AIR m ³ /MIN
MAIN OFFER						
ALTERNATIVE						
ALTERNATIVE						
ALTERNATIVE						

ALTERNATOR	MAKE	FRAME SIZE	EFFICIENCY	NET. CONT. SITE OUTPUT (Kw)
MAIN OFFER				
ALTERNATIVE				
ALTERNATIVE				
ALTERNATIVE				

DIESEL ALTERNATOR COMPONENTS

	MAKE	TYPE	CAPACITY/SIZE	CAT.NO
Diesel fuel filter/water separator				
Oil filter				
Air filter				
Diesel fuel transfer pump				
Governor				
Charging generator/alternator				
Temperature gauge				
Temperature sensor				
Oil pressure gauge				
Oil pressure sensor				
Centre zero dc ammeter				
AvR				

Self-starter				
Starter/control battery				
Dummy loads				
Fuel tank sensing				
Fuel solenoid				
Base construction, duplex/simplex				
Spring mountings (simplex)				
Exhaust ellencer				
Exhaust flexible bellows				

CONTROL CUBICLE COMPONENTS

	MAKE	TYPE	CAPACITY	PARAMETERS	ACCURACY	SCALE	CAT. NO
Controller							
Relays							
Contactors							
Fuses							
Indication Lamps							
LEDs							
Timers (General)							
Mains voltage							
Controller							
Alternator voltage monitor							
Frequency monitor							
Supply failure timer							
Supply restoration timer							
Change-over timer							
Cooling-over timer							
Cooling-off timer							
AC Voltmeter							
AC Ammeter/s							
DC Voltmeter							
DC Ammeter							
Frequency meter							
Hour meter							
Selector Switches							
PROTECTING MCCB's							
1.Mains sensing							
2.Fuel Pump							
3.Battery Charger							
4.Dummy loads							
5.Controller							
6.Alternator CB							
7.Other							
Mains bypass switch							
Change-over contactors							
Battery charger							

2.5. LIGHTNING PROTECTION

LIGHTNING PROTECTION (EXISTING SYSTEM)

DEFINITIONS

The terminology in this section has the same meanings as in SANS 61024 (as amended).

Tests

The existing lightning protection system shall be tested and upgraded where not complying with the standards. After completion of this section of the installation the Contractor shall conduct tests as prescribed by the Engineer.

A certificate of compliance shall be issued by the specialist Lightning Protection Contractor.

DOWN CONDUCTOR

A lightning protection point shall consist of the following:

An earth electrode (min 1,2m x 12,5mm diameter copper rod with earth clamp) driven into the ground to a depth of 200mm below the ground surface.

A 20mm diameter PVC conduit shall be built into the wall, from ground level up to the roof sheeting level.

The bottom end of the conduit shall be installed at a depth of at least 100mm below the ground or concrete apron level.

A 35mm² Green PVC insulated copper conductor shall be connected by means of the earth clamp, and drawn through the 20mm diameter PVC conduit, and joined to the 8mm diameter aluminium roof conductor by means of a test joint.

TEST JOINT

A 100 x 100 x 100mm test joint box with cover shall be installed at a height of 500mm above finished ground level.

The test joint shall connect the 35mm² copper conductor and the 8mm diameter aluminium roof conductor together by means of the following:

Two copper lugs bolted together by means of 2 x 8mm brass bolts and nuts.

ALUMINIUM ROOF CONDUCTOR

An 8mm diameter solid aluminium conductor shall be installed between the test joint and the roof sheeting.

The conductor shall be connected to the roof sheeting and looped to the gutter by means of copper lugs and 8mm brass bolts and nuts.

The aluminium conductor shall be secured to the wall by means of aluminium saddles spaced at intervals not exceeding 500mm.

Special Note 1:

- Refer to the detail drawing submitted.

Special Note 2:

- It is a specific requirement of this contract that specialists who are conversant with this type of work shall do this part of the installation.

The lightning protection installation and test joints shall be built into the brick work and no surface installations will be accepted.

2.6. SMOKE DETECTION INSTALLATION

SMOKE DETECTION

The following basic system requirements will be implemented for the smoke detection system: The system should offer the earliest possible warning of fire, so as to achieve the longest available time for escape.

Detectors shall be optimally spaced and break glass units positioned at exit doors, with alarm bells and spaced for total coverage. The system shall be designed to be simple to operate.

BASIC SYSTEM

Category L automatic fire detection systems, intended for the protection of life, will be installed throughout the buildings with manual fire alarm break glass units at each of the emergency routes together with audible evacuation sirens. This system will comply with the specifications of SANS 10139. All wiring to the system will be adequately protected from the effects of fire.

EQUIPMENT SPECIFICATION

DETECTORS

Detectors shall be designed for mounting on a standard C-type round electrical outlet box.

Detectors shall operate satisfactorily on a nominal 24 V DC non-polarized 2 wire system.

The removal of a detector from the base shall not affect the operation of other detectors on the line.

Detectors shall be able to work on decoded signals.

BREAK GLASS UNIT

These units shall be in accordance with BS 5839-2, except that it shall be resettable.

These units shall have normal open contacts to make contact when the glass front breaks.

Units shall be red in colour, clearly marked "FIRE/BRAND".

CONTROL UNIT

The control panel shall be located at the position that will be determined in consultation with user client and professional team.

The control panel shall house all control units and the mimic.

The system shall be functional for 24 hours of the day and be operated automatically.

The control panel shall further have the facilities to execute the following functions:

- Transmission of a general fire alarm.
- Monitored switching off of air conditioning equipment.
- Monitored alarm outputs.

ELECTRONIC DAILING DEVICE

In the case of an alarm (fire, power failure or panic) it should be possible to automatically, dial up pre-select telephone numbers, (e.g. Fire Brigade, Police, etc.) informing the dialled occupant of the relevant situation.

Inputs to this device will operate on a fire alarm from the fire alarm control panel.

WIRING

PH 30 Fire resistance multicore stranded wires and cables shall be used.

PART 3: DATA SHEETS

Schedule no.	Ref.	Description	Attached Y/N
SHEET 1	Magistrate Court	LOW VOLTAGE CABLE	Y
SHEET 2	Magistrate Court	CIRCUIT BREAKERS	Y
SHEET 3	Magistrate Court	MINIATURE SUBSTATION	Y

TECHNICAL DATA SHEET No. 1

LOW VOLTAGE CABLE

No	Item	Unit	Specified	Offered
1.	<u>LOW VOLTAGE CABLE</u>			
1.1	Manufacturer			
1.2	Type.....		PVC/SWA/ PVC	
1.3	Delivery period.....	Weeks		
1.4	Voltage		1000V	
1.5	Type of insulating material		PVC	
1.6	Symmetrical fault level	KA		
1.7	Earth fault level	kA		
1.8	Conductor size	mm ²	240, 150, 95, 70, 50, 35, 25, 10, 6, 4	
1.9	Diameter over insulation	mm		
1.10	Diameter over bedding	mm		
1.11	Diameter over armour	mm		
1.12	Diameter over sheath	mm		
1.13	Tail length required	m		
1.14	Drum length required if other than that specified	m		
1.15	Catalogue supplied with tender?	Yes / No	Yes	
1.16	Certified copy of type tests to be provided with tender documentation?	Yes / No	Yes	
1.17	Conductor resistance.....			
1.18	Positive and negative sequence series reactance			
1.19	Positive and negative sequence short reactance, capacitive			
1.20	Zero sequence series reactance			
1.21	Zero sequence series resistance			
1.22	Zero sequence short reactance capacitive			
1.23	In accordance with specification	Yes / No	Yes	

TECHNICAL DATA SHEET No. 2				
<u>CIRCUIT BREAKERS</u>				
No	Item	Unit	Specified	Offered
1	<u>Circuit Breakers</u>			
1.1	Manufacturer			
1.2	Dimensions			
1.2.1	Length			
1.2.2	Width			
1.2.3	Height			
1.3	In accordance with the specification	Yes/No	Yes	
1.4	Delivery period	Weeks		
2.	kA Rating			
3	Catalogue Number			
4	Number of Poles			
5	Method of Mounting			
6	Frame Size			
<u>Deviations from specification</u>				
List all the deviations from the specification				
<i>(If no deviations are listed it confirms that the equipment offered complies fully with all aspects of the specification.)</i>				

TECHNICAL DATA SHEET No. 3

MINIATURE SUBSTATION

No	Item	Unit	Specified	Offered
	MINIATURE SUBSTATION WITH OIL TYPE TRANSFORMER AND AUTOMATION			
1	GENERAL			
1.1	Manufacturer			
1.2	Country of Origin			
1.3	Mini Sub Rating			
1.3.1	Power Rating	kVA	515	
1.3.2	Number of Phases		3	
1.3.3	Frequency As per System Electrical Conditions	Hz	50	
1.4	Voltages			
1.4.1	Primary Voltage	kV	11	
1.4.2	Secondary Voltage	V	400	
1.5	Insulation Level			
1.5.1	Primary Voltage	kV	95	
1.5.2	Secondary Voltage	kV	1	
1.6	Electrical System's Operating Parameters		See Specification	
1.7	Physical and Climatic Site Conditions		See Specification	
1.8	Drawings		See Specification	
2	CONSTRUCTION AND FITTINGS			
2.1	Mini sub Type	A/B	A	
2.2	Mini sub Design (Modular/Unitary)		Modular	
2.3	Enclosure Material		Mild Steel	
2.4	Base			
2.4.1	Base type		Skid	
2.4.2	Is a base with removable section required	Yes/No	No	
2.4.3	Block epoxy tar paint required	Yes/No	Yes	
2.5	Are roof lifting lugs required	Yes/No	Yes	
2.6	Padlock protection facility	Yes/No	Yes	
2.7	Alarm - Allen cup access functions	Yes/No	No	
3	MV COMPARTMENT			
3.1	Earth fault indicators	Yes/No	Yes	
3.2	Cables to be Terminated			
3.2.1	Three Core or Single Core		Three	
3.2.2	Type of cable (PILC/2LP2)		PILC	
3.2.3	Cable size	mm ²	75/140/100	

3.2.4	Cable Separation (Ground plane / cable clamps)		Rubber protective over K clamps	
3.3	Switchgear		ETAF Oil Ring Manufacturer	
3.3.1	Manufacturer		Specify	
3.3.2	Country of Origin		Specify	
3.3.3	Conformant to SANS 1874		2SD-CB	
3.3.4	Voltage present when system is off (switching devices)	Yes/No	Yes	
3.3.5	Insulating Medium	Oil/Gas/Air	Oil	
3.3.6	Auxiliary contacts required	Yes/No	Yes	
3.3.7	Local feeder (3-phase) protection			
3.3.7.1	Current tripping or fuse replacement accordance with SANS 1874	CB/SP	FUSE	
3.3.7.2	Rating	A	3720-280	
4	MV PROTECTION			
	Not applicable		N/A	
5	MV AUTOMATION			
	Not applicable		N/A	
6	BATTERY TRIPPING UNIT			
	Not applicable		N/A	
7	TRANSFORMER COMPARTMENT		Specify	
8	LV COMPARTMENT			
8.1	Separate LV earth bar required	Yes/No	Yes	
8.2	Main LV circuit breaker	Yes/No	Yes	
8.3	Main LV switch-disconnector	Yes/No	Yes	
8.4	Number of LV feeders		0	
8.5	LV feeder protection			
8.5.1	MCCBs or fuses to be used		MCCB	
8.5.2	Rating of protection for each feeder	A	To suit cable sizes	
8.6	LV Metering			
8.6.1	Main LV Meter required	Yes/No	Yes	
8.6.2	Manufacturer and model Number			
8.6.3	Metering on each feeder required	Yes/No	Yes, 40mm Ammeter	
8.6.4	Manufacturer and model Number			
8.6.5	CT Ratio		450/5A	
8.6.6	CT Class		0.5	

8.7	LV ammeters for all three phases (Maximum Demand Type with 0 - 1200A scale)	Yes/No	Yes	
8.8	One volt meter (200 - 500V scale) with selector switch to enable any one of phase voltages to be read (compliance with FRC Rules)	Yes/No	Yes	
8.9	Single Phase 10A three pin socket outlet compliant with earth leakage required	Yes/No	Yes	
8.10	LV compartment hump holder required	Yes/No	Yes	
8.11	Street lighting panel provided	Yes/No	Yes	
8.12	Cable Sags (G) and plate (cable clamps)		Sum: Aluminium Gland plate	
9	CONFIRMATION OF MINISUB TESTS CONDUCTED			
9.1	Minisub routine test certificate provided	Yes/No	Yes	
9.2	Minisub type test certificate provided	Yes/No	Yes	
9.3	Transformer Type Tested to IEC 60075-11		Specify	
9.4	Transformer Routine Test to be Conducted			
9.5	Transformer Special Tests to IEC 60076-14			
10	LABELLING AND MARKING			
10.1	Labelling and Marking to SANS 1009	Yes/No	Yes	
11	RATING PLATES			
11.1	Rating plates to SANS 1029	Yes/No	Yes	
12	OVERALL DIMENSIONS			
12.1	Length	mm	Specify	
12.2	Width	mm	Specify	
12.3	Height	mm	Specify	
12.4	Total mass	kg	Specify	
13	FINISHING Colour to SANS 1691			
13.1	External body of mini sub		Dark Admiralty Grey G12 Cold White G80	
13.2	Internal body of mini sub			
13.3	Doors			
13.3.1	MY		Dark Admiralty Grey G12	
13.3.2	TRFL		Dark Admiralty Grey G12	
13.3.3	LV		Light Orange B26	

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13.3.4	Control		Light Orange B&N	
13.4	Paintwork Finish		Specify	
14	CONTRACTUAL			
14.1	Warranty / guarantee	months	12	
14.2	Delivery time (after official order number received)	weeks	Specify	

PART 4: BILLS OF QUANTITIES

PART 5: ADDITIONAL SPECIFICATIONS



public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

STANDARD

ELECTRICAL SPECIFICATIONS

SECTION A: PREAMBLE TO STANDARD SPECIFICATIONS

SECTION B: INSTALLATION SPECIFICATIONS

AUGUST 2004

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SECTION A**A.1 PRE-AMBLE TO STANDARD SPECIFICATION FOR ELECTRICAL INSTALLATIONS****GENERAL****1. INTRODUCTION**

- (a) These Standard Specifications cover the general technical requirements for the equipment, materials, installation, testing, commissioning and maintenance of electrical installations for the Department. These requirements shall be read in conjunction with the Documents as specified below.
- (b) "Document" shall mean the complete set of contract documents, including the Department's Tender Conditions, Tender Specifications, the Standard Specification and the Detail Technical Specification including all drawings and variation orders issued in terms of the contract.
- (c) "Contractor" shall mean the person, partnership, company or firm appointed for the supply, installation, testing, commissioning and maintenance of the Electrical Installation. In the case of the Electrical Installation being a sub-contract, nominated in terms of the Main Contract or otherwise, the word "Contractor" shall also mean "Sub-Contractor" in terms of the Sub-Contract Conditions for the specific installation. Where applicable the Builder or Principal Contractor shall be referred to as "Main Contractor".

2. INSTALLATION WORK

- (a) The complete installation shall comply with the requirements of this Specification. Should any discrepancies or contradictions exist between this specification and the Detail Technical Specification for the specific installation, then the latter shall take precedence.

In the event of discrepancies between the drawings, specifications and bill of quantities the Department shall decide whether the work as executed shall be remeasured on site or whether remeasurement shall be effected from the working drawings only.
- (b) The Department's authorised representative will inspect the installation from time to time during the progress of the work. Discrepancies will be pointed out to the Contractor and these shall be remedied at the Contractor's expense. Under no circumstances shall these inspections relieve the Contractor of his obligations in terms of the Documents.
- (c) The Contractor shall notify the Department timeously when the installation reaches important stages of completion (e.g. before closing cable trenches, before casting concrete, etc.) so that the Department's authorised representative may schedule his inspections in the best interest of all parties concerned.

3. REGULATIONS

- (a) The installation shall be erected and tested in accordance with the Acts and Regulations as indicated in PW 379 or PW 379 (Civil) – "Standard Conditions in respect of the Supply, Delivery and Installation of Electrical, Mechanical, Pneumatic and Vacuum Operated Equipment, Control Systems, Plant and Materials".
- (b) The Contractor shall issue all notices and pay all of the required fees in respect of the installation to the authorities, and shall exempt the Department from all losses, claims, costs or expenditures which may arise as a result of the Contractor's negligence in complying with the requirements of the regulations.
- (c) It shall be assumed that the Contractor is conversant with the above-mentioned requirements. Should any requirement, by-law or regulation, which contradicts the requirements of this Document, apply or become applicable during erection of the installation, such requirement, by law or regulation shall override this Document and the Contractor shall immediately inform the Department of such a contradiction. Under no circumstances shall the Contractor carry out any variations to the installation in terms of such contradictions without obtaining the written permission to do so from the Department.

4. SITE CONDITIONS

Tenderers are advised to visit the site and acquaint themselves with all local conditions pertaining to the execution of the installation before tender closing date. No claims from the Contractor which may arise from insufficient knowledge of site access, type of site, labour conditions, establishment space, transport and loading/unloading facilities, power and water supply, etc. will be considered after submission of tenders.

For services where prior permission is required before contractors can visit the site, a visit will be arranged for all interested parties.

5. ARRANGEMENTS WITH THE SUPPLY AUTHORITY

- (a) The contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local Supply Authority unless specified to the contrary.
- (b) It shall be the responsibility of the Contractor to make the necessary arrangements with the local Supply Authority at his own cost and to supply the labour, equipment and means to inspect, test and commission the installation to the satisfaction of the local and Supply Authorities.
- (c) The Contractor shall supply and install all notices and warning signs that are required by the relevant laws, regulations and/or the Documents.

6. MATERIAL AND EQUIPMENT

- (a) All material and equipment shall conform in respect of quality, manufacture, tests and performance, with the requirements of the South African Bureau of Standards or where no such standards exist, with the relevant current Specification of the British Standards Institution.
- (b) All material and equipment 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.
- (c) The Contractor shall, where requested to do so, submit samples of equipment and material to the Department for approval prior to installation. Samples may be retained in the Department's possession until the contract is completed after which they will be returned.

7. CONNECTIONS INVOLVING ALUMINIUM (CABLES AND TRANSFORMERS)

As a result of the fact that aluminium flows when subjected to pressure and electrical connections based on this principle thus loses proper contact during the course of time, it should be noted that bolted connections between aluminium and copper or any other metal is not acceptable to this Department.

8. CODES OF PRACTICE OR STANDARD SPECIFICATION

Where reference is made to any Code of Practice or Standard Specification in this document the latest edition or amendment shall be applicable, except where specified to the contrary.

SECTION B.1

B.1 INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES

1. GENERAL

1.1 SCOPE

1.1.1 This section covers the installation of conduits and conduit accessories in buildings and other structures under normal environmental conditions and for system voltages up to 600 V.

1.1.2 The following types of conduit installations are included:

- (a) Screwed metallic conduit – black enamelled and galvanised
- (b) Plain-end metallic conduit – black enamelled and galvanised.
- (c) Non-metallic conduit.
- (d) Flexible conduit.

1.1.3 Conduits may be installed as follows:

- (a) In open roof spaces.
- (b) Cast in concrete.
- (c) Surface mounted against walls, concrete slabs, etc.
- (d) In wall chases.

1.1.4 Where conduits are to be installed in concrete, this shall be undertaken while the building work is still in progress. Conduits may only be surface mounted where specified or where the Department has given its written consent.

1.1.5 Under no circumstances will conduit having a wall thickness of less than 1.5mm be allowed in screeding and on top of concrete slabs.

1.1.6 Bending and setting of conduit must be done with special bending apparatus manufactured for the purpose and which are obtainable from the manufacturers of the conduit systems. Damage to conduit resulting from the use of incorrect bending apparatus or methods applied must on indication by the Department's inspection staff, be completely removed and rectified and any wiring already drawn into such damaged conduits must be completely renewed at the contractor's expense.

1.1.7 Tenderers must ensure that general approval of the proposed conduit system to be used is obtained from the local electricity supply authority prior to the submission of their tender. Under no circumstances will consideration be given by the Department to any claim submitted by the contractor, which may result from a lack of knowledge in regard to the supply authority's requirements.

1.1.8 For light and socket outlet circuits, the conduit used shall have an external diameter of 20mm. In all other instances the sizes of conduit shall be in accordance with the "Wiring Code" for the specified number and size of conductors unless otherwise directed in part 2 of this specification or indicated on the drawings.

1.2 OTHER SERVICES

Conduits may not be installed closer than 150 mm to pipes containing gas, steam, hot water or other materials, which may damage the conduits or conductors. Conduits may not touch pipes of other service

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installations, in order to prevent electrolytic corrosion. Where this is unavoidable, cathodic protection shall be provided.

Conduit and conduit accessories used for flame-proof or explosion proof installations and for the suspension of luminaries as well as all load bearing conduit shall in all instances be of the metallic screwed type.

2. SCREWED METALLIC CONDUIT

2.1 GENERAL

2.1.1 In general, screwed steel conduit shall be used in the wiring of buildings.

2.1.2 The installation shall comply with SANS 10142

2.2 GALVANISED CONDUIT

Galvanised conduit and accessories shall be used in the following:

- (a) In damp areas.
- (b) In areas exposed to the weather.
- (c) For all installations within 50 km of the coast.
- (d) In plenum chambers containing humidifying equipment.
- (e) For surface mounted conduit installations in kitchens and boiler rooms.
- (f) In screeds resting directly on earth.
- (g) For connection points to future installations.
- (h) For underground conduit containing earthing conductors.
- (i) In buildings where animals are housed such as cattle, sheep, dogs, etc.

2.3 TERMINATIONS

2.3.1 Spouted Connections.

Conduits shall be connected directly to draw-boxes with spouted connections. Conduits shall be screwed tightly home and no threads shall be visible.

2.3.2 Switchboards, Power skirting, etc.

Conduits shall be terminated by means of a brass female bush and two locknuts in pressed steel switchboards and distribution boxes, cable ducts, power skirting, etc. The conduit shall only project far enough through the entry hole to accommodate the bush and locknut. Alternatively the method detailed in 2.3.3 may be used.

2.3.3 Draw-boxes.

A female bush and two locknuts shall be used to terminate conduits at draw-boxes and cable boxes without spouts, should there be sufficient room in the box. Where there is insufficient room, a coupling, brass male bush and locknut may be used with sufficient allowance for the reduction of the internal diameter by the male bush.

2.3.4 Holes.

Holes to accommodate brass bushes shall be large enough to accommodate the bush with a minimum of clearance.

2.3.5 Bush-nuts.

Bush-nuts for the connection of earth conductors to conduits are not acceptable.

2.4 SCREWS, BOLTS AND NUTS

Steel locknuts of thick gauge steel with milled sides shall be used in all cases. Cadmium-plated bolts and nuts shall be used except where the installation is exposed to the weather in which case brass bolts and

SECTION B.1

nuts shall be used. Screws shall be treated at all lapped holes in fittings and accessories to prevent damage to the screw thread by concrete or plaster. The screws shall be screwed completely down to prevent damage to the thread on the screw.

2.5 CONDUIT ENDS

Conduit ends shall be cut at right angles to ensure that ends cut squarely at joints. Threads shall not be visible at joints and connections except at running joints. The total length of the thread on the two conduit ends shall not exceed the length of the coupling.

2.6 JOINTS

All conduit ends shall be reamed and all joints tightly screwed. Only approved couplings shall be used. Running joints with long threads shall be kept to a minimum and locknuts shall be provided to ensure a strong mechanical and a continuous electrical joint. Running joints in screwed conduit are to be avoided as far as possible and all conduit systems shall be set or bent to the required angles. The use of normal bends must be kept to a minimum with exception of larger diameter conduits where the use of such bends is essential.

2.7 FINISH

All joints shall be painted with red lead to prevent them from rusting in damp areas, areas within 50 km of the coast and in cases where the installation is exposed to the weather for any length of time. Where the galvanising or black paint has been damaged, the area shall first be cleaned and a coat of zinc base paint applied subsequently. Additional coats of paint shall only be applied after the undercoat has completely dried. All surface mounted non-galvanised metallic conduit must be painted. (Refer to par. 8.3 of Section B1).

2.8 CONTINUITY

Mechanical and electrical continuity shall be maintained throughout the conduit installation.

3. PLAIN-END METALLIC CONDUIT

As an alternative to the screwed conduit, plain-end conduit complying with the Department's standard specification for "CONDUITS AND CONDUIT ACCESSORIES", par. 7 of Section C1, may be installed subject to the following additional conditions:

- 3.1 Bending and setting of plain-end conduit must be done with special benders and apparatus manufactured for this purpose and which are obtainable from the suppliers of the system. Damaged conduit resulting from the use of incorrect bending apparatus shall be completely removed and any wiring already drawn into such damaged conduits shall be completely renewed at the Contractor's expense.
- 3.2 Screwed conduit must be used in the following instances:
 - (a) In flameproof installations.
 - (b) Load bearing conduit.
 - (c) For the suspension of luminaires.
 - (d) Surface mounted conduit.
- 3.3 Plain end conduit and associated accessories shall be manufactured of mild steel having a minimum thickness of 1,2 mm and shall comply with SANS 1035. Conduit manufactured of lighter gauge material, i.e. 0,97 mm, will not be permitted.
- 3.4 All conduit and accessories used in areas within 50 km of the coast shall be hot-dip galvanised to SANS 32 6 121. In inland areas Electro-galvanised or cadmium-plated accessories will be accepted.

4. NON-METALLIC CONDUIT

4.1 INSTALLATION CONDITIONS

Where specified for a particular service, non metallic conduit may be installed under the following conditions:

- 4.1.1 All non-metallic conduit shall comply fully with SANS 950 and shall be installed in accordance with Appendix C of the same specification as well as SANS 10142.
- 4.1.2 Insulated heat-resistant boxes shall be used for outlets of totally enclosed luminaires and other fittings where excessive temperatures are likely to occur.
- 4.1.3 Luminaires and other fittings shall not be supported by non-metallic conduit or conduit boxes. These fittings shall be secured to the surrounding structure in a way that is acceptable to the Department. Refer to the Department's standard specification for "INSTALLATION OF LUMINAIRES", Section B9.
- 4.1.4 The conduit shall be supported and fixed with saddles with a maximum spacing of 1 m, even in roof spaces. (Refer to SANS 10142.) The Contractor shall supply and install all additional supporting timbers required.
- 4.1.5 It shall be possible to rewire the completed installation in the future without undue difficulty.
- 4.1.6 Non-metallic conduit and fittings shall not be used under the following conditions:
 - (a) Outside a building (unless protected, or sheltered under eaves).
 - (b) For mechanical load bearing.
 - (c) Where they may be subjected to temperatures below -10°C or above 70°C for prolonged periods.
 - (d) As primary electrical insulation.
 - (e) In areas where they may be subject to mechanical damage.
 - (f) For applications other than those for which they are designed.
 - (g) In concrete slab unless specified to the contrary.

4.2 PAINTING OF CONDUITS

Exposed conduit may be painted with normal oil or PVA paints, but care must be taken to ensure that the paint used does not contain any component that will soften or have any other detrimental effect on the materials from which the conduit and fittings are manufactured.

4.3 CONNECTING OF CONDUIT TO METAL EQUIPMENT/COMPONENTS

When any part of a non-metallic conduit system has to be connected to metal equipment or components (e.g. switchboard, surface socket-outlet or switch box, existing metallic conduit systems, etc.) fittings and joints manufactured specifically for this purpose must be used. Non-metallic conduit must not be threaded to fit metallic connectors.

4.4 BENDS

In conduit of nominal size not exceeding 25 mm, bends may be made in accordance with par. 4.5. In all other cases bends must be achieved by the use of accessories that are introduced into the conduit run. Bends shall comply with SANS 10142.

4.5 BENDING

Conduit of nominal size up to and including 25mm may be cold bent by hand provided that the radius of the bend is greater than six times the nominal size of the conduit, and that the external angle of the bend does not exceed 90°. The procedure (which involves the use of a bending spring) should be as follows:

- (a) Determine the angle through which the conduit is to be bent.
- (b) Warm the cold conduit over the length to be bent by rubbing with hands.
- (c) Select a bending spring which matches the conduit size and insert in to the conduit at the point where the bend is required.
- (d) Bend the conduit slowly with one motion (either with the hands alone approximately 1 m apart, or across the knee) to double the required angle, release the conduit and, when its position is stable, withdraw the bending spring (turning it in an anti-clockwise direction to reduce its diameter) and gently correct the angle.
- (e) Install and secure the conduit immediately following bending.

4.6 ADHESIVE JOINTS

All adhesive joints must be made in a clean dry area. The surfaces of all components to be bonded must be dry and clean.

The insertion depth should be marked on the conduit end and the adhesive applied (by means of a soft clean brush) as quickly as possible to the surfaces to be bonded by brushing lengthwise along the conduit, ensuring that a thin coating of uniform thickness is formed. The joint must be made immediately after the application of the adhesive by pushing the prepared parts squarely together with a twisting motion to the full insertion depth. Care must be taken to avoid squeezing adhesive into the cableway and any excess adhesive must be wiped off.

NOTE: Solvent adhesives contain highly volatile liquids and their containers should not be left open.

4.7 Cutting

A fine-tooth hacksaw should be used to cut conduit to the required length. Each cut end should be square and free from swarf, burrs and loose material. When determining the length of conduit to be cut, allowance must be made for the length of couplings or accessories attached to the conduit. Incorrect determination will cause bulging of the conduit or insufficient joint length.

5. FLEXIBLE CONDUIT

- 5.1 In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors on equipment, for stove connections and where otherwise required by the Department, flexible conduit shall be used for the final connection to the equipment.
- 5.2 The installation shall comply with SANS 10142.
- 5.3 Flexible conduit shall preferably be connected to the remainder of the installation by means of a draw-box. The flexible conduit may be connected directly to the end of a conduit if an existing draw-box is available within 2 m of the junction and if the flexible conduit can easily be rewired.
- 5.4 Flexible conduit shall consist of metal-reinforced plastic conduit or PVC-covered metal conduit with an internal diameter of at least 15mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured of either brass or mild steel plated with either zinc or cadmium.

6. INSTALLATION REQUIREMENTS

6.1 POSITIONS OF OUTLETS

All accessories such as boxes for socket-outlets, switches, lights, etc. shall be accurately positioned. It is the responsibility of the Contractor to ensure that all outlets are installed level and square, at the correct height from the floor, ceiling or roof level and in the correct position relative to building lines and equipment.

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positions as specified. It shall be the responsibility of the Contractor to determine the correct final floor, ceiling and roof levels in conjunction with the Main Contractor. Draw-boxes shall not be installed in positions where they will be inaccessible after completion of the installation. Draw-boxes shall be installed in inconspicuous positions to the approval of the Department's representative and shall be indicated on the "as built" drawings.

0.2 COVER PLATES

All draw-boxes and outlets shall be fitted with cover plates, either as part of the switch or socket assembly or with blank cover plates if unused. Blank cover plates shall match other cover plates in the same area. Flush mounted cover plates in both ceilings and walls shall overlap the draw-box and edges of the recess. If the fixing lugs are substantially deeper than the finished wall surfaces, suitable cored steel wire or tubes shall be used as spacers.

0.3 DRAW-WIRES

Galvanised steel draw-wires shall be installed in all unwired conduits e.g. conduits for future extensions, telephone installations and other services.

0.4 BENDS

A maximum of two 90 bends or the equivalent displacement will be allowed between outlets and/or boxes.

Draw-boxes shall be installed at maximum intervals of 15 m in straight runs. All bends shall be made without heating the conduit or without reducing the diameter of the conduit. The inside radius of a bend shall not be less than five times the outside diameter of the conduit. (Refer to SANS 10142).

0.5 WALL SOCKET OUTLETS

Where more than one socket-outlet is connected to the same circuit, the conduit shall be trapped from one socket box to the following on the same circuit. Where a metal channel is used, the conduit may be installed from the channel directly to the outlet box on condition that the conductors can be looped from one outlet to the next without making any joints in the wires.

0.6 LUMINAIRES

Where the conduit end is used to support luminaires, a ball-and-socket type lid shall be fitted to the pendant box in all cases where the conduit is longer than 500 mm. In all other cases a dome lid may be used. Where luminaires are specified which are fixed directly to the pendant box, the pendant box shall be fixed independently of the conduit installation except where the pendant box is cast into concrete.

0.7 FLUSH MOUNTED OUTLET BOXES

The edges of flush mounted outlet boxes shall not be deeper than 10 mm from the final surface. Spacer springs shall be used under screws where necessary.

0.8 EXCESS HOLES

All excess holes in draw-boxes or other conduit accessories shall be securely blanked off by means of brass plugs to render the installation vermin proof.

0.9 DEBRIS

Care shall be taken to prevent debris or moisture from entering conduits during and after installation. Conduit ends shall be sealed by means of a solid plug which shall be screwed to the conduit end. Conduits shall be cleaned and swabbed to remove oil, moisture or other debris that may be present before conductors are installed. Swabs shall not be attached to the conductors.

6.10 Defects

Each length of conduit shall be inspected for defects and all burrs shall be removed. All conduits that are split, dented or otherwise damaged or any conduits with sharp internal edges shall be removed from site. The Contractor shall ensure that conduits are not blocked.

6.11 WITHDRAWAL OF CONDUCTORS

To ensure that all electrical conductors are easily withdrawable from conduits and to ensure that there are no joints in the conductors, the Department's representative will have the right to have the conductors of any circuit removed at his discretion. If the conductors are found to be in a satisfactory condition after having been withdrawn, the Department shall bear the cost of withdrawing and re-installing such conductors. If the conductors are found to have been damaged during installation or removal or if joints are found, they shall be replaced and the cost shall be borne by the Contractor.

7. INSTALLATION IN CONCRETE

7.1 TIMEOUS INSTALLATION

In order not to delay building operations, the Contractor shall ensure that all conduits and accessories which are to be cast in concrete are placed in position in good time. The Contractor or his representative shall be in attendance when the concrete is cast.

7.2 DRAW-BOXES

Draw-boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw-boxes shall be of the deep type. In hollow block slabs, rear-entry draw-boxes shall be used. In columns where flush mounted draw-boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw-box.

7.3 ELBOWS

Elbows for conduits of 52mm dia. and smaller and sharp bends will not be allowed in concrete slabs.

7.4 COVER PLATES

Draw-boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate, and must preferably be installed in passages or male toilets. The cover plate shall be secured by means of screws.

7.5 NEUTRAL AXIS

All conduits shall be installed as close as possible to the neutral axis of concrete beams, slabs and columns. The conduits shall be rigidly secured to the reinforcing to prevent movement towards the surface of the concrete.

7.6 FIXING TO THE SHUTTERING

All conduits, draw-boxes etc. shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Draw-boxes and outlet boxes shall preferably be secured by means of a bolt and nut inserted from the back of the box through the shuttering. Fixing lugs may also be used to screw the boxes to the shuttering. Wire will not be accepted for securing boxes to the shuttering where off-shutter fixtures are required. Where foreglass shuttering is used by the Bulker Fire equipment shall be fixed to the steel only and no holes shall be drilled or made in shuttering. All draw-boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

Before any concrete slabs are cast, all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

7.7 CONCRETE FLOOR SLABS

Conduits will not be allowed in concrete floor slabs of boiler rooms (or boiler houses), laundries or other damp areas. All socket outlets and three phase outlets in damp areas shall be supplied from above with galvanised conduit and accessories.

7.8 EXPANSION JOINTS

As far as possible, conduits shall not be installed across expansion joints. Where this is unavoidable a conduit expansion joint shall be provided. (Refer to par. 10)

7.9 SCREEDS

The installation of conduits in floor screeds shall be kept to a minimum. Where conduits are installed in screeds, the top of the conduit shall be at least 20 mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. This ruling will always be applicable to the lowest floor of a building. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2 m. The Contractor shall ensure that conduits are not visible above the screed where the conduits leave the screed.

7.10 INSPECTION

All draw-boxes, conduits, etc. which are installed in concrete shall be checked with compressed air and provided with draw-wires two days after removal of the shuttering. Errors that occurred during the installation of the conduits, or any lost draw-boxes, or blocked conduits shall be immediately reported to the Department by telephone and confirmed in writing in order that an alternative route can be planned and approved by the Department before the additional concrete is cast. Any additional cost shall be for the Contractor's account.

B. SURFACE INSTALLATIONS AND INSTALLATIONS IN ROOF SPACES

Wherever possible, the conduit installation is to be concealed in the building work; however, where unavoidable or otherwise specified, conduit installed on the surface must be plumbed or levelled and only straight lengths shall be used.

B.1 APPEARANCE

- (a) All conduits shall be installed horizontally or vertically as determined by the route and the Contractor shall take all measures to ensure a neat installation.
- (b) Where conduits are to be installed directly alongside door frames, beams, etc. that are not true, conduits shall be installed parallel to the frames, beams, etc.
- (c) All labels shall be removed from surface mounted conduit.

B.2 SADDLES

Conduits shall be firmly secured by means of saddles and screws and in accordance with SANS 10142. Where saddles are used to secure vertical lengths of conduit connected to surface mounted switch boxes or socket outlet boxes, the saddles shall be spaced so that the intervals between the box and the first saddle, between any two successive saddles and between the last saddle and the ceiling or roof are equidistant. Conduits shall be secured within 100 mm before and after each 90° bend and within 100 mm of each outlet box.

B.3 JOINTS

Joints will only be allowed in surface conduit lengths exceeding 3,6 m. Threads shall not be visible at joints of completed installations, except where running joints are used. Running joints will be allowed only when absolutely necessary. All running joints shall be provided with locknuts and shall be painted with red lead immediately after installation.

8.4 ACCESSORIES

Inspection bands or ice pieces shall not be used. Non-inspection type bands may be used in the case of 32mm or 50 mm diameter conduits. All draw-boxes supporting luminaires or other equipment shall be fixed independently of the conduit installation.

8.5 OFFSETS

Where an offset is required at conduit terminations or crossovers, the conduit shall be saddled at the offset.

8.6 CROSS-OVER

Conduit routes shall be carefully planned to avoid crossovers. Where a crossover is inevitable, one conduit only shall be offset to cross the other. Crossovers shall be as short as possible and shall be uniform. Alternatively, crossovers shall be installed in purpose-made boxes. This method shall be employed on face brick walls and in other circumstances where required by the Department.

8.7 PARALLEL CONDUIT

Parallel conduit runs shall be equidistant and saddles shall be installed in line. Alternatively, a special clamp may be used to secure all conduits in unison. In the case of conduits of different diameters, the latter method shall only be used if a purpose-made clamp designed to accommodate the various conduit sizes, is provided.

8.8 PAINTING OF CONDUIT

All surface mounted conduits and accessories shall be painted with two coats of a high quality enamel paint or as otherwise specified. The colour shall comply with the colour code specified for the installation or where no code has been specified, shall match the colour of the surrounding finishes.

8.9 CONDUIT IN ROOF SPACES

8.9.1 In open roof spaces (no ceiling) conduits shall run along the wall plates and the rafters. The installation of conduits suspended between the rafters is not acceptable.

8.9.2 Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5 m by means of saddles screwed to the roof timbers for metallic conduit and 1m for non-metallic conduit.

8.9.3 Nails or crampels will not be allowed.

8.9.4 Under flat roofs in false ceilings or where there is less than 900 mm clearance, or in instances where the ceilings are insulated with glass-wool or other insulating material impeding access, the conduit shall be installed in a manner which allows for wiring from below the ceilings.

8.9.5 Conduit runs from switchboards shall terminate in fabricated sheet steel draw-boxes installed directly above or in close proximity to the boards. Refer to the Department's standard specification for 'CONNECTIONS TO SWITCHBOARDS', par. 2 of Section B*2.

8.9.6 Spare conduits covering the total number of spare ways on switchboards, shall be provided between the boards and the roof draw box.

8.9.7 Where non-metallic conduit has been specified for a particular service, the conduit shall be supported and fixed with saddles with a maximum spacing of 450mm throughout the installation. The contractor shall supply and install all additional supporting timbers in the roof space as required.

8.10 FIXING TO WALLS

Only approved plugging materials such as aluminium inserts, core plugs or plastic plugs, etc., and round-head screws shall be used when fixing saddles, switches, plugs etc. to walls. Wood plugs are not acceptable nor should plugs be installed in joints in brick walls.

9. FUTURE EXTENSIONS

9.1 OPEN ROOF SPACES

Conduits intended for future switches and socket outlets, shall terminate 40 mm above the tie beams in roof spaces with more than 900 mm free space. The conduit ends shall be threaded and fitted with a coupling and brass plug.

9.2 CONCRETE SLABS

Conduit ends shall protrude 150 mm from the concrete to facilitate the installation of future extensions above, below or to the side of the concrete slabs. All these conduits shall be connected to a draw-box, which is cast into the concrete within 2 m of the end of the concrete. Conduit ends shall be threaded and fitted with a coupling and brass plug. In cases where holes cannot be drilled through the shuttering to accommodate the conduit end, a deep draw-box with rear entry may be placed over the conduit end.

9.3 COVER PLATES

Unused boxes for switches and socket-outlets shall be covered with metal cover plates. Unused boxes for luminaires shall be covered with round galvanised metal cover plates, which fit tightly against the finished surface. The cover plate shall overlap the outlet box and recess.

9.4 GALVANISED CONDUIT

Galvanised conduit shall be installed at all free ends intended for future extensions. The conduit shall be treated with a paint, which will prevent corrosion and white rust.

10. EXPANSION JOINTS

10.1 Where conduits cross expansion joints in the structure, approved draw-boxes which provide a flexible connection in the conduit installation shall be installed. Refer to the Department's standard drawing No EE3/36/139.

10.2 The draw-box shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the conduit, shall be provided on the side of the draw-box nearest the joint. The one end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box by means of locknuts.

10.3 The circuit conduit passing through the sleeve shall be terminated 40 mm inside the draw-box and in the case of metallic conduit, the conduit end shall be fitted with a brass bush. The gap between the sleeve and the conduit at the joint shall be sealed with 'Prattley Tk-Tac' or equal sealing compound, to prevent the ingress of wet cement. In the case of metallic conduit, an earth clip shall be fitted to the conduit projection inside the draw-box and the conduit bonded to the box by means of 2,5mm² bare copper earth wire and a brass bolt and nut.

10.4 The end of the other circuit conduit shall be secured to the draw-box by means of locknuts and a brass bush in the case of screwed metallic conduit or a standard bushed adaptor for other conduit types.

10.5 In the case of metallic conduit a 2,5mm² bare copper wire shall be installed between the first conduit boxes on either side of the joint, in addition to an earth wire, which may be specified for the circuit. The conduit boxes shall be drilled and lapped and the earth wire shall be bonded to the boxes by means of lugs and brass screws.

10.6 Suitable steel cover plates shall be screwed to draw-boxes installed along the expansion joint. The cover plates shall be installed before the ceilings are painted.

10.7 Where a number of conduits are installed in parallel they shall cross the expansion joint of the structure via a single draw-box. A number of draw-boxes adjacent to each other will not be allowed.

11. CHASES AND BUILDER'S WORK

- 11.1 Except where otherwise specified the Builder or Main Contractor shall be responsible for the builder's work related to the installation of conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes and will undertake the necessary chasing and cutting of walls and the provision of openings in ceilings and floors for luminaries and other electrical outlets. The Contractor shall notify the Builder or Main Contractor of his requirements and the responsibility lies with the Contractor to ensure that all builder's work is clearly indicated or marked in accordance with his requirements.
- 11.2 Electrical materials to be built in must be supplied, placed and fixed in position by the Contractor when required in consultation by the Builder or Main Contractor. The Contractor shall also ensure that these materials are installed in the correct positions.
- 11.3 Where no Builder or Main Contractor is available, the Contractor must provide all chases and is required to cover conduits installed in chases by a layer of 1:1 mixture of coarse sand and cement, finished 6 mm below the face of the plaster and roughened. Chases shall be deep enough to ensure that the top of conduits are at least 12 mm below the finished surface of the plaster.
- 11.4 Where the Contractor is responsible for the cutting of chases or the building in of conduits and other equipment, he will be held responsible for all damage as a result of this work and will be required to make good to the satisfaction of the Department.

This ruling is particularly applicable but not exclusively to the rewiring and renewal of existing installations. Chases shall be made by means of a cutting machine.

- 11.5 Under no circumstances shall face brick walls or finished surfaces be chased or cut without the written permission of the Department. Where it is necessary to cut or drill holes in the concrete structure, the prior permission of the Department shall be obtained.

SECTION B2**B2. INSTALLATION OF WIRING CHANNELS, UNDERFLOOR DUCTING AND POWER SKIRTING****1. RESPONSIBILITY OF THE CONTRACTOR**

The Contractor shall supply and install all wiring channels, underfloor ducting and power skirting as specified or as required for the cable, socket outlet and wiring installation including the necessary supports, hangers, fixing materials, bends, angles, junctions, T-pieces, etc. He shall further liaise with the Main contractor to verify the position of holes and access routes through the structure and finishes.

(Refer to the Department's quality specification for "WIRING CHANNELS, UNDERFLOOR DUCTING AND POWER SKIRTING", Section C2 to determine which types are acceptable).

2. WIRING CHANNELS**2.1 FIXING**

The Contractor shall supply and install all hangers, supports or fixings for the channels. Channels up to and including 76 x 76 mm shall be supported at maximum intervals of 600 mm and larger channels at maximum intervals of 1 m. Channel runs shall be carefully planned to avoid clashes with other services and to ensure that all covers can be removed after completion of the entire installation. Purpose made clamps, hangers, etc. shall be used as required. Where it is not possible to support the channels at the specified intervals, they shall be supported in a sound manner to the satisfaction of the Department.

2.2 INSTALLATION IN CONCRETE

Where channels are cast into concrete, the nest type shall be used. Additional spacer blocks shall be used where necessary to prevent ducts from being deformed while the concrete is cast. Channels shall be filled with polystyrene or other suitable fillers to prevent the ingress of concrete and shall be securely fixed in position to the shuttering.

2.3 COVER PLATES

All channels up to and including 127mm width shall have snap-in cover plates of metal or PVC. Cover plates for wider channels shall be of metal and shall be fixed by means of screws at suitable intervals to prevent warping. Cover plates shall be installed over the full length of the channels. Flush mounted wiring channels shall be fitted with overlapping metal cover plates with plastic edge trim to cover irregularities in the wall recess.

2.4 JOINTS

Adjoining lengths shall be aligned and securely joined by means of fishplates fixed by mushroom bolts, washers and nuts or connection pieces that are pop-riveted to both adjoining sections. All adjoining sections shall be rectangular and shall butt tightly. Covers shall fit tightly across the joints.

Where channels cross expansion joints in the structure, suitable expansion joints shall be provided in the channels by means of fishplates pop-riveted or screwed to the channel on one side of the expansion joint and floating freely in the channel on the other side of the expansion joint.

2.5 SUPPORT FOR CONDUCTORS

All conductors in inverted cable channels shall be retained by means of metal clips or metal spacer bars at not more than 1m centres. Where vertical duct lengths exceed 5m, conductors installed in the channels shall be secured at intervals not exceeding 5m to support the weight of the conductors. Clamps shall be provided in suitable draw-boxes for this purpose.

2.6 CONDUIT CONNECTIONS

Conduit connections shall be terminated by means of two locknuts and a brass female bush. Where the channel is wide enough, conduit connections may be made by means of a conduit box and hole through the back or side of the channel. All holes through which conductors pass shall be filled with bushes or grommets or shall be sleeved.

2.7 INTERNAL FINISHES

Bends and T-joints shall be constructed to ensure compliance with the allowable bending radii specified in SANS 10142: Appendix D in the case of PVC-insulated cables and conductors and shall comply with the relevant specification in the case of other cables. Burs and sharp edges shall be removed and the inside edges of the joints shall be lined with rubber cement or other suitable rubberised or plastic compound to prevent laceration of the conductor insulation.

2.8 VERMIN PROOFING

All cable channels shall be vermin proofed after installation. Holes shall be covered by means of screwed metal plugs or by means of metal strips, which are bolted, or pop-riveted to the channel. Wooden or other plugs which are driven into holes or other temporary plugs or covers are not acceptable.

2.9 SERVICES

Multiple run runs or internal metal partitions shall be used where conductors for power, control, communication and other services are present.

3. UNDERFLOOR DUCTING

3.1 GENERAL

- 3.1.1 Two or three compartment underfloor ducting as specified shall be supplied and installed in the positions and according to the layouts indicated on the drawings.
- 3.1.2 Three compartment ducting shall have a cross-section of approximately 200 x 32mm, subdivided into three approximately equal compartments, of which the centre compartment shall be used for electrical power distribution with the two outer compartments for telephone and other light current services respectively.
- 3.1.3 Unless specified to the contrary in the Detail Technical Specification or on the drawings, each compartment shall be provided with openings (occurring in line) at 1,5 m centres to permit installation of pedestals or recessed outlets in accordance with the design of the system. The openings shall have removable, flush, cover plates and shall have prepared fixing holes for future installation of pedestals or recessed outlets. The centre of the openings shall be offset a distance of 200 mm from the building module lines.

3.2 JUNCTIONS

The underfloor ducting installation shall be provided with flush cross over, T-junction and right angle bend draw-boxes installed in the runs of ducting, generally as indicated on the drawings. The junction boxes shall be complete with cross-over of services. The junction boxes shall have nominal 300 x 300mm removable cover plates secured by means of four countersunk screws.

3.3 PEDESTAL UNITS

Where the system accommodates floor pedestal units, these shall consist of pressed steel or die cast aluminium units, suitable for either two or three services, as specified in the Detail Technical Specification. Where the pedestals are installed on vinyl tiles or similar floors which will be subject to washing, a matching waterproofing gasket shall be supplied below each pedestal to render the junction waterproof.

3.4 INSTALLATION

The underfloor ducting, junction boxes, pedestals, outlets and other accessories shall be installed strictly in accordance with the manufacturer's instructions and according to the following procedure.

- a) The underfloor ducting shall be installed on a mortar bed, provided by the Plasterer for purposes of levelling the channel to the final floor screed level. The Contractor shall assist the Plasterer in marking out the layout of the ducting to ensure the mortar bed to be laid. Final height of the underfloor ducting shall be determined in close liaison with the Builder.
- b) After installation of the mortar bed, the components of the underfloor ducting shall be assembled and installed by the Contractor, following which the screeding will be completed.

3.5 TERMINATIONS

Up bands manufactured by the supplier of the underfloor ducting shall be supplied and installed wherever the ducting is terminated at a switchboard, telephone rack or telephone distribution box or where the ducting terminates behind power skirting.

3.6 WIRING

3.6.1 Power circuit wiring shall be installed in the centre compartment of the underfloor ducting. Sufficient slack shall be provided to allow for the installation of a floor pedestal outlet at each opening in the ducting, whether an outlet is specified at that position or not. This provision shall take the form of loops in the wiring, including the earth wire, wherever the openings occur. The loops shall be pushed back into the channel and the cover plates replaced. In the instances where pedestals/outlets are not installed, these provisions shall of necessity only be made for the area covered by the circuit and not for the run from the switchboard.

3.6.2 The entire underfloor ducting installation shall be effectively earthed and bonded together.

3.6.3 Galvanised draw-wires shall be supplied and installed along the entire length of the telephone and light current service compartments of the underfloor ducting. The draw-wires shall be interrupted at the junction boxes, with enough slack left coiled up to facilitate the drawing in of cables by others.

3.7 EXPANSION JOINTS

Where expansion joints in the buildings are crossed by underfloor ducting, expansion joints shall be provided as detailed in par. 2.4 of this section.

4. POWER SKIRTING

4.1 GENERAL

4.1.1 Two or three compartment power skirting as specified shall be supplied and installed in the positions and according to the layouts indicated on the drawings.

4.1.2 The top compartment shall be used for power wiring and switched socket outlets, whilst the bottom compartments shall be for telephone and other light current services.

4.2 MODULE

4.2.1 The power skirting shall be manufactured from 1mm (minimum) thick sheet steel or aluminium (as specified) in approximately 2,5m lengths.

4.2.2 The covers shall be manufactured in modular lengths, as specified in the Detail Technical Specification or otherwise in 1 m lengths and shall be secured to the wall channel by means of loggins or swivel nuts. Snap-in covers are also acceptable.

4.2.3 At the building module lines, covers of specified length or otherwise in 250 mm lengths shall be installed, against which partition walls may be installed, thereby trapping these covers. The removable modular covers shall be installed between these 'fixed' covers.

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- 4.2.4 Each modular cover associated with the power compartment shall be punched and prepared for the installation of either a 13A or a 16A, 3-pin standard flush switched socket outlet, whether any is specified or indicated for that module or not. Where socket outlets are not installed, the punched holes shall be blanked off with a metal blanking plate, painted the same colour as the power skirting and installed at the back of the covers. These blanking plates shall be easily removable to permit future installation of socket outlets.
- 4.2.5 Unless otherwise specified, no provision shall be made on the covers of the telephone or light current services compartments for the installation of sockets.
- 4.2.6 Factory-made end covers shall be installed at the ends of all runs of power skirting. All internal and external bends or offsets shall be factory-made and shall be installed to provide a neat and workmanlike appearance.

4.3 PAINTING

The power skirting shall be painted in a colour as specified in the Data Technical Specification. The painting of steel power skirting shall comply with the Department's "STANDARD PAINT SPECIFICATION", Section C39. Aluminium power skirting shall be anodised. The power skirting channels and covers shall be individually wrapped or packed to protect them against damage in transit and before installation.

4.4 SOCKET-OUTLETS

- 4.4.1 Standard 13 A or 16 A, 3-pin flush switched socket outlets (100 x 50 mm nominal size) shall be supplied and installed in the positions indicated on the drawings and as specified in the Detail Technical Specification.
- 4.4.2 The switched socket outlets shall be secured to the channel by means of suitable brackets.
- 4.4.3 After installation of the modular front covers, they shall be screwed to the socket outlets to ensure proper alignment between the two components. Separate standard covers need not be provided for the socket outlets.

4.5 CONDUIT FEEDERS

- 4.5.1 Conduits for the circuit wiring to the power skirting shall be installed in the floor slab and shall terminate in flush conduit or boxes, behind the power skirting and installed to match the height of the power, telephone and light current services compartments of the skirting.
- 4.5.2 The wiring/cables shall pass through large diameter holes cut in the rear of the power skirting. The holes shall be suitably bushed or trimmed to prevent damage to the wiring or cables.
- 4.5.3 Alternatively conduits feeding to the telephone compartment may be terminated in boxes facing upwards in the floor slab immediately below the power skirting, with suitable bushed or trimmed openings being provided through the bottom of the power skirting duct for the cables to pass through. (Applicable only where the power skirting occurs at floor level).

4.6 POWER SKIRTING AT DOORWAYS

Where a section of power skirting is interrupted by a doorway, bridging conduits shall be installed to interconnect the power skirting sections. Where conduits are not specifically indicated, a minimum of 1 x 32mm bridging conduit shall be installed for each of the power, light current and telephone compartments.

4.7 CLEANING

Prior to fitting front covers, the power skirting shall be thoroughly cleaned to remove all dust and rubble and damage to paintwork where this has occurred, shall be repaired.

SECTION B3**B.3 INSTALLATION OF CABLE TRAYS AND LADDERS****1. GENERAL**

Cable trays and cable ladders complying with the Department's standard specifications for "CABLE TRAYS AND LADDERS", Section C3 shall be supplied and installed where specified and/or where generally suitable for cable distribution.

2. RESPONSIBILITY OF THE CONTRACTOR

The Contractor shall supply and install all cable trays and/or ladders as specified or as required by the cable routes including the necessary supports, clamps, hangers, fixing materials, bends, angles, junctions, reducers, T-pieces etc. He shall further liaise with the Main Contractor for the provision of holes and access through the structure and finishes.

3. SUPPORTS

Cable tray supports shall consist of two steel hanger rods, at least 8mm in diameter, on both sides of the tray with a substantial steel cross-member on the underside of the tray and bolted to the rods. Alternatively, cable trays may be cantilevered from walls on suitable brackets.

4. SPACING OF HORIZONTAL SUPPORTS

4.1 Horizontal trays shall be supported at the following maximum intervals:

(a)	1,2 mm to 1,6 mm thick metal with 12mm to 19 mm return trays.	4m maximum spacing
(b)	2,5 mm thick metal trays with 75 mm return	1.5m spacing.
(c)	Cable ladders with 76mm side rail of 2mm thickness and with crossrungs	1.5m spacing
(d)	Metal cable ladders other than c) above, including site manufactured angle iron types	4m spacing
(e)	3 mm thick PVC trays with 40mm return.	4m maximum spacing
(f)	4 mm thick PVC trays with 60mm return	1.5m maximum spacing

4.2 In addition to the above spacing on the longitudinal run, trays and ladders shall be supported at each bend, offset and T junction

5. JOINTS

5.1 Joints shall be smooth and without projections or rough edges that may damage the cables. The Contractor will be required to cover joints with rubber cement or other non-hardening rubber seal or plastic compounds if in the opinion of the Department joints may damage cables

5.2 Joints shall as far as possible be arranged to fall on supports. Where joints do not coincide with supports, joints shall be made by means of wrap-around splices of the same material as the tray and at least 460mm long. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 2 round head bolts, nuts and washers. Splices shall have the same finish as the rest of the tray.

5.3 Splices as described above shall be provided at joints, which do coincide with supports if the loaded tray sags appreciably to the joint due to the interruption of the bending moment in the tray.

6. FIXING TO SUPPORTS

Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened against the tray surface to avoid projections which might damage cables during installation.

7. FIXING TO THE STRUCTURE

- 7.1 Where installed on concrete or brick, the supports for cable trays and ladders shall be securely fixed by means of at least 2 heavy duty, expansion type anchor bolts. Cantilevered trays shall be supported by a minimum of two 6mm diameter expansion bolts per support.
- 7.2 It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense. The fixing shall take into account site conditions that prevail during installation.
- 7.3 Where installed on vertical steelwork, cable trays and ladders shall be fixed by means of 6mm diameter bolts and nuts.
- 7.4 On horizontal steelwork, use may alternatively be made of 'CADDY' type fasteners.
- 7.5 Horizontal trays and ladders shall in general be installed 450 mm below slabs, ceilings, etc. to facilitate access during installation of cables.
- 7.6 Multiple runs shall be spaced at least 300 mm apart unless a different spacing is specified in the Detail Technical Specification.

8. INSTALLATION OF CABLES

Cables shall be installed adjacent and parallel to each other on the trays with spacings as specified in the Department's standard specification for "INSTALLATION OF CABLES" Section B6, and snaked slightly to allow for expansion. Cables shall present a neat appearance and shall under no circumstances be bunched. Cables shall be clamped at maximum intervals of 3 m when installed on horizontal trays and at maximum intervals of 600 mm when installed on vertical trays.

9. EARTHING

Metal trays and ladders shall be bonded to the earth bar of the switchboard to which the cables are connected. Additional bare copper stranded conductors or copper tape shall be bolted to the tray or ladder where the electrical continuity cannot be guaranteed. These additional conductors or tapes shall always be installed in outdoor applications and in coastal regions.

10. CORROSION

PVC trays shall be used in corrosive atmospheres. All supports shall be adequately protected against corrosion, preferably with a powder coated paint finish in accordance with the Department's "STANDARD PAINT SPECIFICATION", Section C39.

SECTION B4**B.4 FIXING MATERIALS****1. RESPONSIBILITY**

It is the responsibility of the Contractor to position and securely fix conduits, ducts, cables and cable channels, switchboards, fittings and all other equipment or accessories as required for the installation. The Contractor shall provide and fix all supports, clamps, brackets, hangers and other fixing materials.

2. FINISHING

All unpainted supporting steelwork installed by the Contractor shall be wire brushed and given one coat of rust-resisting primer, followed by one coat of high quality enamel paint before any other equipment is fixed.

3. STRUCTURAL STEEL

Supports, brackets, hangers, etc. may only be welded to structural steel members where prior permission of the Department has been obtained. "CADDY" or similar fasteners may be used to fix equipment to structural steel members.

4. SCREWS AND BOLTS

Where holes exist in equipment to be fixed, bolts and fixing screws as specified shall be used. Where sizes are not specified, the largest bolt or screw that will fit into the hole shall be used.

5. WALL PLUGS

Where the fixing holes in brick or concrete walls are smaller than 10mm dia. and where the mass of the equipment is less than 10kg, wall plugs may be used to fix conduits, cables and other equipment. Fibre or plastic plugs shall be used. Wooden Plugs are not acceptable. Aluminium plugs may be used in face bricks. Plugs installed in joints between bricks are not acceptable. A masonry drill of the correct size shall be used to drill holes for plugs. Round-headed screws of the correct diameter to match the specific plug shall be used throughout.

6. ANCHOR BOLTS

Where the fixing holes are 10mm and larger or where the mass of the equipment is 10kg, equipment shall be fixed by means of expanding anchor bolts or by means of bolts cast into the concrete or built into walls.

7. GALVANISED EQUIPMENT

Brass screws, bolts and nuts shall be used to fix galvanised equipment.

8. SHOT-FIRED FIXING

- 8.1 Materials such as metal cable ducts or channels may be fixed against walls and concrete slabs by means of the shot-fired fixings.
- 8.2 The Contractor shall ascertain whether this method of fixing will carry the weight of the material including conductors, cables and other items of equipment to be installed later. Should it be found that the method of fixing is inadequate and supports tend to loosen, the Contractor will be required to fix the material by an alternative method to the satisfaction of the Department.
- 8.3 Where the shot-fired method is used, warning signs shall be placed at all entrances leading to the area where this work is in progress. The Contractor shall take all reasonable precautions to prevent accidents. Refer also to The Occupational Health and Safety Act.

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B.4 Nails and explosive charges recommended by the manufacturer shall be used throughout.

9. CLAMPS AND BRACKETS

Clamps and brackets used to fix or support equipment such as cable trays, ducts, etc. shall be of a purpose-made type suitable for the specific application. Refer also to the Department's standard specification for "CABLE TRAYS AND LADDERS", Section B3 and "INSTALLATION OF WIRING CHANNELS", Section B2.

SECTION B5**B.5 WIRING**

This section covers wiring in approved wire-ways for electrical installations in buildings or other structures under normal environmental conditions for 50 Hz systems not exceeding 600 V.

1. TYPE OF CONDUCTORS

PVC-insulated or equivalent, stranded copper conductors and bare stranded or green PVC-insulated copper earth conductors complying with the Department's quality specification for "PVC-INSULATED CABLES", Section C4, shall be used exclusively. Only where cables are specified or in instances where the exceptions stipulated in SANS 10142 are applicable, may the Contractor deviate from this requirement.

2. WIREWAYS

- 2.1 All unarmoured conductors shall be installed in conduits, cable channels (trunking) or power skirting and shall under no circumstances be exposed. Cable channels and power skirting shall be of metal construction unless specifically approved to the contrary.
- 2.2 Tenderers must note that common wire-ways will only be permitted for relatively light current-carrying conductors such as lighting and socket-outlet circuits. Refer also to par 4 below. Heavy current-carrying conductors such as feeders to distribution boards and large power points must be installed in separate conduits or wire-ways.

3. ORDER OF WORK

Wiring shall only be carried out after the wire-way installation has been completed, but before painting has commenced. Dusts and moisture shall be removed from the wireways prior to the installation of the conductors.

4. CIRCUITS

Conductors that are connected to different switchboards, shall not be installed in the same wireway. The wiring of one circuit only will be allowed in a 20 mm dia conduit with the exception of the wiring from switchboards to fabricated sheet metal boxes close to switchboards in which case more than one circuit will be allowed. For larger conduit sizes the requirements of SANS 10142, shall be met.

5. LOOPING AND JOINTS

A loop-in wiring system where conductors are looped from outlet to outlet, shall be employed. Joints in conductors shall be avoided as far as possible but where it becomes unavoidable, joints will be accepted in cable channels only and not in conduits. Joints shall be soldered or shall alternatively consist of approved ferruling properly covered with heat-shrink sleeves. The use of PVC insulation tape is not acceptable.

6. GROUPING OF CONDUCTORS

In cases where the conductors of more than one circuit are installed in the same wireway, the conductors of each separate circuit (including earth conductors) shall be taped at intervals of 1 m with PVC insulation tape. The conductors of different circuits shall however remain separate in order that any given circuit can be withdrawn. Conductors entering switchboards or control boards shall be grouped and bound by means of plastic or metal bands (not tape).

7. CABLE TRAYS

Conductors may only be installed directly on cable trays if specifically approved by the Department. In these cases cable trays shall be at least 2m above walkways or working areas. Conductors of the same circuit shall be grouped in the same manner as described in the previous paragraph. All the conductors on the

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cable tray shall then be tied down securely to the cable tray at intervals of 2m or less by means of plastic or metal bands (not tape).

8. DRAWING-IN OF CONDUCTORS

When conductors are drawn through conduit, care shall be taken that they are not kinked or twisted. Care shall also be taken that the conductors do not come into contact with materials or surfaces that may damage or otherwise adversely affect the durability of the conductor.

9. THREE-PHASE OUTLETS

9.1 With the exception of three-phase outlets, circuits connected to different phases shall not normally be present at lighting, switch or socket outlet boxes. Where this is unavoidable, barriers shall be provided between terminals or connections of the various phases and the box shall be suitably labelled internally to indicate the presence of three phase voltages.

9.2 A neutral conductor shall be installed to all three phase outlets intended for equipment connection, whether sockets or isolators, irrespective of whether the particular equipment normally requires a neutral or not.

10. VERTICAL CONDUIT INSTALLATION

Conductors installed in vertical wire-ways shall be secured at intervals not exceeding 5m to support the weight of the conductors. Clamps shall be provided in suitable drawboxes for this purpose.

11. CONNECTIONS

The insulation of conductors shall only be removed over the portion of the conductors that enter the terminals of switches, socket outlets or other equipment. When more than one conductor enters a terminal, the strands shall be securely twisted together. Under no circumstances shall strands be cut off.

12. EARTHING CONDUCTORS

12.1 When earth continuity conductors are looped between terminals of equipment, the looped conductor ends shall be twisted together and then soldered or ferruled to ensure that earth continuity is maintained when the conductors are removed from a terminal.

12.2 The installation shall be earthed to comply with SANS 10142.

12.3 The installation shall be bonded to comply with SANS 10142.

13. COLOURS

The colours of conductor insulation shall comply with SANS 10142. The colours of conductors for sub-circuits shall as far as possible correspond with the colour of the supply phase. The colours of conductors for wiring to two-way and intermediate switches shall preferably differ from the colour of phase conductors.

14. SINGLE-POLE SWITCHES

Single-pole switches shall be connected to the phase conductor and not to the neutral conductor.

15. SIZE OF CONDUCTORS

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

Lighting circuits.	1,5mm ² and 2,5mm ² copper earth conductor
Socket-outlet circuits	2,5mm ² and 2,5mm ² copper earth conductor
Bell circuits.	1,5mm ²
Stove circuits.	4mm ² and 6mm ² copper earth conductor

Clock circuits: 1,5mm²

16. PARTITIONS

16.1 When wiring is installed in removable partitions, the vertical and/or horizontal metal supports of the walls may be utilised for wiring on condition that:

- (a) the conductors are not exposed,
- (b) the metal supports are properly earthed,
- (c) a separate bare earth continuity conductor is drawn in together with the current carrying conductors and is earthed to the metal parts of the switches and/or the socket-outlets, and
- (d) conductors are installed in the metal and non-inflammable sections of the partitions.

16.2 Conductors enclosed in a copper braiding (tarnless wiring) may be installed in removable partitions. The braiding can be used as earth continuity conductor. The wiring shall be joined to the conduit (or cable) installation by interconnecting the conductor and the earth conductors in a crew-box using suitable ferrules and heat shrink sleeves or screwed terminals.

SECTION B6**B.6 INSTALLATION OF CABLES**

This section covers the installation of cables for the distribution of power in buildings, other structures and in ground for system voltages up to 11 kV, 50 Hz.

1. GENERAL**1.1 CABLE TYPES**

- (a) All cables and joining and termination accessories used for power distribution shall comply with the Department's Quality Specifications, Section C.
- (b) Cables with copper conductors shall be used throughout unless otherwise specified or approved.
- (c) All unarmoured cables shall be installed in metal trunking, sleeves or conduit unless clearly specified to the contrary.
- (d) XLPE Cables shall only be used in exceptional circumstances with the written permission of the Department.

1.2 COMPETENCE OF PERSONNEL

It is a definite requirement that the Contractor shall only employ personnel fully conversant with cable manufacturer's recommendations for joining and terminating cables.

2. IDENTIFICATION OF CABLES

- 2.1 Cables shall be identified at all terminations by means of punched metallic bands or marked with labels or tags. (Refer also to SANS 10142).
- 2.2 The use of PVC tape with punched characters is not acceptable.
- 2.3 The identification numbers of cables shall be shown on "as built" drawings of the installation.

3. TRENCHING**3.1 GENERAL**

- 3.1.1 The Contractor shall be responsible for all trenching excavations unless specified to the contrary.
- 3.1.2 The Contractor shall, before trenching commences, familiarise himself with the routes and site conditions and the procedure and order of doing the work shall be planned in conjunction with the general construction programme for other services and building requirements.
- 3.1.3 The Contractor shall acquaint himself with the position of all the existing services such as stormwater pipes, water mains, sewer mains, gas pipes, telephone cables, etc, before any excavations are commenced. For this purpose he shall approach this Department's representative, the local municipal authority and any other authority which may be involved, in writing.
- 3.1.4 The Contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and shall be responsible for the cost of repairs.
- 3.1.5 The Contractor shall take all the necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and/or employees on site are not endangered.
- 3.1.6 The Contractor shall ensure that the excavations will not endanger existing structures, roads, railways, other site constructions or other property.

3.2 MECHANICAL EXCAVATORS

3.2.1 Power driven mechanical excavators may be used for trenching operations provided that they are not used in close proximity to other plant, services or other installations likely to be damaged by the use of such machinery.

3.2.2

3.2.2 The use of power driven mechanical excavators shall be subject to the approval of the Department. Should the excavator produce trenches that exceed the required dimensions, payment based on volumetric excavation rates will be calculated on the required dimensions only.

3.3 BLASTING

3.3.1 No guarantee is given or implied that blasting will not be required.

3.3.2 Should blasting be necessary and approved by the Department, the Contractor shall obtain the necessary authority from the relevant Government Departments and Local Authorities. The Contractor shall take full responsibility and observe all conditions and regulations set forth by the above authorities.

3.4 ROUTES

3.4.1 Trenches shall connect the points shown on the drawings in a straight line. Any deviations due to obstructions in existing services shall be approved by the Department beforehand. Refer also to part 10.4

3.4.2 The Department reserves the right to alter any cable route or portion thereof in advance of cable laying. Payment in respect of any additional or wasted work involved shall be at the documented rates.

3.4.3 The removal of obstructions along the cable routes shall be subject to the approval of the Department.

3.5 SHORING AND WATERLOGGING

3.5.1 The Contractor shall provide shoring for use in locations where there is a danger of the sides of the trench collapsing due to waterlogging or other ground conditions. Refer to the The Occupational Health and Safety Act.

3.5.2 The strength of shoring must be adequate for site conditions prevailing and the shoring must be braced across the trench

3.5.3 The Contractor shall provide all pumps and equipment required to remove accumulated water from trenches. Water or any other liquid removed shall be disposed of without any nuisance or hazard.

3.6 TRENCHING

3.6.1 Trenching shall be programmed in advance and the approved programme shall not be departed from except with the consent of the Department.

3.6.2 Trenches shall be as straight as possible and shall be excavated to the dimensions indicated in this specification

3.6.3 The bottom of the trench shall be of smooth contour, and shall have no sharp dips or rises which may cause tensile forces in the cable during backfilling.

3.6.4 The excavated material shall be placed adjacent to each trench in such a manner as to prevent nuisance, interference or damage to adjacent drains, gulleys, trenches, water furrows, other works, properties or traffic. Where this is not possible the excavated materials shall be removed from site and returned for backfilling on completion of cable laying

3.6.5 Surplus material shall be removed from site and disposed of at the cost of the Contractor.

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- 3.6.6 Trenches across roads, access ways or footpaths shall not be left open. If cables cannot be laid immediately the Contractor shall install temporary "bridges" or cover plates of sufficient strength to accommodate the traffic concerned.
- 3.6.7 In the event of damage to other services or structures during trenching operations the Contractor shall immediately notify the Department and institute repairs. (Refer to par. 3.1.3 and 3.1.4)
- 3.6.8 Prior to cable laying the trench shall be inspected thoroughly and all objects likely to cause damage to the cables either during or after laying shall be removed.
- 3.6.9 Where ground conditions are likely to reduce maximum current carrying capacities of cables or where the cables are likely to be subjected to chemical or other damage or electrolytic action, the Department shall be notified before installing the cables. The Department will advise on the course of action to be taken.
- 3.6.10 Extreme care shall be taken not to disturb surveyor's pegs. These pegs shall not be covered with excavated material. If the surveyor's pegs are disturbed, they shall be replaced by a person qualified to do so.

3.7 DIMENSIONS OF TRENCHES

- 3.7.1 Cable trenches for one or two cables shall not be less than 300 mm wide and need not be more than 450 mm wide. This dimension shall be valid for the total trench depth.
- 3.7.2 The width shall be increased where more cables are installed to allow for the spacings stipulated in par. 4.2.
- 3.7.3 Where trenches change direction or where cable slack is to be accommodated, the Contractor shall ensure that the requirements of the relevant SANS Specification regarding the bending radii of cables are met when determining trench widths.
- 3.7.4 Trench depths shall be determined in accordance with cable laying depths and bedding thickness.
- 3.7.5 Payment will be made on a volumetric excavation rate calculated on the basis of the given maximum dimensions or the actual dimensions whichever is the lesser. Refer also to par. 3.2.2 and 3.7.1 above.

3.8 JOINT HOLES

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 joiner to work efficiently and unimpeded.

3.9 BEDDING

- 3.9.1 The bottom of the trench shall be filled across the full width with a 75mm layer of suitable soil sifted through a 6mm mesh and levelled off.
- 3.9.2 Only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding $1,5^{\circ}\text{C m/W}$) may be used for this purpose. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher sand is acceptable.
- 3.9.3 Where no suitable soil is available on site, the Contractor shall import fill from elsewhere and make all the necessary arrangements to do so. The cost of importing soil for bedding purposes shall be included in the unit rates for excavations.
- 3.9.4 After cable laying a further layer of bedding shall be provided to extend to 75 mm above the cables.
- 3.9.5 The bedding under joints shall be fully consolidated to prevent subsequent settling.

3.10 CABLE SLEEVES

3.10.1 Where cables cross under roads, railway tracks, other service areas, etc. and where cables enter buildings, the cables shall be installed in Polyethylene (6mm thickness), asbestos cement pipes or earthenware pipes. Pilot fibre and PVC pipes are not acceptable because of the adhesion that occurs after a period of time between the pipe and the sheathing or outer serving of the cables.

3.10.2 Pipes shall be joined in accordance with the manufacturer's instructions.

3.10.3 Sleeves shall cross roads and railway tracks at right angles.

3.10.4 Sleeves shall have a minimum diameter of 100mm. They shall extend at least 2m beyond the tracks of a railway line or of the outermost tracks where there is more than one line. In the case of roads, the sleeves shall extend at least 1m beyond the road edge or kerb on both sides of the road.

3.10.5 All sleeves shall be graded 1:400 for water drainage.

3.10.6 Cable sleeves shall be installed to the spacings and depths stated in paragraph 4 below.

3.10.7 Galvanised metallic sleeves up to and including 75mm dia. shall be supplied and installed by the contractor.

3.10.8 The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.

3.11 BACKFILLING

3.11.1 The Contractor shall not commence with the backfilling of trenches without prior notification to the Department so that the cable installation may be inspected. Should the Contractor fail to give a timely notification, the trenches shall be re-opened at the Contractor's cost. Such an inspection will not be unreasonably delayed.

3.11.2 For high voltage cables (1 kV to 11 kV) a coloured plastic marking tape shall be installed 400 mm above the cable. The tape shall be yellow, marked with the words "ELECTRIC CABLE/ELEKTRIESE KABEL" in red. These markings shall not be more than 1m apart from centre to centre.

3.11.3 Backfilling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the backfill material, is 75mm.

3.11.4 The Contractor shall have allowed in his tender for the importation of suitable backfill material if required.

3.11.5 The backfill shall be compacted in layers of 150mm and sufficient allowance shall be made for final settlement. The Contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.

3.11.6 On completion, the surface shall be made good to match the surrounding area.

3.11.7 In the case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

3.12 CABLE MARKERS (FOR HV CABLES ONLY, EXCEPT WHERE OTHERWISE SPECIFIED)

3.12.1 Cable markers shall be provided along all HV cable routes but need only be provided along LV cable routes where specified.

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

3.12.3 Brass plates shall be cast into the tops of the blocks in such a manner that they cannot be prised loose. The wording 'ELECTRIC CABLE/ELEKTRIESE KABEL' shall be stamped on the brass plates as well as direction arrows and the cable voltage rating.

- 3.12.4 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.
- 3.12.5 Cable markers shall be installed at the beginning and end 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.
- 3.12.6 The position of cable markers shall be indicated on the 'as built' drawings.
- 3.13 TRANSNET, PROVINCIAL ADMINISTRATION OR NATIONAL ROAD CROSSINGS**
- 3.13.1 The Contractor shall not trench beneath any railway tracks without the TRANSNET Administration's supervision. The Contractor shall request the Department timeously to arrange for the necessary supervision. The cost of such supervision will be paid for by the Department.
- 3.13.2 The Department will arrange for the necessary wayleave and permission to cross TRANSNET property and railway tracks, or Provincial or National road reserves and TELKOM Authority approval of proposed cable routes.
- 3.13.3 The Contractor shall carry out the crossing installation in strict accordance with the TRANSNET and Provincial Administrations requirements and stipulations. Where these requirements are in contradiction with this specification, the Department's ruling shall be sought.
- 3.13.4 The Contractor shall ensure that he will comply with the various Administration's requirements regarding crossing of Provincial and National roads, especially with regard to the safeguarding of the public. The Contractor shall also provide proof of adequate insurance cover against any claim from any accident as a result of work done by the Contractor during the crossing operation. The Department shall also be indemnified from all liability in this regard.
- 3.13.5 The Contractor shall liaise with the various Administrations well in advance regarding the intended dates, times and expected duration of the crossing operations and obtain their approval of the programme and method of operation before commencing with the work.

4. INSTALLATION OF UNDERGROUND CABLES

4.1 INSTALLATION DEPTHS

- 4.1.1 Cables shall be installed at the following minimum depths below final ground level.
- Up to 11kV : 800mm
- 4.1.2 All cable depth measurements shall be made to the top of the cable when laid directly in ground or to the top of the duct or sleeve where these are provided.
- 4.1.3 The above depths shall apply to the top layer where cables are installed in layers.
- 4.1.4 The Contractor may only deviate from the above depths provided prior authority in writing has been obtained from the Department. In this event the cables shall be protected with a suitable concrete covering.
- 4.1.5 The depth of cable pipes or ducts beneath railway lines or roads shall be not less than 1.4 m below the formation level.

4.2 CABLE SPACINGS

- 4.2.1 Cables installed in the same trench shall be laid parallel to each other with the following spacings between cables (LV: up to 1 kV; HV: 1 kV to 11 kV):

LVLV	-	2 cable diameters
LWHV	-	150mm minimum

HV/HV	.	150mm minimum
L/HV/PILOT	.	1 cable diameter

- 4.2.2 Where HV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800 mm and then covered with 200mm of soil. The soil shall then be compacted, and then backfilled layer by layer and compacted until the trench is completely backfilled.
- 4.2.3 Cables for telephones, communication systems and other low voltage systems (less than 50 V) shall be separated from power cables by at least 1 m. All control or pilot cables without a lead sheath and steel armouring shall be laid at least 300mm from power cables.
- 4.2.4 Cables shall not be buried on top of each other unless layers are specified. The minimum spacing between layers shall be 200mm.
- 4.3 CABLE LAYING**
- 4.3.1 Except where ducts, tunnels or pipes are provided, cables shall be laid directly in the ground.
- 4.3.2 The cable shall be removed from the drum in such a manner that the cable is not subjected to twisting or tension exceeding that stipulated by the cable manufacturer.
- 4.3.3 Cable rollers shall be used as far as possible to run out cables. Rollers shall be spaced so that the length of cable in the trench will be totally suspended during the laying operation and sufficiently close to prevent undue sagging and the cable from touching the ground. Rollers shall also be placed in the trench in such a manner that they will not readily capsize.
- 4.3.4 Cable rollers shall have no sharp projecting parts liable to damage the cables.
- 4.3.5 Where cables have to be drawn around corners, well-lubricated skid plates shall be used. The skid plates shall be securely fixed between rollers and shall constantly be examined during cable laying operations.
- 4.3.6 Where cables have to be drawn through pipes or ducts, a suitable cable sock shall be used and particular care shall be exercised to avoid abrasion, elongation or distortion of any kind. In the case of oil filled cables, a cable sock may never be used. Special eyes giving access to the interior of the cable must be utilised.
- 4.3.7 The maximum allowable tension when pulling a cable, is 70 N/mm² of conductor area.
- 4.3.8 It will be assumed that the price or rates contained in the tender includes for the installation of cables in pipes and ducts or below existing or newly installed services.
- 4.3.9 The Department shall be informed immediately of the intention to carry out all cable laying operations to allow an inspection of the works by the Department if so required.

5. INSTALLATION OF CABLES IN CONCRETE TRENCHES

5.1 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.

5.2 INSTALLATION

Cables shall be installed in one of the following ways:

- (a) On horizontal cable trays
- (b) On horizontal metal supports with suitable clamps.
- (c) On vertical cable trays or metal supports fixed to the side of the trench. The cables shall be clamped in position.

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

5.3 COVERS

5.3.1 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.

5.3.2 Cables shall enter and exit the trench through sleeves protruding 300mm 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.

5.4 FILLED TRENCHES

5.4.1 Where specified, floor trenches shall be filled with fine crusher sand (no river or sea sand).

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

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

- (a) Reinforced concrete covers.
- (b) Sand and cement screed.
- (c) Removable chequer plates.

5.4.4 Method (a) above shall be used where vehicular traffic may be encountered over trenches. Unless otherwise specified allowance for a mass of 2 tons shall be made.

5.4.5 Cable trenches in substations, switch rooms and generator rooms shall be covered in accordance with the Department's standard specification for "COVERING AND SEALING OF CABLE TRENCHES", Part 9 of Section B13.

6. FIXING OF CABLES TO TRAYS OR STRUCTURES

6.1 INSTALLATION

Cables may be installed in one of the following ways:

- (a) On horizontal cable trays.
- (b) Against vertical cable trays with suitable clamps.
- (c) Against horizontal or vertical metal supports or brackets with suitable clamps.
- (d) On clamps which are fixed to the structure.

6.2 CLAMPS

Suitable clamps (cleets) which will secure cables without damage shall be used. Metal clamps or drilled hard wood blocks 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. 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 sizes.

6.3 SPACING OF SUPPORTS

Two methods of supporting cables are found in practice. The most generally known method is the restrained installation where the distance between supports is small enough to prevent any noticeable sag in the cable. The alternative method is the unrestrained installation where the distance between supports should be great enough to ensure that there will be obvious sag in each span between supports.

6.4 SPACING OF SUPPORTS OF UNRESTRAINED CABLES

Large single core cables shall always be installed according to this method. Generally, single core cables with conductors exceeding a cross sectional area of 185mm² should be supported at spacings in excess of 2m since the sag between supports will safely accommodate any thermal expansion.

Reducing the spacing between the supports to 1,5m or less shall be avoided at all costs, as expansion cannot be taken up by a change of sag and chances of sheath failure become considerable.

6.5 SPACING OF SUPPORTS OF RESTRAINED CABLES

Additional cleats shall be installed at each bend or offset 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 550mm for unarmoured cables and 30 times the outside diameter of the cable with a maximum spacing of 900mm for armoured cables. Spacing of supports for cables for high voltage lighting shall be in accordance with Table 6 of SANS 10142. A minimum of 20mm ventilation clearance shall be maintained between cables and the wall to which they are cleated.

7. GROUPING AND SPACING OF CABLES IN BUILDINGS AND STRUCTURES

7.1 SPACING CORRECTION FACTORS

Cables shall as a rule be spaced two cable diameters apart, for which no grouping correction factor need be applied.

7.2 CABLES ON DIFFERENT LEVELS

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 300mm shall be maintained.

7.3 SINGLE CORE CABLES

Where single core cables are installed along a three-phase circuit, the cables shall be installed in trefoil formation and bound together at 300mm intervals.

7.4 HIGH VOLTAGE CABLES

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.

7.5 CABLES FOR OTHER SERVICES

Cables for telephones, communication systems and 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 installed on separate cable trays or shall otherwise be at least 1m away from power cables. Where unarmoured cables are used for these other services, they shall be installed in separate conduits or metal channels.

TABLE B6.1

Cross-Sectional Area of Cable Conductors (mm ²)	MAXIMUM SPACING OF SUPPORTS (CLEATS) (mm) FOR RESTRAINED CABLES			
	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	450	750	300	400
2,5	450	750	300	400
4,0	600	750	300	400
5,0	600	750	300	400
10,0	750	900	400	450
16,0	750	1000	400	550
25,0	900	1000	450	550
35,0	900	1000	450	550
Bigger than 35,0	900	1000	450	550

For larger cables the spacing shall be 10 x outside diameter of the cable.

8. TERMINATION AND JOINTING OF CABLES

8.1 GENERAL

- 8.1.1 Cable ends shall be terminated with glands or in cable boxes with the associated accessories such as clamps, shrouds, etc. complying in all respects with the Department's quality specifications, Section C.
- 8.1.2 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:
- No. 1 conductor : left (red) (A)
 No. 2 conductor : centre (white) (B)
 No. 3 conductor : right (blue) (C)
- 8.1.3 Exposed armoring shall be covered with bitumen-base paint.
- 8.1.4 All cable ends shall be supplied with the necessary earth connection.
- 8.1.5 A channel or other approved means of support shall be provided to remove mechanical stress from the glands.
- 8.1.6 Cable cores shall be marked with heat-shrink sleeves where necessary to identify the phases. Refer to SANS 10142.
- 8.1.7 The current-carrying capacity and breakdown voltage of the cable end shall be the same as for the complete cable.
- 8.1.8 Cables shall be terminated in accordance with the recommendations laid down by the manufacturers of the cables and glands employed.

8.2 TERMINATION OF PAPER-INSULATED CABLES

- 8.2.1 The ends shall be terminated in cable end boxes filled with bituminous, cold filling or resin or semi-fluid compound or heat-shrinkable terminations in accordance with the Department's standard specification for "CABLE END BOXES AND COMPOUND", Section C8 or "CABLE TERMINATIONS AND JOINTS", Section C6.
- 8.2.2 Heat-shrinkable materials shall only be used in exceptional circumstances with the written permission of the Department.

- 8.2.3 Before terminating or joining paper-insulated cables, a test to establish the presence of moisture must be carried out.

The following procedure may be followed:

- (a) Place an adequate quantity of cable impregnating oil in a suitable container and heat up to $+20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.
- (b) Cut a small length ($\pm 300\text{mm}$) of the cable concerned and remove the armoring and sheath, taking care not to handle the dielectric in any way.
- (c) Dip a section of the outer insulating impregnated paper (bet paper) in the heated oil, taking care not to contaminate the tapes with moisture from the hands. If frothing appears on the surface of the oil, this is a clear indication of the presence of moisture in the paper.
- (d) The same procedure should then be repeated on the insulating impregnated paper around the conductors (especially those layers closest to the conductors). Frothing will also indicate the presence of moisture.
- (e) Should only a small number of bubbles appear on the surface of the oil, this is an indication of air bubbles on the paper and not moisture since the presence of moisture will result in a series of bubbles rising to the surface of the oil for a number of seconds, until all moisture has been removed.

- 8.2.4 The armoring shall be bonded to the main earth bar of the switchgear or transformer, but the bond shall be easily removable for testing purposes.

- 8.2.5 The lead sheath shall be wiped against the conical wiping and.

- 8.2.6 All cut cable ends which will be exposed to the atmosphere for more than two hours shall be sealed and wiped to prevent penetration of moisture.

8.3 TERMINATION OF XLPE CABLES

- 8.3.1 These cables shall only be used in exceptional circumstances and only with the written permission of the Department.

- 8.3.2 Cross-linked polyethylene cables (XLPE) shall be terminated in accordance with the Department's standard specification for "CABLE TERMINATIONS AND JOINTS", Section C6 unless a pre-fabricated system based on pre-moulded slip-on EPR stress cones is used.

- 8.3.3 The copper tapes of the earth screen on the cable shall be bonded to the main earth bar of the switchgear or transformer, but the bond shall be easily removable for testing purposes.

- 8.3.4 The cable shall be firmly secured on the switchgear by means of a clamp to prevent mechanical stress on the cable and terminations.

8.4 TERMINATION OF PVC-INSULATED CABLES

- 8.4.1 Cable ends shall be terminated by means of adjustable glands in accordance with the Department's standard specification for "GLANDS FOR PVC-INSULATED CABLES", Section C5.

- 8.4.2 The glands shall be fitted in accordance with the cable and gland manufacturers instructions.

- 8.4.3 The correct size and type of gland shall be used for the particular cable and application.

8.5 CONNECTION OF CABLE CONDUCTORS

- 8.5.1 Suitable lugs shall be used, preferably solidly swaged to the cable conductor ends. Lugs may be crimped, using mechanical or pneumatic tools designed for this purpose, on condition that evidence is submitted that the method used complies with the performance requirements of BS 4579, Part 1: "COMPRESSION JOINTS IN COPPER".

SECTION B.6

- 8.5.2 Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug.
- 8.5.3 Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductor, need not be lugged but the correct terminal size shall be used.
- 8.5.4 Ferrules shall be used as far as possible where cable conductors are connected directly to equipment with screws against the conductor strands.
- 8.5.5 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.

8.6 JOINTS

- 8.6.1 Joints in cable runs will not be allowed unless specified in the Detail Technical Specification or authorised by the Department.
- 8.6.2 Jointing shall be carried out strictly in accordance with the manufacturer's instructions and by personnel competent in jointing the types of cables used.
- 8.6.3 During outdoor jointing operations, the joint bays shall be adequately covered by tents of waterproof material suitably supported. Where 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.
- 8.6.4 The joint shall not impair the anti electrolysis characteristics of the cable.
- 8.6.5 The Contractor shall notify the Department immediately 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 Department because of insufficient notice being given, shall be opened for inspection and redone at the discretion of the Department at the cost of the contractor.
- 8.6.6 HV cable joints on paper insulated cables shall be of the compound cast type and the compound used shall comply with the Department's standard specification for 'CABLE END BOX FILLING COMPOUND', par. 2 of Section C8.
- 8.6.7 HV cable joints on XLPE-insulated cables shall be of the heat shrinkable type and shall comply with the Department's standard specification for 'CABLE TERMINATIONS AND JOINTS' Section C6, or shall be based on a prefabricated system utilising pre-moulded slip-on stress cones.
- 8.6.8 LV cable joints shall be of the epoxy-resin type.
- 8.6.9 Joints shall be fully water and air tight and shall be free of voids and air pockets.
- 8.6.10 The crossing of cores in joints will not be permitted under any circumstances.

9. TESTING

- 9.1 Each cable shall be tested after installation in accordance SANS 1507 (up to 1 kV) and SANS 97 (up to 1 kV) as well as the requirements of the Local and Supply Authorities.
- 9.2 LV Cables shall be tested by means of a suitable megger at 1 kV and the insulation resistance shall be tabulated and certified.

TABLE B6.2

Cable Rating (kV)	TEST VOLTAGE (Applied for 15 minutes) (kV)				
	Paper-insulated cables				XLP-E-insulated cables
	Between conductors		Conductors to sheath		Conductors to screen
	AC (r.m.s.)	DC	AC (r.m.s.)	DC	DC
	12 20	18 30	12 20	18 30	12 18

- High Voltage test with DC to 2kV for 1 minute only. Discharge cable slowly via discharge stick (1 minute). Clamp all conductors to earth for 24 hours.
- 9.3 HV Cables shall be high voltage tested in accordance with Table B6.2 and the exact leakage current shall be tabulated and certified.
- 9.4 The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests. The cost of testing shall have been included in the tender price.
- 9.5 The Contractor shall notify the Department immediately so that a representative of the Department may witness the tests.
- 9.6 On completion of the tests on any cable, the Contractor shall without delay, submit three copies of the certified Test Reports to the Department.

10. MEASUREMENTS

- 10.1 All measurements for payments shall be made jointly by the representatives of the Department and the Contractor and the Contractor shall obtain the signature of the Department's representative including approval of such measurements.
- 10.2 No allowance shall be made for the breaking away of the trench sides, other earth movements or for benches excavated in excess of the stipulated dimensions. Refer also to par. 3.7.5 above.
- 10.3 The classification shall be as follows:

Very hard rock shall mean rock that can only be excavated by means of explosives.

Hard rock shall mean granite, quartzitic sandstone, slate and rock of similar or greater hardness, solid shale and boulders in general, requiring the use of jack hammers and other mechanical means of excavations.

Soft rock and earth shall mean rock and earth that can be loosened and removed by hand-pick and shovel.

- 10.4 Where very hard rock and hard rock are encountered, the prior approval of the Department shall be obtained before proceeding with the excavation. This requirement is stipulated in order to afford the Department the opportunity to determine whether an alternative cable route is justified.
- 10.5 All cable lengths indicated in the Detail Technical Specification and/or shown in the cable route drawings shall be regarded as estimates and are given for tendering purposes only. The successful tenderer shall measure actual cable lengths on site before ordering.
- 10.6 The final price for the supply and installation of all cables will be adjusted, on the basis of the actual lengths of installed cables, in accordance with the unit rates quoted at the time of tendering. Cable lengths shall be measured on site to the nearest 500mm for this purpose and surplus cable will not be paid for.

11. COMPLETION

- 11.1 The Department 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 for completing the installation fully in accordance with the Contract Documents.
- 11.2 The Contractor shall carry out a final "as built" survey of the cable routes and present to the Department "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
- (a) Overall length of each cable.
 - (b) 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 to each joint, shall be used.
 - (c) Identification of each cable.
- 11.3 The works will be deemed to be incomplete until all tests have been conducted successfully and all "as built" drawings and schedules have been handed to the Department.

SECTION B.7**B.7 INSTALLATION OF LIGHT SWITCHES AND SOCKET-OUTLETS****1. GENERAL****1.1 STANDARDS**

Light switches and socket-outlets shall comply with the Department's quality specification for "LIGHT SWITCHES", Section C10 and "UNSWITCHED AND SWITCHED SOCKET-OUTLETS", Section C11. Surface or flush mounted boxes and cover plates, complying with the Department's quality specification for "CONDUIT AND CONDUIT ACCESSORIES", Section C*, shall be provided.

1.2 POSITION OF OUTLETS

Switches and socket-outlets shall be accurately positioned in accordance with the drawings. It is the Contractor's responsibility to ensure that all outlets are installed level and square, at the correct height from the floor and at the correct position relative to building lines and equipment positions as specified. It is the Contractor's responsibility to determine the correct final floor level and ceiling level in conjunction with the Main Contractor.

1.3 COVER PLATES

All switches and socket-outlets shall be fitted with standard metal cover plates. The colour of cover plates shall be as specified or shall otherwise match the surrounding finishes as closely as possible. Unless specified to the contrary, very cover plates shall be installed on painted walls. Cover plates in the same area shall have the same colour. Flush mounted cover plates shall overlap the draw-box and edges of the recess. Cover plates shall under no circumstances be cut unless authorised by the Department.

1.4 ESCUTCHEON PLATES

Where flush mounted switches or socket-outlets are installed in special wall finishes e.g. wood or board panels, acoustic tiles or other cladding, etc. and where the wall finishes must be cut to accommodate the switch, it may be necessary to fix an escutcheon plate to the wall to cover the cut outs. The escutcheon plate shall fit closely around the outlet boxes and shall be fixed independently of the boxes and cover plates. Bevelled cover plates shall be fixed to the outlet boxes and shall fit firmly against the escutcheon plate.

1.5 APPEARANCE

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

1.6 DEEP BOXES

Where switch or socket-outlet boxes have been set deep, spiral type steel wire spacers shall be used to fix the yoke of the switch or socket.

2. INSTALLATION OF SOCKET-OUTLETS**2.1 MOUNTING HEIGHT**

Unless specified to the contrary, socket-outlets shall be installed at the following heights above finished floor level, measured to the centre of the outlet:

Flush mounted in general:	300mm
Showrooms, shops, servants quarters:	1,4m
Domestic kitchens, tea kitchens:	1,05m
Commercial kitchens:	1,4m
Factories, workshops, garages:	1,4m

2.2 WALLS

In cases where socket-outlets must be mounted at a nominal height of 300mm and where the lower portion of the wall consists of face bricks and the upper portion is plastered, the outlets shall be installed in the plastered portion of the wall. If however the plastered portion of the wall commences 500mm or more above floor level the outlets shall be installed in the face bricks. Where a wall has different surface finishes the outlets shall be installed within the same finish and not in the dividing lines between the different wall finishes. All outlets shall be installed at least 150mm away from door frames.

3. INSTALLATION OF LIGHT SWITCHES

3.1 MOUNTING

Light switches shall be installed 1,4m above finished floor level unless specified to the contrary. Mounting heights given shall be measured from the finished floor level to the centre of the switch. All single switches shall be installed with the long side of the toggle vertical.

3.2 DOORS

Unless specified to the contrary, switches adjacent to doors shall be installed on the side containing the lock. If the position of the lock is not shown on the drawings, the position shall be verified before the switch-box is installed. Switch boxes in brick or concrete walls shall be installed 150mm from the door frame. Light switches installed in partitions or door frames shall be of the type designed for that purpose.

3.3 WALLS

Where the lower portion of a wall is face brick and the upper portion plastered, light switches shall be installed wholly in the plaster provided that the lower edge of the plaster is not higher than 1,6m above the finished floor level. In general where different wall finishes are used in the same area, switches shall be installed within the same finish and not on the dividing lines between finishes.

3.4 PARTITIONS

Light switches installed in partitions shall preferably be of the type designed to be accommodated in the partition construction. Switches installed in the metal supports do not require switch boxes. Switches may not be flush mounted in partition walls without switch boxes.

3.5 WATERTIGHT SWITCHES

Switches that are exposed to the weather or are installed in damp areas, shall be of the watertight type complying with the Department's quality specification for "WATERTIGHT SWITCHES", par. 3 of Section C10.

3.6 MULTIPLE SWITCHES

Where several switches are required in one position, multi-lever switches in a common switch box shall be provided wherever possible. All circuits wired into this box shall be on the same phase in order that voltages in excess of 250 V are not present in the box. Where it is not possible or practical to do this, barriers shall be installed and a label shall be prominently displayed within the box stating that voltages in excess of 250 V are present.

SECTION B8**B.8 PHOTO-ELECTRIC DAYLIGHT SENSITIVE SWITCH FOR OUTSIDE LIGHTING****1. INSTALLATION**

- 1.1 The outside lighting of each individual building i.e. light circuits marked 'T' on the drawings, shall be controlled by photo-electric daylight sensitive switches.
- 1.2 The positions of the switches as indicated on the drawings are provisional and the exact positions shall be confirmed with the representative of the Department on site.
- 1.3 Individual outside lighting circuits on a building may be connected directly to the daylight sensitive switch.
- 1.4 Where two or more lighting circuits are to be controlled by a single daylight sensitive switch, a contactor actuated by the unit shall be provided in the switchboard.
- 1.5 A by-pass switch enabling the lights to be turned on at any time, shall be provided.
- 1.6 Standard control circuits are indicated in fig B8.1 and B8.2

2. CONSTRUCTION

- 2.1 The unit shall comprise a photo cell, thermal actuator and change-over switch. The cover of the unit shall be manufactured from a tough, durable material providing protection against tampering. The cover shall have good weathering properties. It shall be ultraviolet-resistant and shall not deteriorate when exposed to sunlight for prolonged periods.
- 2.2 The unit shall be of the wall mounting type and shall be supplied complete with a suitable bracket.
- 2.3 The operational level shall be factory preset for 'ON' at a light level of approximately 54 lux and 'OFF' at approximately 108 lux. Voltage variations shall not materially affect the operational levels.
- 2.4 A time delay of not less than 15 seconds shall be provided to prevent the unit from functioning due to short period changes in illumination.
- 2.5 The unit shall be effectively safeguarded against voltage surges by means of a suitable surge protector which shall preferably form an integral part of the unit.

SECTION B9**B.9 INSTALLATION OF LUMINAIRES****1. POSITIONS**

The mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect to ceiling panels, battens, beams, columns or other architectural features of the space unless otherwise indicated. The layout as shown in the Documents shall generally be adhered to but any discrepancies or clashes with structural or other features must be referred to the Department, before commencing erection of the installation.

2. COVER PLATES

Cover plates shall be fitted over all draw-boxes and outlets intended for luminaires that are not covered by the luminaires canopy, arm-holder, ceiling rose or similar accessories.

3. FIXING TO DRAW-BOXES

Where an outlet box or draw-box provides the necessary support for a luminaire, all luminaires with the exception of fluorescent luminaires mounted against ceilings, shall be fixed directly to the box. Fluorescent luminaires and luminaires with a mass in excess of 10kg shall however be suspended independently of the outlet box.

4. HANGERS AND SUPPORTS

Where provision has not been made for the fixing of luminaires, the Contractor shall supply the necessary supports, hangers, conduit extensions, angle brackets or any other fixing method approved by the Department.

5. SUSPENDED LUMINAIRES

The necessary hangers shall be provided where luminaires which are of the non-suspension type have to be fixed below false ceilings or roof slabs. The use of 20mm conduits fixed to the roof slab or ceiling is preferred. Provision shall be made for adjustments to enable the levelling of luminaires. Suspended conduits shall be fixed to the ceiling by means of screwed dome lids, bolts and nuts. Ball-and-spigot type dome lids shall be used where conduit lengths exceed 600mm. Wiring shall be installed in the conduit hangers.

6. SUSPENDED WIRING CHANNELS

Luminaires (especially fluorescent luminaires) may also be suspended from ceilings by means of suspended metal channels. The metal channel may be supported by conduits or threaded rods. Should metal rods be utilised, these shall be screwed to anchor bolts fixed in the roof slab. Wiring shall either be installed in conduits fixed to the metal channel or in the metal channels and covered with a suitable cover plate. Purpose-made clamps shall be used to fix the luminaires to the cable channel.

7. CEILING BATTENS

Where wooden blocks are used to suspend luminaires, ceiling battens shall not be cut. The wooden blocks shall be cut to fit around battens and shall be screwed to the ceiling. Battens may however be cut where fluorescent or incandescent luminaires with metal canopies have to be installed against a false ceiling.

8. GLASS-BOWL LUMINAIRES

Unless specified to the contrary, suspended glass-bowl luminaires shall be installed with the underside at least 2,1 m above finished floor level.

9. FLUORESCENT LUMINAIRES FIXED TO CONCRETE SLABS

Fluorescent luminaires to be installed directly against concrete slabs or walls shall be securely fixed to the outlet box and at two additional points. Shot-fired fixings are not acceptable. Where approved, fluorescent luminaires may be installed against metal wiring channels in which the wiring is housed. The channel fixing may in this case be shot-fired. Purpose-made fluorescent fixing adaptors shall be used to fix luminaires to cable channels.

10. FLUORESCENT LUMINAIRES FIXED TO CEILINGS

- 10.1 In all cases where luminaires are fixed to false ceilings, the Contractor shall ensure that the ceiling is capable of carrying the weight of the luminaires before commencing installation. Should any doubt exist in this regard, the matter shall be referred to the Department.
- 10.2 In cases where the weight of the luminaire is not carried by the ceiling but by a support or other suspension method, provision shall be made to prevent relative movement between the ceiling and luminaire, ceiling rose or connection point.
- 10.3 Surface mounted fluorescent luminaires shall fit firmly against the ceiling bracking without leaving gaps between luminaire and ceiling. The luminaire shall be fixed directly to the ceiling by means of brass plated round-head wood screws and washers.
- 10.4 In the case of tiled ceilings with exposed or concealed T-section supports, surface mounted luminaires shall be fixed only to the tiles by means of butterfly screws or bolts with nuts and washers. The tiles shall be suitably reinforced.
- 10.5 Luminaires may alternatively be fixed to metal cross-braces resting in the ceiling joists.
- 10.6 Drilling of holes in ceiling tees to support luminaires will not be allowed.
- 10.7 Luminaires shall be fixed in neat relation to the ceiling lay-out.

11. CONTINUOUS ROWS OF LUMINAIRES

In cases where fluorescent luminaires are installed in tandem, only one connection outlet need be supplied per circuit. All luminaires shall be coupled to one another by means of nipples or brass bushes and locknuts to ensure that wiring is not exposed and that earth continuity is maintained. Luminaires on the same circuit may be wired through the channel formed by the luminaire bodies. In this case silicon-rubber insulated conductors shall be used and internal connections shall be made at porcelain terminal blocks, "SCREW-IT" or similar connectors may only be used if prior permission is obtained from the Department. The wiring for any other circuits or outlets, even though these may be in the same row, may not be installed through the luminaire bodies. The Contractor shall ensure that continuous rows are straight and parallel to the relevant building lines.

12. RECESSED LUMINAIRES

- 12.1 Where recessed luminaires are specified, the Contractor shall maintain close liaison with the ceiling Contractor. In the case of tiled ceilings, the luminaires shall preferably be installed while the metal supports are being installed and before the tiles are placed in position. The Electrical Contractor shall be responsible for the co-ordination of the cutting of ceiling tiles with the other contractors concerned.
- 12.2 All mounting rings and other accessories shall fit closely into cut-outs to ensure a proper finish.
- 12.3 In all false ceilings where wiring channels are used, recessed luminaires shall be connected to the wiring channels by means of unswitched 5 A socket outlets.
- 12.4 The following requirements shall be adhered to:
 - (a) Socket-outlets used shall comply with the Department's quality specification for "UNSWITCHED AND SWITCHED SOCKET-OUTLETS", par. 4 of Section 11 and shall be of 5 A minimum rating.

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- (b) The connector cord attached to the luminaire may not exceed 3m in length and shall consist of 1,5mm² minimum, 3-core, PVC-insulated flexible cord.
- (c) The 5A socket-outlets shall be positioned such that they are not more than 600mm above the false ceiling.

13. SPECIAL CEILINGS

In cases where special ceilings e.g. aluminium strips, decorative glass, metal leaves, etc. are to be installed, the Contractor and the Manufacturer of the ceiling shall agree upon the method of fixing of luminaires in the ceiling.

14. BULKHEAD LUMINAIRES

Surface mounted bulkhead luminaires shall not be screwed directly to concrete. The conduit shall terminate in a round draw-box at the top or rear of the luminaire. The PVC-insulated conductors shall terminate in a porcelain terminal strip in the draw-box. Silicon-rubber-insulated conductors shall be installed from the terminal strip to the luminaire lamp-holder. "SCREW-IT" or similar connectors may only be used if prior permission is obtained from the Department.

15. TYPE OF CONDUCTOR

PVC-insulated conductors, unless protected by an approved heat-resistant sheathing, shall not be used where the temperature of the insulation is likely to exceed 70°C. In unventilated luminaires or luminaires capable of housing incandescent lamps over 60W, the interconnecting wiring from the lamp holder to the circuit wiring shall consist of silicon-rubber insulated conductors. Silicon-rubber insulated conductors shall be used exclusively in the case of high bay fittings. Refer also to the provisions of SANS 10142.

16. WIRING OF LAMPHOLDERS

The central terminal of Edison Screw (E.S. type) LAMP-HOLDERS shall be connected to the phase conductor and the screwed housing to the neutral conductor.

17. HIGH BAY LUMINAIRES

- 17.1 High bay luminaires shall be securely suspended from the roof structure.
- 17.2 The luminaires may be fixed to suspended wiring channels containing the wiring on condition that:
 - (a) rigid channels with a maximum width of 42 mm be used,
 - (b) the channels are supported at intervals that will prevent sag or warp and
 - (c) the channels are large enough to accommodate the wiring.
- 17.3 Luminaires may be suspended from metal roof trusses with the aid of "CADDY" or similar fasteners.
- 17.4 Luminaires shall preferably be connected to unswitched 5A socket outlets. Silicon rubber insulated flexible cord shall be used exclusively to connect the luminaire to the outlet.
- 17.5 A safety chain to keep the luminaire from falling when loosened shall be provided.

SECTION B.10**B.10 CONNECTIONS TO EQUIPMENT****1. GENERAL**

This section covers the final electrical connections to switchboards and various equipment in general electrical installations under normal environmental conditions for system voltages up to 600 V. Refer also to the Department's standard specifications for "WIRING", Section B5 and "INSTALLATION OF CABLES", Section B6.

2. CONNECTIONS TO SWITCHBOARDS**2.1 CONDUIT ENTRIES**

- 2.1.1 Where sufficient space for conduit entries as well as adequate space for future conduit entries is available, conduits may be terminated directly on the switchboard.
- 2.1.2 Alternatively, conduits connected to switchboards shall terminate in a common fabricated sheet steel draw-box installed in the vicinity of the switchboard. In open roof spaces this draw-box shall be placed in a roof space of not less than 500mm clearance.
- 2.1.3 Lighting and socket-outlet circuits may be separately grouped in common conduits or metal ducts (trunking) from the distribution board to the draw-box. The drawbox shall be of sheet steel with a minimum thickness of 1,6mm and shall be fitted with a removable cover plate.

2.2 FLUSH MOUNTED SWITCHBOARDS

Where flush mounted switchboards are required, the recessed switchboard tray shall be built into the brick or concrete wall. All conduits from the floor or roof shall be fully recessed and shall be lanced directly to the tray by means of locknuts on both sides and the ends of the conduits filled with a brass bush.

2.3 SURFACE MOUNTED SWITCHBOARDS

Where surface mounted switchboards are specified but where the conduits can be fully recessed, the conduit shall be connected to a recessed connection box installed behind the switchboard. An opening with the same dimensions as the connection box shall be cut in the back of the switchboard and fitted with a suitable grommet.

2.4 SPARE CONDUITS

Where conduits from a switchboard run into a false ceiling space above the board, a minimum of two 25mm and two 20mm spare conduits shall be installed into the ceiling space immediately above the board.

2.5 CABLE CONNECTIONS

- 2.5.1 Where underground cables are to be connected to switchboards, it shall be the responsibility of the Contractor to ensure that metal, earthenware, asbestos-cement or other approved sleeves are built in correctly to enable installation and connection of the cable to the switchboard.
- 2.5.2 PVC or pitch fibre sleeves are not acceptable - refer to par. 3.10 of the Department's standard specification for "INSTALLATION OF CABLES", Section B6.
- 2.5.3 Sleeves shall be installed with a fall from inside to outside of the building to facilitate drainage. The sleeves shall be sealed with a non-hardening compound after installation of the cables to render the installation vermin proof and waterproof.
- 2.5.4 A metal cable channel with removable metal cover plate shall be installed by the Contractor and shall extend from the switchboard to the floor or into the ceiling void as required. The channel shall

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coincide with the position of sleeves. The channel shall be flush mounted except in the case of surface mounted switchboards and then only with the permission of the Department's representative.

- 2.5.5 The cable channel shall be large enough to permit the installation of cable glands and future cables, particularly where spare sleeves have been provided.
- 2.5.6 The colour of the channel cover shall match that of the associated switchboard.

2.6 CABLE TRENCHES

Where cables in floor trenches have to be connected to wall mounted switchboards, approved sleeves or conduits shall be installed from the side of the trench to the bottom of the switchboard. These sleeves shall be positioned and fixed before the concrete is cast.

3. CONNECTIONS TO MOTOR DRIVEN EQUIPMENT.

- 3.1 An isolator or starter containing an isolator shall be installed within 2m of motor driven equipment. The requirements of SANS 10142 shall be met. If this isolator cannot be installed on a wall, switchboard or other suitable place, an approved free standing pedestal shall be provided. The pedestal shall be 1m high and outside normal walkways, access routes, etc.
- 3.2 The connection to the equipment shall be carried out as follows:
 - (a) Metal reinforced plastic or PVC-covered flexible metal conduits with individual conductors or a multi-core PVC insulated cable and separate bare earth conductor installed inside the conduit may be used. The flexible conduit shall not exceed 600mm. Screwed conduit shall be used from the end of the flexible conduit to the isolator and/or starter. Refer to the department's standard specification for "FLEXIBLE CONDUIT", Section B1, par. 5.
 - (b) Multi-core armoured PVC- or rubber-insulated cable and earth conductor. The installation and termination of the cables shall comply with the Department's specification for "INSTALLATION OF CABLES, Section B6.
 - (c) Cables and flexible conduits shall be provided with sufficient slack to allow positional adjustment of the equipment.
- 3.3 Supply cables to equipment may not be installed across floors which are for general use.

4. CONNECTIONS TO WATER HEATERS

- 4.1 Each water heater shall be connected to a separate circuit with a separate earth conductor.
- 4.2 The conduit from the switchboard to the water heater shall terminate in a draw-box within 1 m of the water heater terminals. The connection from the draw-box shall be conductors in conduit or PVC-insulated cable. Only in instances where heaters are mounted out of normal reach may flexible conduit and round boxes with dome lids be used for the final connection.
- 4.3 Three-phase supplies to fixed storage water heaters shall be in accordance with the wiring diagram, Fig. B10.1.
- 4.4 The mounting of the water heater and the provision of the water connections will be undertaken by others. The Contractor shall ensure that the elements and thermostats can easily be replaced.
- 4.5 Before testing a water heater, the Contractor shall confirm with the Plumbing Contractor that the unit is filled with water.
- 4.6 Unless otherwise specified in the Detail Technical Specification, the wiring of hot water heater circuits not exceeding 4 kW shall consist of 4mm² conductors and 2,5mm² earth conductor.

- 4.7 Unless it is specified that isolators for water heaters shall be provided in the switchboard, a local isolator shall be provided for each water heater. In the case of water heaters not exceeding 4 kW, a 30 A double-pole metal-clad isolator shall be surface mounted over the flush conduit outlet box.

5. CONNECTIONS TO HEATERS, FANS AND AIRCONDITIONING UNITS

5.1 ISOLATORS

A flush mounted suitably rated double-pole isolator shall be provided within 1m of the unit. Where the equipment is mounted out of reach, the isolator shall be installed at 1.5m above floor level. Only where units are mounted in easily accessible positions and where an isolating switch is incorporated in the unit, may this isolator be omitted. Where flush isolators are used, flush conduit shall be installed to link with the equipment outlet point. Flexible conduits of sufficient rating may be used for the final connection to the equipment.

5.2 WIRING

The minimum conductor size to be used shall be 4 mm². Each fan, heater or air-conditioning unit shall be on a separate circuit.

5.3 FLUSH MOUNTED CONVECTION HEATERS

The heater frame or tray shall be built or cast into the wall at a height such that the underside of the heater is at 250mm above floor level. Conduits shall terminate on the frame near the terminals.

5.4 SURFACE MOUNTED EQUIPMENT

- 5.4.1 Connections to surface mounted equipment shall consist of a draw-box located in the vicinity of the terminals of the unit. In workshops and industrial areas the connections shall be made by means of flexible conduit connected to dome lids on the draw-box. Conductors shall be connected directly to the unit.

- 5.4.2 In non-industrial applications PVC-insulated 3-core flexible cables may be used for the connection.

- 5.4.3 Where flexible cables are used, a bush shall be provided at the rear of the unit for cable entry and a bush and clamp (or gripper gland) at the draw-box. The clamp shall tightly grip the outer insulation of the cable to prevent tension on the connections between cable and conductors in the draw-box.

- 5.4.4 Where heaters or air conditioning units are situated above power skirting, the isolator shall be installed in the power skirting and the flexible cable or cord to the unit shall be installed in the power skirting through a gripper or compression gland. The cable shall be made as short as practical and shall be neatly added to the surface of the wall.

5.5 RADIANT HEATERS

The installation of radiant heaters and asbestos heaters, where specified, shall comply with the requirements of paragraph 5.4, with the exception that they shall be mounted on spacers, 25mm away from the mounting surface.

5.6 FAN HEATERS

- 5.6.1 The contractor shall allow for the supply, installation and electrical connection of the fan heaters as indicated on the drawings. The fan heaters shall be rated at 3 kW and shall be complete with control units.
- 5.6.2 The heaters shall be secured by means of approved expansion bolts at 2.4m above floor level in positions as shown, with the control units at 1.5m above floor level, directly below the unit.
- 5.6.3 The fan heater shall be installed on a box directly behind the unit.
- 5.6.4 Each connection shall be protected by means of a single-pole circuit-breaker on the associated switchboard.

- 5.6.5 Brass bushes shall be provided to protect the wiring at the rear cable entries to the control unit and fan connection box.

6. CONNECTIONS TO UNDERFLOOR HEATING

- 6.1 Where underfloor heating cable is specified, the Contractor shall supply the cable and thermostats which shall be purchased from a specialist supplier. The cable shall be laid by the specialist supplier and connected by the Contractor. The Contractor shall also be responsible for testing of the cables prior to their being covered by the screed and immediately thereafter. Details of circuit wiring and control of underfloor heating will be specified in the Detail Technical Specification.
- 6.2 PVC-insulated heating cable with a rating of not higher than 13 W per linear metre shall be used. Thermal insulation will be provided by the Builder.
- 6.3 The capacity of the heating cable shall be sufficient to give a 20°C temperature rise with an outside ambient temperature of 5°C.
- 6.4 The total heating load shall, however, not be more than 135 W/m².

7. CONNECTIONS TO INCINERATORS

7.1 GENERAL

This section covers connections to incinerators used for domestic purposes in buildings. Unless specified to the contrary, the supply and installation of incinerators will form part of the electrical installation and shall comply with the Department's quality specification, "INCINERATORS", SECTION C14.

7.2 FLUSH MOUNTED INCINERATORS

Where flush mounted incinerators have been specified, the Contractor shall supply the mounting tray to the Builder in good time for it to be built into the structure.

7.3 MOUNTING HEIGHT

Unless specified to the contrary, incinerators shall be installed with the bottom 1m above finished floor level.

7.4 ISOLATOR

A flush mounted 30 A double-pole isolator shall be installed approximately 1.5m above the finished floor level adjacent to each incinerator. The isolator cover plate shall wholly fall within either the tiled or plastered surface of the wall. Unless specified to the contrary, the cover plate shall be finished in white baked enamel. An engraved label shall be provided at each isolator marked as follows:

"SWITCH OFF TO CLEAN AND REMOVE ASH"
"SKAKEL AF VIR SKOONMAAK EN ASVERWYDERING"

7.5 FLUES

The Contractor shall supply flue pipes to the Builder for installation. Two bends and an "H" piece exhaust canopy shall be allowed for each flue pipe.

7.6 EXHAUST FANS

Where more than 5 incinerators are connected to the same flue or where more than two 90° bends are used in the flue, an exhaust fan shall be installed at the flue outlet. In addition a small fan must be provided at each incinerator.

7.7 WIRING

Single incinerators shall be connected by means of 2 x 4mm² PVC insulated conductors and a 2.5mm² bare copper earth conductor in a 20mm conduit. Each incinerator shall be connected to a separate circuit where a common exhaust fan is not used. Where a common exhaust fan is needed, the following applies:

- (a) All fans and incinerators connected to the same flue shall lie on the same circuit.
- (b) The current rating of the circuit-breaker shall be sufficient to allow the simultaneous operation of all the fans and 50 % of the incinerators.
- (c) A 30 A double-pole isolator shall be flush mounted adjacent to each incinerator as described in paragraph 7.4. However if the current rating of the circuit-breaker protecting the circuit is larger than 15A, a 15A fuse and fuse holder shall be installed at each incinerator in addition to the isolator. The draw-box and cover plate for the isolator shall be large enough to accommodate the isolator and fuse. Alternatively, a 10A circuit breaker may be installed adjacent to each incinerator in lieu of the isolator and fuse.
- (d) The circuitry shall be arranged to ensure that all the fans will operate when any one of the incinerators is running on.
- (e) Earth leakage protection shall be installed on all incinerator circuits.

8. CONNECTIONS TO COOKING APPLIANCES

B.1 Unless specified to the contrary, the circuit connection to each cooking appliance shall consist of:

- (a) 2 x 10mm² PVC-insulated conductors and 6mm² bare copper earth conductor for single phase connections, or
- (b) 4 x 4mm² PVC-insulated conductors and 2.5mm² bare copper earth conductor for three phase connections.

B.2 A 60A double pole or 30A triple pole micro-gap isolator flush mounted in a wall outlet box, shall be installed 1,5m above floor level to the left or right of the appliance in accordance with SANS 10142. A white baked enamel cover plate shall be provided, situated wholly on the tiled or plastered surface as applicable.

B.3 The conduit shall terminate 450mm above floor level behind the appliance position. The conduit end shall be approximately 75mm long and shall face downwards. Connections from the conduit end to the appliance shall be installed in accordance with SANS 10142. Sufficient slack shall be provided in the flexible connection to move the appliance 500mm away from its normal position for cleaning or maintenance.

B.4 Alternatively a 45A, 3-pin socket-outlet may be mounted on a round draw-box 450mm above floor level. The connection to the appliance shall consist of a plug and 10mm² rubber-insulated and sheathed cable in accordance with SANS 1520. The cable shall be long enough to enable the appliance to be moved 500mm from its normal position for cleaning or maintenance.

B.5 Crimped or soldered lugs shall be provided on all conductors intended for connection to cooking appliances.

B.6 Each appliance shall be connected to a separate circuit. A separate earth wire shall be provided for each appliance.

SECTION B.11**B.11 EARTHING**

This section covers the earthing of electrical installations in buildings or other structures. The total earthing system of any electrical installation shall be in complete accordance with SANS 10142.

1. GENERAL RECOMMENDATIONS ON THE PRACTICAL INSTALLATION OF EARTH ELECTRODES

1.1 REQUIREMENTS OF AN EFFECTIVE EARTH

- 1.1.1 An effective earth must prevent dangerous over voltages arising between metallic structures, frames, supports or enclosures of electrical equipment and the ground during fault conditions.
- 1.1.2 An effective earth must be able to permit fault currents of sufficient magnitude to flow so as to operate protective devices to isolate the fault before damage can occur.
- 1.1.3 The ohmic resistance of an effective earth must be low enough to ensure that the step potential on the ground in the vicinity of the earthing point is within safe limits under fault conditions i.e. a voltage gradient not exceeding 40 V/m for fault durations exceeding 1s.

1.2 TYPES OF EARTH ELECTRODES

Three types of earth electrodes are suitable:

1.2.1 Trench Earths

Trench earths comprise a bare copper or galvanised iron conductor laid at a minimum of 800mm below ground level, usually when underground cables are installed. This type of earth electrode provides a relatively large contact area between electrode and surrounding ground, makes contact with a variety of types of soil and soils of varying moisture content en route and is economical to install.

1.2.2 Spike Earths

Spike earths comprise rods of bare copper, copper-coated steel, stainless steel or galvanised steel designed for the purpose of penetrating ground to depths of up to several metres. A low resistance earth may sometimes be obtained by driving multiple spikes at some distance from each other in order to provide parallel paths.

In hard or rocky ground, it is usually necessary to drill holes into which earth spikes are inserted and then packed with soft soil.

1.2.3 Foundation Earths

Foundation earths comprise bare copper or galvanised iron conductors laid under the foundations of buildings, miniature substations, distribution pillars, bases of wooden, concrete or steel poles and structures. Because soil under foundations usually retains moisture, foundation earths are located to take advantage of this favourable condition. Furthermore, they are economical to install.

1.3 MATERIALS FOR EARTH ELECTRODES

- 1.3.1 Bare copper, either in stranded, strip or rod form, is considered the most suitable general purpose material for earth electrodes, its main disadvantage is its cost and susceptibility to theft.
- 1.3.2 Bare galvanised iron and steel, either in stranded, strip or rod form, has a satisfactory record of survival in non-aggressive soils and is more economical than copper.
- 1.3.3 Bare aluminium is unsuitable as electrode material.

1.4 CORROSION

Because galvanised ferrous metals corrode sacrificially to copper, galvanised iron and steel electrodes should not be buried in close proximity to bare copper.

2. TECHNICAL REQUIREMENTS OF NEUTRAL EARTHING

The following relevant aspects have been extracted from the 'AMEU CODE OF PRACTICE FOR THE APPLICATION OF NEUTRAL EARTHING ON LOW VOLTAGE DISTRIBUTION SYSTEMS.'

2.1 DISTRIBUTION SYSTEMS

Multiple Earthing Neutral (MEN) and Protective Multiple Earthing (PME) systems.

Distribution equipment associated with transformer substations that are either ground mounted or pole mounted and fed by underground cable or overhead line, with or without an earth continuity conductor, (ECC), should be installed, connected and earthed in accordance with the following requirements:

- (a) Where the resistance to earth of the HV equipment earth is 1 ohm or less, it is permissible to earth the LV neutral to the HV earth electrode.
- (b) Where the HV equipment earth exceeds 1 ohm the LV neutral shall be earthed at a minimum distance of 6m from the HV equipment earth (i.e. 6m from the HV electrodes and also from any earthed metalwork connected thereto).
- (c) Notwithstanding the requirements of (b) above, where transformers are associated with HV overhead lines, it is considered good practice to separate the HV and LV earth electrodes. The minimum earth separation should be 6m or one LV span.
- (d) The overall resistance to earth of the neutral of an LV distributor or distribution system must not exceed 10 ohms.
- (e) The LV neutral may be connected to other supply neutrals, earth electrodes, cable sheaths and armouring and these connections used to obtain the required earthing value of 10 ohms or less specified in par. (d) above.
- (f) The neutral of underground and overhead LV distributors must be earthed at the remote ends of each distributor.
- (g) Where the overall resistance to earth of the neutral of the distributing system exceeds 10 OHMS the neutral shall be earthed at intermediate positions on the distributor/s to reduce its resistance to earth to below this limit.
- (h) The cross-sectional area of the neutral of all LV distributors must not be less than that of a phase conductor.
- (i) No circuit-breakers, isolators, fuses, switches or removable links shall be installed in the neutral between the transformer star point and the remote end of any LV distributor or service connection.
- (j) All metallic sheathing and armouring of cables and all metalwork associated with meter cabinets, fuse barrels, etc., supporting or enclosing LV cables shall be bonded to the distributor neutral conductor.
- (k) Where a Separate Neutral Earth (SNE) cable is part of an MEN or PME system, the armouring and/or metallic sheath and any ECC shall be bonded to the neutral at the supply end of the cable.
- (l) To ensure the integrity of the neutral, it is recommended that all connections and joints on or to overhead line conductors be made by compression fittings or, alternatively double bolted connectors.
- (m) MEN or PME may be applied to any single LV distributor without alterations to other LV distributors supplied from the same transformer.

2.2 PROTECTIVE NEUTRAL BONDING (PNB) SYSTEM

Since the neutral is earthed at one point only, the question of multiple earthing does not arise and there is therefore no necessity to meet the MEN/PME technical requirements.

2.3 SERVICE CONNECTIONS

2.3.1 MEN System

The following conditions apply to consumers' service connections as well as service connections to traffic signals, road signs, street lighting and other power-consuming equipment installed in public places:

- (a) All service connections must be by means of cable with an insulated phase, an insulated neutral conductor and an ECC.
- (b) A single phase service connection comprises a live, a neutral and an ECC.
- (c) A polyphase service connection comprises two or three phase conductors, a neutral and an ECC.
- (d) The service neutral and ECC must be solidly and separately connected to the distributor neutral at the tie-off point.
- (e) The consumer's earthing lead is connected to the Supply Authority's earth terminal which is in turn connected to the ECC in the service cable at the consumer's supply point.
- (f) The neutral must not be connected to earth at the consumer's supply point.
- (g) If required by the Supply Authority, and earth electrodes must be installed at the consumer's supply point.
- (h) In a service connection to traffic signals, street light and other power-consuming equipment installed in public places, such equipment is earthed to the ECC of the service connection.

2.3.2 PME System

- (a) All service connections must be by means of a cable with an insulated phase and an insulated neutral conductor.
- (b) A single phase service comprises a live conductor and a neutral.
- (c) A polyphase service connection comprises two or three phase conductors and a neutral.
- (d) The consumer's earthing lead is connected to the supplier's neutral and to a mandatory earth electrode at the consumer's supply point.
- (e) A label must be attached at the consumer's supply point on his premises indicating that the installation is part of a PME system.

Note: It is not recommended that the PME system be applied to supply traffic signals, street signs or other power-consuming equipment installed in public places, because the PME system is inherently unsafe under "broken-neutral" conditions.

3. SUBSTATION EARTHING

In order to comply with the requirements of par. 1 and 2 above, an earth resistivity measurement shall be undertaken at the site of a new substation or miniature substation, preferably by a specialist firm. The contractor shall then submit to the Department details of a proposed substation earth indicating whether a trench earth, spike earth or augmentation earth is intended and the proposed interconnections with the installation.

4. FENCES OF OUTDOOR SUBSTATIONS

In cases where substations contain transformers or switch-gear installed outdoors, the compulsory fence shall be earthed as follows, if no other method is specified :

- (a) A 70mm² earth wire shall be installed 400mm below ground level and 500mm from the fence on the outside of the sub-station along the entire length of the fence. This earth wire shall be earthed at each corner by means of a 1,8m earth rod and the rod and earth wire bonded to the fence. The earth wire shall also be bonded, at least at two points, to the main earthing system.
- (b) A 70mm² earth wire shall also be buried at a depth of 400mm around each transformer and switch and bonded to the main earthing system.

5. EARTHING OF A GENERAL ELECTRICAL INSTALLATION

5.1 GENERAL

All earth conductors shall be stranded copper with or without green PVC insulation. The conductors shall comply with the Department's quality specification for 'PVC-INSULATED CABLES', Section C4. All earth conductor sizes shall be determined in accordance with SANS 10142, par. 4.6 where the earth does not form an integral part of the cable.

5.2 SWITCHBOARDS

A separate earth connection shall be supplied between the earth busbar of the main switchboard and the earth busbar of every sub-switchboard. These connections shall consist of bare or insulated stranded copper conductors installed along the same routes as the supply cables or in the same conduit as the supply conductors. Alternatively armoured cables with earth continuity conductors included in the armouring may be utilised.

5.3 SUB-CIRCUITS

The earth conductors of all sub-circuits shall be connected to the earth busbar in the supply switchboard in accordance with SANS 10142.

5.4 RING MAINS

Common earth conductors may be used where various circuits are installed in the same wiring channel in accordance with SANS 10142. In such instances the sizes of earth conductors shall be specifically approved by the Department. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-terminals or soldered. The common earth shall not be broken.

5.5 CONNECTIONS

Under no circumstances shall connection points, bolts, screws, etc. used for earthing be utilised for any other purpose. It will be the responsibility of the Contractor to supply and fit earth terminals or clamps on equipment and materials that must be earthed where these are not provided. Unless earth conductors are connected to proper terminals, the ends shall be tinned and lugged. Lugs may be crimped, using mechanical or pneumatic tools designed for this purpose, on condition that evidence is submitted that the method used complies with the performance requirements of BS 4579 Part 1: "COMPRESSION JOINTS IN COPPER."

5.6 NON-METALLIC CONDUIT

Where non-metallic conduit is specified or allowed, stranded copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including switch boxes, socket-outlet boxes, draw-boxes, switchboards, luminaires, etc. The securing of earth conductors by means of self-threading screws will not be permitted.

5.7 FLEXIBLE CONDUIT

An earth conductor shall be installed in all non-metallic flexible conduit. This earth conductor shall not be installed external to the flexible conduit but within the conduit with the other conductors. The earth conductor shall be connected to the earth terminals at both ends of the circuit.

5.8 WATER PIPES

Metal cold water mains shall be bonded to the earth busbar in the Main Switchboard by solid 15 x 2mm copper strapping. All other hot and cold water pipes shall be connected by 12 x 0,5mm perforated or solid copper strapping (not conductors) to the nearest switchboard. The strapping shall be fixed to the pipe work by brass nuts and bolts and against walls be brass screws at 150mm centres. In all cases where metal water pipes, down pipes, flues, etc. are positioned within 1,0 m of switchboards, an earth connection consisting of copper strapping shall be installed between the pipe work and the board. In vertical building ducts accommodating both metal water pipes and electrical cables, all the pipes shall be earthed at each switchboard.

5.9 ROOFS

Where service connections consist of overhead conductors, all metal parts of roofs, gutters and down pipes shall be earthed. One bare 10mm² copper conductor shall be installed over the full length of the ceiling void, fixed to the top purlin and connected to the main earth conductor of each switchboard. The roof and gutters shall be connected at 15m intervals to this conductor by means of 12 x 0,5mm copper strapping (not conductors) and galvanised bolts and nuts. Self tapping screws are not acceptable. Where service connections consist of underground supplies, the above requirements are not applicable.

SECTION B.12**B.12 PROVISION FOR TELEPHONE INSTALLATION****1. CONTRACTOR'S RESPONSIBILITY**

The Contractor shall only supply and install outlet points, wiring channels and/or conduits for telephones. The telephone installation will be carried out by others.

2. REGULATIONS

All provisions for telephones in buildings shall comply with the latest issue of "FACILITIES FOR TELECOMMUNICATION SERVICES IN BUILDINGS" as issued by the Department of Posts and Telecommunications.

3. SEPARATION OF SERVICES

3.1 Cables or conductors for telephone services shall be separated from all other services by:

- (a) providing separate metal channels or conduits, or
- (b) installing power cables, conductors and accessories at a minimum distance of 300mm from routes reserved for telephone cables, or
- (c) an earthed metal barrier installed in such a manner to ensure that the minimum distance through free air space between the telephone cables and other services is at least 300mm.

3.2 In cases where high voltage cable runs are parallel to telephone cable runs for more than 50m, the correct spacing shall be determined by conferring with the Department of Posts and Telecommunications.

3.3 Conduits or wiring channels provided for telephone services may not be used for any other purpose. Where non-metallic channels are used, the separation stated in par. 3.1 (b) shall be maintained throughout the installation.

4. MAIN TELEPHONE DISTRIBUTION BOARD

4.1 The size and position of the Main Telephone Distribution Board, where required, shall be in accordance with the requirements of the Detail Technical Specification.

4.2 The board shall consist of a metal tray, architrave frame and hinged doors and shall be flush mounted in the position shown on the drawing(s).

4.3 A 20mm thick soft wooden panel (fine grade pine to SANS 1359, without knots) shall be installed in the main telephone distribution board and shall cover the entire back of the board. Chipboard or similar materials are not acceptable.

4.4 All conduits and sleeves to telephone outlets or sub-distribution boards in the buildings or on the site as well as the main incoming sleeves, shall terminate at the main telephone distribution board as indicated on the drawing(s).

4.5 Where 100 x 100 x 50mm draw-boxes are specified as main or sub-distribution boards, the boxes shall be flush mounted and provided with a cover plate. A wooden panel need not be provided in these cases.

5. VERTICAL BUILDING (SERVICE) DUCTS

5.1 If the telephone cables are to be installed in the same duct as power cables the separation of services described in par. 3 shall be maintained.

- 5.2 Conduits and metal channels to and from building duct(s) shall be installed from the section containing the telephone cables to obviate telephone cables crossing power cables or other services in the duct.
- 5.3 Where more than one vertical building duct is provided in the structure, the ducts shall be interconnected by at least 2 x 52mm dia. conduits at each floor level unless otherwise specified or indicated on the drawings.

6. TELEPHONE OUTLETS

- 6.1 Blank cover plates shall be fitted to all telephone outlets.
- 6.2 Telephone outlets in walls shall consist of flush mounted 100 x 100 x 50mm draw-boxes.
- 6.3 Telephone outlets in floors shall be of the same type as floor outlets for power socket-outlets. These provisions also apply to underfloor ducting. If the type of floor outlet is not specified, 100 x 100 x 50mm flush mounted draw-boxes shall be provided in the floor at the positions indicated on the drawings. The cover plates for these draw-boxes shall be of the diecast type.
- 6.4 Where twin underfloor ducts are provided and where the one duct is intended for telephone cables, the separation between the ducts shall be maintained throughout the underfloor ducting installation.
- 6.5 Where power skirting is specified for telephone installations, the Contractor need only install the skirting with covers since the telephone socket will be fixed directly to the cover. Where multiple power skirting is provided containing other services, no other cables may be installed in the section intended for telephone cables and the separation between the sections shall be maintained throughout the installation.
- 6.6 Refer also to the Department's standard specification for the 'INSTALLATION OF WIRING CHANNELS UNDERFLOOR DUCTING AND POWER SKIRTING', Section B2

7. CONNECTION OF TELEPHONE OUTLETS

- 7.1 Telephone outlets shall be inter-connected and connected to the telephone distribution boards as shown on the drawings.
- 7.2 If the inter-connecting conduits are not specified, conduit sizes shall be determined as follows:
- Inter-connection of 10 outlets maximum - 25mm dia. conduit.
- Inter-connection of 20 outlets maximum - 32mm dia. conduit.
- 7.3 Metal channels or power skirting installed on the same floor level on opposite walls of the same area as well as parallel runs of underfloor ducting intended for the installation of telephone cables, shall be interconnected at intervals of 6m. Conduit may be used for these inter-connections.
- 7.4 All conduits and all ducts or channels which do not have removable covers, shall be provided with galvanised steel draw-boxes.
- 7.5 Conduit connections to power skirting or surface mounted metal channels, shall consist of a 100 x 100 x 50mm draw-box which is flush mounted immediately behind the duct or channel in which the telephone cables are to be installed. A hole shall be cut in the back of the duct or channel, immediately opposite the draw-box. The edges of the hole shall be grommeted. The draw box shall be accessible from the front when the cover is removed.
- 7.6 Purpose-made accessories for the connection of conduits to underfloor ducts shall be used. Where these are not available, a 100 x 100 x 50mm draw-box shall be installed below the underfloor duct opposite a floor telephone outlet. Inter-connecting conduits shall terminate at the draw-box. The edges of the hole shall be grommeted. The draw-box shall be accessible from the top via the floor outlet.

SECTION B.12

- 7.7 Exposed conduit ends intended for future extensions shall be terminated by means of a coupling and screwed brass plug. Only galvanized conduit shall be used in these instances.

SECTION B13

B.13 SUBSTATIONS SWITCH ROOMS AND GENERATOR ROOMS

This section covers the general building arrangement and special requirements for high and low voltage switch rooms, transformer rooms and generator rooms.

1. STANDARD BUILDINGS

The following list indicates the standard substation designs and corresponding standard departmental drawing number which are available.

- 1.1 High voltage room, transformer room for one transformer up to 800kVA, low voltage room and a generator room for one emergency generator set from 200 to 500kVA EE3/136/131A.
- 1.2 High voltage room, transformer room for one transformer up to 800kVA, low voltage room and a generator room for one emergency generator set from 80 to 200kVA EE3/136/131B.
- 1.3 High voltage room, transformer room for one transformer up to 800kVA, low voltage room and a generator room for one emergency generator set up to 30kVA EE3/136/131C.
- 1.4 High voltage room, transformer room for one transformer up to 300kVA and low voltage room FF3/136/131D.
- 1.5 High voltage room, transformer room for one transformer up to 800kVA, low voltage room and a generator room for two emergency generators up to 200kVA each EE3/136/131E.
- 1.6 Large high voltage room, transformer room for one transformer up to 800kVA and low voltage room EE3/136/131F.
- 1.7 High voltage room, transformer room for two transformers of up to 800kVA each, large low voltage room and a store room EE3/136/131G.
- 1.8 Emergency generator buildings EE3/136/118.

2. OTHER BUILDINGS

If the standard buildings cannot accommodate the equipment required, suitable substation rooms complying with the following constructional details shall be provided:

- 2.1 The rooms shall have a ceiling height of at least 2.8 m above finished floor level.
- 2.2 A concrete roof slab shall be provided or alternatively a roof consisting of corrugated iron, or clay or cement tiles with an asbestos ceiling.
- 2.3 The rooms shall be waterproof, vermin proof and fireproof.
- 2.4 Door openings shall be 1.85 m wide by 2.5 m high with steel louvered ventilation openings over at least 60 % of the floor area. Doors shall open outwards and it shall be possible to readily open them from the inside. Provision shall be made for a night latch and a pad lock.
- 2.5 The floor and transformer base shall be on the same level. Each transformer base shall be able to support a mass of 3 tons on castors.
- 2.6 Vermin proof steel louvered ventilation openings shall be provided with an area of at least 20 % of the total floor area for transformer and generator rooms and 10 % for switch rooms if not specified to the contrary. 50 % of the ventilation openings shall be installed in the lower part of the walls, not more than 300 mm above floor level and the other 50 % of the ventilation openings shall be installed in the upper part of the walls, not more than 300 mm below ceiling level to achieve good cross and

convection ventilation. Louvers contained in the roof can normally be considered to provide the 50 % required in one of the walls.

- 2.7 Where possible, windows with an area equal to 5 % of the floor area shall be included to provide natural lighting. It shall not be possible to open these windows. The windows shall be in the upper portion of the walls, as high as possible.
- 2.8 Corners of transformer bases and cable ducts shall be cut off at an angle of 45° with the splay at least 100mm wide.
- 2.9 Cable entrance openings shall be at least 600mm wide x 500mm deep and level with the bottom of the cable trenches. Alternatively a separate sleeve for each cable and at least one spare sleeve, shall be provided.
- 2.10 Cable trenches shall be 600mm wide and 300mm deep unless specified to the contrary.
- 2.11 The floors of cable trenches shall have a fall of 1 : 100 to make provision for the natural draining of water.
- 2.12 At least one light with a switch adjacent to the entrance and one standard 16A 3-pin earth leakage protected socket outlet shall be provided in each room. The illumination level in the substations shall not be less than 200 lux. If a battery supply is available one incandescent light per substation room shall be connected to this supply and the switch in the circuit marked 'EMERGENCY' : 'GHT'/'NOODI G'.
- 2.13 The floors shall be floated to a smooth finish with a steel trowel.
- 2.14 Any one of the following interior wall finishes is acceptable.
 - (a) Plastered and painted white.
 - (b) Unpainted face brick (preferably light colour brick).
 - (c) Off shutter concrete painted white.

3. NOTICES

The following notices in both official languages shall be exhibited at all entrances to and suitable places within premises in which are situated generating plant and transforming, switching or linking apparatus:

A notice showing the 'Lightning' sign with the wording, Danger- ngozi-Gevaar.

- 3.1 A notice prohibiting unauthorised persons from entering such premises.
- 3.2 A notice prohibiting any unauthorised persons from handling or interfering with electrical apparatus.
- 3.3 A notice detailing procedure in case of fire.
- 3.4 A notice containing directions for resuscitation of persons suffering from the effects of electric shock.

4. HIGH VOLTAGE SWITCH ROOMS (ABOVE 1 KV)

- 4.1 The equipment shall be installed and secured to the floor in accordance with the manufacturer's specification.
- 4.2 Sufficient space shall be provided between the switchboard and the walls of the switch room to allow for the installation, maintenance and operation of the switchboard.
- 4.3 In the case of switchboards with uninsulated conductors accessible from the back, a clear space of at least 1,2 m shall be provided between the back and sides of the board and the wall.

- 4.4 In the case of switchboards which are of a totally enclosed construction the minimum clear space between the back and sides of the board and the wall shall be at least 900mm.
- 4.5 A space of at least 1,2 m shall be provided in front of a switchboard for operating and maintenance personnel. If the circuit breakers are of the withdrawable carriage type the space shall be at least 900 mm when the breaker carriages are in the fully withdrawn position.
- 4.6 The access door into the room shall be in front of the switchboard.
- 4.7 The tools and earthing and operating devices for the switchgear shall be contained in a purpose-made sheet metal cupboard secured to the wall of the substation.
- 4.8 A reconnection diagram displaying sufficient detail to be able to assess problems and trace faults (both on the HV and LV sides of the system) shall be mounted against a wall in the HV switch room behind clear plastic.

5. LOW VOLTAGE SWITCH ROOMS (BELOW 1 KV)

- 5.1 The equipment shall be installed and secured firmly to the floor or wall of the switch room.
- 5.2 Sufficient space shall be provided between the switchboard and the walls of the switch room to allow for the installation, maintenance and operation of the switchgear. In general this space shall be 900mm at the back and sides of the board and 1,2 m in front of the switchboard.
- 5.3 In the case of switchboards with uninsulated conductors which are exposed and accessible from the back a clear space of at least 1,2 m shall be provided at the back.
- 5.4 A LV reconnection diagram displaying sufficient detail of at least the main LV reconnection in order to be able to assess problems shall be mounted against a wall in the LV switch room behind clear plastic.

6. TRANSFORMER ROOMS OTHER THAN IN STANDARD BUILDINGS

- 6.1 Transformer rooms shall be large enough to accommodate the transformer with a 900mm clear space between the walls and the transformer. The minimum dimensions of a transformer room shall in any case be not less than 3,5m wide and 4,0m long.
- 6.2 The dimensions of the room shall be determined by using the transformer dimensions of TABLE 2 of SANS 790.
- 6.3 Where natural cross ventilation of the transformer room is not possible, adequate forced ventilation shall be provided to dispose of the transformer's losses and to prevent the air temperature in the transformer room from exceeding 40 °C.
- 6.4 The cable entrances to the transformer room shall be sealed off after the cables have been installed.

7. GENERATOR ROOMS OTHER THAN IN STANDARD BUILDINGS

- 7.1 The ventilation of generator rooms shall be sufficient to dispose of the heat radiated from the engine while delivering full power.
- 7.2 The heat from the radiator shall be released outside the building via a ventilator duct or an external heat exchanger.
- 7.3 The exhaust emission shall be released outside the building and shall comply with the local environmental control regulations.
- 7.4 The fuel storage tank shall be installed in compliance with SANS 10131 and the position shall be approved by the local Fire Department. When the storage tank must be located outdoors, it should be underground to insulate the fuel from severe temperature variations which may impede fuel flow.
- 7.5 An electrical schematic diagram indicating mains supply and change-over arrangement as well as all standby plant electrical control circuitry, shall be mounted on a wall behind clear plastic.

- 7.6 An emergency light with automatically rechargeable Nickel-Cadmium batteries shall be installed above the generator set to facilitate manual starting or fault tracing in the event that the set does not start during a power failure.

8. CABLES

- 8.1 Cables shall be installed in cable trenches which shall be provided for this purpose. The installation shall comply with the Department's standard specification for "INSTALLATION OF CABLES", par. 5 of Section B6.

- 8.2 Under normal circumstances cables shall not be installed directly on the floor.

9. COVERING AND SEALING OF CABLE TRENCHES

- 9.1 All the cable trenches shall be covered with steel chequer plate or a compound wood, bound with a water resistant binder, or an approved fibreglass grating. The following types of compound wood coverings are acceptable:

- (a) Five ply marine ply, 12 mm thick.
- (b) Exterior grade particle board, 22mm thick.
- (c) Tempered hardboard, 12,7mm thick.

- 9.2 The trench coverings shall be ridged and shall not sag more than 5 mm with two normal persons standing on one section.

- 9.3 The trench covering shall be in sections not exceeding 1,25 m.

- 9.4 The trench coverings shall be provided with holes or recessed handles to make it possible to remove and replace the covers easily.

- 9.5 The trench coverings shall be neatly cut where necessary to accommodate cables.

- 9.6 The covers shall overlap the trench on both sides and shall be recessed to fit flush with the surface of the floor.

- 9.7 The cable entrances in the trenches of the switch rooms, transformer rooms and generator rooms shall be closed and sealed after the cables have been installed to prevent the backfill material and water from entering the trenches in the building.

- 9.8 The cable entrances shall be closed with bricks, without mortar in such a way as to prevent the weight of the bricks from resting on the cables. These bricks shall be plastered on the inside with a 10:1 ratio of sand and cement.

- 9.9 If the cables enter the trenches via sleeves, these sleeves shall be plugged on both sides with weak mortar, an asbestos and cement mixture or a non-hardening compound.

SECTION B14**B.14 OVERHEAD ELECTRICAL TRANSMISSION LINES****1. GENERAL**

- 1.1 This section covers the supply, delivery, erection and commissioning of overhead transmission lines up to 22 kV on wooden poles.
- 1.2 An overhead line shall comprise the wooden poles, cross-arms, stays, conductors, insulators, isolators, fuse-links, transformers, lightning arrestors and any other auxiliary equipment specified.
- 1.3 All materials and fittings used shall be new and of high quality.
- 1.4 Overhead lines shall be erected in accordance with the "CODE OF PRACTICE FOR OVERHEAD POWER LINES FOR CONDITIONS PREVAILING IN SOUTH AFRICA", issued by the S.A. Institute of Electrical Engineers.

2. STATUTORY REQUIREMENTS

- 2.1 Occupational Health and Safety Act, (1993) Act 85 of 1993 and subsequent amendments and regulations issued thereunder.
- 2.2 The Post Office Act, No. 44 of 1958 and the Postmaster General's Requirements issued in terms of that Act
- 2.3 The Mines and Works Act, No. 27 of 1956 and subsequent amendments and regulations issued thereunder
- 2.4 The Electricity Act, (1994) Act 41 of 1994
- 2.5 The Fencing Act, No. 31 of 1953
- 2.6 The Forest Act, Article 34 of Act No. 72 of 1966.
- 2.7 The Advertising on Roads and Ribbon Development Act, No. 21 of 1940 and No. 18 of 1962.
- 2.8 The Air Navigation Regulations promulgated in terms of the Aviation Act, No. 74 of 1962
- 2.9 Explosives Act, No. 26 of 1958.
- 2.10 The South African Transport Services Safety Regulations

3. RELEVANT SANS SPECIFICATIONS

- 3.1 SANS 182 : Conductors for overhead electrical transmission lines.
PART 3 : Aluminium Conductors, Steel Reinforced.
- 3.2 SANS 60383 : Ceramic and glass insulators for overhead lines of nominal voltage greater than 1000V.
- 3.3 SANS 61284 : Non-current-carrying line fittings for overhead power lines.
- 3.4 SANS 755 : Wooden power transmission poles and cross-arms.
- 3.5 SANS 470 : Concrete poles for telegraph, telephone, power and lighting purposes (reinforced and prestressed types).
- 3.6 SANS 61643 : Low voltage lightning arresters

4. STANDARD DEPARTMENTAL SPECIFICATIONS

- 4.1 INSULATORS AND FITTINGS FOR OVERHEAD LINES, Section C38.
- 4.2 DISTRIBUTION TRANSFORMERS, Section C38.
- 4.3 INSTALLATION OF CABLES, par 3.13, Section B6.
- 4.4 EARTHING, Section B11.

5. NOTICES AND PRECAUTIONS

- 5.1 The Contractor shall issue all notices and make the necessary arrangements with Supply Authorities, the Postmaster General (TELKOM), Transnet, S.A. Transport Services, Provincial or National Road Authorities and other authorities as may be required with respect to the installation of overhead lines.
- 5.2 The Contractor shall take all the necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and/or employees are not endangered.
- 5.3 The Contractor shall acquaint himself with the position of all existing services and infrastructure prior to commencing the installation.
- 5.4 The Contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and will be responsible for the cost of repairs.

6. PEGGING THE ROUTE

- 6.1 The Contractor shall peg out the route for the overhead line but shall maintain close liaison with the Department's representative.
- 6.2 Should the proposed position of poles appear unsatisfactory due to obstructions, poor soil conditions, rock, etc. the Department's representative shall be consulted and a ruling obtained.
- 6.3 The Department reserves the right to alter the line route at any time prior to the installation of the overhead wires. Payment in respect of any additional or wasted work involved shall be at the documented rates.
- 6.4 The removal of obstructions along the route shall be subject to the approval of the Department.

7. LINE IMPULSE LEVEL

The line Basic Impulse Level (BIL) shall be maintained at the full voltage, namely:

Line Voltage (kV)	Impulse Voltage withstand level (kV)
Up to 6,6	75
11	95
22	150

8. LINE CONFIGURATION

- 8.1 Lines shall generally be configured as indicated in the drawings included in this specification, Fig. B14.1 - B14.7.
- 8.2 Alternate arrangements shall be submitted to the Department for approval.

9. POLES

- 9.1 The line configuration and support structure shall be suitable for the proposed route. Refer also to the Occupational Health and Safety Act.
- 9.2 Wooden poles shall normally be used and shall comply with SANS 753, Group strength 'A' and shall bear the SANS mark of approval.
- 9.3 Preservative of the poles shall comply with the requirements for Type A1 of SANS 1290 and the impregnation shall be carried out in accordance with SANS 10006 using the empty-cell pressure process.
- 9.4 Poles shall be LOCK TENSION banded at both ends.
- 9.5 Concrete poles where specified shall comply with SANS 470 and the Detail Technical Specification.
- 9.6 If the spacing of poles is not more than 80m specified in the Detail Technical Specification, poles for 11 kV and 22 kV lines shall be spaced not more than 80m apart and poles for LV lines shall be spaced not more than 45m apart. The spacing of LV lines in suburban areas shall be arranged to suit the requirements of city blocks and street lighting.
- 9.7 All the poles shall be installed with the marking tags facing the roadside where applicable or shall face in the same direction where a road does not exist alongside the overhead line.
- 9.8 The pole minimum dimensions listed in the table below shall be used. Poles not complying with these dimensions shall be removed from site.

Length (m)	Minimum top dia (mm)
9,0	160
10,2	160
12,0	160
13,0	160
16,0	200

- 9.9 Templates shall be used for drilling holes required to fix cross-arms, brackets, insulators, etc. to the poles. After drilling, the holes shall be coated with a mixture of creosote and tar.
- 9.10 The poles shall be planted at the following minimum depths.

Length	Planting depth (m)
9,0	1,7
10,0	1,8
12,0	2,0
13,0	2,2
16,0	2,6

- 9.11 Kicking blocks shall be provided where ground with poor bearing qualities is encountered.
- 9.12 Poles shall be planted vertically plumb and in line and sufficiently stayed to maintain that position.

10. CROSS-ARMS

- 10.1 Cross-arms shall be of wood. Steel cross-arms shall only be used when clearly specified in the Detail Technical Specification. Wooden cross-arms are preferred due to their higher electrical resistance and better lightning performance of the line.
- 10.2 Steel cross-arms where specified shall be manufactured from standard steel sections complying with BS 4363.

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- 10.3 Wooden cross-arms shall comply with SANS 753, Group Strength 'A' and shall be straight in grain. Preservatives shall comply with par. 9.2. above. The minimum diameter of cross-arms shall be as follows:

Length (m)	Diameter (mm)	
	min.	Max.
2,4	140	150
3,0	140	160
3,6	160	185
4,5	160	185

- 10.4 Cross-arms shall be LOOP TENSION bent at both ends.
- 10.5 Tie straps shall be manufactured of mild steel to Grade 43 of BS 4360.
- 10.6 Cross-arms shall be long enough to accommodate the insulator spacing specified below.
- 10.7 Cross-arms and tie straps shall be bolted to poles using galvanised bolts, nuts and washers. Curved wood pole washers shall be fitted between bolt heads and the poles and between cross-arms and the poles. Back straps and U-bolts may be used to attach wooden cross-arms to the poles.
- 10.8 Curved wood pole washers shall be galvanised malleable cast iron or mild steel with a minimum thickness of 3 mm and shall have a minimum square outside dimension of 63 mm.

11. INSULATORS AND FITTINGS

- 11.1 Insulators shall be chosen to provide the mechanical strength and insulation level required by the line at every point in accordance with the Department's standard specification for "INSULATORS AND FITTINGS FOR OVERHEAD LINES", Section C38.
- 11.2 Insulators shall be spaced to provide the conductor clearance required.
- 11.3 Pin insulators and their pins complying with SANS 60383 shall be used in straight line intermediate positions only.
- 11.4 Disc insulators shall be used in all strain, tension or angle positions. Clevis-and-tongue or ball-and-socket type insulators complying with SANS 60383 shall be used. Disc insulators may be of glass or porcelain.
- 11.5 Curved wood pole washers shall be fitted between the collars of insulator pins and the cross-arm or pole and between the pin nut and the cross-arm or the pole. The washers shall comply with par. 10.8 above.
- 11.6 Insulator hooks shall be of an approved pattern and shall be manufactured from BS 4360 grade 43 mild steel or forged.
- 11.7 Terminating and yoke straps shall be manufactured from BS 4360 grade 43 steel or forged to a design approved by the Department.
- 11.8 All steel or ironwork i.e. fittings, cross-arms, bolts, nuts, washers, etc., shall be hot dip galvanised to SANS 32 & 121.

12. CONDUCTORS

- 12.1 Steel reinforced aluminium conductors to SANS 162, Part 3 shall be used for overhead lines. Should copper conductors be specified, they shall comply with SANS 162, Part 1. The cross-sectional area shall comply with the Detail Technical Specification.

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- 12.2 The spacing between phase conductors shall be increased by 20 % over the spacing determined according to the formula in par 4.7.5 of the "Code of Practice for Overhead Power lines" to compensate for sag movement and other factors and to maintain the R.L.L. of par 7 above.

The minimum conductor spacing are :

Pole Spacing (m)	SUPPLY VOLTAGE		
	Up to 0.6 kV	11 kV	22 kV
	CONDUCTOR SPACING (mm)		
60	575	635	790
70	635	700	850
80	700	750	910
90	750	810	975

- 12.3 Manufacturer's stringing and tensioning charts shall be used to erect conductors. Conductors shall not be tensioned to more than 25 % of the breaking strength of the conductor at -5.5°C with no wind.
- 12.4 Conductor running blocks shall be installed on all pole positions to run out the conductors. Conductors shall not be dragged along the ground. The three conductors shall be tensioned simultaneously using suitably rated chain-ratchet pullers and 'come along' specially designed for the particular conductor.
- 12.5 The minimum conductor to ground clearances as stipulated in Occupational Health and Safety Act shall be closely observed. Allowance shall be made for conductor creepage and subsequent increased sag after a period.
- 12.6 Conductors shall be prestressed for not less than one hour before binding in.
- 12.7 Mid span joints shall be kept to a minimum and where unavoidable, shall be made with approved full tension line splices.
- 12.8 Conductor joints at non-tension points shall be made with two bolt parallel groove clamps of a type approved by the Department. The current carrying capacity of the clamps shall be at least equal to that of the conductor.

Non-oxidising conducting paste shall be liberally applied to the inside of these clamps.

- 12.9 Where aluminium to copper connections are made suitable copper clamps shall be used.

13. CONDUCTOR TERMINATIONS

- 13.1 Cold compression, bolted shail clamps or preformed terminations shall be used. Suitable thimble clamps shall be used with the preformed terminations.
- 13.2 The conductor shall be bound in at pin insulators by a single stirrup and binding. A chafar tape of soft aluminium shall be wrapped around the conductor at the insulator contact area. The conductor shall be bound to the stirrup for a distance of 50mm on either side of the insulator. 5mm diameter hard drawn aluminium wire shall be used for binding.
- 13.3 Suitably sized preformed wrap lock ties with pads may be used as an alternative method to par 13.2 above.
- 13.4 Trails and bridge wires must be neatly disposed and connected with clamps or line taps with a minimum of two per connection or by means of other approved mechanical connectors.

14. STAYS

- 14.1 The position of stays may or may not be indicated in the instructions for the service, but it is the responsibility of the Contractor to provide staying adequate to maintain correct tension of the line and the verticality of every pole in the line, with or without the additional use of kicking blocks as he may decide.
- 14.2 Wind stays must also be provided for straight lines in exposed positions. Struts shall not be used if this can be avoided by the use of aerial stays and piton stays.
- 14.3 Stay wires shall be spliced and bound in, in the accepted manner. Approved preformed materials may also be used.
- 14.4 The angle between the stay and the pole must be between 35° and 45°. The stay must be made off on the pole, as near as practicable to the point of resultant stress, with one and a half complete turns around the pole supported by a suitable clamp.
- 14.5 For terminal poles of vertical line arrangements, at least two stays shall be used to prevent deformation of the pole, with the stay plates buried at least 1,8 m apart.
- 14.6 Stay holes shall be vertical, not less than 1,5 m deep and no wider than necessary to accommodate the baseplate, with a narrow side channel cut to embed the rod at the correct angle.

The baseplate and portion of rod within the stay pole shall be firmly packed with hard material or concrete where necessary.
- 14.7 Stay plates shall be concreted into the ground with top and bottom kicking blocks where required by the nature of the soil.
- 14.8 Porcelain stay insulators shall be installed in one stay wire as high as possible above ground level but far enough away from the structure to ensure that the portion of the stay below the insulator does not become a live.
- 14.9 Stay wire shall be of galvanised steel and the individual steel strands shall have a breaking stress of not less than 695 MPa and shall comply with BS 163 or SANS 102, Part 5. Stay wire make-offs shall be painted with bituminous paint on completion.
- 14.10 Stay rods shall comply with BS Pattern 2 and shall be of circular section with tubular type turn buckles. Heavy duty construction, deep contoured type thimbles shall be used.
- 14.11 Galvanised steel stay plates shall be used.
- 14.12 Stay guards are required in the vicinity of public paths and roadways.

15. EARTHING OF STRUCTURES

- 15.1 Earthing requirements for service connections are specified in the Department's standard specification for "EARTHING", Section B11.
- 15.2 Protective overhead earth wires shall only be provided where specified in the Detail Technical Specification. In cases where overhead earth wires are specified, a low impedance earth as determined by the Basic Impulse Level of the line shall be provided at every pole along the line.
- 15.3 An earth connection is not required at every pole along a line with wooden poles and without overhead earth wires. Lines with metal poles shall be earthed at every pole.
- 15.4 Steelwork on wooden poles shall generally not be earthed except at structures for transformers, isolators, fuse-links, cable boxes, lightning arresters or other equipment which impairs the impulse flashover value of the insulation provided by the wooden structure.

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- 15.5 All metalwork to be earthed, shall be bonded together with 1 mm² bare copper conductors. These common bonds shall be connected to a 35mm² bare stranded or solid copper earth down lead conductor.
- 15.6 The connection between the overhead conductors and lightning arresters and between the arresters and the earth down lead shall consist of bare copper conductors of not less than 25mm². The connecting leads shall have smooth bones and shall follow the shortest possible route.
- 15.7 The earth down lead conductor shall be stapled to the pole at intervals not exceeding 1m. Where atmospheric corrosion is likely to cause galvanic action, staples shall be of non-ferrous metal and an earth clip used where possible.
- 15.8 The earth conductor shall be threaded through a black polyethylene sleeve for at least 2m above the ground.
- 15.9 The earth conductor shall not be installed in steel conduit nor shall the conductor be wrapped around the pole at any point since this will increase the resistance of the down lead.
- 15.10 A trench earth shall be installed at earthed structures carrying equipment such as transformers, fuse-links, lightning arresters, etc. extending 10 m on four sides of the structure in the form of a cross. The ends of the earth wires shall be bonded to four earth electrodes of at least 1.8m in length driven into the ground.
- 15.11 Intermediate earthing for overhead earth wires may consist of wrapping the earth wire 5 - 6 times around the pole below ground level.
- 15.12 The earth resistance shall be determined following the installation of the trench earth. Earth resistance values specified or required by protective devices shall be checked. The earth resistance values required to maintain the B.I.L. of the line as specified in par. 7 (assuming an average lightning current value of 25 kA), are as follows:

	Impulse Level (kV)	Earth Resistance (ohm)
Up to 6.6	75	3,0
11	95	3,8
22	150	5,0

- 15.13 Should the earth resistance be higher than specified or required, additional earthing shall be provided. Trench earths shall not exceed 50m. Proprietary clays may be used for soil treatment to improve the earth resistance.

16. EARTH WIRE ON LV SYSTEMS

- 16.1 Where specified, a continuous earth wire shall be installed along LV (up to 660 V) overhead lines in order to provide earth continuity between installations served by the line (ECC).
- 16.2 The earth wire shall be connected to every earth along the route in addition to the substation earth. Refer also to par. 4 of the Department's standard specification for 'EARTHING', Section B.11.
- 16.3 All metalwork and the top positions of stay wires shall be bonded to the earth wire.
- 16.4 The earth wire shall be above the conductors.

17. LIGHTNING ARRESTERS

- 17.1 Lightning arresters shall be of a type approved by the Department.
- 17.2 Lightning arresters shall be installed at all points where the steelwork has to be earthed and where specified.
- 17.3 The arresters shall be connected to the overhead conductors by 25mm² (minimum) copper conductors minimum and suitable parallel groove clamps.

- 17.4 Lightning arresters shall be placed on all the phase conductors at the following points in addition to those specified in the Detail Technical Specification:
- (a) As near as possible to the transformer terminals on the transformer side of the fused protection where applicable.
 - (b) At each termination of a cable on the overhead line.
 - (c) At every line sectionaliser or recloser.
 - (d) At each connection point to secondary lines.
- 17.5 Lightning arresters shall be mounted below the overhead conductors in order to reduce the length of the discharge path.
- 17.6 An earth shall be supplied and installed at each point where lightning arresters are installed in accordance with par. 15 above.

18. FUSE-LINKS

- 18.1 Fuse-links shall be of a type approved by the Department.
- 18.2 Details of fixing methods and mounting shall be submitted to the Department for approval.
- 18.3 Fuse-links shall be installed at all transformers and where specified.

19. TRANSFORMER MOUNTINGS

- 19.1 Transformers shall comply with the Department's standard specification for "DISTRIBUTION TRANSFORMERS", Section B36.
- 19.2 Transformers with a maximum power rating of 25kVA may be mounted on a single pole with the mounting brackets as specified in SANS 780.
- 19.3 Transformers with a power rating in excess of 25kVA and with a maximum of 200kVA shall be mounted on a platform between two poles.
- 19.4 The transformer platform for pole mounting shall consist of galvanneal steel channels bolted to the two poles. The platform shall be manufactured and installed in accordance with Fig B14.5 and B14.6.
- 19.5 All steelwork as well as the bolts, nuts and washers shall be galvanised to SANS 32 & 121.
- 19.6 An earth wire shall be installed against each pole of the structure and must extend for at least 500mm above the poles. These earth wires shall be bonded across at the top of the poles to shield the transformer.
- 19.7 Earthing in accordance with par. 15 shall be provided.

20. SUBSTATION EARTH

Substation earths and earths at transformers along the route intended for earth continuity connections to installations served by the line, shall be provided in accordance with the Department's standard specification for "EARTHING", Section B11.

21. ANTI-CLIMBING DEVICES

- 21.1 Anti-climbing devices shall be fitted to all poles carrying transformers or mechanically operated fuses or switchgear.

- 21.2 Galvanised barbed wire wound around the poles for at least 1m at a height of 2m above ground may be employed for this purpose.

22. CRADLES

Where HV overhead lines cross roadways, railways and other supply lines, important communication lines and where an HV line is run above an LV line, an earthed cradle shall be installed. The longitudinal wires of the cradle shall not be less than 7,2mm² and the cross-lacing not less than 4mm².

23. DANGER NOTICES (LIGHTNING SIGN)

Danger notices with the wording "DANGER-GEVAAŘ-INGOZI" shall be fitted to all structures with transformers, mechanically operated switchgear and fuses.

24. EXCAVATIONS

- 24.1 Excavations for poles, stays and trench earths shall remain open for as short a period as possible. The Contractor shall erect and maintain guards, warning notices and lights at open excavations and soil heaps.

- 24.2 Excavations shall be classified as follows -

Very hard rock shall mean rock that can only be excavated by means of explosives.

Hard rock shall mean granite, quartzitic sandstone, slate and rock of similar or greater hardness, solid shale and sculders in general requiring the use of jack hammers and other mechanical means of excavation.

Soft rock and earth shall mean rock and earth that can be loosened and removed by hand-pick and shovel.

- 24.3 After poles and stays have been planted the holes shall be backfilled and well compacted. Compaction shall be executed in layers of not more than 300mm to obtain a high compaction density.

- 24.4 The following dimensions shall be used when calculating the cubic capacity of excavations.

- (a) Pole holes: 1,2m x 0,5m x depth
- (b) Stay holes: 1,2m x 0,5m x 1,0m
- (c) Trench earths: 0,5m x 0,5m x length

- 24.5 Poles shall be installed in accordance with the Detail Technical Specification of the installation.

- 24.6 Poles shall not be installed in clayey soil or in swampy conditions without the necessary precautions to stabilise the installation.

- 24.7 If unsatisfactory conditions for the installation of poles and stays are encountered during the excavations, the Department shall be informed without delay in order to facilitate alteration of the foundation design or alteration of the route of the line.

- 24.8 Poles and stays shall be installed in undisturbed soil.

- 24.9 If wooden poles are installed in a concrete or other water retaining foundation, the pole shall protrude through the concrete to ensure adequate natural drainage to prevent rotting of the wooden pole in the foundation due to the accumulation of water between the pole and the foundation.

25. SAMPLES

Samples of equipment, materials and SANG Test Reports proposed for the installation shall be submitted to the Department on request.

SECTION B15

B.15 INSPECTIONS, TESTING, COMMISSIONING AND HANDING OVER

1. PHYSICAL INSPECTION PROCEDURE

- 1.1 Once the Contractor has completed the installation, written notice shall be given to the Department in order that a mutually acceptable date can be arranged for a joint inspection.
- 1.2 During the course of the inspection, the representative of the Department will compile a list of items (if any) requiring further attention. A copy of this list will be provided to the Contractor who will have a period of 7 days in which to rectify the offending items of the installation.
- 1.3 The Contractor shall then provide written notice that he is ready for an inspection of the remedial work to the offending items.
- 1.4 This procedure will continue until the entire installation has been correctly completed to the satisfaction of the Department.

2. TESTING AND OPERATIONAL INSPECTION PROCEDURE

- 2.1 In addition to the above the Contractor shall have the complete installation tested and approved by the local authorities where applicable.
- 2.2 Subsequent to the above testing and approval, the Contractor shall in the presence of the representative of the Department test all circuits with respect to:
 - (a) Phase balance.
 - (b) Insulation level.
 - (c) Polarity.
- 2.3 Upon completion of the installation and within 3 months of the handover date, the Contractor shall provide and make available a recording voltmeter to record the voltage at three locations in the complex over a period of 48 hours each. These locations will be nominated by the Department.

3. "AS BUILT" DRAWINGS

- 3.1 As each portion of the work is completed, the Contractor shall provide the Department with as-built drawings showing the exact location measured from fixed points of all cables, transmission lines, earth outlet point, etc.
- 3.2 In addition a complete reticulation diagram showing all supply cables and switchboards shall be provided behind a plastic cover in the substation or adjacent to the Main Switchboard if not located in a substation.
- 3.3 The installation will not be regarded as complete until all of the above requirements listed in 1, 2 and 3 above have been met.



public works

Department:
Public Works
REPUBLIC OF SOUTH AFRICA

**STANDARD
ELECTRICAL SPECIFICATION**

**SECTION C: QUALITY SPECIFICATIONS
FOR MATERIALS AND EQUIPMENT OF ELECTRICAL
INSTALLATIONS**

SEPTEMBER 2005

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SECTION C.1**C.1 CONDUIT AND CONDUIT ACCESSORIES****1. GENERAL**

This section covers the requirements for conduit and conduit accessories for general installations under normal environmental conditions.

The type of conduit and accessories required for the service, i.e. whether the conduit and accessories shall be of the screwed type, plain-end type or of the non-metallic type and whether metallic conduit shall be black enamelled or galvanised, is specified in Part 2 of this specification. Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the applicable SANS Specifications as set out below and the conduit shall bear the mark of approval of the South African National Standards.

- (a) Screwed metallic conduit and accessories: SANS 1065 parts 1 and 2.
- (b) Plain-end metallic conduit and accessories: SANS 1065 Parts 1 and 2.
- (c) Non metallic conduit and accessories: SANS 950

Bushes used for metallic conduit shall be brass and shall be provided in addition to lock nuts at all points where the conduit terminates at switchboards, switch-boxes, draw-boxes, etc.

Only one manufacture of conduit and conduit accessories will be permitted throughout the installation.

All metallic conduits shall be manufactured of mild steel with a minimum thickness of 1,2mm for plain-end conduit and 1,6mm in respect of screwed conduit.

2. SCREWED CONDUIT

- 2.1 Conduits shall comply with SANS 1065 and shall bear the SANS mark.
- 2.2 All conduit shall be heavy gauge, welded or solid drawn, hot-dip galvanised or black enamelled, screwed tube.
- 2.3 Galvanised conduit shall be hot-dipped inside and outside in accordance with SANS 32 & 121.
- 2.4 All conduit ends shall be reamed and threaded on both sides and delivered with a coupling at one end and a plastic cap on the other end.

3. METAL CONDUIT ACCESSORIES

All metal conduit accessories shall be of malleable cast iron or pressed steel with brass bushes in accordance with SANS 1065. Alloy or pressure cast metal accessories or zinc base alloy fittings are not acceptable. All fittings whether galvanised or black enamelled, shall be fitted with brass screws.

4. CIRCULAR TYPE BOXES

- 4.1 The boxes shall be of the long spout pattern, manufactured of malleable cast iron or pressed steel and shall be enamelled jet black or galvanised as required. The two cover fixing holes shall be diametrically opposite each other, drilled and tapped at 50mm centres.
- 4.2 Junction, draw-in and inspection boxes shall be of adequate size and shall be supplied with heavy gauge metal cover plates.
- 4.3 Boxes shall comply with SANS 1065.

5. SWITCH BOXES AND SOCKET OUTLET BOXES

- 5.1 All switch boxes and socket outlet boxes shall be manufactured of pressed galvanised steel of at least 1mm thickness. All boxes shall be fitted with the necessary lugs to suit standard flush mounted switches and socket outlets manufactured in accordance with SANS 1085.
- 5.2 Light switch boxes shall be 100 x 50 x 50mm with two 20mm knockouts on the sides, one 20mm knockout on the top, bottom, side and back.
- 5.3 Socket outlet boxes shall be 100 x 100 x 50mm with two 20mm knockouts each on the top, bottom sides and back.
- 5.4 Switch and socket outlet cover plates shall comply with SANS 1094.

6. FLEXIBLE CONDUIT

Flexible steel conduit and adaptors shall comply with BS 701, part 1 where applicable. Flexible conduit shall be of galvanised steel construction and in camp areas of the plastic sheathed galvanised steel type. Flexible conduit shall only be used as specified and shall then be installed in accordance with par. 5.4.4 of SANS 10142.

7. PLAIN-END METALLIC CONDUIT

- 7.1 As an alternative to the threaded conduit, plain-end (unthreaded) metallic conduit with accessories may be used under the conditions stated in the Department's standard specification for "INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES", par. 3 of Section B1.
- 7.2 Unthreaded conduit shall be manufactured of mild steel with a minimum thickness of 1,2mm and shall comply with SANS 1065.
- 7.3 Bending and setting of conduit shall be done with the correct apparatus recommended by the manufacturer of the conduit.
- 7.4 The Contractor or Supplier shall be responsible for obtaining the approval of local authorities for the use of this system.
- 7.5 All conduit and accessories used in areas within 50 km of the coast shall be hot-dip galvanised to SANS 32 & 1211 in and areas electro-galvanised or cadmium-plated accessories will be accepted.

8. NON-METALLIC CONDUIT

Non-metallic conduit shall comply fully with SANS 950 and shall be installed in accordance with Appendix C of the same specification as well as the Department's standard specification for "INSTALLATION AND TERMINATION OF CONDUITS AND CONDUIT ACCESSORIES" par. 4 of Section B1.

9. EARTH CLAMPS

Earth clamps shall consist of copper strips at least 1,2mm thick and not less than 12mm wide secured with a brass bolt, nut and washer and shall be so constructed that the clamp fit freely in the conduit without any additional packing.

SECTION C.2**C.2 WIRING CHANNELS, UNDERFLOOR DUCTING AND POWER SKIRTING****1. WIRING CHANNELS****1.1 GENERAL**

1.1.1 The channels shall be manufactured of rolled sheet steel.

1.1.2 The minimum thickness of the sheet steel shall be:

- (a) 1,5mm for ribbed channels with a maximum width of 42mm,
- (b) 2,0mm for unribbed channels with a maximum width of 42mm
- (c) 1,2mm for channels with a width in excess of 42mm.

1.1.3 The channels shall be finished as follows.

(a) In coastal areas (under all installation conditions)	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated
(b) Cast in concrete	Pre-galvanised
(c) False ceiling voids	Pre-galvanised
(d) Vertical building ducts coated	Hot-dip galvanised to SANS 32 & 121 or epoxy powder
(e) Surface mounted in plant rooms, substations, service tunnels, basements	Epoxy powder coated or electro galvanised
(f) Damp areas, exposed to weather underground runs in contact with earth	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated
(g) Undercover industrial applications	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated

1.1.4 The above-mentioned finishes shall apply unless specified to the contrary or approved - by the Department. Hot-dip galvanised ducts shall be cold galvanised at all joints, sections that have been cut and at places where the galvanising has been damaged. Powder coated ducts shall likewise be touched up at joints, cuts and damaged portions using methods recommended by the manufacturer of the channels.

1.2 COVER PLATES

1.2.1 All channels shall be supplied with cover plates.

1.2.2 Channels up to 127mm wide shall have snap-in cover plates of metal or PVC.

1.2.3 For channels wider than 127mm only metal cover plates shall be used.

1.2.4 The finish of steel cover plates shall be the same as the finish of the channels.

1.3 ACCESSORIES

All accessories i.e. hangers, brackets etc. shall be purpose made and in general have the same finish as the channels.

1.4 WIRING SUPPORTS

Wiring supports shall be provided in order to prevent the wires 'slinging out' when cover plates are removed.

2. UNDERFLOOR DUCTING

2.1 GENERAL

- 2.1.1 The ducting shall be manufactured of 2mm thick rolled sheet steel or rectangular tubing. Galvanised steel shall be used or shall be epoxy coated after manufacture.

2.2 OUTLETS

- 2.2.1 Outlets shall be provided on a modular basis in the ducting to accommodate pedestal or recessed socket units. Tapped holes shall be provided to fix the pedestal units to the ducting.
- 2.2.2 Draw boxes at junctions of perpendicular ducts shall have removable barriers for wiring and shall be provided with a heavy gauge cover plate.

2.3 PEDESTALS

- 2.3.1 Pedestals shall be manufactured of die-cast aluminium or pressed steel.
- 2.3.2 The finish of pedestals shall be epoxy powder coating of an approved colour.

3. POWER SKIRTING

3.1 GENERAL

- 3.1.1 The channel and cover shall be manufactured of 1mm thick rolled sheet steel.
- 3.1.2 The channel and cover shall be epoxy coated after manufacture.

3.2 OUTLETS

- 3.2.1 Outlets pre-punched on a modular basis shall be provided to accommodate socket outlets or future socket outlets.
- 3.2.2 In addition to standard lengths, covers of 250mm length shall be provided for installation on building module lines

SECTION C.3**C.3 CABLE TRAYS AND LADDERS****1. METAL CABLE TRAYS**

Metal cable trays shall be manufactured from perforated rolled steel. Metal trays manufactured to the following standards shall be used.

(a) Less than 150mm wide	1,2mm minimum thickness with 12mm minimum return
(b) 160mm to 457mm	1,2mm minimum thickness with 19mm minimum return
(c) 460mm to 510mm (Heavy duty)	2,5mm minimum thickness with 26mm return

2. CABLE LADDERS

- 2.1 Metal cable ladders shall consist of a 76mm high side rail of 2mm minimum thickness. Cross pieces shall be spaced at maximum intervals of 250mm. Where cables of 10mm² or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm. Cables shall be clamped in position by means of purpose-made cable clamps that fit into the cross pieces.
- 2.2 Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring upon the prior approval of the Department.
- 2.3 Purpose-made cable trays consisting of 8mm angle iron and 5 x 40mm minimum cross pieces are acceptable in industrial applications. Cross pieces shall be welded in pairs at 250mm maximum centre-to-centre intervals. The pairs shall be spaced approx. 10mm apart to allow cable clamps or metallic binding bands to affix the cables to the tray.

3. PLASTIC CABLE TRAYS

Rigid un-plasticised PVC cable trays complying with the following standards may be used if specified in the Detail Technical Specification:

The up stands of trays listed in (a) and (b) shall not be perforated and the top of the up stand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

4. FINISHES

Metal cable trays and ladders shall be finished as follows:

(a) In coastal areas	Hot-dip galvanised to SANS 32 & 121 or epoxy powder coated
(b) False ceiling voids	Electro-galvanised baked enamel powder coated
(c) Vertical building ducts	Hot dip galvanised to SANS 32 & 121 or baked enamel epoxy powder coated
(d) Plant rooms, substations, service tunnels	Electro-galvanised baked enamel or less than 10% epoxy powder coated
(e) Damaged areas, exposed to weather	Hot dip galvanised to SANS 32 & 121 baked enamel or epoxy powder coated
(f) Undercover industrial application	Hot-dip galvanised to SANS 32 & 121 or baked enamel epoxy powder coated

SECTION C.3

The above-mentioned finishes shall apply unless specified to the contrary in the Detail Technical Specification. Hot-dip galvanised trays and ladders shall be cold galvanised at all joints, sections that have been cut and at places where the galvanising has been damaged. Powder coated or enamel painted trays and ladders shall likewise be touched up at joints, cuts and damaged portions using spray canisters recommended by the manufacturer of the trays and ladders.

5. ACCESSORIES

Horizontal and vertical bends, T-junctions and cross connections shall be supplied by the Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected. The radius of all bends shall be 1m minimum. The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall be 45° mitred.

SECTION C.4

C.4 PVC-INSULATED CABLES 600/1 000 V GRADE

1. GENERAL

This section covers the requirements for PVC-insulated cables for general installations under normal environmental conditions.

2. CONSTRUCTION

- 2.1 Cables shall be manufactured in accordance with SANS 1507, shall come only from fresh stocks, and shall be constructed as follows.
- (a) Unarmoured cables PVC-insulated/PVC-sheathed
 - (b) Armoured cables PVC-insulated/PVC-bedded/armoured/black extruded PVC outer sheath
 - (c) Single core cables PVC insulated/unsheathed
- 2.2 The conductors shall be of high conductivity annealed stranded copper and the cores may be shaped or circular.
- 2.3 The insulation shall be general purpose PVC, 600/1 000V Grade.
- 2.4 The bedding shall consist of a continuous impermeable sheath of PVC extruded to fit the core or cores closely and in the case of multi-core cables, to fill the interspaces between the cores.
- 2.5 Where armouring is specified it shall consist of one layer of galvanised steel wire in the case of multi-core cables and nonmagnetic metallic wire in the case of single core cables. Aluminium strip or tape armouring is not acceptable.
- 2.6 Where specified, an earth continuity conductor shall be provided in the armouring in accordance with SANS 1507.

3. PVC-SHEATHED ALUMINIUM-COVERED CABLES

- 3.1 Aluminium-covered cables shall comprise PVC-insulated copper conductors protected by an aluminium foil tape screen and a PVC sheath.
- 3.2 Cable ends shall be made off with compression glands fitted with a neoprene ring to seal the end.
- 3.3 Aluminium sheathed cable shall be installed on surface only using matching saddles installed at suitable intervals to prevent sagging.
- 3.3 Where exposed to sunlight, the cable shall have a stabilised black outer sheath.

4. LENGTHS

Cable shall be manufactured and supplied in one length to the lengths specified unless these lengths exceed a standard drum length in which case a ruling shall be obtained from the Department.

5. TESTS

At the option of the Department, acceptance tests shall be carried out on production runs of the cable in accordance with SANS 1507.

SECTION C5**C.5 GLANDS FOR PVC-INSULATED CABLES**

1. Glands to be used for terminating PVC/PVC/SWA/PVC cables shall be of the adjustable type.
2. Glands shall be suitable for general purpose 600/1 000 V Grade cable with steel armoring.
3. The glands shall be made of nickel-plated titanium plated or in coastal area bronze or brass.
4. The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass or a heavy galvanised steel nutrod screwed into the other end. The galvanising shall comply with SANS 32 & 121.
5. Non-watertight glands must be easily converted to watertight glands by means of a waterproofing shroud and inner seal kit. On the cable entry side of the barrel a concave groove shall be provided to accommodate the top rim of the waterproofing shroud.
6. The shrouds shall be made of non-deteriorating neoprene or other synthetic rubber, and shall be resistant to water, oil and sunlight. The shrouds shall fit tightly around the glands and cable.
7. Glands shall be provided with ISO threads and shall be suitable for the specified cable sizes.
8. Flameproof glands shall comply with SANS 208, Groups 1, 2a and 2b.
9. Suitable accessories shall be provided with glands to be used on ECC armoured cables to facilitate a bolted lug connection of the earth continuity conductors. Grooves cut into the barrel or cone bush to accommodate the earth continuity conductors are not acceptable.
10. For unarmoured cables the cone bush and compression ring of the gland shall be replaced with a synthetic rubber compression bush and ring to provide the required grip on the outer sheath of the cable.

SECTION C.6**C.6 CABLE TERMINATIONS AND JOINTS****1. HEAT-SHRINKABLE MATERIALS****1.1 GENERAL**

- 1.1.1 Heat-shrinkable materials may only be used in exceptional circumstances with the written permission of the Department.
- 1.1.2 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.
- 1.1.3 An illustrated set of instructions for the installation of the materials shall accompany every kit.
- 1.1.4 The joints and 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 onto the termination or joint is preferred above other methods.
- 1.1.5 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.
- 1.1.6 The heat-shrinkable and other materials used for the terminations and joints shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

1.2 TERMINATIONS WITH HEAT-SHRINKABLE MATERIALS

- 1.2.1 Terminations shall be made of a material that gives lasting protection against ultraviolet radiation.
- 1.2.2 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 shrink-on protective layer against surface tracking, ultraviolet radiation and weathering.
- 1.2.3 Outdoor terminations shall be designed to prevent flashover under wet or contaminated conditions and to ensure additional mechanical strength. This shall be achieved with shrink-on insulating spacers and rain shields.

1.3 JOINTS WITH HEAT-SHRINKABLE MATERIALS

- 1.3.1 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.
- 1.3.2 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.

2. RESIN FILLED JOINTS

- 2.1 The resin filled joint kit shall comprise a self-sealing plastic mould of high mechanical strength having sufficient connector space.
- 2.2 The exact amount of cold hardening resin shall be provided in a two compartment plastic bag.
- 2.3 The resin shall have absolute minimum shrinkage.
- 2.4 The mould and resin shall be completely waterproof and non-hygroscopic and shall be resistant to ultraviolet radiation.
- 2.5 Joint kits shall be of "SCOTCH-CAST", "CFI-PACK" or similar.

3. CABLE JOINTS BOX

- 3.1 Cable joint boxes shall be manufactured of die cast aluminum material for normal conditions or glass fibre reinforced thermosetting compound where exposed to corrosive conditions.
- 3.2 The lid shall provide an absolute moisture barrier.
- 3.3 Boxes shall contain 2, 3 or 4 entries as required.
- 3.4 Unused entries shall be sealed with watertight blanking plugs.
- 3.5 Earth continuity shall be maintained through the box by means of the material of the box in the case of aluminium boxes or by means of earth straps and studs in the case of glass fibre reinforced boxes.

SECTION C.7**C.7 PAPER-INSULATED CABLES****1. GENERAL**

This section covers the requirements for paper-insulated cables for general installations under normal environmental conditions.

2. CONSTRUCTION

- 2.1 Cables shall be manufactured in accordance with SANS 97 and shall come only from fresh stocks.
- 2.2 The cable construction shall be impregnated paper-insulated/lead or lead alloy E sheathed/PVC padding/galvanised steel wire armoured/outer PVC sheath.
- 2.3 The conductors shall be of high conductivity, annealed, stranded copper that may be shaped or circular.
- 2.4 The conductor insulation shall consist of impregnated paper tapes either pre-impregnated or mass impregnated with a non-drawing compound.
- 2.5 The sheath shall be lead or lead alloy E. The cable shall be sheathed with watertight extruded black PVC to eliminate electrolytic corrosion of the cable. Abbreviation for this type is PLSTC or PEETC.
- 2.6 Armouring shall consist of galvanised steel wire. It should be noted that a cable with wire armour has a much higher fault rating than a cable with tape armour and that in vertical installations only wire armour shall be used.
- 2.7 The cable insulation shall be suitable for the supply voltage specified and the cable must be suitable for a system with an unearthed neutral.

3. LENGTHS

Cable shall be manufactured and supplied in one length to the lengths specified unless these lengths exceed the standard drum length.

4. TESTS

Tests shall be carried out on production runs of the cable in accordance with SANS 97.

SECTION C8**C.8 CABLE END BOXES AND COMPOUND****1. CABLE END BOXES**

- 1.1 Cable end boxes shall be suitable to accept PLSTB, PLSTC, PE51B and PE5TC cables.
- 1.2 The cable end boxes shall be of the metal clad type suitable for indoor or outdoor use as required for the specific application.

Only inverted type boxes shall be supplied for outdoor use. The insulators of the inverted type boxes are angled downwards.
- 1.3 The boxes shall be equipped with armour clamps and brass or gunmetal control wiring glands.
- 1.4 All cable end boxes shall comply with BS 542.
- 1.5 The cable boxes shall be suitable for filling with bituminous, cold filling compound or resin oil semi-fluid compound.
- 1.6 The cable boxes for resin oil semi-fluid compound shall be equipped with a sight glass for compound level indication.

2. CABLE END BOX FILLING COMPOUND

- 2.1 Bituminous Compound
 - 2.1.1 The compound shall be suitable for filling metal clad cable end boxes.
 - 2.1.2 The compound shall comply with BS 1858, shall be non-hygroscopic and shall have a high dielectric strength and insulation resistance.
 - 2.1.3 The compound shall have good adhesive properties and shall not be susceptible to cracking.
 - 2.1.4 The compound shall be suitable for use in high ambient temperatures and system voltages of up to 22kV nominal.
- 2.2 Resin Oil Semi-fluid Compound
 - 2.2.1 The compound shall be suitable for filling metal clad cable end boxes with level indicators.
 - 2.2.2 The compound shall have a pouring temperature above 100°C.
 - 2.2.3 The compound shall be non-hygroscopic and shall have a high dielectric strength and insulation resistance.
 - 2.2.4 The compound shall have minimal contraction when cooling.
 - 2.2.5 Specification "HENLEY COMPOUND NO. 5701B, INSULOL DE" conforms to this specification.

3. QUANTITY

An adequate quantity of compound shall be supplied to fill each cable end box. The supply of the compound is included in the contract. The compound level shall be checked after approximately 6 months and topped up.

SECTION C.9**C.9 WIRING TERMINALS**

1. Terminal bodies and screws shall be of non-corrosive metal, enclosed in fire resistant, moulded plastic insulating bodies. Terminal bodies or screws shall not project beyond the insulating material and shall afford suitable protection against accidental contact by personnel and against short circuits and tracking.
2. The construction of the terminal block and mounting rail shall be such as to ensure a firm and positive location of the terminal blocks. It shall be possible to add additional terminal blocks within the terminal sequence without having to disconnect or dismantle the terminal strip. The terminal blocks shall be held in position by means of standard end clamps.
3. It shall be possible to intermix terminals of various sizes, i.e. for different sizes of conductors, whilst utilising the same mounting rail. Where smaller terminal blocks occur adjacent to larger terminal blocks, suitable shielding barriers shall be inserted to cover the terminals that might otherwise be exposed.
4. The terminal bodies and clamping screws shall be so constructed as to ensure that conductors are not nicked or scored when the clamping screws are tightened. Screws shall not come in direct contact with the conductors.
5. Terminals shall be sized and rated to match the conductors that are connected to them.
6. Each terminal block shall have provision for clip-in numbering or labelling strips to be installed, together with protective, clear caps over the sheets.

SECTION C.10**C.10 LIGHT SWITCHES****1. GENERAL**

This section covers the requirements for switches for use in general installations under normal environmental conditions.

2. FLUSH AND SURFACE MOUNTED SWITCHES

- 2.1 All switches shall be suitable for mounting in 100 x 50 x 50mm boxes shall comply with SANS 1663 and shall bear the SANS mark.
- 2.2 Switches shall be of lumbar operated microgap type rated at 16A, 220/250V.
- 2.3 Switches shall have protected terminals for safe wiring.
- 2.4 Contacts shall be of silver material.
- 2.5 On multi-lever switches, it shall be possible to individually change any of its switches.
- 2.6 The yoke strip shall be slotted to allow for easy alignment.
- 2.7 The covers of surface mounted switches shall have toggle protectors.
- 2.8 Where light switches are installed in partitions, they shall, where possible, be of the special narrow type intended for installation into the mullions.

3. WATERTIGHT SWITCHES

- 3.1 Watertight switches shall be of the microgap type suitable for surface mounting and shall bear the SANS mark.
- 3.2 The housing shall be of galvanised cast iron or die cast aluminium with watertight cover plate and toggle.
- 3.3 The switch shall have a porcelain base and a quick acting spring mechanism and shall be rated at 16A, 220/250V.
- 3.4 The ON/OFF position shall be clearly marked on the switch housing.

4. CEILING SWITCHES

- 4.1 Ceiling switches shall be rated at 16A, 220/250V and shall be suitable for ceiling mounting on a round conduit box.
- 4.2 The switch shall be made of high impact strength nylon material.
- 4.3 Adequate space shall be provided within the unit for ease of wiring.
- 4.4 The switch colour shall be white and shall be fitted with a nylon cord 1.25m long.

5. COVER PLATES

- 5.1 Cover plates shall be finished in ivory coloured baked enamel, anodised bronze or aluminium unless otherwise specified.
- 5.2 Cover plates shall overlap the outlet to cover wall imperfections.
- 5.3 Cover plates shall comply with SANS 1024.

SECTION C11**C 11 UNSWITCHED AND SWITCHED SOCKET-OUTLETS****1. GENERAL**

This section covers the requirements for unswitched and switched socket-outlets for use in general installations under normal environmental conditions.

2. FLUSH AND SURFACE MOUNTED SWITCHED SOCKETS

- 2.1 All switched socket-outlets shall be suitable for mounting in 100 x 100 x 50mm or 100 x 50 x 50mm boxes, shall comply with SANS 164.
- 2.2 Switches shall be of the lumbar operated microswitch type rated at 16A, 220/250V.
- 2.3 Terminals shall be enclosed for safe wiring.
- 2.4 Contacts shall be of silver material.
- 2.5 Safety shutters shall be provided on live and neutral openings.
- 2.6 The yoke strap shall be slotted to allow for easy alignment.
- 2.7 The covers of surface mounted switched socket shall have legible protectors.
- 2.8 Miniature circuit-breakers shall be used in lieu of a switch where specified.
- 2.9 Where 13A 110V switched socket-outlets are specified, these shall comply with BS 1363.

3. WATERTIGHT SWITCHED SOCKETS

- 3.1 The housing of watertight switched sockets shall be of galvanized cast iron or die cast aluminium with watertight machined joints.
- 3.2 The switch shall have a porcelain base and a quick-acting spring mechanism and shall be rated at 16A, 220/250V.
- 3.3 The ON/OFF positions shall be clearly marked on the switch housing.
- 3.4 The socket openings shall be rendered watertight by means of a gasketed cover plate which is screwed onto the body of the unit. The cover plate shall be secured to the body of the unit by means of a chain.

4. UNSWITCHED SOCKET-OUTLETS

- 4.1 Unswitched socket-outlets shall only be used in the case of 5A, 220/250V, 3-pin socket-outlets intended for the connection of recessed light fittings installed in false ceilings.
- 4.2 The socket-outlets shall have shuttered live and neutral openings.
- 4.3 The socket-outlets shall be suitable for installation in pre-punched wiring channels, deep round conduit boxes, 100 x 50 x 50mm or 100 x 100 x 50mm boxes.

5. THREE-PHASE SWITCHED SOCKET-OUTLETS

- 5.1 Three-phase switched socket-outlets shall have 5 pins, one for each phase, neutral and earth. The current rating shall be as specified in the Detail Technical Specification.
- 5.2 The units shall be interlocked to prevent switching on if the plug top is not installed.
- 5.3 The units shall be supplied complete with plug top.

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5.4 The live terminals shall be shrouded and shall be completely safe when the plug top is removed.

5.5 Samples shall be submitted to the Department for approval prior to the installation.

6. SHAVER SOCKETS

6.1 Shaver sockets shall comprise a double wound isolating transformer rated at 20 VA.

6.2 A three hole system shall be provided to provide for 115 V or 230V systems and also to cater for various types of shaver plugs.

6.3 Insertion of a shaver plug shall automatically switch on the unit by energising the primary side of the isolating transformer. Removal shall switch it off.

6.4 The unit shall be protected against overload by a thermal overload device.

6.5 The unit shall comply with BS 3052.

SECTION C12**C.12 LUMINAIRES FOR INTERIOR AND EXTERIOR APPLICATIONS****C.12.1 TUBULAR FLUORESCENT LAMP LUMINAIRES FOR INTERIOR APPLICATIONS****1. SCOPE**

This specification covers the requirements for fluorescent luminaires using tubular fluorescent lamps for general indoor use. The types of luminaires covered are open-channel, industrial, decorative and recessed types and includes luminaires with one or more lamps with standard wattage ratings as specified in the project specification. Luminaires for use in special applications or atmospheres are not included in this specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications or technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South African National Standards shall apply to this luminaire specification:

3.1	SANS 1119	Interior luminaires for fluorescent lamps.
3.2	SANS 1250	Capacitors for use with fluorescent and other discharge lamp ballasts.
3.3	SANS 690	Ballasts for fluorescent lamps
3.4	SANS 1464	Safety of luminaires.
3.5	SANS 1479	Glow starters for fluorescent lamps.
3.6	IEC 400	Lamp holders for tubular fluorescent lamps.
3.7	SANS 1041	Tubular fluorescent lamps for general service.
3.8	SANS VC 8031	Coatings applied by the powder-coating process.
3.9	SANS 783	Baked enamels.
3.10	SANS 10142	The wiring of Premises

Any standard referred to in the above specifications.

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for standard indoor use in buildings under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting in or against ceilings as described in the project specification.

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- 4.3 ENVIRONMENTAL: Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +26°C.
- 4.4 SAFETY: The luminaire shall bear the SANS 1464 safety mark.
- 4.5 NOISE: Movable ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of SANS 890, Part 1.

5. GENERAL TECHNICAL REQUIREMENTS

6.1 GENERAL

- 5.1.1 Tubular fluorescent lamp luminaires shall comply fully with SANS 1119 and all amendments as well as the additional requirements of this specification. Luminaires shall bear the SANS mark, or at least have a SANS Certificate of Compliance.
- 5.1.2 The Department reserves the right to have samples of luminaires offered tested by the SANS for compliance with SANS 1119. If a sample luminaire is found not to comply with SANS 1119 the cost of such tests shall be borne by the Tenderer.

6.2 CONSTRUCTION

- 5.2.1 A luminaire shall consist of a ventilated body manufactured of cold rolled sheet steel not less than 0,8mm thick, suitably braced or stiffened to prevent distortion. The body shall be of sufficient strength for the mounting of the entire luminaire.
- 5.2.2 The luminaire shall be designed to accommodate the control gear, wiring, lamp holders and, where applicable, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.
- 5.2.3 Except for mounting holes and/or slots and the required openings in air-return luminaires, the back of the body channel shall be closed over the full length of the luminaire.
- 5.2.4 Suitable knockouts shall be provided in the rear of the luminaire body for wire entry.
- 5.2.5 All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.

6.3 INTERNAL WIRING

- 5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.
- 5.3.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.
- 5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 5.3.5 An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

6.4 LAMP HOLDERS

Lamp holders shall preferably be of the telescopic spring-loaded type. Where twist-lock type lamp holders are provided, the mounting of the holders shall be able to accommodate the tolerances experienced in the length of lamps and in the manufacture of luminaires.

5.5 CONTROL GEAR

- 5.5.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted. All luminaires shall operate on a switch-start basis.
- 5.5.2 Ballasts shall comply with SANS 890 and SANS 891, suitable for operation on 220V to 250V, 50Hz supplies.
- 5.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in paragraph 3.5 of SANS 1119 are not exceeded.
- 5.5.4 Starters shall comply with SANS 1479 or with BS 3772 if it is not covered by SANS 1479. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.
- 5.5.5 Starters shall be accessible from the outside of the luminaire, and the replacement of the starter shall not necessitate the removal of lamps.

5.6 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0.65.

5.7 LAMPS

- 5.7.1 Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with SANS 1041.
- 5.7.2 If no colour is specified in the Detail Technical Specification, the light colour shall correspond to colour 2 (< 300K) of SANS 1041.
- 5.7.3 Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.
- 5.7.4 There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost to the Department.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

8. CHANNEL LUMINAIRE

- 8.1 Channel luminaires shall consist of a ventilated, enclosed channel body with one or more lamps as specified in the project specification. The channel body shall house the ballast, capacitor, terminals and internal wiring.
- 8.2 Provision shall be made for the addition of reflector wings and/or diffusers.
- 8.3 Three sets of mounting slots and knock-outs suitable for mounting onto standard round conduit boxes and/or 20mm diameter conduit per cent rods, shall be provided in the rear of the channel, one in the centre and one approximately one sixth from each end.
- 8.4 A knockout suitable for a 20mm diameter conduit entry shall be provided at each end of the channel. The distance between the back of the luminaire and centre of the knockout shall be approximately 20mm.
- 8.5 The knockouts shall be positioned on the centre line of the channel.
- 8.6 The body channel shall incorporate a removable cover acting as a reflector manufactured of cold rolled steel, not less than 0.8mm thick, designed and mounted to completely cover the interior of the

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body channel and its contents and extending over the full length of the luminaire as to the lamp holders.

- 8.7 The reflector shall be firmly held in position with a latching device consisting of knurled, coin slot captive screws. Plastic, used as a spring mechanism, is not acceptable as a fixing device for reflectors. The action of the latching device shall not deteriorate due to use and/or ageing.

9. INDUSTRIAL LUMINAIRES

- 9.1 Industrial type luminaires shall consist of a basic channel luminaire fitted with detachable side reflectors.
- 9.2 The reflectors shall be manufactured of cold rolled steel, not less than 0,8mm thick.
- 9.3 The reflectors shall be designed to improve the downward light output ratio and decrease the upward light output ratio to a value of less than 2%.

10. DECORATIVE LUMINAIRES

- 10.1 Decorative luminaires shall incorporate an injection moulded prismatic acrylic diffuser or a high-grade optical reflector covering the entire reflecting surface of the luminaire.
- 10.2 The diffuser shall be hinged or easily removable for maintenance and lamp replacement. Optical reflectors shall be hinged.
- 10.3 Decorative luminaires with diffusers shall be constructed and so installed to prevent the ingress of dust and insects.
- 10.4 Highly polished reflectors shall be protected and carefully handled and to prevent fingerprints showing on the surface.
- 10.5 Surface mounted luminaires on suspended ceilings shall be arranged to suit the grid and shall fit tightly against the ceiling.

11. RECESSED LUMINAIRES

- 11.1 Recessed luminaires shall be suitable for mounting in the ceiling structure specified in the project specification.
- 11.2 The attachment of the prismatic diffuser or reflector shall be similar to that specified in paragraph 10 above.
- 11.3 The diffuser or reflector shall fit flush with the ceiling and the only visible portion shall be the reflector or diffuser.
- 11.4 Should the luminaire be so designed that a surrounding frame is visible then the frame shall be manufactured of anodised aluminium. The frame shall form a neat form with the ceiling. The corners of the surrounding frame shall be mitred and reinforced.

12. LOW-BRIGHTNESS LUMINAIRES

- 12.1 The luminaire shall be provided with an aluminium louver with V-shaped longitudinal vanes and extruded stepped cross-shielding plates.
- 12.2 Louvers shall be constructed from high purity aluminium (99,96%), chemically brightened and anodised.
- 12.3 The total Light Output Ratio (LOR) shall be 82% or better. In the plane between 60 and 90 (from the vertical), the LOR shall be below 3%.

13. LOW GLARE LUMINAIRES

- 13.1 The luminaire shall be provided with a die-formed, bright anodised high-purity aluminium (99,96%) cover with parabolic reflecting surfaces in both directions.

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- 13.2 The total LOR shall be 0.2% or better. In the plane between 60 and 90 (from the vertical), the LOR shall be less than 1.3%.

14. LUMINAIRES FOR USE IN AREAS WITH VISUAL DISPLAY TERMINALS

- 14.1 The luminaire shall have anodised specular louvers to provide the brightness control required for this type of application.
- 14.2 At angles between 60 and 90 (from the vertical) the luminance shall not exceed 200cd/m².
- 14.3 At the above angles the LOR shall be less than 0.6%. At angle between the vertical and 60 the LOR shall be 5.1% or better.

SECTION C12.2**C12.2 PRISON CELL LUMINAIRE****1. SCOPE**

This specification covers the requirements for a fluorescent luminaire for use in prison cells and prison ablution areas. The luminaire shall be suitable for operation with 1 or 2 fluorescent lamps of 36W or 58W each, with an optional 9W compact fluorescent night-light. The exact requirements will be stated in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.

3. STANDARDS

The following standard specifications of the South African National Standards shall apply to this luminaire specification.

- 3.1 SANS 1119: Interior luminaires for fluorescent lamps.
- 3.2 SANS 1250: Capacitors for use with fluorescent and other discharge lamp ballasts.
- 3.3 SANS 890: Ballasts for fluorescent lamps.
- 3.4 SANS 1464: Safety of luminaires.
- 3.5 SANS 1479: Glow starters for fluorescent lamps.
- 3.6 IEC 400: Lamp holders for tubular fluorescent lamps.
- 3.7 SANS 1041: Tubular fluorescent lamps for general service.
- 3.8 SANS VCR003: Coatings applied by the powder-coating process.
- 3.9 Any other standards referred to in the above specifications.

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 AREA OF APPLICATION: The luminaire is to be used inside prison cells and in the ablution areas of prison cells.
- 4.2 FIXING: The luminaire shall be of the surface-mounted type. The main body of the luminaire shall be rigid and so designed that it can be firmly fixed flush onto the mounting surface without exposing gaps into which fat objects can be inserted.
- 4.3 TAMPERING: Due to the location of the luminaire special attention is required to render the luminaire tamper-proof and materials used shall be vandal resistant.
- 4.4 ENVIRONMENTAL REQUIREMENTS
 - 4.4.1 The luminaire shall have an Ingress protection rating of P66 and this shall be substantiated by a certificate of the South African National Standards.
 - 4.4.2 The luminaire shall have no dust-collecting or sharp edges and corners on the accessible side of the luminaire.
 - 4.4.3 The luminaire shape shall be designed so as to prevent the manual gripping of the luminaire to prevent persons from hanging onto the body of the luminaire.

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- 4.5 **THERMAL:** The luminaire must be able to withstand an ambient temperature of 45°C. To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings. Test reports from an independent authorised testing facility proving this requirement shall be made available to the Department on request.
- 4.6 **SAFETY:** The luminaire shall bear the SANS 1464 safety mark.
- 4.7 **NOISE:** Due to the sensitive environment in which the luminaire is used, the noise level emitted from the luminaire shall be kept as low as possible. The ballasts shall, therefore, comply fully with the requirements of the latest edition of SANS 990 Part 1.

5. CONSTRUCTION

- 5.1 **BODY:** Nominal dimensions shall be 1 310 x 140 x 120mm (for the 36W model) or 1 610 x 140 x 120mm (for the 68W model). The luminaire shall have a rigid high-pressure die-cast aluminium body at least 1mm thick, or, alternatively shall be made from 0,8mm thick cold rolled mild steel. The body shall have a minimum of four holes for mounting flush to the mounting surface by means of expansion bolts. The body shall be suitable to house 2 fluorescent lamps of 36W or 68W each plus a 9W PL fluorescent lamp when fully equipped.
- 5.2 **MOUNTING MATERIALS:** Mounting studs and materials shall be provided with each luminaire, including installation instructions as necessary.
- 5.3 **DIFFUSER**
- 5.3.1 The diffuser shall consist of a one-piece injected moulding of clear ultra-violet-stabilised polycarbonate of high-impact resistance. The light control shall be achieved by internal prisms moulded longitudinally as part of the diffuser. The outer surface of the diffuser shall be completely smooth and shall be shaped to prevent persons from obtaining a firm handgrip on the diffuser.
- 5.3.2 The diffuser shall be provided with a replaceable neoprene gasket and the diffuser shall be fixed to the luminaire body by means of six tamper-proof stainless steel bolts with stainless steel washers. The bolt-heads shall preferably be of a flat construction with two pinholes for the insertion of a special tool for fastening or loosening. Burken hex-heads (for Allen keys) shall preferably not be used. Other tamper-proof proposals may be submitted to the Department for approval.
- 5.3.3 The diffuser and body shall be manufactured within close tolerances so that no gaps exist between the body and the diffuser when the diffuser is screwed down.
- 5.4 **GEAR TRAY**
- 5.4.1 The control gear tray shall also act as a reflector and shall be manufactured from sheet steel of at least 0,7mm thickness. The gear tray shall be white epoxy powder coated after all cutouts and holes have been prepared on the tray. Alternatively, the gear tray may be made from bright anodised extruded aluminium.
- 5.4.2 The gear tray shall be mounted to the body by means of identical tamper proof bolts to those holding the diffuser. The mounting shall, however, be provided with a slide in facility so that the gear tray can be easily removed without unscrewing the bolts completely. The gear tray shall be completely removable for workshop maintenance and interchangeability.
- 5.4.3 The gear tray shall be provided with restraining devices to prevent the tray from falling when the gear-tray is slid out. These restraints shall be unhooked for removal of the tray.
- 5.4.4 The gear-tray shall house the ballast, capacitors and glow-starters in the top section, whilst the lamp holders and lamps must occupy the bottom side of the reflector plate.
- 5.4.5 The gear tray should be equipped with control gear and circuits to operate one or two 36W (or 68W) fluorescent lamps on a switch-start basis. However, the gear tray shall be pre-punched to accommodate one 9W PL fluorescent lamp and control gear that can be separately switched as a night light. Equipping for this option is specified in the detail specification if it is required.
- 5.4.6 Preparation of all metal surfaces for the painting or epoxy powder coating thereof shall be done in

accordance with SANS V06041

5.5 ELECTRICAL REQUIREMENTS

- 5.5.1 The luminaire shall be suitable for operation on a 230V, single-phase 50Hz mains supply.
- 5.5.2 Power factor capacitors shall be supplied to correct the power factor to at least 0,85 in the cases of operating either one 36W (or 58W) lamp alone or one 9W lamp alone or one 36W (or 58W) plus one 9W lamp together. Similarly a combination of two 36W (or 58W) lamps together or two 36W (or 58W) lamps plus one 9W lamp or one 9W lamp alone shall apply if the luminaire is fully equipped.
- 5.5.3 Each luminaire shall be supplied with all lamps required and specified in the project specification.
- 5.5.4 The luminaire shall be provided with a 20mm diameter back entry for wiring access.
- 5.5.5 Internal wiring of the luminaire shall be in accordance with SANS 1119.
- 5.5.6 Terminals for connection of the mains supply and on ballasts and other internal equipment shall have screw-down plates bearing on the wires. Terminals where screws bear down directly on the wires will not be acceptable.
- 5.5.7 The luminaire shall be marked with identification labels stating the brand name and model and shall bear the SANS mark or shall at least have an SANS certificate of compliance.

6. LUMINAIRE PERFORMANCE

- 6.1 The luminaire diffuser shall be so designed as to reduce the luminance (glare) of the luminaire to maximise the comfort of the room occupants.
- 6.2 The total light output ratio of the luminaire shall be 56% or better.

7. MAINTENANCE REQUIREMENTS

- 7.1 For ease of maintenance it is imperative that the gear-tray should be completely removable with ease, including the disconnection of the electrical supply internally. Removal of the diffuser and gear tray must only be possible by means of a special unscrewing tool.
- 7.2 The connection between the gear tray equipment and the incoming mains shall preferably be via a suitable sturdy plug and socket for easy disconnection.

7.3 LAMP HOLDERS

Lamp holders shall preferably be of the telescopic spring-loaded type. Where twistlock type lamp holders are provided, the mounting of the holders shall be able to accommodate the tolerances experienced in the length of lamps and in the manufacture of luminaires.

8. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

9. TECHNICAL INFORMATION

The tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C12.3**C12.3 BULKHEAD LUMINAIRES FOR USE WITH COMPACT FLUORESCENT OR TUNGSTEN FILAMENT LAMPS FOR INTERIOR AND EXTERIOR APPLICATIONS****1. SCOPE**

This specification covers the requirements for bulkhead type luminaires, using compact fluorescent or tungsten filament lamps, for general indoor and outdoor use. The types of luminaires covered are decorative round, rectangular or square surface-mounted and recessed types and include luminaires with one or more lamps with standard wattage ratings as specified in the project specification. Luminaires for use in special applications or atmospheres are not included in this specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification.

3.1	SANS 1113:	Interior luminaires for fluorescent lamps. Note: The latest Amendments whereby luminaires with compact fluorescent lamps are covered, shall apply.
3.2	SANS 1250:	Capacitors for use with fluorescent and other discharge lamp ballasts.
3.3	SANS 890, IEC 920 & IEC 921:	Ballasts for fluorescent lamps.
3.4	SANS 1464:	Safety of luminaires.
3.5	SANS 1475:	Glow starters for fluorescent lamps.
3.6	IEC 400:	Lamp holders for tubular fluorescent lamps.
3.7	SANS 1041, IEC 81 & IEC 901:	Tubular fluorescent lamps for general service.
3.8	SANS 1247:	Coatings applied by the powder-coating process.
3.9	SANS 783:	Baked enamels.
3.10	SANS 10142:	The wiring of Premises.
3.11	SANS 55:	Incandescent lamps.
3.12	Any standard referred to in the above specifications.	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for standard indoor and exterior use in buildings under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting against ceilings or walls as described in the project specification.
- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaires shall be

suitable for operation in ambient temperatures between -10°C and $+45^{\circ}\text{C}$.

- 4.4 SAFETY: The luminaire shall bear the SANS 1464 safety mark.
- 4.5 NOISE: Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of SANS 890 Part 1 or IEC 920 and IEC 921.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 Compact fluorescent lamp luminaires shall comply fully with SANS 1119 and all amendments as well as the additional requirements of this specification. Luminaires which bear the SANS mark, are preferred. Luminaires shall at least have an SANS Certificate of Compliance.
- 5.1.2 The Department reserves the right to have samples of luminaires offered tested by the SANS for compliance with SANS 1119. If a sample luminaire is found not to comply with SANS 1119 the cost of such tests shall be borne by the Tenderer.
- 5.1.3 Luminaires for tungsten filament lamps shall not materially differ from those for compact fluorescent lamps, but shall be capable of dissipating the extra heat generated without deterioration in the luminaire materials.

5.2 CONSTRUCTION

- 5.2.1 A luminaire shall consist of a ventilated body manufactured from die-cast aluminium. The body shall be of sufficient strength for the mounting of the entire luminaire.
- 5.2.2 The luminaire shall be designed to accommodate the control gear wiring, lamp holders, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.
- 5.2.3 Except for mounting holes and/or slots, the back of the body shall be closed over the full extent of the luminaire.
- 5.2.4 Suitable knockouts shall be provided in the rear of the luminaire body for wire entry.
- 5.2.5 All components including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.
- 5.2.6 The luminaire shall, as an option, be available with a high-pressure die-cast aluminium skirt, which shall be designed in such a way that it covers the base completely when mounted. The skirt shall be mounted onto the body by means of at least three screws.

5.3 INTERNAL WIRING

- 5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.
- 5.3.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components when changing lamps.
- 5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 5.3.5 An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

5.4 LAMP HOLDERS

Lamp holders shall be of the type suitable for the relevant connected fluorescent or general lighting service lamp. The following standard lamps and lamp holders shall apply:

LAMP	HOLDER	LAMP	HOLDER
7W PL	2G11	13W PLC	G24d-1
9W PL	2G11	16W 2D	CR10q
11W PL	2G11	18W PLC	G24d-2
60/100E GLS	E27, porcelain		

5.5 CONTROL GEAR

5.5.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted. All fluorescent luminaires shall operate on a switch-start basis where external starters are employed.

5.5.2 Ballasts shall comply with SANS 690 & SANS 691, or IEC 920 & IEC 921 as applicable and shall be suitable for operation on 220V to 250V 50Hz supplies.

5.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in paragraph 3.5 of SANS 1119 are not exceeded.

5.5.4 Starters shall comply with SANS 1479 or with BS 3772 if it is not covered by SANS 1479. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

5.5.5 Starters shall be accessible from the outside of the luminaire, and the replacement of the starter shall not necessitate the removal of lamps.

5.5.6 The luminaire reflector shall act as the gearmounting tray and shall be manufactured from sheet steel at least 0,7mm thick. The gear tray shall preferably be white epoxy powder coated after all the cut-outs and holes have been made on the tray. The tray shall be mounted to the body of the luminaire by means of screws and the tray shall be provided with a hole through which the screw head can pass plus a slot of the same width as the screw thickness so that the tray can be removed without removing the screws completely.

5.5.7 The gear tray shall be equipped with the components suitable for the luminaires specified in the project specification.

5.6 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0,85.

5.7 LAMPS

5.7.1 Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with the applicable clauses of SANS 1041 and, where it does not apply, the lamps shall comply with IEC 81 or IEC 921.

5.7.2 If no colour is specified in the Detail Technical Specification, the light colour shall correspond to colour 2 (4 300K) of SANS 1041.

5.7.3 Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

5.7.4 There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost to the Department.

5.7.5 The following standard lamps shall be used for the purposes of this specification:
PL lamps: 7W, 9W AND 11W

PLC Lamps	10W
2D Lamps	18W
GLS Lamps	60 and 100W

5.8 DIFFUSER

- 5.8.1 The diffuser shall consist of a high-impact resistant ultra-violet stabilised acrylic moulding. The diffuser shall be either transparent or opaque as described in the project specification. Where transparent diffusers are required, these shall be moulded with internal prismatic refractors and the outer surface shall be smooth.
- 5.8.2 The diffuser shall be mounted to the body by means of an external mounting ring and at least three screws, which should preferably not pass through the diffuser body as well. A silicon sponge gasket which fits into a groove on the diffuser shall be used to allow breathing of the luminaire whilst prohibiting the ingress of insects.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements shall be submitted with the luminaire.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C12.4**C12.4 POST TOP LUMINAIRES FOR EXTERIOR APPLICATIONS****1. SCOPE**

This specification covers the requirements for post top type luminaires, using tungsten filament, compact fluorescent, mercury vapour, sodium vapour or metal halide lamps for general outdoor and indoor use. The luminaires covered are decorative types and include luminaires with one or more lamps with standard wattage ratings as specified in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.3 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.4 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification:

3.1	SANS 60166:	High-pressure mercury vapour lamps.
3.2	IEC 662:	High-pressure sodium vapour lamps
3.3	IEC 61167:	Metal Halide lamps
3.4	SANS 56:	Incandescent lamps
3.5	SANS 1256:	Capacitors for use with fluorescent and other discharge lamp Ballasts.
3.6	SANS 1454:	Safety of luminaires.
3.7	IEC 922 & IEC 923:	Ballasts for discharge lamps.
3.8	IEC 926 & IEC 927:	Starting devices (other than glow starters).
3.9	SANS 990, IEC 920 & IEC 921:	Ballasts for fluorescent lamps
3.10	IEC 400:	Lamp holders for fluorescent lamps
3.11	SANS 1247:	Coatings applied by the powder-coating process.
3.12	SANS 783:	Baked enamels
3.13	SANS 10142:	The wiring of Premises
3.14	SANS 1507:	Electric cables with extruded solid electric insulation for fixed installations.
3.15	SANS 60238 and VC8011:	Lamp holders
3.16	SANS 1277:	Street lighting luminaires.
3.17	SANS 1086:	Luminaire entries and spigots
3.18	Any standard referred to in the above specifications	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION.** The luminaires are intended for standard exterior use on premises under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting on vertical poles. Spigot entries shall have an internal diameter of 75mm and shall be 75mm deep in accordance with SANS 1088 Table 1 (Type 2).

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- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +45°C. The luminaire shall have an ingress protection rating of IP55 in order to prevent air from entering the lamp compartment and this rating shall be certified by a SANS report.
- 4.4 **SAFETY:** The luminaire shall bear the SANS 1464 safety mark.
- 4.5 **NOISE:** Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of IEC 920, 921, 922 and 923.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 The internal components of the luminaire shall be able to withstand internal temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.
- 5.1.2 The luminaire colour shall be as specified in the project specification.
- 5.1.3.1 The luminaire shall bear the SANS 1277 mark.

5.2 CONSTRUCTION

- 5.2.1 The luminaire shall consist of a spigot base manufactured from high-pressure die-cast aluminium, a lamp compartment with integral control gear as applicable, and a prismatic diffuser and top canopy. The base shall be of sufficient strength for the mounting of the entire luminaire.
- 5.2.2 The luminaire shall be designed to accommodate the control gear, wiring, lamp holders, the diffuser and reflectors where applicable. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.
- 5.2.3 All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.
- 5.2.4 The luminaire spigot shall be provided with at least three M8 stainless steel Allen grub screws for mounting onto the pole.

5.3 INTERNAL WIRING

- 5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.
- 5.3.2 The wiring shall preferably be totally metal enclosed to prevent any possible contact with live components while changing lamps.
- 5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 5.3.5 An earth terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

5.4 LAMP HOLDERS

Lamp holders shall be of the type suitable for the relevant lamp used. Lamp holders shall not deteriorate as a result of normal operating temperatures in the luminaire.

6.5 CONTROL GEAR

- 6.5.1 The control gear ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.
- 6.5.2 Ballasts shall comply with IEC 920, 921, 922 and 923 as applicable and shall be suitable for operation on 220V to 250V 50Hz supplies.
- 6.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in Clause 5.1.3 above are not exceeded.
- 6.5.4 The luminaire control gear shall be mounted onto a control gear mounting assembly which also contains the amp holder. The assembly shall be mounted on the spigot base and the whole assembly shall be removable as a unit without dismantling the luminaire as such.
- 6.5.5 The luminaire body shall be equipped with the components suitable for the luminaires and lamps specified in the project specification.
- 6.5.6 In those applications where igniters are used, these shall be of the superposed pulse type.
- 6.5.7 The reflector, if specified in the project specification, shall be mounted on a white epoxy powder coated steel mounting plate at least 0.7mm thick, which shall be mounted to the spigot body. The reflector shall be made from highly polished anodised aluminium plate and shall be manufactured to give optimum performance with the prismatic diffuser.

5.6 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0.85.

5.7 LAMPS

- 5.7.1 The following standard lamps shall be used for the purposes of this specification:

<u>Lamp</u>	<u>Lamp holder</u>
Mercury Vapour 50W, 80W and 125W	E27

<u>Lamp</u>	<u>Lamp holder</u>
Sodium Vapour 50W and 70W	E27
100W and 150W	E40

All lamps shall be of the elliptical coated type.

Metal halide lamps 70W and 150W (tubular) RX7s 100W (elliptical)	E27

Fluorescent lamps PL 24W PLC 18W PLC 26W	2G11 G24d-2 G24d-3

Incandescent lamps 100W	E27

- 5.7.2 The lamps shall be prevented from loosening in the holders as a result of vibrations under normal working conditions.

6.8 DIFFUSER

- 6.8.1 The diffuser shall consist of a high-impact resistant ultra violet stabilised acrylic moulding with internal prismatic refractors and the outer surface shall be smooth. The prisms shall be designed to

work in conjunction with the reflectors to provide the optimum light output.

- 5.8.2 The diffuser shall be mounted to the body by means of a round ring surface at the bottom which fits onto the spigot base with a neoprene gasket. A drip ridge shall be provided at the bottom edge to prevent direct contact by rainwater with the gasket. The diffuser top shall be formed in such a manner that the top canopy-cover fits over the diffuser.
- 5.8.3 The top canopy cover shall be manufactured from a robust material that is highly resistant to weather, hail, corrosion and vandalism. The inside of the canopy shall be provided with ribbed struts, formed as part of the moulding, to provide additional strength to the canopy. The canopy shall be provided with an internal groove into which the diffuser top edge shall fit and this shall be sealed by means of a neoprene gasket. The cover shall be bolted down onto the body by means of a single central nut on top of the cover.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaires as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaires.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaires offered with the tender.

SECTION C12.5**C12.5 SECURITY LUMINAIRES FOR USE WITH DISCHARGE LAMPS OR COMPACT FLUORESCENT LAMPS FOR PRISON APPLICATIONS****1. SCOPE**

This specification covers the requirements for bulkhead type luminaires and pole mounted luminaires, using sodium vapour or compact fluorescent lamps for outdoor use at prisons. The luminaires covered are of the decorative rectangular or polygonal surface-mounted type as well as streetlight and floodlight luminaires and include luminaires with one or more lamps with standard wattage ratings as specified in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc., and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this Luminaire specification

3.1	SANS 10098:	Code of practice for public lighting.
3.2	SANS 10142:	The wiring of Premises
3.3	SANS 60236 & VC8011	Lamp holders
3.4	SANS 783	Baked enamels
3.5	SANS 1119	Interior luminaires for fluorescent lamps (clauses applicable to compact fluorescent lamps)
3.6	SANS 1222:	Enclosures for electrical equipment
3.7	SANS 1247	Coatings applied by the powder-coating process
3.8	SANS 1250	Capacitors for use with fluorescent and other discharge lamp ballasts
3.9	SANS 1277	Street lighting luminaires
3.10	SANS 1279	Floodlighting luminaires
3.11	SANS 1464	Safety of luminaires
3.12	SANS 1507:	Electric cables with extruded solid dielectric insulation for fixed installations
3.13	IEC 662:	High-pressure sodium vapour lamps
3.14	IEC 922 & IEC 923	Ballasts for discharge lamps
3.15	IEC 926 & IEC 927:	Starting devices (other than glow starters)
3.16	Any standard referred to in the above specifications.	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for exterior use in establishments under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting against horizontal or vertical surfaces, walls, perimeter fences or on poles as described in the project specification.

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- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaire shall be suitable for operation in ambient temperatures between -10°C and +45°C. The luminaire shall have an ingress protection rating as indicated below and this shall be certified in a SANS report.

- 4.4 **SAFETY:** The luminaire shall bear the SANS 1464 safety mark.

- 4.5 **NOISE:** Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of IEC 922 and 923.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

The internal components of the luminaire shall be able to withstand internal temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.

Bulkhead luminaires shall also be available with an optional wire guard and a decorative skirt of the same material and finish as the luminaire body.

6. CONSTRUCTION

6.1 BULKHEAD OR BRACKET-MOUNTED LIGHT.

1. The luminaire shall consist of a body manufactured from high-pressure die-cast aluminium, with a transparent prismatic diffuser. The body shall be of sufficient strength for the mounting of the entire luminaire.
2. The luminaire shall be designed to accommodate the control gear, wiring, lamp holders, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.
3. Except for mounting holes and/or slots, the back of the body shall be closed over the full extent of the luminaire. At least three mounting holes shall be provided.
4. All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.
5. The luminaire shall be provided with a cable entry at the back of the luminaire by means of a plastic gland. However, it shall be possible to provide 20mm diameter conduit entries or cable entries from the sides of the luminaire and suitable drilling increments or knockouts shall be furnished on the luminaire body.
6. A heavy gauge galvanised steel stirrup bracket for mounting the luminaire shall be supplied with the luminaire unless omitted in the project specification.
7. The luminaire shall be suitable for use with 2 x 24W PL or 2 x 26W PL C or 1 x 250W elliptical HPS lamp.
8. The luminaire shall have an ingress protection rating of at least IP55.

6.2 FLOOD-LIGHTS

1. The luminaire shall consist of a body manufactured from either high-pressure die-cast aluminium or ultra-violet stabilised glass-fibre reinforced polyester material. The body shall be hail-proof, weatherproof and corrosion and vandal resistant.
2. The housing shall be equipped with either a flat armoured glass fixed in a sturdy, hinged die-cast frame with a silicon-rubber gasket or a clear transparent high-impact resistant acrylic bowl, treated against discolouring due to UV and lamp radiation, with a silicon-rubber gasket. The glass frame or dome shall preferably be hinged and mounted with stainless steel clips.
3. The luminaire shall be equipped with integral control gear mounted internally. Alternatively, the

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control gear may be mounted in a separate control gear compartment, in which case the compartment shall have the same IP rating as the luminaire.

4. The luminaire shall be suitable for 2 x 24W FLC lamps or 1 x 250W tubular HPS lamp.
5. The luminaire shall have an ingress protection rating of at least IP40.
6. A heavy gauge hot-dipped galvanized steel mounting-stirrup with pre-punched holes shall be supplied with the luminaire unless otherwise specified in the project specification.

6.3 STREET-LIGHT TYPE LUMINAIRES

1. Luminaires must bear the SANS 1277 mark.
2. The luminaire shall consist of a high-pressure die-cast aluminium body or a body manufactured from UV stabilised filled polypropylene. The body shall be hail, weather and corrosion proof and shall be vandal resistant.
3. The body shall preferably consist of a single unit with two compartments, viz. a lamp compartment and a control gear compartment.
4. The luminaire's diffuser shall be suitable for Class B roads in terms of SANS 10096. The clear high-impact acrylic bowl shall be hinged and attached to the body by means of at least three clips of either stainless steel or other durable material. The diffuser shall be sealed on the lamp compartment by means of a silicon-sponge rubber gasket in a tongue and groove arrangement.
5. The control gear compartment shall have a hinged cover for bottom access. The control gear, capacitor and gniot, where fitted, shall be mounted on a removable gear tray.
6. The light fitting shall be provided with a bottom spigot entry in compliance with SANS 1088, Table 1, Type 2: 76mm diameter x 75mm deep.

6.4 INTERNAL WIRING

- 6.4.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.
- 6.4.2 The wiring shall be totally metal encased to prevent any possible contact with live components when changing lamps.
- 6.4.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 6.4.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 6.4.5 An earth terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

6.5 LAMP HOLDERS

- 6.5.1 Lamp holders shall be of the type suitable for the relevant lamp used. Lamp holders shall not deteriorate as a result of normal operating temperatures in the luminaire. Lamp holders shall comply with SANS VCB011 and shall be able to withstand a temperature of 240°C.

6.6 CONTROL GEAR

- 6.6.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.
- 6.6.2 Ballasts shall comply with IEC 922 and 923 as applicable and shall be suitable for operation on 220V to 253V, 50Hz supplies.

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- 6.6.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in Clause 5.1.1 above are not exceeded.
- 6.6.4 The luminaire control gear shall be mounted onto the inside of the control gear compartment of the body on a separate mounting plate. The gear-mounting tray shall be manufactured from sheet steel at least 0.7mm thick and shall be epoxy powder coated.
- 6.6.5 The gear tray and luminaire body shall be equipped with the components suitable for the luminaires and fuses specified in the project specification.
- 6.6.6 In those applications where ignitors are used, these shall be of the superposed pulse type.
- 6.6.7 The reflector shall be mounted on the luminaire body. The reflector shall be made from highly polished 99.98% pure specular anodised aluminium plate and shall be manufactured to give optimum performance with the prismatic diffuser as applicable.

6.7 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each fitting shall be corrected to at least 0.85.

6.8 LAMPS

- 6.8.1 The following standard lamps shall be used for the purposes of this specification:

LAMP

Sodium Vapour
150W or 250W

Compact fluorescent types.
24W PL
26W PLC

LAMP HOLDER

B10 (All lamps shall be of the tubular clear type.)

2G11
G24d.3

7. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements shall be submitted with the luminaire.

8. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C12.8**C12.8 STREET-LIGHT LUMINAIRES****1. SCOPE**

This specification covers the requirements for street-light luminaires using sodium vapour, mercury vapour or compact fluorescent lamps with standard wattage ratings as specified in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification:

3.1	SANS 10086:	Code of practice for public lighting.
3.2	SANS 10142:	The wiring of Premises
3.3	SANS 60236 & VC8011	Lamp holders
3.4	SANS 782:	Baked enamels
3.5	SANS 1119	Interior luminaires for fluorescent lamps (clauses applicable to compact fluorescent lamps)
3.6	SANS 1222:	Enclosures for electrical equipment
3.7	SANS 1247	Coatings applied by the powder-coating process
3.8	SANS 1250	Capacitors for use with fluorescent and other discharge lamp ballasts
3.9	SANS 1277	Street lighting luminaires
3.10	SANS 60188	Mercury vapour lamps
3.11	SANS 1464	Safety of luminaires
3.12	SANS 1507:	Electric cables with extruded solid dielectric insulation for fixed installations
3.13	IEC 662	High-pressure sodium vapour lamps
3.14	IEC 922 & IEC 923:	Ballasts for discharge lamps.
3.15	IEC 926 & IEC 927:	Starting devices (other than glow starters).
3.16	Any standard referred to in the above specifications.	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for exterior use at establishments under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting on brackets against horizontal or vertical surfaces, walls, perimeter fences or on poles as described in the project specification.
- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +45°C.

The luminaire shall have an ingress protection rating of IP 65 for the lamp compartment and IP23 for the control gear compartment and this shall be certified in a SANS report.

- 4.4 SAFETY- The luminaire shall bear the SANS 1484 safety mark.
- 4.5 NOISE- Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of IEC 922 and 923.

5. GENERAL TECHNICAL REQUIREMENTS

- 5.1 The internal components of the luminaire shall be able to withstand external temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.
- 5.2 All metal components shall be manufactured from corrosion-resistant materials or shall be treated to prevent corrosion.
- 5.3 All screws and other components must be easily reachable and must be mounted on the luminaire body.
- 5.4 Luminaires shall bear the SANS 1277 mark.

6. CONSTRUCTION

6.1 BODY

- 6.1.1 The luminaire shall consist of a high-pressure die-cast aluminium body or a body manufactured from UV stabilised filled polypropylene. The body shall be hail weather and corrosion proof, it shall be vandal resistant and the ingress of insects shall be prevented. The body shall also be equipped with an effective air-filter.
- 6.1.2 The body shall preferably consist of a single body with two compartments, viz. a lamp compartment and a control gear compartment.
- 6.1.3 Provision shall be made for the effective dissipation of heat emanating from the lamp and the control gear.
- 6.1.4 The luminaire shall be provided with a spigot entry in compliance with SANS 1088 and shall nominally be 42mm with a length of 125mm for side entry and 76mm with a length of 76mm for bottom entry. The requirements shall be as mentioned in the project specification.

6.2 DIFFUSER

- 6.2.1 The diffuser shall be manufactured from heat-resistant glass or high-impact acrylic non-discolouring material.
- 6.2.2 The size and shape of the diffuser shall be designed so that it neatly fits onto the luminaire body and it shall be of sufficient size to house the lamp or lamps.
- 6.2.3 The diffuser shall preferably be mounted in a sturdy hinged metal frame, which prevents warping or cracking of the diffuser when the diffuser is sealed onto the body.
- 6.2.4 Prisms shall form an integral part of the diffuser itself.
- 6.2.5 The diffuser frame shall be hinged on one side and shall be attached to the body in the closed position by means of at least three quick-release clips made from stainless steel or other durable material.
- 6.2.6 The diffuser frame shall be sealed on the body by means of a silicon-sponge rubber gasket in a tongue and groove arrangement.

6.3 REFLECTION

- 6.3.1 The reflectors shall be manufactured from high-purity aluminium, anodised in accordance with BS 1615.
- 6.3.2 The reflector shall be sufficiently rigid to ensure that it does not bend or distort as a result of heat

developed within the luminaire.

- 6.3.3 The reflective properties of the reflector shall not change as a result of periodic cleaning by maintenance personnel. No part of the reflector shall become detached or distorted as a result of normal handling of the luminaire or vibration under working conditions.
- 6.3.4 The reflectors shall be manufactured with such close tolerances that all luminaires of the same type have the same light distribution characteristics.
- 6.4 CONTROL GEAR
 - 6.4.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.
 - 6.4.2 Ballasts shall comply with IEC 922 and 923 as applicable and shall be suitable for operation on 220V to 250V, 50Hz supplies.
 - 6.4.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in Clause 5.1 above are not exceeded.
 - 6.4.4 The luminaire control gear shall be mounted inside a separate control gear compartment. The gear mounting tray shall be manufactured from sheet steel at least 0.7mm thick and shall be epoxy powder coated. The gear-mounting tray shall be hinged and shall open under gravitational force when the luminaire is in its normal mounted position.
 - 6.4.5 The gear tray and luminaire body shall be equipped with the components suitable for the luminaires and lamps specified in the project specification.
 - 6.4.6 In those applications where ignitors are used, these shall be of the superposed pulse type.
 - 6.4.7 Capacitors shall comply with SANS 1250. The power factor of each complete luminaire shall be corrected to at least 0.95.
- 6.5 INTERNAL WIRING
 - 6.5.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.
 - 6.5.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.
 - 6.5.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
 - 6.5.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable. The terminal block shall be mounted in the control gear compartment.
 - 6.5.5 An earth terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.
 - 6.5.6 All circuits that require ignitors shall have an insulated wire between the ignitor and the lamp holder, suitable to withstand a voltage of at least 5kV.
- 6.6 LAMP HOLDERS
 - 6.6.1 Lamp holders shall be of the type suitable for the relevant lamp used. Lamp holders shall not deteriorate as a result of normal operating temperatures in the luminaire. Lamp holders shall comply with SANS VC8011 and shall be able to withstand a temperature of 240°C.
 - 6.6.2 Lamp holders shall be adjustable for cut-off or semi-cut-off light distribution characteristics.
 - 6.6.3 Lamp holders shall not degenerate under normal working conditions and shall not work loose as a

result of vibration.

6.7 LAMPS

6.7.1 The following standard lamps shall be used for the purposes of this specification:

<u>LAMP</u>	<u>LAMP HOLDER</u>
Sodium Vapour	
70W	F77 (This lamp shall be of the elliptical type)
150W	F40
250W	E40 (These lamps shall be of the tubular clear type.)
400W	E40
Compact fluorescent	
25W PL/C	G24d-3
Mercury vapour	
80W	E27
175W	E27
250W	E40
400W	E40
(All mercury vapour lamps shall be of the elliptical coated type.)	

7. ELECTRICAL SUPPLY

7.1 The luminaires shall be suitable for connection to a single-phase electricity supply with a nominal voltage of 220V to 250V at 50Hz.

7.2 The actual voltage will be furnished in the project specification.

8. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

9. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C12.7**C12.7 HIGH BAY LUMINAIRES****1. SCOPE**

This specification covers the requirements for high bay luminaires using sodium vapour, mercury vapour or metal halide lamps with standard wattage ratings as specified in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification:

- 3.1 SANS 10142: The wiring of Premises.
- 3.2 SANS 50238: Lamp holders and VCSOU
- 3.3 SANS 762: Baking enamels.
- 3.4 SANS 1222: Enclosures for electrical equipment.
- 3.5 SANS 1247: Coatings applied by the powder-coating process.
- 3.6 SANS 1250: Capacitors for use with fluorescent and other discharge lamp ballasts.
- 3.7 SANS 1464: Safety of luminaires.
- 3.8 SANS 1507: Electric cables with extruded solid dielectric insulation for fixed installations.
- 3.9 IEC 662: High-pressure sodium vapour lamps.
- 3.10 SANS 60166: Mercury vapour lamps
- 3.11 IEC 61167: Metal halide lamps
- 3.12 IEC 922 & IEC 923: Ballasts for discharge lamps.
- 3.13 IEC 926 & IEC 927: Starting devices (other than glow starters).
- 3.14 Any standard referred to in the above standards.

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 AREAS OF APPLICATION: The luminaires are intended for interior use in establishments under the control of the Department of Public Works.
- 4.2 FIXING: The luminaires shall be suitable for mounting against, horizontal surfaces or beams or as described in the project specification.
- 4.2 ENVIRONMENTAL: Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +45°C. The luminaire shall have an ingress protection rating of IP 22 for the control gear compartment and this shall be certified in a SANS report.
- 4.4 SAFETY: The luminaire shall bear the SANS 1464 safety mark.
- 4.5 NOISE: Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of IEC 922 and 923.

5. GENERAL TECHNICAL REQUIREMENTS

- 5.1 The internal components of the luminaire shall be able to withstand internal temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.
- 5.2 All metal components shall be manufactured from corrosion-resistant materials or shall be treated to prevent corrosion.
- 5.3 All screws and other components must be easily reachable and must be mounted on the luminaire body.
- 5.4 Luminaires shall preferably bear the SANS mark.

6. CONSTRUCTION

6.1. BODY

- 6.1.1 The luminaire shall consist of two components, viz. a reflector housing the lamp and a control gear compartment onto which the lamp holder is fixed.
- 6.1.2 Provision shall be made for the effective dissipation of heat emanating from the lamp and the control gear.
- 6.1.3 The overall height of the luminaire shall not exceed 550mm.
- 6.1.4 The mass of the complete luminaire shall not exceed 12kg.

6.2. REFLECTOR

- 6.2.1 The reflector shall be of a spun-aluminium construction. The aluminium shall be of high purity and shall be brightened and anodised.
- 6.2.2 The size and shape of the reflector shall be designed so that it neatly fits onto the control gear body and it shall be of sufficient size to house the lamp. The reflector shall preferably be adjustable to accommodate the particular type of lamp used.
- 6.2.3 The reflector shall be shaped to provide the maximum light output and shall minimise glare. The reflector shall have a maximum diameter of not more than 540mm.
- 6.2.4 The reflector shall be sufficiently rigid to ensure that it does not bend or distort as a result of heat developed by the lamp or control gear.
- 6.2.5 The reflective properties of the reflector shall not change as a result of periodic cleaning by maintenance personnel. No part of the reflector shall become detached or distorted as a result of normal handling of the luminaire or vibration under working conditions.
- 6.2.6 The reflectors shall be manufactured with such close tolerances that all luminaires of the same type have the same light distribution characteristics.

6.3. CONTROL GEAR

- 6.3.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry accepted and for the lamps specified in the project specification.
- 6.3.2 Ballasts shall comply with EC 922 and 923 as applicable and shall be suitable for operation on 220V to 250V 50Hz supplies.
- 6.3.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in Clause 5.1 above are not exceeded.
- 6.3.4 The luminaire control gear shall be mounted inside a separate control gear compartment. The control gear housing shall consist of two parts. The top part shall be provided with 25mm diameter conduit entry knock-outs and mounting facilities to enable the mounting of this part of the control

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gear compartment by means of mounting brackets, vibration-proof mounting bolts or suspension hooks as detailed in the project specification.

6.3.5 The bottom part of the control gear compartment shall be hooked or hinged onto the top portion so that it can be fixed onto the top portion after prior installation of the top part. The bottom section shall house the control gear which shall be mounted on a removable gear tray.

6.3.6 The gear-mounting tray shall be manufactured from sheet steel at least 0,7mm thick and shall be epoxy powder coated.

6.3.7 In those applications where igniters are used, these shall be of the superposed pulse type. The wire between the ignitor and the lamp holder shall be insulated to withstand a voltage of at least 5kVDC.

6.3.8 Capacitors shall comply with SANS 1250. The power factor of each complete luminaire shall be corrected to at least 0,85.

6.4 INTERNAL WIRING

6.4.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.

6.4.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

6.4.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration. Silicon insulation shall be used throughout.

6.4.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable. The terminal block shall be mounted in the control gear compartment.

6.4.5 An earth terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

6.4.6 All circuits that require ignitors shall have an insulated wire between the ignitor and the lamp holder, capable of withstanding a voltage of at least 5kV.

6.5 LAMP HOLDERS

6.5.1 Lamp holders shall be of the type suitable for the relevant lamp used. Lamp holders shall not deteriorate as a result of normal operating temperatures in the luminaire. Lamp holders shall comply with SANS VCB011 and shall be able to withstand a temperature of 240°C.

6.5.2 Lamp holders shall not degenerate under normal working conditions and shall not work loose as a result of vibration.

6.6 LAMPS

6.6.1 The following standard lamps shall be used for the purposes of this specification:

<u>LAMP</u>	<u>LAMP HOLDER</u>
Sodium Vapour	(These lamps shall be of the tubular clear type.)
150W	E40
250W	E40
400W	E40
Mercury Vapour	(All mercury vapour lamps shall be of the elliptical coated type.)
250W	E40
400W	E40
Meta Halide	(These lamps shall be of the elliptical coated type.)

250W	F40
400W	E40

7. ELECTRICAL SUPPLY

- 7.1 The luminaires shall be suitable for connection to a single-phase electricity supply with a nominal voltage of 220V to 250V at 50Hz.
- 7.2 The actual voltage will be furnished in the project specification.

8. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

9. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C12.8**C12.8 FLOODLIGHT LUMINAIRES****1. SCOPE**

This specification covers the requirements for floodlight luminaires, for outdoor applications, using high-pressure sodium vapour, mercury vapour or metal halide lamps with standard wattage ratings as specified in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, reflectors, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this Luminaire specification:

3.1	SANS 10142:	The wiring of Premises.
3.2	SANS 60238 SVC8011	Lamp holders
3.3	SANS 753:	Baking enamels.
3.4	SANS 1222:	Enclosures for electrical equipment.
3.5	SANS 1247:	Coatings applied by the powder-coating process.
3.6	SANS 1250:	Capacitors for use with fluorescent and other discharge lamp ballasts.
3.7	SANS 1278:	Floodlighting luminaires.
3.8	SANS 1464:	Safety of luminaires.
3.9	SANS 1507:	Electric cables with extruded solid dielectric insulation for fixed installations.
3.10	IEC 662:	High-pressure sodium vapour lamps.
3.11	SANS 60188:	Mercury vapour lamps
3.12	IEC 61467:	Metal halide lamps
3.13	IEC 922 & IEC 923:	Ballasts for discharge lamps
3.14	IEC 926 & IEC 927:	Starting devices (other than glow starters).
3.15	Any standard referred to in the above standards.	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for exterior use in establishments under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting against horizontal or vertical surfaces, walls, perimeter fences or on poles as described in the project specification.
- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and +45°C. The luminaire shall have an ingress protection rating as indicated below and this shall be certified in a SANS report.
- 4.4 **SAFETY:** The luminaire shall bear the SANS 1464 safety mark.

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- 4.5 NOISE: Noisy ballasts will not be accepted and shall be replaced at no cost in the Department. All ballasts shall comply with the requirements of the latest edition of IEC 902 and IEC 923.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 The internal components of the luminaire shall be able to withstand internal temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.

- 5.1.2 The luminaire shall bear the SANS 1279 and SANS 1484 marks.

5.2 CONSTRUCTION

A. Floodlight for use with 150/100/70W HPS or 125/50W MV lamps

1. The luminaire shall consist of a body manufactured from high-pressure die-cast aluminium, or from RHD ultra-violet stabilised glass-fibre reinforced polyester with a transparent prismatic diffuser.
2. The housing shall be equipped with a clear transparent high-impact resistant acrylic bowl, coated against discolouring due to UV and lamp radiation, with a silicon-rubber gasket. The bowl shall preferably be hinged and mounted with stainless steel clips.
3. The luminaire shall be designed to accommodate the control gear, wiring, lamp holders, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.
4. The reflector shall be mounted on the luminaire body. The reflector shall be made from highly polished 99,98% pure specular anodised aluminium plate and shall be manufactured to give optimum performance with the prismatic diffuser as applicable. For wider beam spread, a hammered finish shall be provided.
5. All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.
6. The luminaire shall be provided with a cable entry at the back of the luminaire by means of a plastic gland. However, it shall be possible to provide 20mm diameter conduit entries or cable entries from the sides of the luminaire and suitable drilling indents or knockouts shall be furnished on the luminaire body.
7. A heavy gauge galvanised steel strap bracket for mounting the luminaire shall be supplied with the luminaire unless omitted in the project specification.
8. The luminaire shall be suitable for use with 1 x 150W (circular) or 100W or 70W (both elliptical) high-pressure sodium vapour lamp; or 1 x 125W or 50W (both elliptical) mercury vapour lamp. The amps required shall be as specified in the project specification.
9. The luminaire shall have an ingress protection rating of at least IP43.

B. Floodlights for use with 400/250/150W HPS or 400/250W MH or 400/250W MV lamps

1. The luminaire shall consist of a body manufactured from high-pressure die cast aluminium. The body shall be hail-proof, weatherproof and corrosion and vandal resistant.
2. The housing shall be equipped with a flat armoured glass fixed in a sturdy, die-cast frame with a silicon-rubber gasket. The glass frame shall be hinged and mounted with stainless steel screws and mounting plates.
3. The luminaire shall be equipped with integral control gear mounted in a separate control gear compartment.
4. The reflector shall be mounted on the luminaire body. The reflector shall be made from highly

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polished 99,98% pure specular anodised aluminium plate and shall be manufactured to give optimum performance with the prismatic diffuser as applicable. For wider beam luminaires a hammered finish shall be provided.

5. The luminaire shall be suitable for the following lamps: the replacement of which shall be by means of a removable side-mounted cast aluminium lamp holder housing with a heat-resistant water-proof gasket.

High-pressure sodium: 100W, 250W or 150W tubular type and 400W, 250W and 150W Elliptical type

Metall-halide lamps: 400W or 250W tubular type and 400W or 250W elliptical type

Mercury vapour lamps: 400W or 250W elliptical type

The lamps required shall be as stated in the project specification.

6. The luminaire shall have an ingress protection rating of at least IP65.
7. A heavy gauge hot-dipped galvanised steel mounting-arrup with pre-punched holes shall be supplied with the luminaire unless otherwise specified in the project specification.

5.3 INTERNAL WIRING

- 5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.
- 5.3.2 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.
- 5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 5.3.5 Where circuits requiring the use of ignitors are used the wire between the ignitor and the lamp holder shall be insulated to withstand at least 5kV.
- 5.3.6 An earth terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

5.4 LAMP HOLDERS

- 5.4.1 Lamp holders shall be of the type suitable for the relevant lamp used. Lamp holders shall not deteriorate as a result of normal operating temperatures in the luminaire. Lamp holders shall comply with SANS VC8011 and shall be able to withstand a temperature of 240°C.

5.5 CONTROL GEAR

- 5.5.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry accepted.
- 5.5.2 Ballasts shall comply with IEC 922 and 923 as applicable and shall be suitable for operation on 220V to 250V, 50Hz supplies.
- 5.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in Clause 5.1.1 above are not exceeded.
- 5.5.4 The luminaire control gear shall be mounted onto the inside of the control gear compartment of the body on a separate mounting plate. The gear mounting tray shall be manufactured from sheet steel at least 0,7mm thick and shall be epoxy powder coated.
- 5.5.5 The gear tray and luminaire body shall be equipped with the components suitable for the luminaires.

and lamps specified in the project specification.

- 5.5.6 In those applications where ignitors are used, these shall be of the superposed pulse type.

5.6 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0,85.

5.7 LAMPS

- 5.7.1 The following standard lamps shall be used for the purposes of this specification:

<u>LAMP</u>	<u>LAMP HOLDER</u>	<u>LAMP TYPE</u>
HP Sodium Vapour 400W, 250W, 150W or 100W 70W	E40 E27	Tubular clear or coated elliptical Coated elliptical
Metal halide 400W or 250W	E40	Tubular clear or coated elliptical
Mercury vapour 400W and 250W 125W and 80W	E40 E27	Coated elliptical Coated elliptical

- 5.7.2 The actual lamp ratings and types shall be as specified in the project specification.

6. LIGHT DISTRIBUTION

The floodlights shall be available with at least three types of symmetrical light distribution characteristics. These shall be:

- 6.1 Wide beam
- 6.2 Medium beam
- 6.3 Narrow beam

7. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements, shall be submitted with the luminaire.

8. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaires offered with the tender.

SECTION C12.9**C12.9 PENDANT LUMINAIRES FOR USE WITH COMPACT FLUORESCENT OR TUNGSTEN FILAMENT LAMPS FOR INTERIOR APPLICATIONS****1. SCOPE**

This specification covers the requirements for pendant type luminaires, using compact fluorescent or tungsten filament lamps, operating at a nominal voltage of 230V, for general indoor use. The types of luminaires covered are decorative types with metal, acrylic and glass shades and include luminaires with one or more lamps with standard wattage ratings as specified in the project specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification.

3.1	SANS 1116:	Interior luminaires for fluorescent lamps. Note: The latest amendments whereby luminaires with compact fluorescent lamps are covered, shall apply.
3.2	SANS 1250:	Capacitors for use with fluorescent and other discharge lamp ballasts.
3.3	SANS 880, & IEC 820 & 921:	Ballasts for fluorescent lamps.
3.4	SANS 1464:	Safety of luminaires
3.5	SANS 1479:	Glow starters for fluorescent lamps.
3.6	SANS VCR031:	Coatings applied by the powder-coating process.
3.7	SANS 763:	Baking enamels.
3.8	SANS 10142:	The wiring of Premises
3.9	SANS 60238:	Lamp holders and VCR011
3.10	SANS 60238:	Lamp holders and VCR011
3.11	Any standard referred to in the above standards.	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for standard indoor use in buildings under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting against ceilings as described in the project specification.
- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and $+45^{\circ}\text{C}$.
- 4.4 **SAFETY:** The luminaire shall bear the SANS 1464 safety mark.

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- 4.5 NOISE: Noisy ballasts will not be accepted and shall be replaced at no cost to the Department. All ballasts shall comply with the requirements of the latest edition of SANS 850 - Part 1 or IEC 920 and IEC 921.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 Compact fluorescent lamp luminaires shall comply fully with SANS 1119 and all amendments as well as the additional requirements of this specification. Luminaires which bear the SANS mark are preferred. Luminaires shall at least have an SANS Certificate of Compliance.
- 5.1.2 The Department reserves the right to have samples of luminaires offered tested by the SANS for compliance with SANS 1119. If a sample luminaire is found not to comply with SANS 1119 the cost of such tests shall be borne by the Tenderer.
- 5.1.3 Luminaires for tungsten filament lamps shall not materially differ from those for compact fluorescent lamps, but shall be capable of dissipating the extra heat generated without deterioration in the luminaire materials.

5.2 CONSTRUCTION

- 5.2.1 The luminaire shall consist of the following basic parts:
- 5.2.2 A mounting bracket which fits onto a standard round conduit ceiling box by means of two screws.
- 5.2.3 A suspension hook from which the luminaire cable is suspended to prevent the luminaire from hanging from the connector block.
- 5.2.4 A connector block for wiring the luminaire to the mains wiring.
- 5.2.5 A ceiling cup which can be moved upwards over the luminaire cable to cover the connections at the ceiling.
- 5.2.6 A white heat-resistant three-core flexible cable with a nominal length of 1,5m connected onto the terminal block in the ceiling box, and the other end factory-connected to the lamp holder or control circuit of the luminaire.
- 5.2.7 A shade of either metal, non-discolouring acrylic material or glass as specified in the project specification.
- 5.2.8 All components, including screws, bolts and nuts utilized in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated, brass or stainless steel materials are preferred.
- 5.2.9 Where the mass of the luminaire exceeds 1,5kg a separate stainless steel suspension cable to support the luminaire shall be provided.

5.3 INTERNAL WIRING

- 5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in metal parts.
- 5.3.2 The wiring shall be totally metal encased to prevent any possible contact with live components while changing lamps.
- 5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 5.3.5 An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal.

by means of a crimped lug.

5.4 LAMP HOLDERS

Lamp holders shall be of the type suitable for the relevant compact fluorescent or general lighting service lamp. For incandescent lamps brass holders with porcelain gaskets shall be provided. The following standard lamps and lamp holders shall apply:

5.4.1	<u>LAMP</u>	<u>HOLDER</u>
	7WPL	2G11
	9WPL	2G11
	13W.PLC	G24d-1
	60/100W GLS	E27 or Bayonet Cap, porcelain

5.5 CONTROL GEAR

5.5.1 Where applicable, the control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted. All fluorescent luminaires shall operate on a switch-start basis where external starters are employed.

5.6 LAMPS

5.6.1 Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with the applicable clauses of SANS 1041 and, where it does not apply, the lamps shall comply with IEC 81 or IEC 901. If no colour is specified in the Detail Technical Specification, the light colour for fluorescent lamps shall correspond to colour 2 (4 300K) of SANS 1041.

5.6.2 Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

5.6.3 There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost to the Department.

5.6.4 The following standard lamps shall be used for the purposes of this specification:

PL lamps: 7W and 9W

PLC Lamps: 13W

GLS Lamps: 60 and 100W

5.7 LAMP SHADES

5.7.1 Metal Lamp Shades

The metal shade shall be manufactured from aluminium and shall be spun into a pleasing decorative shape which shall provide a circular distribution pattern with an angle of approximately 60° to the vertical in all directions.

5.7.1.1 The shade shall be epoxy-powder coated inside and outside and shall be white on the inside. The outside colour shall be as described in the project specification.

5.7.1.2 The shade shall be suitably ventilated to prevent the building-up of excessive heat.

5.7.2 Acrylic Lamp Shades

5.7.2.1 The shade shall consist of a high-impact resistant ultra-violet stabilised acrylic moulding which will not discolour as a result of the heat or the particular radiation of the lamp used in the luminaire. The shade shall be either transparent or opaque as described in the project specification and shall have a pleasing decorative shape.

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5.7.2.2 The shade shall provide sufficient upward light to make full use of ceiling reflection.

5.7.3 Glass lamp shades.

5.7.3.1 The shade shall be made from frosted opaque white glass (unless otherwise specified in the project specification) and shall be manufactured with a pleasing shape.

5.7.3.2 The shade shall provide sufficient upward light to make full use of ceiling reflections.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements shall be submitted with the luminaire.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C12.10**C12.10 INFRA-RED ENERGY SOURCES FOR USE IN POULTRY APPLICATIONS****1. SCOPE**

This specification covers the requirements for infra-red units or luminaires used as heating sources in the rearing of broiler chickens in enclosed chicken pens, with wattage ratings as specified.

2. GENERAL

- 2.1 To promote work creation in South Africa, the units or luminaires should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the equipment offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Units/luminaires and associated equipment shall be new and unused and shall be supplied complete with infrared source/lamp, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps, where applicable, shall be delivered separately.

3. STANDARDS

The following standard specifications of the South African National Standards and the International Electrotechnical Commission shall apply to this specification:

- 3.1 SANS 10142: The wiring of Premises.
- 3.2 SANS 60238: Lamp holders and VC80/1
- 3.3 SANS 1222: Enclosures for electrical equipment.
- 3.4 SANS VC8931: Coatings applied by the powder-coating process.
- 3.5 SANS 1464: Safety of luminaires.
- 3.6 SANS 1507: Electric cables with extruded solid dielectric insulation for fixed installations.
- 3.7 Any standard referred to in the above standards.

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 AREAS OF APPLICATION: The units/luminaires are intended for interior use in establishments under the control of the Department of Public Works.
- 4.2 FIXING: The units/luminaires shall be suitable for mounting on brackets against horizontal or vertical surfaces, or for suspension from chains or cables from roof structures as described in the project specification.
- 4.3 ENVIRONMENTAL: Unless otherwise specified in the detail specification the units/luminaires shall be suitable for operation in ambient temperatures between -10°C and +45°C.

To enable cleaning of the enclosures by means of water spraying, the unit/luminaire shall preferably be splash proof. Where luminaires are offered, these shall have an ingress protection rating of at least IP 23.

- 4.4 SAFETY: If luminaires are offered, these shall bear the SANS 1464 safety mark.

5. GENERAL TECHNICAL REQUIREMENTS

- 5.1 The internal components of the unit or luminaire shall be able to withstand internal temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.

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5.2 All metal components shall be manufactured from corrosion-resistant materials or shall be treated to prevent corrosion.

5.3 All screws and other components must be easily reachable and must be mounted on the unit/luminaire body.

6. CONSTRUCTION

6.1. GENERAL

The energy source required may be either a heat source making use of an open IR source or a luminaire utilising an infrared lighting source.

6.2. OPEN SOURCE DEVICES.

6.2.1 The body shall consist of an enclosed connection box, manufactured from epoxy powder-coated or galvanised sheet-metal, equipped with an aluminium reflector and a wound IR source.

6.2.2 The connection box shall be provided with an eyebolt or hook for suspension and mounting of the unit.

6.2.3 The unit shall be provided with 2 metres of cable/re cable and a connected 15A plug-top.

6.2.4 The unit shall have a maximum height of 210mm and the reflector shall have a diameter of not more than 330mm. The mass of the unit shall not exceed 1,7kg.

6.2.5 The reflector shall be manufactured from high-purity anodised aluminium.

6.2.6 The infrared source shall be on a porcelain base and shall have a maximum rating of not more than 550W on a 230V power supply.

6.2.7 The IR source shall emit infrared radiation with more than 60% in the 3-700nanometre range.

6.2.8 To facilitate cleaning, it shall be possible to immerse the whole unit in water when the power supply is disconnected.

6.3. LIGHT SOURCE DEVICES

6.3.1 The luminaire shall consist of a non-corrosive metal body shaped as to house the infrared lamp. The inside and outside of the housing shall preferably be epoxy powder coated and shall be of a neutral colour such as grey.

6.3.2 The housing shall be suitable for use with PAR 38 lamps with E27 bases.

6.3.3 The housing shall be equipped with a heat-resistant lamp holder, capable of withstanding the operating temperature of the lamp in the ambient conditions as described in clause 4 above.

6.3.4 The housing shall be equipped with a wire grille to prevent accidental contact with the lamp.

6.3.5 The luminaire shall be provided with a suitable suspension hook for vertical mounting of the luminaire or as described in the project specification.

6.3.6 The luminaire shall be provided with an integral connection box and 2m of cable/re cable with a 15A plug-top mounted on the free end.

6.3.7 The lamp shall be constructed from hardened glass to withstand water droplets while in operation. The lamp rating shall be 100W at 230V.

6.3.8 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.

6.3.9 The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

6.3.10 The conductor insulation shall be rated to withstand the temperature inside the luminaire body.

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without deterioration.

- 6.3.11 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 6.3.12 An earth terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

7. ELECTRICAL SUPPLY

- 7.1 The luminaires shall be suitable for connection to a single-phase electricity supply with a nominal voltage of 220V to 250V at 50Hz.
- 7.2 The actual voltage will be furnished in the project specification.

8. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender

SECTION C12.11**C12.11 BULKHEAD LUMINAIRES FOR USE WITH DISCHARGE LAMPS FOR INTERIOR AND EXTERIOR APPLICATIONS****1. SCOPE**

This specification covers the requirements for bulkhead type luminaires, using mercury vapour, sodium vapour or metal halide lamps, for general outdoor and indoor use. The luminaires covered are decorative rectangular or polygonal, surface-mounted types and include luminaires with one or more lamps with standard wattage ratings as specified in the project specification. Luminaires for use in special applications or atmospheres are not included in this specification.

2. GENERAL

- 2.1 To promote work creation in South Africa, the luminaire should preferably be manufactured within the Republic of South Africa and should have a local content of at least 50%.
- 2.2 If the luminaire offered is of foreign origin, full specifications on technical performance and quality must be submitted and full reasons shall be given why the unit had to be imported.
- 2.3 A sample luminaire shall be provided for evaluation and approval by the Electrical Engineer prior to installation.
- 2.4 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective covering.
- 2.5 Lamps shall be delivered separately.

3. STANDARDS

The following standard specifications of the South-African National Standards and the International Electrotechnical Commission shall apply to this luminaire specification.

3.1	SANS 00188-	High-pressure mercury vapour lamps.
3.2	IEC 662-	High-pressure sodium vapour lamps.
3.3	IEC 61167-	Metal Halide lamps.
3.4	SANS 1250-	Capacitors for use with fluorescent and other discharge lamp ballasts.
3.5	SANS 1464-	Safety of luminaires.
3.6	SANS 1278-	Interior luminaires for low pressure sodium vapour and high intensity discharge lamps.
3.7	IEC 922 & IEC 923-	Ballasts for discharge lamps.
3.8	IEC 926 & IEC 927-	Starting devices (other than glow starters).
3.9	SANS VC8031	Coatings applied by the powder-coating process.
3.10	SANS 763-	Baked enamels.
3.11	SANS 10142-	The wiring of Premises.
3.12	SANS 15C7-	Electric cables with extruded solid dielectric insulation for fixed installations.
3.13	SANS 50238 & VC8011	Lamp holders.
3.14	Any standard referred to in the above specifications.	

4. PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

- 4.1 **AREAS OF APPLICATION:** The luminaires are intended for standard indoor and exterior use in buildings under the control of the Department of Public Works.
- 4.2 **FIXING:** The luminaires shall be suitable for mounting against horizontal or vertical surfaces and walls as described in the project specification.
- 4.3 **ENVIRONMENTAL:** Unless otherwise specified in the detail specification the luminaires shall be suitable for operation in ambient temperatures between -10°C and $+45^{\circ}\text{C}$.

The luminaire shall have an ingress protection rating of IP66.

- 4.4 **SAFETY:** The luminaire shall bear the SANS 1464 safety mark.
- 4.5 **NOISE:** Noisy Ballasts will not be accepted and shall be replaced at no cost to the Department. All Ballasts shall comply with the requirements of the latest edition of IEC 622 and IEC 923.

5. GENERAL TECHNICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 The internal components of the luminaire shall be able to withstand internal temperatures of at least 45°C without resulting in any electrical or mechanical component exceeding its maximum rated operating temperature. Certified proof from an authorised testing facility shall be presented on request.
- 5.1.2 The luminaire shall also be available with an optional wind guard and a decorative skirt of the same material and finish as the luminaire body.

5.2 CONSTRUCTION

- 5.2.1 The luminaire shall consist of a body manufactured from high-pressure die-cast aluminium, with a transparent prismatic diffuser. The body shall be of sufficient strength for the mounting of the entire luminaire.
- 5.2.2 The luminaire shall be designed to accommodate the control gear, wiring, lamp holders, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.
- 5.2.3 Except for mounting holes and/or slots, the back of the body shall be closed over the full extent of the luminaire. At least three mounting holes shall be provided.
- 5.2.4 All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.
- 5.2.5 The luminaire shall be provided with a cable entry at the back of the luminaire by means of a plastic gland. However, it shall be possible to provide 20mm diameter conduit entries or cable entries from the sides of the luminaire and suitable drilling indent or knockouts shall be furnished on the luminaire body.

5.3 INTERNAL WIRING

- 5.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body or control gear trays.
- 5.3.2 The wiring shall be totally metal encased to prevent any possible contact with live components while changing lamps.
- 5.3.3 The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.
- 5.3.4 The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires. Terminals where screws bear down directly on wires will not be acceptable.
- 5.3.5 At each terminal, forming part of the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

5.4 LAMP HOLDERS

Lamp holders shall be of the type suitable for the relevant lamp used. Lamp holders shall not deteriorate as a result of normal operating temperatures in the luminaire.

5.5 CONTROL GEAR

- 5.5.1 The control gear, Ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.
- 5.5.2 Ballasts shall comply with IEC 922 and 923 as applicable and shall be suitable for operation on 220V to 230V, 50Hz supplies.
- 5.5.3 Ballasts shall further be suitable for the particular luminaires to ensure that the thermal limits specified in Clause F 1.1 above are not exceeded.
- 5.5.4 The luminaire control gear shall be mounted onto the inside of the body and not on a separate mounting plate.
- 5.5.5 The luminaire body shall be equipped with the components suitable for the luminaires and lamps specified in the project specification.
- 5.5.6 In those applications where igniters are used, these shall be of the superposed pulse type.
- 5.5.6 The reflector shall be mounted on a white epoxy powder coated steel mounting plate at least 0.7mm thick which is mounted to the body by means of four screws. The reflector shall be made from highly polished anodised aluminium plate and shall be manufactured to give optimum performance with the prismatic diffuser.

5.6 CAPACITORS

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0.85.

5.7 LAMPS

- 5.7.1 The following standard lamps shall be used for the purposes of this specification.

<u>LAMP</u>	<u>LAMP HOLDER</u>
Mercury Vapour (50W, 80W and 125W)	E27
Sodium Vapour 50W and 70W	E27
100W and 150W	E40

NB. All lamps shall be of the elliptical coated type.

<u>LAMP</u>	<u>LAMP HOLDER</u>
Metal halide lamps 70W and 150W (tubular)	RX7s
100W (elliptical)	E27

5.8 DIFFUSER

- 5.8.1 The diffuser shall consist of a high-impact resistant ultra-violet stabilised acrylic moulding with internal prismatic refractors and the outer surface shall be smooth. The prism shall be designed to work in conjunction with the reflectors to provide the optimum light output.
- 5.8.2 The diffuser shall be mounted to the body by means of an external mounting ring and at least four Allen screws, which should preferably not pass through the diffuser body as well. The diffuser shall be attached to the mounting frame by means of screw-down holding plates.
- 5.8.3 A silicon sponge gasket which fits into a groove on the body shall be used to allow breathing of the luminaire whilst prohibiting the ingress of insects.

6. PHOTOMETRIC DATA

Photometric data sheets of the luminaire as prepared by a laboratory that complies with SANS requirements,

shall be submitted with the luminaire.

7. TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaire offered with the tender.

SECTION C.13**C.13 FIXED WATER STORAGE HEATERS**

1. The water heaters shall comply with SANS 151 and shall bear the SANS mark.
2. This specification covers the following types of water heaters:
 - TYPE 1: (Free outlet type) - A water heater provided with an open outlet. The flow of water is controlled by means of a stopcock in the inlet pipe.
 - TYPE 2: (Combination type) - A water heater having an integral cold water cistern. The flow of water is controlled on the outlet side.
 - TYPE 3: (Low pressure type) - A water heater designed for a working pressure of 100kPa with or without an open expansion or vent pipe and intended to work from a supply derived from either a pressure control valve or a cold water cistern that does not form an integral part of the heater. The flow of water is controlled on the outlet side.
 - TYPE 4: (High pressure type) - A water heater designed for a working pressure of 400kPa derived from the mains via a combined pressure control/expansion valve. The flow of water is controlled on the outlet side.
3. The background colour of the nameplate indicating details of the cylinder shall be in accordance with the appropriate working pressure specified in SANS 151 namely:
 - 50kPa or less - Yellow
 - 100kPa - Blue
 - 200kPa - Black
 - 300kPa - Brown
 - 400kPa - Red
 - 500kPa - Gray
4. The working pressure of types 1 and 2 shall be 20kPa and the minimum working pressure of type 3 shall be 100kPa. Where a working pressure higher than 100kPa is required, type 4 shall be used.
5. The rating of the heating units shall be as follows:

TYPE	CAPACITY (LITRES)	220/250 V, 50 Hz (kW)
1	15	0,5
1 & 3	25	0,5
2 & 3	50	1,0
2 & 4	100	2,0
2 & 4	150	3,0
2 & 4	200	4,0
2 & 4	250	4,0
3	350	Will be specified by the
3	450	Department
3	550	

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6. The paint finish shall be at least equal to Class I baked enamel of SANS 157 with a dry film thickness of at least 0,03mm.
7. The insulation between the cylinder and the outer casing shall consist of a 50mm high density fibreglass blanket or granulated cork.
8. The heating element shall be of the immersion type.
9. The following safety accessories shall be supplied as standard :
 - On types 1, 2 & 3 (a) Fail-safe type thermostat graduated to operate at any temperature between 40°C and 75°C
 - On type 4 (b) Fail-safe type thermostat graduated to operate at any temperature between 40°C and 75°C
- (=) Emergency over-pressure/temperature Relief valve relieving at 600/650 kPa or at 94-97°C
10. In areas with aggressive water, an incolloy heating element shall be provided

SECTION C14**C.14 INCINERATORS****1. GENERAL**

This section covers sanitary incinerators for installation in single or multi-storey buildings.

2. CONSTRUCTION**2.1 BODY**

The incinerator shall be suitable for either surface or floor installation as specified in the Detail Technical Specification. The body shall be of substantial construction with white stove enamelled finish.

2.2 FAN

The fan shall be driven by a shaded pole motor and shall provide circulation of air between the combustion chamber and outer body to ensure a cool outer surface during and after operation.

2.3 HEATER

The heater shall comprise high temperature resistance wire wound on ceramic formers and shall be completely housed in a nickel alloy container. The electrical loading of the heater shall not be less than 1,5 kW.

2.4 TIMER

The timing period shall be for a minimum of 15 minutes and shall be initiated on opening of the door. If the machine is re-used whilst already in a burning cycle, the timer shall be reset to avoid partial incineration.

2.5 ASH DISPOSAL

An automatic ash shaker shall be provided to break up residual ash deposits and an ash drawer shall be provided to collect residual ash for disposal.

3. MAINTENANCE

No maintenance of working parts shall be necessary as all components shall be lubricated for life.

4. WIRING

All wiring shall be brought to a ceramic terminal block and the unit shall be provided with knockouts for 20mm conduit.

SECTION C.15**C.15 BUSBARS (RISING AND OVERHEAD FOR VOLTAGES UP TO 1 KV)****1. GENERAL**

- 1.1 Busbars shall be designed and manufactured in compliance with SANS 1473 and SANS 1195.
- 1.2 Rising and overhead busbar trunking shall be fully enclosed in a sheet metal duct which shall form part of the busbar support.
- 1.3 The entire busbar system shall be manufactured in sections. It shall be possible to remove intermediate sections without having to dismantle or remove adjacent sections.

2. BUSBAR ENCLOSURE

- 2.1 The metal enclosure shall form an integral part of the bus section and shall be of the same length as the conducting sections of the busbar. Bus sections shall be securely fixed at each joint by means of bolted fishplates.
- 2.2 The busbar shall be splash proof and vermin proof and adequately ventilated.
- 2.3 Each bus section shall have at least four fixing points. These points shall be capable of accepting M10 bolts with hexagonal heads.
- 2.4 The covers of the busbar trunking shall be firmly secure to one chassis or framework by at least four points per section.
- 2.5 Self-lapping screws are not acceptable as a means of fixing or securing any part or component on busbar trunking.
- 2.6 Suitable locking devices, i.e. spring washers or locknuts, shall be incorporated with all threaded parts to withstand vibration and stresses caused under normal and fault conditions.
- 2.7 Busbar covers shall be so designed to facilitate removal of the covers after installation. Sections of the busbars which pass through walls and floors shall have separate covers. This is necessary because the walls and floors will be built up to the busbar enclosure as a fire barrier.

3. PAINT FINISH

Metal components of the framework and panels of the busbar trunking shall be painted in accordance with the Department's "STANDARD PAINT SPECIFICATION", Section C.39. The colour shall be 'LIGHT CRANGE', colour R25 of SANS 1091.

4. BUSBARS**4.1 GENERAL**

Busbars shall be manufactured of solid drawn high conductivity copper with a rectangular cross section in accordance with SANS 1473 and SANS 1195 and BS 159 and BS 1433 where applicable.

- 4.1.2 The voltage and current rating of the busbar shall comply with the Detail Technical Specification.
- 4.1.3 The current rating shall be indicated on a stamped metal label on each section of the busbar trunking as well as the name and address of the manufacturer.

4.2 VOLTAGE RATING

- 4.2.1 The busbar system shall be designed to withstand the service voltage and the corresponding test voltage specified in SANS 1473.
- 4.2.2 The minimum clearance between current carrying parts and other metal parts specified in SANS 1473 shall be maintained.

4.3 CURRENT RATING

4.3.1 The maximum allowable temperature of busbars (including joints) carrying full load current in an ambient temperature as specified shall not exceed 60°C, unless different ambient temperatures are specified, an ambient temperature of 35°C shall be assumed with a maximum temperature increase of 45°C.

4.3.2 Table C15.2 may be used as a guide in determining busbar ratings where the distance between the phase busbars is at least the distance of the longer side of the cross-section with a minimum spacing of 50mm and at least 150mm from the sheet metal enclosure. It is however essential that the busbar manufacturer shall make due allowance for the "proximity and skin" effects, the effect of ferrous enclosures, ventilation etc. and for the arrangement used in his busbar design. Manufacturers shall, where requested, prove that the busbar rating and enclosure design comply with the temperature rise specified above. The busbars can also be rated to DIN 43671 for painted busbars.

4.3.3 Neutral busbars in three-phase, four wire supplies shall have the same dimensions as the phase busbars.

4.3.4 Busbars may not be tapered. The rating of the bars shall be equal to the incoming current rating. In cases where the main switch is an isolator, the isolator rating may not be taken as the incoming current rating.

4.3.5 In addition to the current rating busbars shall comply with the following fault level rating:

$$A = 8.2 \times I \times t^{1/2}$$

where

A = minimum cross-section (mm²)

I = prospective fault current (kA)

t = maximum time in seconds required for protection equipment to clear the fault.

(Minimum allowable value for t = 0.2s).

4.3.6 Where a busbar consists of two or more busbars per phase (laminations), the laminations shall be separated by a minimum distance of the thickness of one lamination. The laminations shall be clamped together with copper spacers at intervals not exceeding 450mm in order to equalise the current distribution in the laminations. The busbar ratings in Table C15.2 shall be multiplied by the factors shown in Table C15.1 to determine the total current rating per phase.

4.4 MOUNTING

4.4.1 Busbar sections shall be supported at a minimum of two points in each section.

Busbars shall be supported by resin bound synthetic wood panels or other suitable dielectric material. The surface of these supports shall be treated to prevent surface tracking. The supports shall be bolted securely to the framework and busbars shall fit tightly in the supports.

4.4.2 The rating and fixing of busbars shall be designed to withstand mechanical and temperature stresses during fault conditions. The busbar system shall withstand a fault current under test conditions of 20 times rated current for 1 second when applied:

(a) between all three phases,

(b) any two phases,

(c) neutral and the adjacent phase, and

(d) earth conductor and nearest phase conductor.

4.4.3 If no other methods are specified, the stresses under fault conditions shall be calculated as follows, taking into account correction factors for different configurations.

Mechanical stresses

$$F = \frac{16 \times I^2 \times k}{D \times 10\,000} \text{ Nm}$$

where F = force (N/m)

I = maximum fault current (A RMS symm.)

d = spacing between bars (m)

k = space factor for rectangular bars (Fig. C-5.1)

- 4.4.4 The maximum allowable spacing of busbar supports for fault levels of 16 kA and more is 600mm

4.5 BENDS

Busbars shall be radius edged where they change direction

4.6 BUSBAR SECTIONS

Busbars shall be divided into sections (par. 1.3) and jointed to overlap for a distance equal to twice the width of the bar to prevent localised heating. Contact surfaces shall be tinned (apricot-paste flux may not be used) or silver-plated and bolted down with cadmium-plated bolts and nuts and spring washers with an applied torque in accordance with SANS 1473. Busbars shall be prepared for extension where they terminate at the ends of the trunking.

4.7 EARTH BUSBAR

- 4.7.1 An earth busbar shall be installed in a convenient position along the entire length of the busbar

- 4.7.2 The cross-sectional area of earth busbars shall be calculated in accordance with the following formula in IEC 439 with a minimum cross-section of 6,3 x 20mm.

$$S = \frac{I \times t^{0.5}}{X \times (d)^{0.5}}$$

where S = cross-section (mm²)

I = the r.m.s. value of the current (A)

X = 13 for Copper

t = operating time of protection equipment (s) (Minimum value = 0,2s)

dT = temperature rise (°C) = 120°C for insulated conductors = 180°C for uninsulated conductors

If t is between 2s and 5s, then dT may be increased in the same formula to

dT = 145°C for insulated conductors

= 215°C for uninsulated conductors.

- 4.7.3 In addition to the above considerations, the longer side of the earth busbar shall be at least twice the diameter of the largest bolt that will be fitted to the busbar.

- 4.7.4 The method of installation of the earth bar shall permit the connection of earth conductors at any point.

4.8 EXPANSION JOINTS

- 4.8.1 Expansion joints to allow for thermal expansion and contraction shall be provided at intervals not

exceeding 10m to allow for a temperature variation from 0°C to 90°C

- 4.8.2 These expansion joints shall be made with flexible braided copper strap or laminated copper foil with the same current carrying capacity as the rest of the busbar trunking.

- 4.8.3 Connections to transformers and switchboards shall consist of similar flexible connections

5. EARTHING OF METAL PARTS

- 5.1 All non-current carrying metal parts of the busbar system, e.g. framework, panels, transformer cores, metal covers, etc. shall be bonded to the earth busbar.
- 5.2 Provision shall be made at each fused take-off for a connection to the earth bar. This connection shall consist of a hole to accommodate one or more M10 bolts with nuts and washers and be prepared as described in par. 4.6.

6. BOLTS AND NUTS

Only cadmium plated high tensile steel bolts and hexagonal nuts may be employed at busbar joints and connection points. All nuts shall be provided with spring washers or be of the "NYLOCK" type with washers. The largest possible size bolt that will fit into holes in lugs and fixing holes of equipment shall be used in every instance. Bolts shall be of sufficient length so that at least two but not more than five threads protrude beyond the nut.

7. ACCESSORIES AND CONNECTIONS

- 7.1 All the accessories such as bends, cable connection boxes and fused take-offs shall be purpose-made and comply with the same specification as the busbars.
- 7.2 The temperature rise of terminals or connections at incoming or outgoing cables may not exceed the temperature rating of the cable insulation. This final temperature shall not exceed 70°C for PVC insulated cables.
- 7.3 Where busbars terminating at the ends of switchboards are intended for future extension, these busbars shall be pre-drilled to accommodate the extension. Where pre-empted space is specified for future equipment, the busbars in the proposed position shall be pre-filled and nuts and bolts shall be provided to accommodate the future busbars or cables feeding the equipment.

8. FUSED TAKE-OFFS

- 8.1 Fused take-offs for secondary supplies and equipment shall be supplied and installed in accordance with the Detail Technical Specification.
- 8.2 No connections shall be made to the main busbar without fuses. Take-offs shall comply with SANS 1473.
- 8.3 The fuses of these take-offs shall comply with the Department's standard specification for 'CARTRIDGE FUSES AND FUSE HOLDERS', Section C22.

9. FIRE BARRIERS

- 9.1 Two fire barriers in the busbar trunking shall form an integral part of each section of rising busbars. Non-flammable, non-conducting material such as asbestos-cement shall be used for this purpose.
- 9.2 The fire barriers shall be placed to prevent the spreading of fire from one floor of a building to the next but not restrict the ventilation of the busbars.
- 9.4 Overhead busbars shall be equipped with fire barriers where the busbars pass through walls or partitions from one room to another, in accordance with par. 3.5 of SANS 1473.

10. TESTING

- 10.1 Completed busbars shall be subjected to a test voltage of 2,5 kV r.m.s. for 1 min. in accordance with

10.2 Where required, fault current tests in accordance with par. 4.4.2 above shall be conducted.

TABLE C15.1

DERATING FACTORS FOR LAMINATED BUSBARS

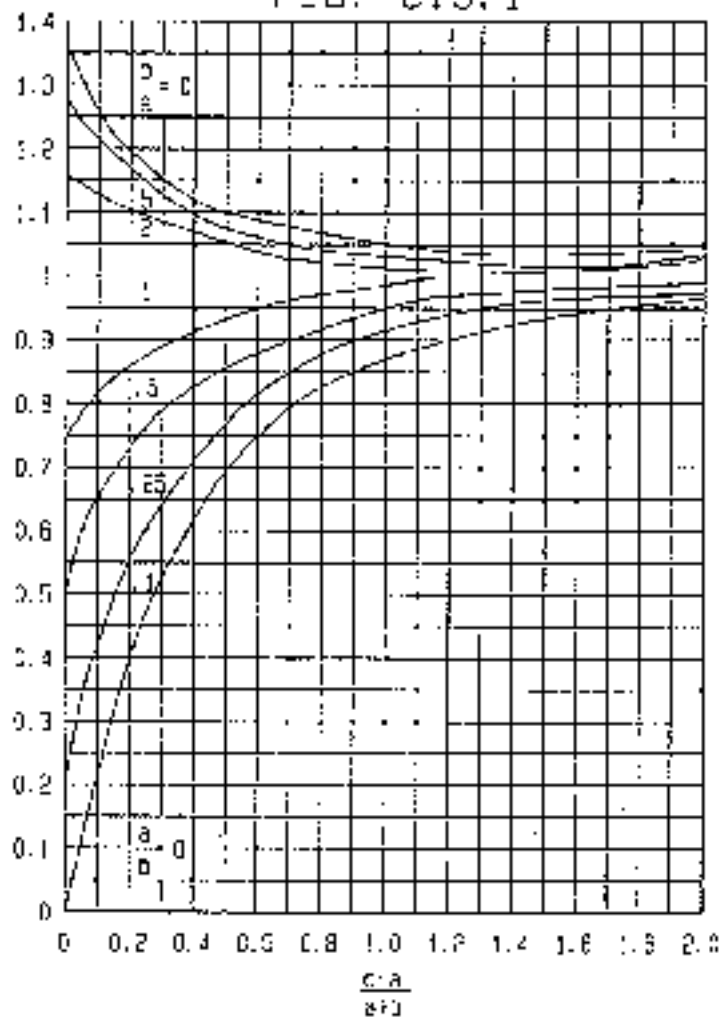
Area of Cross Section (mm ²)	No of parallel busbars per phase		
	2	3	4
500	1,78	2,45	3,13
1 000	1,72	2,30	3,00
1 500	1,65	2,24	2,84
2000	1,60	2,16	2,70
2500	1,55	2,10	2,60
3000	1,52	2,02	2,52
3500	1,48	1,96	2,46
4000	1,44	1,90	2,40

TABLE C15.2

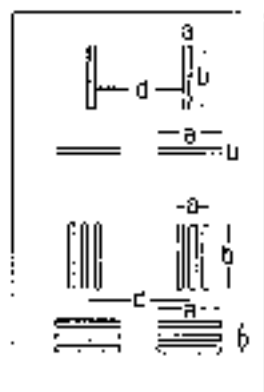
CURRENT RATING OF SINGLE COPPER BUSBARS (A)

Width (mm)	Thickness (mm)						
	2,5	3,15	4,0	5,3	10	12,5	16
12,5	155	180					
16	190	220	250				
20	230	265	300				
25	280	320	365	470			
31,5	340	385	440	560			
40	420	475	540	680	870		
50	510	575	650	820	1030	1160	
63			790	990	1240	1370	
80			970	1200	1480	1640	
100			1160	1430	1760	2180	
125				1740	2100	2310	2570
160				2070	2530	2780	3090
200						3290	3660
250						3900	4300
315						4630	5120
400							6230

FIG. C15.1



k-space factor for rectangular bars



SECTION C16**C.16 EARTHING ELECTRODES****1. GENERAL**

This section covers uncoated, coated and metal clad circular rod electrodes intended to provide an earth in soil for electrical and lightning arrestor systems.

2. CATEGORY AND TYPE

2.1 Only the following type of earth rods shall be used:

- 1(a) - Solid copper.
- 1(b) - Solid stainless steel.
- 2 (a) - Solid steel with bonded copper protection.
- 2 (b) - Solid steel with plated copper protection.
- 2 (c) - Solid steel with a shrunk-on copper jacket.
- 3 - Solid steel with a shrunk-on stainless steel jacket.
- 4 - Galvanised steel.

2.2 Bare aluminium is not acceptable as an electrode material.

2.3 All rods shall be solid and of circular cross section with length as specified in the Detail Technical Specification.

2.4 The nominal diameter of the earthing rods shall not be less than 16mm unless the rods are specified for placing in pre-drilled holes in which event the minimum nominal diameter shall not be less than 12mm.

3. COUPLINGS AND CONDUCTOR CLAMPS

3.1 Earthing electrodes shall be provided with (n-1) couplings where n = number of rods supplied.

3.2 Rods designed for coupling by means of external sleeves shall be provided with an adequate quantity of hydrocarbon or silicon grease to be applied to the coupling before the joint is made.

3.3 Rods designed for coupling by means of internal pins or spines shall be provided with thin-walled tubes and hydrocarbon or silicon grease to seal the joint.

3.4 Conductor clamps shall be provided to suit the type and size of rods provided and the type and size of conductor specified in the Detail Technical Specification.

3.5 The material of the clamps shall be electrolytically compatible with the rod and conductor materials.

3.6 Where brazed or welded connections are specified, the supplier of the rods shall stipulate at least two types of metals which are compatible with the rod and conductor materials.

3.7 An adequate number of driving caps or bolts shall be supplied with the rods to protect the ends of the earthing rods whilst being driven into hard soil.

SECTION C17**C.17 SWITCHBOARDS (UP TO 1 KV)****1. GENERAL****1.1 SCOPE**

This section covers the manufacturing and testing of flush mounted, surface mounted and floor standing switchboards for general installations in normal environmental conditions and for system voltages up to 1 kV.

1.2 SIZE

All switchboards shall be of ample size to accommodate the specified switchgear and provide space for future switchgear. For every 4 (or part of 4) 5kA circuit-breakers on a switchboard, space for an additional 5kA circuit breaker shall be allowed unless future space requirements are clearly specified. For circuit breakers above 5kA, this factor shall be + 5%. The clearance between adjoining switchgear openings shall be as specified in par. 6.2.

1.3 EXTERNAL DIMENSIONS

The maximum allowable height of free standing switchboards is 2.2m. Cubicle type boards may be up to 2.4m high if they can be fully dismantled into individual cubicles. Where, due to space restrictions, a board exceeds 2.4m in height, equipment not normally requiring access, shall be installed in the top section, enabling equipment normally requiring access to be installed lower down in the board. All other specified external dimensions for switchboards shall be strictly adhered to. If the clearances specified in par. 6.2 cannot be adhered to as a result of restricting external dimensions, the Contractor shall obtain the approval of the Department before manufacturing the switchboards.

1.4 MOISTURE AND VERMIN

All switchboards shall be rendered moisture proof and vermin proof and shall be adequately ventilated. Refer to par. 4.10 and 4.11.

1.5 LOAD BALANCE

The load shall be balanced as equally as possible across multiphase supplies.

2. CONSTRUCTION OF FLUSH MOUNTED SWITCHBOARDS**2.1 STANDARD**

Flush mounted switchboards shall comply fully with SANS 1765. Unless the depths of the switchboards are specified, the depths shall be determined in accordance with par. 6.

2.2 EXPANDED METAL

Where switchboards are to be built into 15mm thick walls, expanded metal shall be spot-welded to the rear of the bonding trays. The expanded metal shall protrude at least 75mm on each tray side to prevent plaster from cracking.

2.3 KNOCK-OUTS

Knock-outs shall be provided in the top and bottom ends of each switchboard tray to allow for the installation of conduits for the specified and future circuits. Knock-outs shall be provided for an equal number of 20mm and 25mm dia. conduits.

2.4 PANEL

Front panels shall have machine punched slots for housing the specified and future flush mounted switchgear. The distance between the inside of the closed doors and the panel shall not be less than 20mm. No equipment may be mounted on the panel unless the panel is permanently hinged to the switchboard frame.

2.5 FIXING OF FRONT PANELS

The front panel shall be secured to the architrave frame by means of 6mm studs and chromium-plated hexagonal domed nuts, tank nuts or captive fasteners. Alternatively the panel may be secured to the architrave frame by means of two pins at the bottom and a latch or lock at the top of the panel. Self-tapping screws will not be allowed. All front panels shall be provided with a minimum of one chrome plated handle.

2.6 DOOR HANDLES AND CATCHES

Switchboard doors shall be equipped with handles and catches. Locks shall only be provided when specified. In all cases where lockable doors are required and in all cases where the switchboard doors are higher or wider than 450mm, handles consisting of a push-button-and-handle combination with spring loaded catch, or rotary handle-and-catch combination shall be installed. Switchboard doors smaller than 450mm in height and width may be equipped with spring loaded flush mounted ring type handles. Square key operated catches are not acceptable unless specified.

3. CONSTRUCTION OF SURFACE MOUNTED SWITCHBOARDS

3.1 STANDARD

Surface mounted switchboards shall comply with SANS 1755.

3.2 SWITCHBOARD TRAY

Surface mounted switchboards shall be equipped with a 1.6mm minimum sheet steel reinforced tray suitably braced and stiffened to carry the chassis, door and equipment. Lugs to secure the switchboard to a vertical surface shall be provided.

3.3 CONSTRUCTION

All joints shall be welded or securely bolted. The tray shall be square and neatly finished without protrusions. The front tray sides shall be rounded with an edge of at least 20mm to accommodate flush doors.

3.4 CHASSIS

A sheet steel chassis for the mounting of equipment shall be bolted to the tray and shall comply with the requirements of par. 6.1 and 6.3.

3.5 FRONT PANEL AND DOOR

The front panel and door shall comply with par. 2.4 to 2.6 above. Doors shall fit flush in the tray when closed.

3.6 DIMENSIONS

Unless the depth of the switchboards is specified, the dimensions shall be determined in accordance with the requirements of par. 6.2 and 6.3.

4. CONSTRUCTION OF FREE STANDING SWITCH BOARDS

4.1 FRAMEWORK

A metal framework for free standing switchboards shall be manufactured from angle iron, channel iron or 2mm minimum folded metal. A solid U-channel base frame, sufficiently braced to support all equipment and span floor trenches and access holes shall be provided. Switchboards shall be of cubicle design with 2mm side panels forming dividers between cubicles. The maximum allowable cubicle width is 1.5m. (Refer also to par. 4.7). Joints shall be non-continuously full-welded. Welds shall be ground smooth and the joint wiped with plumber's metal in order to provide a smooth finish. Switchboards wider than 2m shall be fitted with

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screwed eye-bolts attached to the framework to facilitate loading and transportation of the board.

4.2 REAR AND SIDE PANELS

The rear panels shall be removable and shall be manufactured from 2mm minimum sheet steel. The panels shall have rounded edges which are recessed in the frame or which fit over lips on the switchboard frame. The panels shall be secured to the frame by means of studs and chromium-plated hexagonal domed brass nuts or hank nuts or captive fasteners equal or similar to "DZUS" or "CAMLOC". Where switchboards are intended for installation in vertical building ducts or against walls, the rear and side panels may consist of a single folded sheet which is either bolted or welded to the frame or which forms part of the folded metal frame.

4.3 FRONT PANELS

4.3.1 The front panels of floor standing switchboards shall preferably be hinged except where flush mounted equipment prevents this. Alternatively, panels shall be secured by means of the methods described in par. 2.5. The panels shall be arranged in multi-tiered fashion to allow for the logical grouping of equipment in accordance with par. 5.

4.3.2 The hinged front panels shall have a dished appearance with 20mm upturns which fit over a lip on the switchboard frame. Alternatively the hinged panels shall have folded edges and shall be fitted flush or slightly recessed in the switchboard frame. The latter method shall be used where doors are required. (Also refer to par. 4.6) Corners shall be welded and smoothed.

4.3.3 The panels shall be of 2mm minimum sheet steel with machine punched slots to allow for the flush mounting of instrumentation, switchgear toggles and operating handles. A minimum clearance of 50mm shall be maintained between the rear of equipment mounted on the panels (taking into account terminals or other projections) and the frame and chassis of the switchboard. Separate panels shall preferably be provided for the mounting of instrumentation and for covering flush mounted switchgear. Enclosed switchgear with front panels e.g. combination fuse-switch units, may be flush mounted in the board in lieu of separate hinged panels.

4.3.4 Hinged panels shall be suitably braced and stiffened to carry the weight of flush mounted equipment and to prevent warping.

4.3.5 Hinged panels with flush mounted equipment and panels higher than 800mm shall be supported by hinges of adequate strength to ensure smooth and reliable operation. 16mm pedestal or similar heavy duty hinges with single fixing bolts may be used on panels smaller than 600mm. On the larger panels long pedestal type hinges with two fixing bolts per hinge are preferred. Piano hinges are not acceptable for this application.

4.3.6 A tubular chromium-plated handle shall be fitted on each panel. The handle may be omitted if "DZUS" or "CAMLOC" fasteners are used.

4.3.7 Blanking plates shall be fitted over slots intended for future equipment. These plates shall be fixed in a manner which does not require the drilling of holes through the front panel. Dummy circuit-breakers may be fitted where applicable.

4.3.8 Front panels containing live equipment such as instrumentation or control switches shall be bonded to the switchboard frame with a braided copper earth trap with an equivalent cross-sectional area of at least 4mm².

4.4 SECURING OF FRONT PANELS

Hinged panels shall be secured in position by means of square key operated non-ferrous fasteners designed to draw the panels closed or similar quick-release fasteners. Self-tapping screws are not acceptable. Where non-hinged removable panels are specified, they shall be secured in position by means of 5mm studs and hexagonal chromed brass dome nuts and washers or hank nuts. Non-hinged removable panels may alternatively be secured in position by means of two pins at the bottom and a latch or lock at the top.

4.5 CHASSIS

A suitably braced chassis for the mounting of switchgear and equipment shall be firmly secured to the frame of the switchboard. The chassis shall be designed so that the switchgear can be installed in accordance with

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par. 6. Circuit-breakers and isolating switches which are not of the moulded-case air-break type and the insulators of busbars for ratings of 200 A and more may be secured directly to the framework. (Refer to par. 6.1).

4.6 DOORS

- (a) Doors need only be provided when specified. Doors shall be arranged in multi-tiered fashion to allow for the logical grouping of equipment in accordance with par. 6.
- (b) Doors shall have a dished appearance with a minimum of 20mm upturns which fit over a lip on the switchboard frame or shall fit flush in the switchboard frame. Corners shall be welded and smoothed.
- (c) Doors shall be of aluminum sheet steel with machine punched slots to allow for the flush mounting of instrumentation, control and protection equipment. Switchgear shall be flush mounted in the front panels behind the doors unless specified to the contrary. A minimum clearance of 50mm shall be allowed between the rear of equipment mounted on doors (including terminals and projections) and the frame, front panel and chassis.
- (d) Doors shall be suitably braced and stiffened to carry the weight of the equipment and to prevent warping.
- (e) Hinges for doors shall be provided as described in par. 4.3.5. At least three hinges shall be provided on doors higher than 1,2m.
- (f) Doors shall be fitted with handles consisting of a push-button-and-handle combination with springloaded catch or a rotary handle-and-catch combination. Flush mounted ring type handles or square key operated latches are not acceptable. The same key shall fit all locks on the switchboard in cases where locks are required.
- (g) Doors shall be fitted with hypalon or neoprene seals.
- (h) Doors containing any electrical equipment shall be bonded to the switchboard frame with a braided copper earthing wire with an equivalent cross-sectional area of at least 4mm².

4.7 SECTIONS

For ease of transportation and to facilitate access to the allocated accommodation, switchboards may be dismantled into cubicles or sections. Each section shall be rigidly manufactured to ensure that damage to the switchgear will not occur during transportation and handling. Where required, switchboards shall have temporary wood or steel bracing to protect switchgear and facilitate handling.

4.8 GROUPING OF SWITCHGEAR

The switchgear shall be logically arranged and grouped as described in par. 6. Depending upon the number and size of components, a common front panel may be installed over one or more groups of equipment. All equipment shall be installed in accordance with the requirements of par. 6.

4.9 CABLE GLAND PLATE

A cable gland plate shall be installed across the full width of each power cubicle at a minimum height of 300mm above the bottom of the switchboard to house the cable glands. A steel cable channel or other approved support shall be provided to carry the weight of the cable and remove mechanical stress from the cable glands. A minimum distance as required by the bending radius of outgoing cables shall be provided between the lowest terminals of major equipment and the gland plate.

4.10 VENTILATION

Switchboards shall be properly ventilated, especially cubicles containing contactors, transformers, motor starters, lighting dimmers and other heat producing equipment. Louvres shall be fitted to provide adequate down or cross ventilation. All louvres shall be vermin proofed with 1.5mm brass mesh or perforated steel plate internally spot welded over the louvres. The internal ambient temperature shall not exceed 40°C.

4.11 VERMIN PROOFING

Free standing boards shall be protected against vermin, especially from below, where cables have to pass

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through the gland plate, rubber grommets shall be provided and enough non-hardening compound shall be delivered with the board so that these holes can be sealed properly after installation of the cables.

5. CONSTRUCTION OF MAIN LOW TENSION SWITCHBOARDS

Main low tension switchboards and sub-main low tension switchboards heavily equipped shall comply with par. 4.1 to 4.11 as well as the following exceptions or additions:

- (a) These boards shall be fully extensible with removable busbar cover plates in the side panels.
- (b) Doors shall not be supplied unless specifically called for.
- (c) Switchgear and equipment shall be installed in accordance with the requirements of par. 8.
- (d) Provision for metering equipment shall be made in accordance with requirements of local authorities where applicable.

6. MOUNTING OF EQUIPMENT

- 6.1 The mounting of equipment shall comply with SANS 1765 where applicable. Equipment to be mounted on the chassis shall be mounted by bolts, washers and nuts or by bolts screwed into tapped holes in the chassis plate. In the latter case the minimum thickness of the chassis plate shall be 2,5mm. The latter method shall not be used where boards will be subject to vibration or mechanical shocks. Self-tapping screws will not be accepted.

6.2 SPACE REQUIREMENTS

In designing the switchboards the following requirements shall be strictly adhered to:-

- (a) A minimum of 50mm between any piece of equipment and the frame or internal partitioning. This minimum space is required on all sides of the equipment. In the case of a single row of single-pole circuit-breakers the spacing on one side row may be reduced to 25mm if the incoming side of the circuit-breakers is busbar connected.
- (a) A minimum of 75mm between horizontal rows of equipment. The maximum outside dimensions of equipment shall be considered.
- (c) Circuit-breakers up to a fault rating of 10 kA may be installed adjacent to each other. For higher ratings a minimum of 40mm shall be allowed between circuit-breakers or solenoids.
- (d) Sufficient space shall be provided for wiring allowing for the appropriate bending radius.
- (e) Space for future equipment shall be allowed as described in par. 1.2.

6.3 MOUNTING OF CHASSIS

The chassis of flush mounted and smaller surface mounted boards shall be mounted in accordance with SANS 1765. For all free standing switchboards and surface mounted switchboards where the main switch rating exceeds 100 A (triple-pole), space for wiring shall be provided between the chassis and tray. This space shall be adequate to install the supply cable behind the chassis and terminate on the main switch without sharp bends in the cable cores.

6.4 GROUPING OF EQUIPMENT

- 6.4.1 Equipment shall be arranged and grouped in logical fashion as follows:

- (a) Main switch - to be installed either at the top or bottom of the board.
- (b) Short circuit protection equipment - fuse gear or fuse-switches
- (c) Change-over contactors or other contactors controlling the supply.
- (d) Motor supplies

- (e) Fuse-switches for outgoing circuits.
- (f) Other circuits and equipment.

6.4.2 Where a portion of the equipment on the switchboard is supplied from a standby power source, the change-over contactor and the associated equipment shall be grouped in a separate compartment.

6.4.3 Where earth leakage units are required, the associated circuit-breakers shall be installed adjacent to the unit.

6.5 MOUNTING OF CIRCUIT-BREAKERS

All moulded-case circuit-breakers shall be flush mounted with only the toggles protruding. Miniature circuit-breakers may be installed in clip-in trays mounted on the frame. All other circuit-breakers shall be bolted to the chassis. Special provision shall be made for large main switches when designing the framework. Care shall be exercised that the rear studs of circuit-breakers are properly insulated from the steel chassis. Where necessary, insulating material shall be installed between the rear studs and the chassis. Circuit-breakers shall be installed so that the toggles are in the up position when "ON" and down when "OFF".

6.6 INSTRUMENTATION

All metering instruments shall be flush mounted in the front panel or door. The rear terminals of instruments mounted on doors shall be covered with an insulating material to prevent accidental contact. Current transformers for metering shall be mounted so that the rating plate is clearly visible. Fuses for instrumentation shall be mounted in an easily accessible position and clearly marked.

6.7 MOUNTING OF FUSES

6.7.1 Fuse holders shall be mounted semi-recessed in the front panel so that fuses can readily be changed without removing the front panel. Busbar mounted fuses for instrumentation shall be used as far as possible.

6.7.2 Where equipment requiring fuses is specified on a board (fuse switches etc), a ruling shall be obtained from the Department on the quantity of spare fuses to be provided.

6.8 EQUIPMENT IN MAIN BOARDS

Equipment in main low tension switchboards and sub-main boards shall be grouped in individual compartments. Equipment shall be installed as follows:

6.8.1 Rack-out type air circuit-breakers shall be mounted in the bottom section, flush behind the panel with the handle only protruding. If this is not possible, the panel shall be omitted and the air circuit-breakers installed behind a door.

6.8.2 If the main switch is a moulded-case circuit-breaker or isolator it shall be flush mounted.

6.8.3 Contactors controlling the supply shall be installed behind separate front panels.

6.8.4 All metering, protection and indicating equipment shall be clearly visible from the front of the board. Current transformer ratios and multiplication factors shall be clearly marked. Where doors are specified the equipment shall be installed flush in the doors and covered as described in par. 6.6.

6.8.5 All circuit-breakers and fuses (with the exception of fuse-switches) may be grouped together behind one or more panels as described in par. 4.8.

6.8.6 Fuses or fuse-switches providing back-up protection for circuit breakers, shall be grouped with the associated circuit-breakers. Exposed surface effuse-switches shall be of the same finish and colour as the rest of the board where practical.

6.9 STANDBY SUPPLIES

6.9.1 Where standby power from a diesel-generator set or other sources is available and has to be connected to some of the equipment on a switchboard, the switchboard shall be divided into separate sections with sheet metal divisions to isolate standby power and mains power sections.

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- 6.9.2 Standby and normal supply shall each have its own incoming isolator or circuit-breaker.
- 6.9.3 The two sections of the switchboard shall be labelled "ESSENTIAL" and "NON-ESSENTIAL" respectively.
- 6.9.4 The front panels of standby and no-break supply sections shall be painted in distinctive colours as follows:
- | | | | |
|-----|-----------------|---------------------------------|--|
| (a) | Normal supply | "LION" ORANGE" | colour 025 of SANS 1091 |
| (b) | Standby power | "SIGNAL RED", | colour A11 of SANS 1091 |
| (c) | No-break supply | "DARK VIOLET",
"OLIVE GREEN" | colour F08 or
colour H05 of SANS 1091 |

7. BUSBARS IN SWITCHBOARDS

7.1 APPLICATION

- 7.1.1 Busbars shall be manufactured of solid drawn high conductivity copper with a rectangular cross-section in accordance with SANS 1473, SANS 1195 and BS 129 and BS 1433, where applicable.
- 7.1.2 Although SANS 1473 refers only to overhead or rising busbars, busbars in switchboards shall comply with applicable sections of this specification especially as far as insulation and clearance values, creepage distance, joints, insulation resistance, dielectric strength, deflection test, absorption resistance and rated short time withstand current are concerned.
- 7.1.3 Busbars shall be supplied for the following applications:
- (a) Distribution of supply voltage
 - (b) Connection of equipment with ratings exceeding the current rating of 70mm² conductors (par. 8.6).
 - (c) Connection of outgoing circuits with current ratings in excess of that allowed for 70mm² conductors (par. 7.8).
 - (d) Collector bars for parallel cables (par. 8.1).
 - (e) Connection bars for neutral conductors (par. 7.9).
 - (f) Earth busbars (par. 7.10).
 - (g) Connections to miniature circuit-breakers (par. 8.6).

7.2 SEE PART C15 FOR FURTHER DETAILS.

8. WIRING

8.1 CABLING

Cables connected to incoming or outgoing circuits shall be terminated on the gland plate supplied for this purpose (Refer to par. 4.9). Power cables up to and including 70mm² may terminate on clamp type terminals where the clamping screws are not in direct contact with the conductor. Connection to the equipment can then be made with cables that are similarly connected to the clamp terminal. All power cables larger than 70mm² terminate on busbars that are connected to the associated equipment. Parallel incoming or outgoing cables shall be connected to a collector busbar without crossing the conductors.

8.2 TERMINAL STRIPS

External wiring for low voltage, control, interlocking, alarm, measuring and DC circuits shall terminate on numbered wiring terminals complying with Department's standard specification for "WIRING TERMINALS", Section C9. The correct terminal size as recommended by the manufacturer for each conductor to be connected shall be used throughout. The terminal numbers shall appear on the wiring

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diagrams of the switchboard. Terminals for power wiring shall be separated from other terminals. Terminals for internal wiring shall not be interposed with terminals for external circuits. All connections to terminals shall be identified as described in par. B.8. Where switchboards consist of separate sections, the control wiring passing between sections shall be terminated on strips in each section so that control wiring can be readily re-insulated when re-assembling the board.

B.3 CURRENT RATINGS

The current rating of conductors for the internal wiring shall be sufficient for the maximum continuous current that can occur in the circuit. This value shall be determined from the circuit breaker or fuse protection of the circuit.

TABLE 17.3

CURRENT RATING FOR INTERNAL

Nominal cross- Section mm ²	CONDUCTOR RATING (A)				
	Number of conductors in bunch				
	1	2-3	4-5	6-9	10 and more
2.5	26	25	22	19	15
4	37	33	30	26	22
6	47	42	38	33	28
10	64	54	51	44	38
16	85	76	68	59	51
25	112	101	89	78	67
35	138	124	110	95	88
50	172	154	137	120	103
70	213	191	170	149	127

The above table shall be applied for ambient temperatures up to 30°C. (Refer in table 41.2 in VDE 0100). For higher ambient temperatures the values shall be derated as prescribed by SANS 10142, Table 10.

B.4 INTERNAL WIRING

- Standard 800/1 000 V grade PVC-insulated stranded annealed copper conductors to SANS 1507 shall be employed for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2.5mm². Flexible cord of minimum size 1.0mm² may be used for control wiring.
- Where heat generating equipment is present and the internal temperature of the board is likely to exceed 50°C, silicon-rubber insulated stranded conductors shall be used.
- Wiring shall be arranged in horizontal and vertical rows and shall be bound with suitable plastic straps or installed in PVC wiring channels. Under no circumstances may PVC adhesive tape be used for the bunching of conductors or for the colour identification of conductors.
- Bunched conductors shall be neatly formed to present a uniform appearance without twisting or crossing the conductors. Conductors leaving the harnesses shall be so arranged that they are adjacent to the chassis.

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- (e) Conductors to hinged panels and doors shall be secured on both the door and the frame and shall be looped between the two points. The loop shall be arranged to produce a twisting motion when the door is opened or closed. A flexible protection sleeve shall be installed over the conductors.
- (f) Where wiring channels are used, they shall be installed horizontally and vertically. Under no circumstances may power and control circuit wiring be installed in the same wiring channels. Channel shall not be more than 40% full.
- (g) All wiring between different Panels within the same switchboard shall be installed in wiring channels.
- (h) Grommets shall be installed in each hole in the metalwork through which conductors pass.
- (i) All wiring shall be installed away from terminals, slugs or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges protected where they cross metal edges.
- (j) Conductors may be joined at equipment terminals or numbered terminal strips only. No other connections are allowed.
- (k) Where conductors change direction, smooth bends shall be formed with a radius of at least 5 times the outside diameter of the conductor or harness.
- (l) Where screened cables are specified, the screening shall be earthed in the switchboard or control board only unless clearly specified to the contrary. Screened cables entering control boxes through pressed knock-outs, shall terminate in compression glands. Conductors shall as far as possible remain inside the screening at terminations. Where conductors have to separate from the screen, the braiding shall be separated and the conductors drawn through the braid without damaging the braiding. The conductors shall then be connected to their respective terminals and the screening smoothed and connected to the earth terminal.
- (m) Where neutral connections are looped between the terminals of instruments, it is essential that the two conductor ends be inserted into a common lug or ferrule and are crimped or soldered together in order that the neutral connection is not broken when the conductors are removed from one of the instruments.
- (n) Wiring should as far as possible be confined to the front portions of switchboards for ease of access. This requirement is important for wiring between smaller circuit-breakers and the associated main circuit-breaker as well as the wiring from circuit-breakers to lighting and socket-outlet circuits.
- (o) A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (e.g. a main circuit-breaker feeding other circuit-breakers), stub busbars shall be provided for the various conductors. Refer also to par. 8.6.

8.5 LOAD END CONNECTIONS

The supply end connections to all equipment shall under all circumstances be at the top and the load end connections at the bottom.

8.6 WIRING TO CIRCUIT-BREAKERS

Equipment with a rating exceeding the current rating of 70mm² conductors shall be connected by means of busbars to the main busbars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, busbars shall be used and equipment connected individually to the busbars. Where miniature circuit-breakers are mounted in continuous rows and supplied by busbars connected to each MCB, each busbar shall be supplied by a separate conductor. This conductor shall be connected to the busbar by means of a separate lug and not via an MCB terminal.

8.7 CONDUCTOR TERMINATIONS

Conductors connected to terminals complying with the Department's standard specification for "WIRING TERMINALS", Section C9 need not be soldered or ferruled. Connections to circuit-breakers, isolators or contactors shall be made by one of the following methods.

- (a) A ferrule of the correct size
- (b) soldering the end of the conductor, or
- (c) winding a conductor strand lightly around the end to totally cover the end.

All conductors terminating on meters, fuse holders and other equipment with screwed terminals shall be fitted with lugs. The lugs shall be soldered or crimped to the end of the conductor. The correct amount of insulation shall be stripped from the end to fit into the terminal. Strands may not be cut from the end of the conductor.

8.8 IDENTIFICATION

8.8.1 The colour of the conductors for all 220/250 V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black.

8.8.2 All other conductors in the board, supplying control circuits, etc. shall be coded in colours other than those specified above. A colour code shall be devised for each board and the colour code shall be shown on the wiring diagrams.

8.8.3 All conductors that terminate at wiring terminals and all conductors used for the internal wiring of the switchboard, shall further be identified at both ends by means of durable cable marking ferrules. PVC or other tape is not acceptable.

8.8.4 The numbers on the markers shall be shown on the wiring diagrams.

9. PAINT FINISH

Meta components of the framework, panels and chassis shall be painted in accordance with the Department's "STANDARD PAINT SPECIFICATION", Section C39.

10. LABELLING

10.1 Care shall be taken to ensure that all equipment is fully labelled and that accurate descriptions and safety warning notices appear in both official languages.

10.2 MATERIAL

Engraved plastic or ivory sandwiched strips shall be used throughout. The strips shall bear white lettering on a black background for normal labels and red letters on a white or yellow background for danger notices.

10.3 MAIN SWITCHBOARDS

Main switchboards and sub-main switchboards shall be supplied with the following bilingual labels:

- (a) Number and allocation of switchboard. Example:

CONTROL BOARD A4

BEHEERBORDA4

Lettering: at least 10 mm high prominent position. Label on the outside in a prominent position.

- (b) Designation of busbar sections. Example:

BUSBAR SECTION 2

GELEISTAMSEKSIIE2

Lettering: at least 10 mm high. Label on the outside in a prominent position.

- (c) Designation of all switchgear including circuit-breakers, isolators, contactors, etc. If the current rating of circuit-breakers is not clearly marked on the equipment, the value shall be indicated on the engraved label. Example:

SUPPLY TO BOARD C3 TOEVOER NA
BOARD C3

PUMP SUPPLY
POMPTOEVOER

Letters at least 3mm high. Labels on the outside of the switchboard.

- (d) All other equipment including meters, instruments, indicator lights, switches, push-buttons, circuit-breakers, fuses, contactors, control relays, protection relays, etc. shall be identified. The function of the equipment and circuits shall be clearly indicated. The main switch shall be labelled as such and designated

"SWITCH OFF IN CASE OF EMERGENCY"
"SKAKKEL AF IN NOODGEVAL"

Flush mounted equipment within doors or front panels shall be identified with labels fixed to the doors or front panels respectively. The labels for equipment installed behind panels shall be fixed to the chassis close to the equipment. If this equipment is positioned too close together to accommodate descriptive engraved labels the equipment may be identified by a code or number on an engraved label which shall be fixed close to the equipment. The code number shall be identified on a legend card which shall be installed on the switchboard behind a plastic or other protective cover.

10.4 OTHER SWITCHBOARDS

All equipment on switchboards shall be identified with the necessary bilingual labels. The circuit numbers shall appear at grouped single-pole circuit-breakers. The circuit numbers shall correspond to the circuit numbers on the final installation drawings. The above-mentioned circuits shall be identified on a legend card, which shall be installed on the inside of the switchboard door, or in any other position where it can conveniently be observed. All fuses, including instrument fuses, shall have labels stating function, fuse rating and duty or type where applicable. All other equipment shall be identified separately and their functions shall be clearly indicated.

10.5 FIXING OF LABELS

- 10.5.1 Labels shall not be fixed to components or trunking cut to doors, panels, chassis or other permanent structures of the switchboard.
- 10.5.2 Engraved strips shall be secured to facilitate a neat alteration of the designation of the labels. Sufficient fixing points shall be provided to prevent labels from warping. Labels in slotted holders shall be secured in position to prevent unauthorised removal. Labels may be secured by the use of brass nuts and nuts, self-tapping screws, slotted label holders or pop-rivets.

11 TESTS

- 11.1 The Department shall be notified when the mechanical construction of the switchboard, i.e. frame, panels and base frame, is complete in order that it may be inspected at the factory.
- 11.2 Function tests of all equipment, control and interlocking circuits shall be conducted to the satisfaction of the Department. Testing equipment and facilities including instruments, dummy loads and additional switchgear and cables shall be provided by the Contractor at no extra cost. The Department shall be notified in writing two weeks in advance of any test to be conducted, to allow its representative to be present at such tests. A complete report on the tests shall be handed to the Department.

12. DRAWINGS

12.1 DRAWINGS FOR APPROVAL

A set of three prints of the shop drawings for the switchboards shall be submitted to the Department for approval before the boards are manufactured. The following information shall be presented:

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- (a) A complete wiring diagram of the equipment on the boards.
- (b) A complete layout of the arrangement of the switchboards indicating all equipment dimensions and the construction of the boards. The positions and method of fixing and sizes of busbars shall be shown.
- (c) All labelling information in both the official languages on a separate sheet.
- (d) The make, catalogue number and capacity of all equipment such as isolators, circuit-breakers, fuses, contactors, etc.

The approval of drawings shall not relieve the Contractor of his responsibility to the Department to supply the switchboards according to the requirements of this Specification.

12.2 FINAL DRAWINGS

A complete set of "as-built" transparent drawings of all switchboards shall be submitted to the Department within two weeks after delivery of the boards. The following information shall be presented:

- (a) Item (a) to (d) of the previous paragraph.
- (b) Terminal strip numbers, numbers and colours of conductors connected to the terminal strips and numbers and colours of the conductors utilized for the internal wiring.
- (c) A separate schedule of all equipment.

12.3 MANUALS

Three sets of manuals for all specified main and sub-main switchboards shall be supplied to the Department at no extra cost. These manuals shall include the following information:

- (a) Complete information on the operation of the equipment.
- (b) Complete information for maintenance of the equipment.
- (c) Brochures and ordering information.
- (d) A complete equipment list indicating quantities and relevant catalogue numbers.

12.4 COMPLETION

The supply contract shall be regarded as incomplete until all tests have been conducted successfully and all drawings and manuals have been handed to the Department.

SECTION C.18**C.18 LOW VOLTAGE DISTRIBUTION CUBICLES (KIOSKS)****1. GENERAL**

This specification covers the manufacture of distribution kiosks for general recalculation and distribution systems in normal environmental conditions for three-phase, four-wire, 400/231V, 50 Hz systems.

2. SIZE

Kiosks shall be of ample size to accommodate the specified equipment and provide space for future requirements as specified.

3. MOISTURE AND VERMIN

3.1 Kiosks shall be weatherproof. To prevent the ingress of water onto live equipment, the door entry surrounds shall have a channel shape, at least 12mm deep, to accommodate the door edge.

3.2 The roof shall be constructed with an overhang above non continuous panelling and shall be provided with a drip-edge.

4. VENTILATION

4.1 Two ventilation grilles or slots, approximately 150 x 125mm, vermin proofed and insect proofed by means of 1,0mm brass mesh or perforated steel plate spot-welded on the inside, shall be provided on the top and bottom of both side panels.

4.2 The construction of the grilles shall prevent the ingress of rain or water.

5. FIBREGLASS CANOPIES**5.1 APPLICATION**

Where specified and for all kiosks to be installed within 50km of the coast and in corrosive industrial atmospheres, the canopy and doors shall be manufactured of fibreglass.

5.2 CONSTRUCTION

5.2.1 The laminate shall be constructed to SANS 141.

5.2.2 An outer isophthalic resin gelcoat with a minimum thickness of 0,4mm and ultraviolet absorption properties to prevent degradation of the surface from exposure to the sun shall be provided.

5.2.3 The gelcoat shall be backed by multiple layers of chopped strand mat glass rendering not less than 1,2kg/m². The strength shall be increased to 1,8 kg/m² on kiosks with panelling larger than 500 x 500mm.

5.2.4 The fibreglass shall be thoroughly impregnated with polyester resin. The resin should preferably be clear.

5.2.5 The resin to fibreglass ratio shall not be less than 2,5:1 and not more than 3:0:1.

5.2.6 Air entrapment between the glass mat layers shall be thoroughly worked out. The laminate must be free of air bubbles and voids.

5.2.7 All edges shall be reinforced with an additional 700 g/m² of fibreglass.

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- 5.2.8 All large surfaces, wider than 300mm, shall be reinforced or panelled to improve stiffness and rigidity.
- 5.2.9 A resin coat shall be applied to the inside of the kiosk to cover the fibre pattern.
- 5.2.10 Brass or steel backing plates shall be laminated into the fibreglass at hinge points, locking mechanism catch support areas, door restraint fixing points and all other points which will be subjected to mechanical stresses.
- 5.2.11 Doors shall be adequately braced, reinforced, ribbed or double laminated with an air gap between the two layers of laminate to ensure rigidity.
- 5.2.12 The fibreglass canopy shall be fixed to the internal equipment support frame with bolts accessible through the door only.

5.3 FINISH AND COLOUR OF FIBREGLASS KIOSKS

- 5.3.1 The outside surface of the kiosk shall have a glossy, smooth finish to ensure good weathering. To obtain this the manufacturer shall ensure that the mould is smooth, free of voids, hairline cracks, pores or other defects.
- 5.3.2 Compound rubbing or sanding of the outside surface will not be permitted.
- 5.3.3 Pigments shall be added to the outer gelcoat to obtain a matching colour to SANS 1091 "AVOCADO GREEN", colour C12 or "LIGHT STONE", colour C37.
- 5.3.4 Fibreglass kiosks shall not be painted.

6. SHEET STEEL CANOPIES

- 6.1 Where specified the canopy and doors shall be manufactured of either mild steel or 304 stainless steel to the following requirements:
- 6.1.1 A metal framework shall be manufactured from solid angle iron, channel iron or 2,5mm minimum folded sheet steel.
- 6.1.2 Joints shall be non-continuously butt welded. Welds shall be ground smooth and the joint wiped with plumber's metal in order to provide a smooth finish.
- 6.1.3 Side panels, doors and the roof shall be manufactured from 2mm minimum sheet steel. The panels shall have upturned edges which are recessed in the frame or which fit over lips on the frame. The side panels may be either bolted or welded to the frame or form part of the folded metal frame.
- 6.1.4 The roof of the cubicle shall be removable and shall be fitted by means of bolts which shall be accessible from inside the cubicle only.
- 6.1.5 All panels and doors shall be suitably braced and stiffened to ensure rigidity and to prevent warping.
- 6.1.6 The steel canopy and framework shall be fixed to the base frame by four M16 high tensile steel bolts.

6.2 FINISH AND COLOUR OF SHEET STEEL KIOSKS

- 6.2.1 Metal components of the framework, panels and doors shall be painted in accordance with the Department's "STANDARD PAINTING SPECIFICATION", Section C39.
- 6.2.2 The colour shall be "AVOCADO GREEN", colour C12 or "LIGHT STONE", colour C37 of SANS 1091. A tin of matching touch up paint (not smaller than 500ml) shall be provided with each consignment.

7. CAST IRON KIOSKS

- 7.1 Where specified the cubicle panels and doors shall be manufactured from cast iron to the following requirements.

- 7.1.1 A metal framework shall be manufactured from solid angle iron or channel iron.
- 7.1.2 Cast iron panels shall be bolted to the frame work and shall be replaceable with standard cast iron panels.
- 7.1.3 The panels shall be bolted to the frame from the inside of the cubicle. Bolts or nuts on the outside of the cubicle are not acceptable.
- 7.1.4 The roof of the cubicle shall be one casting and shall be bolted in position from inside the cubicle.
- 7.1.5 The minimum thickness of the cast iron panels and doors shall be 6mm.
- 7.1.6 All cast iron panels and doors shall be fettled prior to painting.

7.2 FINISH AND COLOUR OF CAST IRON KIOSK:

- 7.2.1 Metal components of the framework, panels and doors shall be painted in accordance with the Department's "STANDARD PAINTING SPECIFICATION" Section C39.
- 7.2.2 The colour shall be "AVOCADO GREEN", colour C12 or "LIGHT STONE", colour C37 of SANS 1591. A tin of matching touch-up paint (not smaller than 500ml) shall be provided with each consignment.

8. DOORS

- 8.1 Doors shall be fitted to the front and to the rear of each cubicle. The doors shall provide free access to equipment which has to be operated and shall provide a full view of all meters. Cubicles wider than 700mm shall be provided with double doors.
- 8.2 Doors shall have well returning edges to fit into the channel of the door entry surrounds. Refer to par. 3.1 and 6.1.3.
- 8.3 Doors shall swing through 135°.
- 8.4 Brass hinges shall be used to hang the doors. The hinges shall be bolted to the canopy with brass bolts and nuts. Bolt heads or nuts shall not protrude beyond the outer surface of the kiosk. Nylon, aluminium or piano hinges are not acceptable.
- 8.5 Doors shall be fitted with lever locks with a 135° movement. The locking mechanism shall have a catch on the rear which catches behind the frame or door entry surround. The locking mechanism as well as the catch support area shall be backed with brass or galvanised steel plates. The locking mechanism shall be lockable by padlocks. Padlocks will be provided by the Department.
- 8.6 The locking mechanism shall be made of brass or stainless steel.
- 8.7 Door restraints shall be provided. Cloth or canvas straps are not acceptable. The fixing points of the restraint at both the door and canopy shall be reinforced.
- 8.8 At least three hinges shall be supplied on steel doors higher than 12mm.
- 8.9 Doors shall be fitted with neoprene or equivalent seals.
- 8.10 Metal doors shall be earth bonded to the frame by means of a copper braided strap, tooth washers, bolts and nuts.

9. EQUIPMENT SUPPORT FRAME

- 9.1 A free standing, angle iron or similar type rigid support framework shall be provided.
- 9.2 The frame shall be bolted down on the base by four M16 high tensile steel bolts. The holding-down bolts shall be accessible from the inside of the cubicle only. The frame of sheet steel canopies may be bolted to the canopy framework.
- 9.3 A galvanised steel cable gland plate shall be bolted to the bottom of the frame across the full width of the cubicle to cover the cable entry opening in the base.

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- 9.4 The gland plate shall be suitably punched to accept the number and size of cables specified.
- 9.5 All steelwork shall be hot-dip galvanised in accordance with SANS 32&121.
- 9.6 A panel of resin bound synthetic wood or other suitable dielectric material shall be provided for the mounting of all equipment and busbars. Impregnated hardboard, other treated or untreated wood products are not acceptable.
- 9.7 Alternatively, all equipment and busbars shall be flush mounted within a purpose-made sheet metal frame enclosed by a machine punched removable front panel through which the operating handles of the equipment protrude. Care shall be exercised that the rear studs of circuit-breakers are properly insulated from the steel chassis. Miniature circuit-breakers may be installed in clip-in trays mounted on the frame.

10. CONCRETE BASES AND BASE FRAMES

- 10.1 To ensure stability of the kiosk after installation, it shall be mounted on a base frame which, in turn, shall be bolted to a concrete base cast into the bottom of the cable trench.
- 10.2 The base frame shall be constructed of angle iron, at least 50 x 4mm thick and shall be of welded construction hot-dip galvanised and coated with epoxy resin tar.
- 10.3 The vertical height of the box frame shall be at least 900mm and the construction shall be such as to provide a rigid support for the kiosk.
- 10.4 The base frame shall protrude to a maximum height of 200mm above ground level. Provision shall be made for the protection and concealing of the cables entering the kiosk and to prevent access of animals and vermin.
- 10.5 The base frame shall be secured by at least four M16 bolts to the support frame of the kiosk and four M16 anchor bolts and nuts to the concrete base. The bolts, nuts and washers shall be galvanised and supplied with the kiosk.
- 10.6 All galvanising shall be to SANS 32&121.
- 10.7 The kiosk manufacturer shall supply a detailed drawing of the base frame and the concrete base required.
- 10.8 Alternative designs and materials for the base (or roof) of the kiosk will be considered but full details must be submitted for approval by the Department.

11. BUSBARS

See Section C.15 for details

12. WIRING

See Section 17.8 for details

13. MOUNTING OF EQUIPMENT

- 13.1 The mounting of equipment shall comply with SANS 1765 where applicable. Equipment shall be fixed to the support panel with bolts, nuts, washers and spring washers or self locking nuts with washers. Self-lapping screws are not acceptable.
- 13.2 Equipment shall be arranged and grouped in a logical fashion.
- 13.3 All equipment shall be flush mounted behind panels with only circuit-breaker and isolator toggles and meter faces protruding. The front panels shall be secured in position by 6mm studs and hexagonal chromed brass dome nuts and washers or hex nuts fasteners. Self-lapping or similar screws are not acceptable.
- 13.4 Blanking plates shall be fitted over slots intended for future equipment. These plates shall be fixed so that fixing holes do not need to be drilled through the front panel.

14. ACCESS

All equipment, busbars and wiring shall be completely accessible with the door open and the back door and front panel removed. In the case of fibreglass kiosks the complete canopy shall be removable.

15. LABELLING

15.1 All equipment shall be fully labelled and accurate descriptions shall be given in both official languages.

15.2 Engraved brass shall be used for labels. The labels shall be riveted to the kiosks.

15.3 The following labels shall be supplied as a minimum requirement:

15.3.1 Number and allocation of kiosk, e.g. KIOSK B26

(Lettering: At least 10mm high. Label on the outside in a prominent position)

15.3.2 Designation of circuit i.e. circuit-breaker, isolator, meter, etc. e.g.

HOUSE 473
HUIS473

PUMP SUPPLY
POMPVOEDVOER

(Lettering: At least 5mm high. One label installed directly below each item of equipment pertaining to the particular circuit shall be provided).

15.3.3 The main switch shall be marked in accordance with the regulations.

15.3.4 The function and circuits of all other equipment shall be clearly identified. Flush mounted equipment within the front panel shall be identified by labels fixed to the front panel. The labels for all equipment installed behind panels shall be fixed to the support panel close to the equipment.

15.3.5 The labels shall be secured by means of rivets. Self-tapping screws are not acceptable. Labels shall not be glued to their mounting positions. Sufficient rivets shall be provided to prevent labels from warping.

15.3.6 All label designations shall be confirmed with the Department before manufacture.

16. NOTICES

At least one with the words "DANGER/INGOZIGEVAAR" shall be mounted outside on the front of the kiosk. This notice shall be riveted to the steel or cast iron door so that it cannot easily be removed. Brass rivets shall be used. The notice shall be laminated into the fibreglass door in the case of fibreglass kiosks.

17. INSPECTION

The Department shall be notified at least two weeks in advance of the completion of the kiosks in order that an inspection may be carried out before delivery.

18. DRAWINGS

18.1 DRAWINGS FOR APPROVAL

18.1.1 A set of three prints of the shop drawings of the cubicles shall be submitted to the Department for approval before the cubicles are manufactured. The following information shall be presented:

- (a) Schematic and wiring diagrams of the cubicles.
- (b) A complete layout of the arrangement of the cubicles showing all equipment, dimensions and constructional details. The positions and method of fixing of busbars shall be shown.

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- (c) All labelling information in both the official languages on a separate sheet.
- (d) The makes, catalogue numbers and capacities of all equipment.
- (e) A detail drawing of the concrete plinth, showing concrete mixes, dimensions, sizes, steel reinforcing details and holding-down bolt fixing details.

15.1.2 The approval of drawing shall not relieve the Contractor of his responsibility to the Department to supply the cubicles according to the requirements of this Specification.

15.2 FINAL DRAWINGS

A complete set of 'as built' drawings of the cubicles shall be submitted to the Department within two weeks after delivery of the kiosks. The information contained in part 15.1.1 shall be provided.

16.3 COMPLETION

The supply contract shall be regarded as incomplete until all drawings have been handed to the Department.

SECTION C19**C.19 METAL CLAD AIR CIRCUIT BREAKERS, WITHDRAWABLE TYPE**

1. This section covers withdrawable air circuit breakers for use in power distribution systems up to 1kV, 50 Hz.
2. The circuit breakers shall be metal clad and shall comply with BS 4752 and IEC 157.
3. The circuit breaker shall be horizontally withdrawable and shall be a self-contained unit of the dead front type, allowing maintenance and tests to be carried out without having to remove the circuit breakers from the withdrawal mechanism.
4. The unit shall contain the necessary mechanical interlocks to prevent:
 - (a) Access to "LIVE" terminals when the circuit breaker is withdrawn.
 - (b) The withdrawal or insertion of the unit, when the circuit breaker is in the closed position.
 - (c) Closing of the circuit breaker following an automatic trip condition without resetting the mechanism.
5. Adjustable thermal overload releases shall be provided to suit the required current range. In addition instantaneous magnetic short circuit trips which are adjustable shall be fitted. The tripping devices shall be direct acting. The delay adjustment shall be bypassed with an instantaneous making current release when the circuit breaker is closed to prevent the delay timer from operating when the circuit breaker is closed on a fault.
6. The air circuit breakers shall be of the quick make and quick break type with a stored energy spring assisted operating mechanism provided with:
 - (a) A trip free mechanical hand operated closing mechanism.
 - (b) A manually operated mechanical trip mechanism suitably protected to prevent inadvertent tripping.
 - (c) A positively driven mechanical device to provide ON/OFF/ TRIP indication. This indication shall be clearly visible with the circuit breaker in position.
7. Provision shall exist for the addition, if required, of a supply side under voltage release.
8. Air circuit breakers shall have electrically separate auxiliary contacts as specified. Where none are specified two N/O and two N/C auxiliary contacts shall be provided.
9. Shunt trips and electrical stored energy circuit breakers shall be interlocked to prevent repeated operation of the trips or winding mechanisms when the circuit breaker is in the tripped or closed position.
10. All non current carrying metal parts of air circuit breakers shall be solidly interconnected and connected to an earth contact on the truck which shall engage with a mating contact or copper plate on the cradle which is connected to the earth busbar of the switchboard. The arrangement shall be such that the air circuit breaker frame is earthed in the test position and before the circuit breaker contacts engage the live fixed contacts.
11. The fixed cradle shall be of high mechanical strength.
12. The circuit breaker shall have "RACKED OUT", "TEST" and "ENGAGED" positions that are clearly marked.
13. The air circuit breaker shall bear a clearly legible rating plate indicating the current rating, breaking capacity and voltage rating.
14. The complete circuit breaker and its electrical and mechanical constituents and accessories shall be from a standard product range of a single original supplier.

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15. Extension type operating handles shall be fixed to the air circuit breaker on completion of the installation.
16. A description and illustration of the circuit breaker as well as trip curves, operating manuals and rupturing test certificates shall be provided.
17. The circuit breakers shall be designed to allow the incoming terminals to be at the top or bottom without affecting the operation of the unit.
18. Circuit breakers shall be derated if necessary to compensate for the following environmental factors:
 - (a) Maximum ambient air temperature in excess of 40°C or the daily average ambient air temperature in excess of 30°C. This is especially important with regard to the type of enclosure in which the circuit breaker is to be installed.
 - (b) Height above sea level.
 - (c) Operational duty cycle and estimated loading.

SECTION C.20**C.20 MOULDED-CASE CIRCUIT-BREAKERS**

1. This section covers single or multi pole moulded case circuit breakers for use in power distribution systems, suitable for panel mounting, for ratings up to 1200 A, 600 V, 50 Hz.
2. The circuit breakers shall comply with SANS 156.
3. The continuous current rating, trip rating and rupturing capacity shall be as specified.
4. The contacts shall be silver alloy and shall close with a high pressure wiping action.
5. Where specified, the circuit breaker shall be capable of accommodating factory fitted shunt trip or auxiliary contact units or similar equipment.
6. The operating handle shall provide clear indication of "ON", "OFF" and "TRIP" positions.
7. The mechanism shall be of the TRIP-FREE type preventing the unit from being held in the ON position under overload conditions.
8. All moulded case circuit breakers in a particular installation shall as far as is practical be supplied by a single manufacturer.
9. The incoming terminals of single pole miniature circuit breakers shall be suitable for connection to a common busbar.
10. The circuit breaker shall have a rating plate indicating the current rating, voltage rating and breaking capacity.
11. Extension type operating handles shall be provided for units of 800 A rating and above.

SECTION C21**C.21 COMBINATION FUSE-SWITCH UNITS**

1. Combination fuse switch units shall be triple pole devices fitted with neutral links and shall comply fully with SANS 80547 or BS 6419.
2. The fuse-switches shall be of the on load type capable of carrying the rated current continuously making and breaking rated current and tested to IEC 408 for making and breaking capacity.
3. The units shall be of the double air-break, quick-make, quick-break type with an arc chamber. The mechanism shall be driven by springs on both sides.
4. The unit shall consist of a fixed contact assembly, heavy duty mechanism, moving contact carriage and a retractable operating handle mounted on a rigid frame. The contacts shall be of high quality material e.g. silver plated.
5. The fixed contacts shall be shrouded.
6. When the fuse-switch is in the open position, the double air-break shall isolate the HRC fuse links, permitting fuse replacement in safety.
7. Interlocks shall be provided to prevent the cover from being opened when the switch is 'ON' and to prevent the switch from being operated when the cover is open unless purposely defeated.
8. The cartridge fuses used in the units shall comply with SANS 172 or BS 88 or the equivalent DIN and VDE standards. The category of duty shall be suitable for the voltage level and the fault level at the point where the fuses are installed. Time/current characteristics shall be matched to the equipment supplied and protected by the switch.
9. Fuse-gear carrying the HRC fuses on the cover, the cover also forming the operating lever, is regarded as a fuse isolator and is not acceptable.

SECTION C22**C.22 CARTRIDGE FUSES AND FUSE HOLDERS**

This section covers cartridge fuses and holders used for the protection of distribution and power system equipment up to 600 V.

1. TYPES

- 1.1 The following fuse and fuse holder types are acceptable for use in distribution and power systems:
 - (a) A cartridge type fuse link which fits into a fuse carrier together with a fuse base with fixed terminals. The fuse can be removed by taking out the fuse carrier and then removing the fuse from the carrier.
 - (b) A cartridge type fuse link which fits into a fuse base with fixed terminals. In this case a fuse puller is required to disengage the fuse from the base. These fuses are only acceptable on equipment imported with these fuses as a standard item. One puller shall be supplied for each board or box in which these fuses are used.
- 1.2 Rewirable fuses are not acceptable and shall not be used.
- 1.3 Fuses shall normally be installed in moulded plastic fuse holders or rigid isolating barriers shall be installed between the fuses. Sufficient spacing to prevent accidental contact when inserting or withdrawing fuses shall be maintained. The covers or barriers shall be manufactured for the specific fuses to be used.
- 1.4 Striker pin fuses shall be equipped with an alarm contact so that the contact closes and remains closed when the striker pin operates.

2. STANDARDS

All fuses used for distribution systems shall comply with the following standards:

- 2.1 Fuses : SANS 1172 or BS 88, Parts 1 and 2
- 2.2 Holders : SANS 172.
- 2.3 Fuses of the types described in par. 1 above and complying with the relevant DIN (49513, 49511, 49515, 49522, 49330, 49367) and VDE (0635, 0660) standards are also acceptable.

3. RATINGS

- 3.1 Fuse ratings shall be accurate to within $\pm 5\%$ of the published value for unused fuses and shall not vary significantly after long periods of service.
- 3.2 Fuses shall be derated for ambient temperatures above 25°C in accordance with the manufacturer's recommendation. If no such recommendation exists, a derating factor of 1% per °C above 25°C shall be applied.
- 3.3 Fuses shall be derated for elevations of more than 1 000m above sea level in accordance with the manufacturer's recommendation. If no such recommendation exists, a derating factor of 1% per 300m above 1 000m above sea level shall be applied.
- 3.4 Time-current characteristics shall be chosen to suit the application
 - 3.4.1 Cable protection: The fusing factor shall not exceed 1,5.
 - 3.4.2 Motor circuits: Time lag characteristic so that the starting currents will not cause deterioration of the fuse.
 - 3.4.3 Capacitor circuits: Fuses shall be chosen to withstand a higher than

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normal full load current (1.5 times rated capacitor current) to allow for harmonics and shall not deteriorate due to the high transients at switch on.

- 3.4.4 Distribution systems: The total operating FI let through by secondary (minor) fuses shall be less than that of primary (major) fuses in any specific branch.
- 3.5 It shall be ensured that the rupturing capacity of a fuse chosen for a specific application shall be adequate, both as far as short circuit current and applied voltage are concerned.

SECTION C23**C.23 DIRECT ACTING INDICATING INSTRUMENTS**

This section covers direct acting indicating instruments suitable for flush mounting in switchboards or instrument panels.

1. GENERAL REQUIREMENTS

- 1.1 Instruments shall be suitably rated for the supply voltage and frequency to be applied, which shall be 400/230 V, 50 Hz unless specified to the contrary.
- 1.2 All the instruments used for a particular application or a specific project shall be from the range of a single reputable supplier and shall have the same face dimensions. The face dimensions shall be square and not less than 96 x 96mm.
- 1.3 All instruments shall comply with BS 88 and/or IEC 51.
- 1.4 Instruments shall be screened against magnetic interference and shall have anti static, impact-resistant glass faces.
- 1.5 Preference will be given to locally manufactured instruments.
- 1.6 Instruments shall be insulated to achieve a 2 kV insulation resistance to earth.
- 1.7 All instruments shall be splash proof and dustproof unless more stringent requirements are specified for hazardous locations.
- 1.8 Instruments shall be sufficiently resistant to vibration that may be encountered in the specific application.
- 1.9 For normal environmental and supply conditions, instruments shall be suitable for use inside the limits specified in Tables I-I and VI of IEC 51.
- 1.10 All instruments shall be capable of withstanding overloads of continuous or short duration in accordance with section 8.3 of IEC 51.
- 1.11 Instruments shall be provided with studs for rear connection. Shrouds shall be provided to prevent accidental contact where instruments are to be installed in ringed panels of switchboards.

2. VOLTMETERS AND VOLTMETER SELECTOR SWITCHES

- 2.1 Unless specified to the contrary, voltmeters shall be scaled from 0 - 250V in the case of LV applications.
- 2.2 Voltmeters shall be of the moving iron type with class 1.5 accuracy as specified in IEC 51.
- 2.3 A zero adjustment screw shall be provided.
- 2.4 Unless specified to the contrary, a single voltmeter and selector switch shall be provided. The voltmeter switch shall have an "OFF" and three metering positions to indicate readings between neutral and each of the three phases.
- 2.5 The markings shall be indicated clearly on the face plate of the selector switch and the handle position shall be accurate in relation to the markings on the face plate.
- 2.6 The selector switch shall be of the cam-actuated or wiping air break type with two breaks per pole.

3. AMMETERS

- 3.1 Ammeters shall have a moving coil element to indicate instantaneous values.

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- 3.2 Direct reading ammeters up to a maximum rating of 60 A may be used. Current transformer operated ampereters shall be 5 A full scale, calibrated to read actual primary circuit currents. The current transformer ratio shall be indicated on the face plate.
- 3.3 A zero adjustment screw shall be provided.
- 3.4 Where combined maximum demand and indicating ammeters are specified, a bimetallic spiral element shall be provided in the same housing to indicate mean value over a 15 minute period.
- 3.5 The bimetal element shall drive a residual pointer to indicate maximum mean current between readings. This pointer shall operate on the main scale and shall be of a distinctive colour. The pointer shall be resettable from the face of the meter.
- 3.6 The bimetal element shall be designed to compensate for limits of ambient temperature between -20°C and 70°C .
- 3.7 Full load or rated current shall be clearly indicated, preferably with a red line. Unless specified to the contrary, a 100% condensed over scale shall be provided for instantaneous reading instruments and no over scale for combined maximum demand ammeters.
- 3.8 The intrinsic error, expressed in terms of the fiducial value in accordance with IEC 61, shall be class 1.5 for the instantaneous readings and class 2.5 for the mean maxima.
- 3.9 Where saturation current transformers are required, these shall form an integral part of the meter. Separate saturation current transformers are unacceptable to the Department.

4. KILOWATT-HOUR METERS

- 4.1 Unless specified to the contrary, kilowatt-hour meters shall be suitable for operation on 220/250 V, 50 Hz systems.
- 4.2 Meter elements shall be of the inductor disc type and designed to carry the rated current continuously.
- 4.3 Kilowatt-hour meters shall comply with the relevant parts of BS 37 and BS 5535.
- 4.4 The integrating period on maximum demand meters shall be 30 minutes unless specified to the contrary.
- 4.5 The registering mechanism shall be of the cyclo-meter type, providing a six digit readout with the sixth digit indicating one-tenth of a unit.
- 4.6 Unless specified to the contrary, the meters shall conform to accuracy Class 1 as specified in IEC 61.
- 4.7 Kilowatt-hour meters shall be graded and calibrated for the specific application to avoid the application of multiplication factors where possible. Where multiplication factors are unavoidable this shall be clearly indicated in unit form and not as a combination of several factors. Current transformer ratios shall be incorporated in the factor.
- 4.8 The kilowatt-hour meter shall preferably be provided with a magnetic type of bearing for the disc spindle.
- 4.9 Facilities for a security seal shall be provided on the fixing screws of the cover.

5. FREQUENCY METERS

- 5.1 Frequency meters may be of the vibrating reed type or the direct indicating type consisting of a moving coil milli-ammeter and a current/frequency transducer.
- 5.2 Unless specified to the contrary, the indicating range shall be 45 Hz - 55 Hz.
- 5.3 The accuracy class shall be class 0.5 in accordance with IEC 61 unless otherwise specified.
- 5.4 Where required an adjustable speed alarm contact shall be provided, adjustable over the complete scale range.

6 RUNNING HOUR-METERS

- 6.1 Running hour-meters shall be of the electrically operated cyclometer type, suitable for flush mounting.
- 6.2 Numerals shall be clearly defined white on a black background.
- 6.3 The range of hour-meters shall be five digits, the fifth digit indicating one tenth of an hour, i.e. from 0 to 9999,9 hours.
- 6.4 The accuracy class shall be class 1 in accordance with IEC 51 unless otherwise specified.

SECTION C.24**C.24 EARTH LEAKAGE RELAYS**

1. Earth leakage relays shall be single or three-phase units with a sensitivity of 30mA with associated circuit breaker or on-load switch for use on 220/250V single phase or 380/433 V three phase, 50 Hz, supplies.
2. The units shall be suitable for installation in switchboards in clip-in trays or bolted to the chassis.
3. The earth leakage relay shall function on the current balance principle and shall comply with SANS 757 as amended, and shall bear the SANS mark. Integral test facilities shall be incorporated in the unit.
4. Circuit breakers with trip coils used integrally with earth leakage units (two pole for single phase units and three pole for three phase units) shall comply with SANS 155.
5. On-load switches used integrally with earth leakage units (two pole for single-phase units and three pole for three phase units) shall comply with SANS 60497.
6. The fault current rating of the unit shall be 2,5kA or 5kA as required, when tested in accordance with SANS 156.

SECTION C.25**C.25 MICRO-GAP SWITCHES**

1. Micro-gap switches shall be suitable for ratings up to 400 A at 660 V (triple pole) and may be used for main and distribution switches in domestic applications, offices, small factories and similar applications.
2. Double pole switches shall be suitable for voltages up to 230V $\pm$ 10%.
3. The switches shall comply with SANS 60947.
4. Micro-gap switches may be used on AC circuits only.
5. Metal clad and moulded casings are acceptable.
6. Micro-gap switches shall be capable of carrying rated current continuously and making and breaking rated current.
7. Heavy, fully accessible, brass terminals with two screws each shall be provided to facilitate easy wiring. Contacts shall have large contact surfaces, made from high quality material such as solid silver.
8. The "ON" and "OFF" positions and the rating of the switch shall be clearly and indelibly marked.

SECTION C26**C.26 CURRENT TRANSFORMERS****1. GENERAL**

Current transformers shall comply with the requirements of BS 2938 and IEC 125 with the exception of the required impulse test level, par.6 below

2. RATINGS

Current transformers shall be suitable for the primary currents listed hereunder and their decimal multiples:

10, 12.5, 15, 20, 25, 30, 40, 50, 60 and 75.

The preferred values are

10, 15, 20, 30, 50 and 75.

- 2.2 Current transformers shall have secondary ratings of 1, 2 and 5A, with 5A being preferred.
- 2.3 Current transformers shall have standard outputs of 2, 5, 10, 15 or 30 VA as applicable in terms of the burden of the instruments and interconnecting wiring. The current transformer output shall match the actual instrument burden as closely as possible in order not to introduce unnecessary errors.

3. ACCURACY CLASS

- 3.1 For metering applications, accuracy classes of 0.1, 0.2, 0.5, 1, 3 or 5 are applicable. Where no accuracy class has been specified, the following table may be used as a guide:

Application	Primary Current	Suggested Class
Indicating instruments	A1,	5
Metering Applications	Up to 200 A	1
Metering Applications	250 to 800 A	0.5
Metering Applications	800 A and above	0.2

- 3.2 Where ring type current transformers are specified, the aperture shall not be unnecessarily large as accuracy is thereby reduced.
- 3.3 The classes for protection are 5P, 10P, 15P, 20P or 30P with 5P and 10P being standard. Turns compensation shall not be employed on protection current transformers for ratios greater than 15/5.
- 3.4 Class X current transformers shall be used in differential protection systems.
- 3.5 Manufacturers shall supply the magnetisation curve details and saturation factors for each different transformer ratio.

4. MARKINGS

All current transformers shall come complete with a label on which the following information is indelibly stamped.

Manufacturer.

Serial No. or Type.

Rated primary and secondary current.

Rated frequency.

Rated output and accuracy class.

Highest system voltage.

Rated insulation level.

5. FAULT CURRENT

Current transformers shall be capable of withstanding the dynamic forces resulting from the maximum through-fault current which may be encountered at the point where they are installed. The short time current rating of current transformers shall be at least equal to that of the associated circuit breaker.

6. IMPULSE LEVEL

Current transformers used in system voltages in excess of 600 V shall withstand an impulse test level of 95 kV. Impulse levels for current transformers used in system voltages up to 600 V shall comply with BS 3938.

7. TESTS

7.1 One protection current transformer of each type used in a contract shall be tested to confirm the estimated characteristics. The following results shall be submitted:

- (a) Magnetisation Curve
- (b) Secondary resistance
- (c) Secondary leakage reactance, if not negligible or if required by the Department.

7.2 The power frequency, secondary to earth and over voltage inter-lum tests in accordance with BS 3938 shall be conducted on all current transformers. Impulse tests shall be conducted on all current transformers intended for use in system voltages in excess of 600 V.

SECTION C27**C.27 INDICATOR LIGHTS**

1. Indicator lights shall be of neon, incandescent (filament) or LED types. Lamp voltages shall suit the supply or control voltage. Lamps shall be derated for continuous duty by using economy resistors or using input voltages at least 20% lower than the rated lamp voltages.
2. Where LEDs are used as indicators on main supply voltages a suitable current limiting capacitor and reverse voltage protection diode shall be used. For low AC or DC voltages (≤ 24 V) a current limiting resistor will suffice.
3. Indicator lights shall comply with BS 1060 where applicable.
4. Indicator lights shall be suitable for installation in switchboard panels and doors and shall consist of interchangeable lenses, lamp base, suitably rated and accessible terminals and a chromed screw-on retaining ring or other suitable means to secure the units.
5. It shall be possible to replace lamps from the front of the panel without the use of tools.
6. Surface mounted indicator lights shall be housed in purpose-made boxes with suitable cover plates.
7. Indicator lights shall be equipped with standard removable legend plates. Alternatively, the function shall be clearly indicated by means of labels or by engraving on the lenses.
8. All indicator lights for a specific application or switchboard shall be from the range of one manufacturer and shall preferably be of the same size and shall use the same lamp types.
9. The following are the preferred colours for indicator lights:

(a)	RED	: Abnormal state.
(b)	YELLOW	: Attention or caution, (or amber)
(c)	GREEN	: Ready for operation.
(d)	WHITE	: Circuit live or circuit operating (or clear) normally
(e)	BLUE	: Any function not covered by the above colours.

SECTION C.28**C.28 TRIPLE POLE ON-LOAD ISOLATORS**

1. This section covers switches suitable for panel mounting for use in power distribution systems up to 600 V, 50 Hz. Switches for motor isolation are included.
2. The switches shall be of the triple pole, hand operated type complying with SANS 60947.
3. The switches shall have a high speed closing and opening feature.
4. The switches shall be suitably rated for the continuous carrying, making and breaking of the rated current specified as well as the through-fault current capacity as specified.
5. To distinguish the switches from circuit breakers the operating handles shall have a distinctive colour and/or the switch shall be clearly and indelibly labelled "ISOLATOR".

SECTION C20**C.20 ROTARY CAM SWITCHES**

1. This section covers rotary cam switches used for control functions in switchboards, motor control centres, etc., up to 600 V.
2. The switches shall be rotary cam switches and shall comply with BS 4754, IEC 537 and VDE 0113, where applicable.
3. The switches shall be of the cam actuated type with two breaks per pole. The required number of poles and number of control functions shall be provided by the assembly of switching units on a common spindle.
4. The spindle shall be operated by a control handle suitable for the method of installation of the switch. The control handle shall be located by a key way on the spindle.
5. The switches shall be provided with a suitable face plate of non-conductive material, indicating the angle of throw and the switch positions. The latching mechanism shall ensure positive positioning in accurate relation to the positions indicated on the face plate.
6. The switches shall be suitable for use with the supply voltage level. The contacts shall be silver plated or gold laminated and shall be suitably rated for the switching functions intended.
7. For normal applications the making capacity of the switch shall be at least three times the normal current rating. For AC4 duties (inching, reversing, dugging) the rated current of the switch shall be at least equal to the stalled rotor current of the motor.
8. Special contacts, e.g. late-making, early-breaking, etc. shall be inherent in the design and shall not be improved by loading or latching contacts, etc.
9. Time delay units (if required) shall be of the electronic type with an adjustable time delay on energisation from 50 to 600 s. The units shall be suitable for DIN rail mounting and supply voltage as specified.

SECTION C30**C.30 TIME SWITCHES AND PHOTOCELLS**

1. Time switches shall be of single-pole type, suitable for 220/250 V systems, with contacts rated for the duty to be performed with a minimum rating of 15A. Contacts shall be of high quality material, e.g. silver-plated or solid silver.
2. The clock shall be driven by a self-starting, hysteresis synchronous motor, keeping accurate mains time. All clocks shall be controlled by an electrically wound escapement providing the main spring with a minimum of 15 hours reserve in case of a power failure. The main spring shall be kept fully wound without the use of slipping clutch devices that may wear and fall out of adjustment.
3. The main spring shall have a minimum of 15 hours reserve under full load and if fully discharged, shall be completely rewound within 15 minutes of the restoration of power.
4. An external manual bypass switch shall be provided to permit the circuit to be switched "ON" or "OFF" manually without affecting the operation of the time switch.
5. The time switch shall have a 24 hour dial, with day and night indication, that can be set to switch in 30 minute steps. The dial shall be fitted with 48 tappets corresponding to 48 change-over operations in a 24 hour period.
6. The time switch shall be fitted with a day omission dial comprising a total of 14 tappets which can be set to switch in 12 hour steps.
7. The time switch shall be housed in a dust-tight moulded plastic or metal case, consisting of a plastic clip-on front cover and a moulded plastic or metal base. Time switches to be used for surface mounting on walls shall be provided with a suitably positioned 20 mm conduit knock-out.

PHOTOCELLS**1. GENERAL**

- 1.1 The switches shall be used for the control of street lights and shall be provided with switch contacts able to carry at least 5 A. The current during no-load conditions may not exceed 50 mA.
- 1.2 The units shall be suitable for 240 V $\pm$ 6%, 50Hz, single-phase alternating current.

2. CONSTRUCTION

- 2.1 The units shall be weather and vibration resistant as they are to be mounted on top of streetlight luminaires. The design shall be of such a nature that the units will be able to withstand both hail damage and damage by stone-throwers. If the units do not meet with these requirements, separate wire screens shall be provided for this purpose.
- 2.2 The units shall be provided with a standard NEMA plug and socket. The socket shall have a bracket for mounting on a pole.
- 2.3 All components shall be treated to be corrosion resistant.

3. OPERATING CONDITIONS

- 3.1 The units shall be suitable for operating under dusty conditions between temperatures of -5 EC and 55 EC.

4. TECHNICAL REQUIREMENTS

- 4.1 units shall switch on when the light intensity drops to $< 5 \text{ lux} \pm 20\%$ and shall switch off when the light intensity again reaches $40 \text{ lux} \pm 20\%$.
- 4.2 When the unit is in the "on" position there must be a delay of one minute if it were to switch off in the case of a sudden increase in the light intensity.

SECTION C.31**C.31 CONTACTORS**

1. Contactors shall be of the open or totally enclosed, triple- or double-pole, electromechanically operated, air-break type suitable for 380/433 V or 220/250 V supplies and shall comply with SANS 1092.
2. Contactors shall have the following characteristics:
 - (a) Enclosed coil easily replaceable.
 - (b) A permanent air gap in the magnetic circuit to prevent sticky operation.
 - (c) Provision for quick and simple inspection of contacts.
 - (d) Clearly marked main and auxiliary terminals.
3. All parts shall be accessible from the front.
4. Contactors which are not located in switchboards shall be housed in enclosures which comply with IP 34 of IEC 144.
5. The current rating of the contactor shall be as specified for the circuit with a switching duty in accordance with the SANS 1092 or IEC 158-1, utilisation category AC1 for lighting and power circuits and utilisation category AC3 for motor starting.
6. In addition to the required current carrying capacity and switching duty of a contactor, the contactor chosen for a particular application shall be rated for the maximum through fault current allowed by the back-up protection devices at the point where the contactor is installed. Careful co-ordination of short circuit devices shall take place.
7. All armatures of the magnetic system of the contactor shall be tightly clamped. Noisy contactors will not be accepted.
8. Non-current-carrying metallic parts shall be solidly interconnected and a common screwed earth terminal shall be provided. The contactor shall be earthed to the switchboard earth bar.
9. Latched contactors shall be provided with a trip coil and a closing coil. The contactor shall remain closed after de-energising the closing coil and shall only trip on energising the trip coil.
10. Contactor operating coils shall have a voltage rating as required by the control circuitry and shall have limits of operation and temperature rise as specified in Clause 7.5 and Table IV of IEC 158-1. Latched contactors shall be capable of being tripped at 50% of the rated coil voltage.
11. Contactors for normal standby changeover circuits shall be electrically and mechanically interlocked. Contactors in star-delta starters shall be electrically interlocked.
12. Contactors with provision to add auxiliary contacts and convert auxiliary contacts on site are preferred. Contactors with permanently fixed auxiliary contacts shall have at least 1 x N/O and 1 x N/C spare auxiliary contacts in addition to the contacts specified for control purposes, and in addition to contacts required for self-holding operations or economy resistances. Where the number of auxiliary contacts required is greater than the number of contacts that can be accommodated on the contactor an auxiliary relay or additional contactor shall be provided to supply the additional contacts.
13. It shall be possible to replace main contacts without disconnecting wiring.
14. Auxiliary contacts shall be capable of making, carrying continuously and breaking 6A at 230V AC, unity power factor for contactors used on 380-433/220-250 V systems.
15. Auxiliary contact functions required e.g. "lazy" contacts late-make, late-break, make-before-break, etc. shall be inherent in the contact design. Under no circumstances may these functions be

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improved by bending contacts, loading contacts, etc. These functions shall be available in all contactors.

16. Spare auxiliary contacts shall be wired to numbered terminal strips in the switchboard and shall appear on the switchboard drawings.
17. All contactors on a specific project shall be from a standard range of one single manufacturer, unless specified to the contrary.

SECTION C32**C.32 PUSH-BUTTONS AND PUSH-BUTTON ASSEMBLIES**

1. Push buttons and push-button arrangements may be used in switchboards and control boards or in self-contained units for control functions.
2. Push-buttons and push-button assemblies for one specific project shall be supplied from a single reputable supplier's product range.
3. The various types of push-buttons employed shall be specifically selected for the required duty and mounting characteristics, e.g. flush mounted, enclosed, self-contained, illuminated, etc.
4. All push-buttons on a specific switchboard shall be of the same physical dimension (round or square) and shall be fully interchangeable as far as possible. Push-buttons must preferably be interchangeable with indicator lamps, key switches, etc.
5. Push-buttons shall be designed for long life, low contact bounce and constant contact resistance. Mechanisms may be of the mechanical type with spring control and a clutch or catch frame or of the solid state type operating on the principle of a non-contacting, inductive proximity switch.
6. All push-buttons shall be provided with replaceable lenses with a variety of symbols. Legend plates shall be interchangeable.
7. Push-button terminals shall be suitable for the application with regard to spacing, conductor capacity, etc. Terminals shall be suitable for conductor sizes to be used. Push-button assemblies mounted on doors of control boards shall be enclosed to prevent inadvertent contact with the terminals and when the doors are open.
8. Push-buttons shall be suitable for the environmental conditions to be encountered, e.g. moisture, excessive temperatures, mechanical shock, vibration, etc.
9. Contact duty shall be chosen to suit the application. Wiping contacts shall be used for low voltages and currents and snap action contacts for high voltages and currents. Contacts shall be constructed of high quality material such as silver-tipped or gold laminated contacts.
10. Illuminated push-buttons may employ neon, incandescent or LED lamps. Lamp voltages shall suit system control voltages. Lamps shall be derated when used for continuous duty e.g. using 20 V supply on 28 V rated lamps. External resistors shall be used with LED lamps to avoid excessive current.
11. Push-buttons may be grouped together in purpose-made stations, suitable for the environment in which they are to be installed.
12. Keylock push-buttons shall be supplied with duplicate keys. The removal action of the key shall suit the application.
13. Push-buttons shall comply with the applicable requirements of BS 4794.
14. The following are the preferred colours for push-buttons:

(a)	RED	:	Stop or emergency stop.
(b)	GREEN	:	Start (preparation)
(c)	GREEN	:	Start (implementation) (or black)
(d)	YELLOW	:	Interrupt a function (action)
(e)	WHITE	:	Any function not covered by the (or pale blue) above colours

SECTION C.33**C.33 INDOOR SURGE ARRESTORS**

1. Surge arrestors shall comply with the requirements of SANS 61643 or VDE 3675.
2. Surge arrestors shall be suitable for installation at altitudes of up to 1800m above sea level.
3. The unit shall be contained within a thermoplastic or cast resin housing and all internal components shall be fully sealed in.
4. The unit shall be supplied complete with a galvanised steel mounting bracket for convenient mounting onto the metalwork or tray of a switchboard.
5. Alternatively, the unit shall be of the type which can be mounted into the clip-tray of a switchboard.
6. Surge arrestors shall be provided in all cases where a switchboard is supplied directly from an overhead line.
7. In other cases, surge arrestors, if required, will be specified in the Data Technical Specification.

SECTION C34**C.34 INDOOR METAL CLAD SWITCHGEAR AND ASSOCIATED EQUIPMENT****1. GENERAL**

- 1.1 This section covers the manufacturing and testing of indoor metal-clad switchgear and associated equipment for general installations in normal environmental conditions and for system voltages of 3.3 kV to 11 kV.
- 1.2.1 A switchboard shall comprise metal-clad, pedestal type three-phase single or duplicate busbar extensible switch panels, each panel containing a circuit breaker or switch and the associated auxiliary equipment.

2. STANDARDS

All materials and apparatus shall be new and of the best quality and shall comply with the relevant current specifications of the SANS, BSI or IEC and as stated in this document.

The following standards may be used as a guide but must not be regarded as a complete list.

<u>DESCRIPTION</u>	<u>SANS</u>	<u>BSI</u>	<u>IEC</u>
Air & Oil Switches	118b	5463	265-A-C
Busbar & Busbar Connections		169	
Bushings		223	
Cable Glands & Sealing Boxes		542, 2562	
Circuit Breakers		5311	56
Current Transformers		3935	185
Voltage Transformers		3941	186
HV Fuses		2692	282-1
LV Fuses	172	88	269-1
Electrical Power Switchgear		5227	298
Galvanising	328/21	729	51
Indicating Instruments		89	298
Insulating Oil	555	148	129
Isolators and Earthing Switches		5253	43
Meters		37	255
Protective Relays		142	
Colours for Specific Purposes	1091		

4. SERVICE CONDITIONS

Nominal Voltage	3.3 kV	6.6 kV	11 kV
Rated Breaking Capacity	25 kA	20 kA	20 kA
Insulation Level	45 kV	75 kV	85 kV
High-voltage System Voltage	3.6 kV	7.2 kV	12 kV
Rated Short Time Current (3 s) 28,3 kA		21.9 kA	18.3 kA
Frequency	50 Hz		
Phases	3		
Atmospheric Temperature	-5°C minimum +40°C maximum		
Altitude	0 m minimum 1850 maximum		
Lightning & Dust	severe		
Average Power Factor	0.8		
Maximum Humidity	95%		

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The system neutrals will be solidly earthed. However, all switchgear and auxiliary equipment shall be designed to withstand the stresses of an unearthed system.

4. SWITCHGEAR LAYOUT

- 4.1 The switchboard shall be designed as a continuous assembly in a straight line, capable of being extended at either end.
- 4.2 The switchboard will be located in a totally enclosed, naturally ventilated chamber and shall be suitable for installation directly on a finished floor.

5. CIRCUIT BREAKERS

5.1 GENERAL CONSTRUCTION

- 5.1.1 Circuit breakers may be of the low oil content, inert gas (gas) or vacuum type.
- 5.1.2 Circuit breakers shall be of the horizontal draw-out truck mounted type with either vertical or horizontal isolation action.
- 5.1.3 Each circuit breaker shall be installed in a free standing metal clad cubicle and the front of each panel shall be totally enclosed.
- 5.1.4 It shall be possible to remove the circuit breakers from the cubicles without moving the cubicle, without removing parts thereof or without disconnecting any wiring thereto. Secondary wiring may be unplugged.
- 5.1.5 Any circuit breaker shall be interchangeable with any other panel of the board of the same rating. It shall not be possible to insert a circuit breaker into a higher rated circuit.
- 5.1.6 Contact spouts, bushings, covers, busbar insulators, etc. shall be designed to minimise dust collection.
- 5.1.7 Mechanical stops shall be provided to ensure accurate location of the circuit breaker truck prior to racking into the service position. The breaker carriage shall be locked in position on both sides of the cubicle with a robust mechanical lock that will not distort or jam under fault conditions.
- 5.1.8 All openings, joints, etc. in the entire switchboard shall be adequately weather proofed.
- 5.1.9 All components including screws, nuts, bolts, washers, etc. used in the construction of or fixing of components shall be rendered corrosion proof.

5.2 CIRCUIT BREAKING FEATURES

- 5.2.1 The contacts shall ensure rapid and consistent extinction of the arc with a minimum release of arc energy under all loading and fault conditions and a low power factor.
- 5.2.2 The arcing contacts shall be tipped or coated with an erosion resistant material, preferably a tungsten alloy.
- 5.2.3 The main contacts shall be self-aligning with a high contact pressure and a self-cleaning action.

5.3 BUSBAR AND CIRCUIT SHUTTERS

- 5.3.1 Protective shutters, which automatically cover the contacts of the fixed portion of the switchgear when the circuit breaker or voltage transformer is withdrawn to the isolation position, shall be provided.
- 5.3.2 The busbar and voltage transformer orifices shall be provided with automatic separate shutters.
- 5.3.3 Facilities shall be provided for interlocking the shutters in the closed position.
- 5.3.5 All shutters shall close automatically after being opened by hand and it shall not be possible for the shutters or shutter operating links to be jammed by the circuit breaker.

5.3.5 Shutters shall be painted and designated as follows:

- (a) Busbar shutters: The word "BUSBAR" in black lettering on a red background.
- (b) Circuit shutters: The word "CABLE" in black lettering on a yellow background.
- (c) Earthing shutters: The word "EARTH" in black lettering on a green background.

Lettering shall be a minimum of 40 mm high.

5.4 INTERLOCKS

The switchgear shall be mechanically interlocked in accordance with BS 5227 and all interlocks shall be robust and shall not distort or jam in the event of a maloperation. The minimum safety features provided shall prevent the following actions:

- (a) A closed circuit breaker from being withdrawn from or inserted into the isolating contacts. The circuit breaker shall not trip if an attempt is made to do so.
- (b) The closing of the circuit breaker except when it is correctly located and fully racked in the 'service' or 'earthing' positions or in the fully lowered position. It must, however, be possible to close the circuit breaker when it is fully withdrawn from the cubicle.
- (c) The lowering of the tank of bulk oil circuit breakers unless the circuit breaker is fully withdrawn and the racking-in of the circuit breaker unless the tank is securely bolted in position.
- (d) The circuit breaker from being closed when the secondary circuits are not fully engaged. It shall also not be possible to remove the secondary circuit plugs unless the circuit-breaker contacts are fully open.
- (e) Electrical tripping of the circuit breaker when the circuit breaker is in the earthed position. Padlocking facilities shall also be provided to lock off the mechanical trip lever on the breaker mechanism.
- (f) The integral earthing switch (where applicable) from closing unless the circuit breaker is in the correct earth position. It must not be possible to close the earth switch onto live busbars.

5.5 EARTHING

5.5.1 An earth busbar in accordance with the requirements of par. 7.3 shall be provided.

5.5.2 All joints shall be tinned or silver-soldered and clamping bolts, nuts, washers and lockwashers of cadmium-plated high tensile steel shall be fitted.

5.5.3 Integral earthing facilities through the circuit breaker are preferred, but separate earthing devices or earthing switches mounted on separate trucks are acceptable.

5.5.4 Where separate earthing devices or earthing trucks are supplied, the gear shall be suitable for use on all the circuit breakers in a switchboard and shall also be suitable for earthing either the busbar or the cables. A full set of earthing devices or earthing trucks shall be supplied for each switchboard.

5.5.5 Earthing equipment shall have a making capacity and a 3s short time current rating equal to the rest of the switchboard.

5.6 CAPACITIES AND FAULT LEVELS

5.6.1 The complete primary circuit (OCB's, busbars, etc.) shall be capable of withstanding the rated short time current specified in par. 3 above.

5.6.2 The circuit breakers shall have continuous current ratings as specified in the Detail Technical Specification.

5.6.3 Circuit breaker tanks and top plates shall be capable of withstanding, without permanent distortion, a hydraulic pressure of 700kPa for 1 minute, unless a lower pressure is approved after reference to actual pressures measured during short circuit tests.

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- 5.6.4 Each circuit breaker shall be clearly and indelibly marked to show the current and voltage ratings and breaking capacities.

5.7 CLOSING MECHANISMS

- 5.7.1 The closing mechanism shall be either of the hand charged, spring or hand operated, spring assisted or motor wound spring charging or solenoid operated types as specified in the Detail Technical Specification.

- 5.7.2 The closing action of the hand operated, spring assisted mechanisms shall ensure that once closing is initiated the action becomes independent of the operator.

- 5.7.3 Motor wound spring charging mechanisms shall be provided with hand cranks for emergency use should the electrical closing circuitry become inoperative.

- 5.7.4 Slow closing facilities shall be provided on all mechanism types for maintenance purposes and these facilities shall only be accessible with the circuit breaker in the "withdrawn" position.

- 5.7.5 All mechanisms shall be of the trip free type and it shall not be possible for the mechanism to maintain the circuit breaker in a "closed" position during fault conditions or when the "open" signal has been initiated.

- 5.7.6 The electrical closing circuitry shall be open circuited as soon as the closing sequence has been completed to prevent continued electrical loading of the closing circuitry and to deactivate the closing signal until a new sequence is initiated.

- 5.7.7, Where auto-reclosing duties are specified, the mechanisms shall be capable of performing a "BREAK-MAKE-BREAK" operation.

- 5.7.8 All electrically operated closing devices shall be at least suitable for operation at any voltage between 80% - 120% of the nominal control voltage at the device terminals. The nominal control voltages are specified in the Detail Technical Specification.

- 5.7.9 Anti-pumping devices shall be provided on all mechanisms to prevent latching while the closing circuit remains energized and the circuit breaker either fails to latch or trip during closing due to the operation of the protection system. The arrangement shall be to the approval of the Department.

5.8 TRIPPING MECHANISMS

- 5.8.1 A manual tripping mechanism shall be provided on each circuit breaker. It shall be clearly marked "MANUAL/HAND-TRIP".

- 5.8.2 Two 2.5 A trip coils (for overload and short circuit protection) and one 1.0 A trip coil (for earth fault protection) shall be provided where current transformer operated direct acting series tripping is specified. The trip coils shall be suitably rated to withstand the secondary saturation current of the current transformers specified.

- 5.8.3 Where shunt tripping is specified DC shunt trip coils shall be provided. The rated nominal voltage shall be 32 V DC unless specified to the contrary in the Detail Technical Specification.

- 5.8.4 Shunt trip coils shall be suitable for operation at any voltage between 50% -120% of the nominal voltage at the device terminals.

- 5.8.5 Secondary contacts operated by the circuit breaker mechanism shall be provided and rated to interrupt the maximum trip coil current after the circuit breaker has opened. These contacts shall close the tripping circuitry before the circuit breaker closes.

5.9 RACKING MECHANISMS

The racking mechanisms for inserting or withdrawing the circuit breaker shall be designed and constructed to provide a positive action throughout the operations.

5.10 INDICATING DEVICES

- 5.10.1 Each circuit breaker shall be equipped with mechanical indicators to indicate the switching positions.

and the state of the spring mechanisms (if applicable).

5.10.2 A mechanical indicator shall also be provided to indicate whether the circuit breaker is racked in or out.

5.10.3 All mechanical indicators shall be clearly visible from the front of the panel.

5.10.4 In all cases positive indication must be provided.

5.11 AUXILIARY CONTACTS

5.11.1 Circuit breakers shall be provided with sufficient auxiliary contacts to suit the circuits served.

5.11.2 Auxiliary contacts shall be coupled in such a manner as to follow positively the operation of the switching device concerned.

5.11.3 At least two spare normally open and two spare normally closed contacts shall be provided and shall be completely wired to an accessible terminal block.

6. NON-AUTOMATIC OIL SWITCHES AND FUSED OIL SWITCHES

6.1 GENERAL

6.1.1 Oil switches shall be of the fault-making, load-breaking type with earthing and testing facilities.

6.1.2 Oil switches shall be manufactured and tested in accordance with BS 5469.

6.2 CONSTRUCTION

6.2.1 The switches shall be totally enclosed, metal-clad of the bulk or low oil content type.

6.2.2 The switch units shall be designed for extension with circuit breaker panels described in this specification and/or similar switch units.

6.2.3 Each unit shall be installed in a free standing metal clad cubicle and the front of the cubicle shall be totally enclosed.

6.2.4 The switch may be either of the horizontal draw-out with vertical or horizontal isolation or non-withdrawable fixed tank types.

6.3 BUSBAR AND CIRCUIT SHUTTERS

Busbar and circuit shutters shall be provided on all withdrawable type switches as specified for circuit breakers.

6.4 INTERLOCKS

6.4.1 The mechanism shall be incapable of moving directly to the "EARTH" position from the "ON" position.

6.4.2 A time delay shall be built into the mechanism to prevent immediate opening of the switch after closure. This shall be achieved by means of non-reversible operating handles, mechanical sliding interlocking gates or a non-reversible movement.

6.4.3 Padlocking facilities shall be provided.

6.4.4 Access to the testing facilities shall only be possible with the switch in the "EARTH" position. With the testing devices fitted operation to either the "ON" or "OFF" positions shall be prevented.

6.4.5 Interlocks shall be provided on withdrawable type switches to prevent:

- (a) The switch from being withdrawn from or inserted into the isolating contacts.
- (b) The closing of the switch except when it is correctly coasted or fully withdrawn.
- (c) The opening of the tank unless the switch is fully withdrawn and the racking-in of the switch unless the tank is securely fitted.

6.5 OPERATING MECHANISM

6.5.1 The switch shall have three positions, namely "ON", "OFF" and "EARTH".

6.5.2 Except for removing the earth, the switch actuating mechanism shall have a positive action and shall be spring assisted to ensure that once the operation is initiated it becomes completely independent of the operator.

6.5.3 The fused oil switch shall close fully when making onto a fault to ensure full clearance of the fault by the fuses before tripping and opening the switches.

6.5.4 A blown fuse on any of the three phases shall open all three phases of the switch and shall inhibit the closure of the switch pending fuse replacement.

6.6 EARTHING

6.6.1 Refer to par. 5.5.1.

6.6.2 Integral cable earthing facilities shall be provided for non-withdrawable switch units. For withdrawable switches earthing facilities similar to that of circuit breakers shall be provided. Refer to par. 5.5.2, 5.5.3 and 5.5.4.

6.7 CABLE TEST FACILITIES

6.7.1 Cable test facilities are required and must be easily accessible.

6.7.2 Refer to par. 6.4.4 regarding interlocking of test facilities.

6.7.3 In the event of a separate test unit being provided, it shall be easily fitted.

6.8 RATINGS

6.8.1 The fault making capacities, impulse levels and bushing ratings shall be identical to the ratings of the circuit breakers installed in the same switchboards.

6.8.2 The continuous current rating shall not be less than 400A.

6.8.3 Each unit shall be clearly marked to show the current and voltage ratings and fault making capacity.

6.9 INDICATING DEVICES

6.9.1 Each switch shall be equipped with positive mechanical indicators to indicate the switching position and the racked mode (where applicable).

6.9.2 All indicators shall be visible from the front of the panel.

6.9.3 Neon indicator lights shall be provided on the incoming panel of a switchboard to indicate the status of all three phases of the incoming cable.

6.10 FUSES

6.10.1 Fuses shall comply with BS 2682.

6.10.2 Fuse links shall be of the striker pin type, hermetically sealed and shall be suitable for use under oil.

6.10.3 The fuse link carriage shall be suitable to accept either 254mm or 359mm long fuses both with a diameter of 63.5mm. The carriage shall be adjustable for this purpose and shall not necessitate additional parts.

6.10.4 Automatic shutters shall be provided to safeguard against inadvertent contact with live parts when the fuse carriage is removed.

6.10.5 The ratings of the fuses shall be as specified.

7. BUSBARS

See Section C15 for details

8. CABLE END BOXES

- 8.1 Cable end boxes to accept the cables specified for each panel shall be provided.
- 8.2 The boxes shall be of the metal clad type suitable for indoor use. They shall be equipped with armour clamps and brass or gunmetal conical wiping glands for lead covered steel tape or galvanised steel wire armoured, paper-insulated cables.
- 8.3 The cable end boxes shall comply with the Department's standard specification for "CABLE END BOXES AND COMPOUND", Section C9
- 8.4 The cable boxes shall be fitted with insulating pieces to allow for the possible future installation of frame leakage busbar zone protection when specified in the Detail Technical Specification.
- 8.5 The lowest point of any cable gland position shall be at least 300mm above finished floor level.
- 8.6 Cable boxes shall be so designed that cable terminal connections can be made below compound level

9. SECONDARY CIRCUITRY

9.1 CABLING

- 9.1.1 Gland plates, suitably drilled to accept the glands for all the external power, control, protection and DC supply cables, shall be provided.
- 9.1.2 The internal wiring to be connected to the cabling mentioned in par.
- 9.1.3 Where external DC supplies are connected to the switchboard, semiconductor diodes of a suitable power and voltage rating shall be installed in all DC circuits, in both the positive and negative conductors, to prevent reverse polarity connections

9.2 WIRING

- 9.2.1 All wiring shall present a neat appearance and shall be suitably braced, placed in wiring channels or clipped and/or banded.
- 9.2.2 Connections to equipment mounted on doors shall be arranged to give a twisting motion and not a bending motion to the conductors.
- 9.2.3 All panel and equipment terminals, labels, etc. shall be completely accessible after the wiring and cabling has been completed.
- 9.2.4 Conductors shall be identified at both ends by means of durable closed ring interlocking cable marking ferrules, PVC or other tape is not acceptable. The numbers on the markers shall also be shown on the wiring diagrams.
- 9.2.5 Where conductors are terminated on equipment terminals that do not require the use of lugs, the identification ferrules shall be fixed so that they do not fall off when disconnecting a conductor.
- 9.2.6 Identification ferrules shall read from the terminal along the wire.
- 9.2.7 All wiring terminating on meters, fuse holders and other equipment with screwed terminals shall be fitted with lugs. The lugs shall be soldered or crimped to the end of the conductor. Conductors connected to terminals complying with the Department's standard specification for "WIRING TERMINALS", Section C9 need not be soldered or ferruled.
- 9.2.8 Secondary wiring shall generally consist of insulated stranded copper conductors with a minimum cross-sectional area of 2.5mm². Solid core conductors are not acceptable. Flexible cords not smaller than 1.0mm² shall be installed between equipment mounted on doors and the rest switchboard. For voltage ratings in excess of 50 V the wiring insulation shall withstand a test voltage of 2 kV to earth

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for one minute. For voltages of 50 V or less the insulation shall withstand 500 V to earth for one minute.

- 9.2.9 All wiring between different panels within the same switchboard shall be installed in wiring channels. Grommets shall be installed in each hole in the metalwork through which conductors pass. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges. All wiring shall be installed away from terminals, clamps or other current carrying parts.
- 9.2.10 Conductors may be jointed at equipment terminals or numbered terminal strips only.
- 9.2.11 To minimise the effect of electrolysis, DC circuits shall be so arranged that the isolator or N/O operation contacts are connected to the positive pole of the battery.

9.3 SECONDARY TERMINALS

- 9.3.1 All external wiring and connections to auxiliary contacts, all alarm, protection, interlocking, DC supply circuits, etc. shall terminate on numbered terminal strips. All numbers shall appear on the switchboard drawings.
- 9.3.2 Terminals of the type where clamping screws are in direct contact with the conductor are not acceptable.
- 9.3.3 Where slot type terminals are provided they shall have a minimum size of 0 BJA.
- 9.3.4 Approximately 10% with a minimum of 2 spare terminals shall be provided on each terminal strip.
- 9.3.5 Terminal and test blocks shall be provided in each panel for the secondary wiring of the current transformers.

10. CUBICLE CONSTRUCTION

10.1 GENERAL

- 10.1.1 All cubicles shall be of the totally enclosed, floor mounted type and shall be vermin proof and where possible dust proof.
- 10.1.2 Cubicles shall be designed so that it is possible to add additional panels to existing switchboards without undue difficulty.

10.2 SEGREGATION OF CIRCUITS

- 10.2.1 Each circuit in a switchboard shall be provided with an individual cubicle so arranged that accidental contact with live metal in adjacent circuit cubicles is impossible.
- 10.2.2 It shall be possible to terminate the cables of any circuit without exposure to any live conductors of the same circuit while the busbars are energised.

10.3 DOORS

- 10.3.1 Where doors are provided on circuit breaker or switch cubicles, the doors shall be fitted with handles consisting of a push-button and handle combination with spring loaded latch or a rotary handle-and-catch combination. The closing mechanism shall be designed to draw the door closed. Flush mounted ring type handles or square key operated latches are not acceptable. Locking latches shall be padlock able.
- 10.3.2 Doors shall be suitably braced and stiffened to carry the weight of equipment installed in doors and to prevent warping.
- 10.3.3 Control panel doors shall be fitted with handle closing mechanisms as described in per 10.3.1 above. Alternatively, captive knurled bolts designed to be screwed in by hand may be used.
- 10.3.4 Doors shall have stops to prevent overswing of the door when opening and to prevent interference with adjacent panels.
- 10.3.5 Doors shall be fitted with suitable rubber or synthetic rubber seals.

10.3.6 All doors shall be bonded to the framework by a braided copper earth strap.

10.4 EARTHING

10.4.1 All metal parts other than those forming part of electrical circuits shall be connected to the cubicle earth bar.

10.4.2 All non-current carrying conductive parts, including relays, instruments, transformer and contactor cores, etc. shall be effectively connected to the earth bar either by means of their mounting arrangements on the panel or by means of a special earthing conductor fitted with lugs for attaching to the earth bar.

11. CURRENT TRANSFORMERS

11.1 GENERAL

11.1.1 Current transformers shall comply with the Department's standard specification for "CURRENT TRANSFORMERS", Section C26.

11.1.2 The short time current rating of current transformers shall not be less than that of the associated circuit breaker.

11.1.3 Current transformers shall be easily replaceable.

11.1.4 The secondary windings of the current transformers shall be brought out to terminal and test blocks. Windings shall be earthed at one point only. (Refer also to par. 9.3.5)

11.1.5 Current transformers shall be installed and labelled so that the ratio is clearly visible.

12. VOLTAGE TRANSFORMERS

12.1 GENERAL

12.1.1 Voltage transformers shall comply with BS 3941 and IEC 195A and EC 358 where applicable.

12.1.2 The transformers shall be double wound. The neutral (star point) connection shall be brought out via a neutral link. The secondary voltage shall be 110V unless specified to the contrary.

12.1.3 Voltage transformers shall be metal-clad, of the oil-immersed or epoxy resin encapsulated type. Oil filled types may not be used with air or vacuum circuit-breakers.

12.1.4 The transformer shall be withdrawable and shall be so arranged that the primary fuses are not accessible unless the transformer is in the fully isolated or withdrawn position. The voltage transformer shall be padlock able in both the withdrawn and inserted positions.

12.1.5 Automatic shutters shall be provided to cover the isolating contact when the transformer is withdrawn. Refer also to par. 5.3. The shutters shall be padlock able.

12.2 VOLTAGE TRANSFORMER PROTECTION

12.2.1 The primary side of all voltage transformers shall be connected to the circuit through high voltage HRC fuses.

12.2.2 Secondary HRC fuses shall be provided on the voltage transformer, preferably under a removable cover secured by captive knurled nuts. The fuses shall be located as close as possible to the transformer output terminals.

12.3 VOLTAGE TRANSFORMER RATINGS AND TESTS

12.3.1 The voltage transformers shall have an output suitable for the connected load but at least 200VA per phase at class B accuracy.

12.3.2 The voltage ratios shall be suitable for the primary busbar and the required output voltages.

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- 12.3.3 Voltage transformers shall be tested in accordance with BS 3941 and shall withstand an impulse level of 95 kV.

13. PROTECTION RELAYS

- 13.1 Protection relays shall be contained in dustproof cases which shall not allow accumulated dust to fall into the relay when opened.
- 13.2 All cases shall be of the flush mounting withdrawable type.
- 13.3 Relay contacts shall be capable of repeatedly making and, where the circuit renders it necessary, repeatedly breaking the maximum current possible in the circuits they control.
- 13.4 Where more than one set of contacts are provided, all contacts shall operate simultaneously.
- 13.5 Tripping contacts shall not close due to vibration engendered by the normal or the fault condition operation of the associated or adjacent circuit breakers.
- 13.6 Hand resetting shall be accomplished without opening the case and these relays shall be accessible to a person standing on the floor.
- 13.7 All relays shall be provided with test blocks to permit tests to be carried out without disconnecting any wiring. These test blocks may be either included in the relay cases or separately mounted.
- 13.8 The ratio of the associated current transformer shall be clearly marked on the relay face plate.
- 13.9 All relays shall be adjusted during manufacture to conform to the limits stipulated in BS 142.

14. INSTRUMENTS

- 14.1 Instruments, i.e. ammeters, voltmeters, combined maximum demand and indicating ammeters, kilowatt-hour meters, frequency meters and running-hour meters shall generally comply with the Department's standard specification for "DIRECT ACTING INDICATING INSTRUMENTS", Section C23.
- 14.2 voltmeter and ammeter scales shall have a full scale reading at least 5% higher than the system voltage or associated current transformer rating with the latter values clearly marked.
- 14.3 The instruments shall be suitably rated for the supply voltage, current and frequency.
- 14.4 Each voltmeter shall be protected with easily accessible HRC fuses.
- 14.5 Each circuit breaker shall be equipped with a trip counter with cyclometer dial.

15. AUXILIARY EQUIPMENT

15.1 CONTROL SWITCH-ES

- 15.1.1 Circuit breaker closing and tripping control switches shall close the associated circuit breaker when rotated clockwise.
- 15.1.2 Control switches may be fitted with one pair of latching contacts, i.e. contacts which make when the control switch is turned to the closed position, remain closed when the handle returns to the neutral position and only open when the control switch is moved to the trip position.
- 15.1.3 The switches shall be provided with a suitable face plate indicating the angle of throw and the switching positions.
- 15.1.4 The switches shall be suitable for the supply voltage and the contacts shall be silver-plated or gold laminated and shall be suitably rated for the switching functions intended.
- 15.1.4 Control switches shall be lockable in the "NEUTRAL" or "OFF" position.

15.2 FUSES

- 15.2.1 All fuses for the protection of auxiliary circuits shall be of the high rupturing capacity cartridge type and shall be mounted on insulated draw-out carriers which shall hold the fuses positively after withdrawal.
- 15.2.2 The top terminal shall be the live terminal in all cases.
- 15.2.3 HRC fuses shall be provided in the positive leads of all DC circuits.
- 15.2.4 Fuses shall be so positioned that they are readily accessible to a person standing on the floor in front of the panel.
- 15.2.5 Labels shall be fitted adjacent to fuses stating their use, rating and duty.

15.3 INDICATOR LAMPS

- 15.3.1 Indicator lamps shall comply with the Department's standard specification for "INDICATOR LIGHTS", Section C27.
- 15.3.2 The following indications shall be provided:

<u>FUNCTION</u>	<u>COLOUR</u>
Circuit breaker closed	Red
Circuit breaker open	Green
Incoming supply available (on incoming panel only)	White
Auto-trip	Amber
Trip circuit healthy	White

- 15.3.3 A lamp test push-button for all the indicating lights shall be provided on each switchboard.
- 15.3.4 The 'trip circuit healthy' indication shall normally be off and a push-button shall be provided to indicate the status. The purpose of the indication is to ensure that the tripping voltage supply is available on the panel before the circuit breaker is closed. An indicator light with push-button is required on each panel and one indication per switchboard is not sufficient. The circuitry shall be arranged to provide an indication with the circuit breaker in both the "OPEN" and "CLOSED" positions.
- 15.3.5 The condition indicated shall be designated below each light.
- 15.4 Push-buttons and Push-button Assemblies Push-buttons and push-button assemblies shall comply with the Department's standard specification for these items, Section C32.

16. DC AUXILIARY SUPPLIES

If specified, a battery derived DC supply shall be provided with the switchboard. The nominal voltage shall be 32 V DC unless specified to the contrary.

16.1 BATTERIES

- 16.1.1 The batteries shall be of the nickel-cadmium type and the cells shall be in high impact polystyrene containers with a large reserve of electrolyte.
- 16.1.2 The number of cells and capacity shall be determined from the voltage requirements of the circuit breaker closing and tripping circuitry and the discharge duties required by the switchboard.
- 16.1.3 The battery capacity shall be sufficient to perform either of the following functions:
- (a) Five successive tripping and reclosing operations of all the circuit breakers on the switchboard,
 - or
 - (b) A single tripping and reclosing operation of all the circuit breakers on the switchboard plus supplying

all the standing loads on the battery for at least 10 hours.

Note: The alternative requiring the larger battery shall be used.

16.2 BATTERY CHARGING UNIT

16.2.1 A constant voltage type charger with current limiting facilities shall be provided. The output voltage shall be kept within 1% of the final charge voltage designed for maximum charge conservation and a maximum battery life for variations of $\pm 10\%$ of the input voltage.

16.2.2 The ripple content in the output of the charger shall be less than 2%.

16.2.3 The charger capacity shall be adequate to supply any standing load on the battery plus a charging current which will recharge a fully discharged battery within 8 hours.

16.2.4 A switch operated boost charge control shall be provided.

16.2.5 An auxiliary winding shall be added to the charger transformer providing a secondary

16.2.6 AC output suitable for all the indicating lights on the switchboard. The lights shall be supplied from this winding and not from the batteries.

16.2.7 The charger shall be suitable for operation on a nominal 230 V, 50 Hz mains supply or from a supply obtained from a voltage transformer.

16.2.8 The charger shall be complete with all the required controls including the following standard equipment:

- (a) Power supply isolator.
- (b) Ammeter indicating rectifier output.
- (c) Battery voltmeter.

16.2.9 The following MRC fuses shall be provided:

- (a) Input fuses.
- (b) Rectifier output fuses.
- (c) Voltmeter fuses.
- (d) Fuses in charger transformer auxiliary output.
- (e) A pair of fuses for each DC circuit plus fuses for 3 spare circuits.

If more than one battery output circuit is specified, each circuit shall be fitted with a pair of fuses.

16.3 CUBICLE

16.3.1 The batteries and charger shall be housed separately from the switchboard in a self-contained cubicle with the same finish and colour as the switchboard.

16.3.2 The cubicle shall be dust proof and vermin proof.

16.3.3 An undrilled removable cable gland plate shall be provided for bottom cable entry.

17. FINISH

17.1 All welds shall be ground smooth and joints wiped with plumber's metal in order to provide a smooth finish.

17.2 All the metalwork shall be painted in accordance with the Department's "STANDARD PAINTING SPECIFICATION", Section C39.

- 17.5 The final colour shall be 'ADMIRALTY GREY', colour G12 to SANS 1031.

18. LABELS

- 18.1 Care shall be taken to ensure that all equipment is fully labeled and that accurate descriptions appear in both official languages.
- 18.2 Panel designation labels shall appear on the front and back of each panel and on the circuit breaker truck.
- 18.3 Engraved sandwiched interchangeable plastic or ivory strips shall be used throughout. The strips shall bear white lettering on a black background.
- 18.4 Labels shall be secured by means of brass bolts, nuts and washers. Where this is not practicable cadmium-plated self-tapping screws may be used. The gluing of labels will not be acceptable. Sufficient fixing screws shall be provided to prevent labels from warping.

19. TESTS

19.1 MANUFACTURER'S TESTS

- 19.1.1 All component parts of the equipment shall be subject to type tests and routine tests in accordance with the relevant SANS, BSI or IEC standard specifications.
- 19.1.2 All circuit-breakers shall be subjected to the following tests in accordance with BS5311- Part 4, adjusted for atmospheric correction:

Type Tests:	(a)	Mechanical Endurance.
	(b)	Temperature Rise.
	(c)	Dielectric Strength and
	(d)	Impulse Voltage.
	(e)	Making and Breaking Capacity
	(f)	and Short Time Current.
Routine Tests:	(a)	Power Frequency Voltage
	(b)	Resistance of the Main Circuit.
	(c)	Mechanical Operation.

19.2 ON SITE TESTS

- 19.2.1 The equipment shall be tested on site after erection and prior to commissioning.
- 19.2.2 The following minimum tests shall be performed:
- (a) Pressure tests on the primary and secondary circuits in accordance with BS 5227 or IEC 298.
 - (b) Insulating oil tests in accordance with SANS 555.
 - (c) Insulation resistance tests.
 - (d) Primary injection tests.
 - (e) Earth continuity and earth resistance tests.
 - (f) Operating tests.
 - (g) Any other tests which may be required to ascertain the correct functioning of the equipment.

19.3 TEST CERTIFICATES

- 19.3.1 Copies of type test certificates shall be submitted together with the tender.
- 19.3.2 Copies of test certificates of all other tests i.e. routine tests and on site tests shall be forwarded to the Department on completion of the tests.

19.4 TEST PERFORMANCE AND INSPECTION

19.4.1 The Department shall be notified in writing at least two weeks in advance of any tests to be conducted to allow its representative to be present at such tests.

19.4.2 The Department shall also be notified immediately of the completion of the equipment in order that an inspection may be carried out prior to delivery.

20. OIL AND COMPOUND

20.1 The first filling of insulating oil for all the circuit breakers, oil switches, voltage transformers, etc. shall be provided by the switchgear supplier.

20.2 An adequate quantity of bituminous or cold filling compound shall be provided by the switchgear supplier for all the cable and boxes.

20.3 All other oils or compounds which may be required shall be provided by the switchgear supplier.

21. TOOLS AND AUXILIARY EQUIPMENT

The following equipment shall be provided with each switchboard and the cost shall be included in the tender price:

- (a) One raising and lowering handle for every three circuit breakers.
- (b) One complete set of special maintenance tools for all sizes of circuit breakers.
- (c) A full set of earthing devices or earthing trucks.
- (d) One wall mounted steel box for the storage of the above loose equipment. The door shall be padlockable.
- (e) At least six spare HRC fuses of each rating for secondary circuits and three voltage transformer, high voltage HRC fuses.
- (f) At least three spare high voltage HRC fuses of each rating suitable for the fused oil switches.
- (g) One cable test unit for each size circuit breaker or oil switch housed in a wall mountable metal box.

22. TECHNICAL INFORMATION

22.1 Tenderers shall submit descriptive literature of the equipment with their tenders.

22.2 Two copies of erection, operating and maintenance instruction manuals covering each type of equipment shall be provided with each switchboard.

23. DRAWINGS AND DIAGRAMS**23.1 DRAWINGS FOR APPROVAL**

23.1.1 A set of three prints of the following drawings shall be submitted to the Department for approval.

- (a) General Arrangement Drawings.
- (b) Detailed Dimensional Drawings.
- (c) Schematic Diagrams.
- (d) Wiring Diagrams.
- (e) Foundation Drawings.

23.1.2 The approval of drawings shall not relieve the Contractor of his responsibility to the Department to supply the switchboards according to the requirements of this Specification.

23.2 FINAL DRAWINGS

23.2.1 On completion, a complete set of final transparent drawings shall be delivered to the Department. These drawings shall include the following:

- (a) An accurate 'as built' wiring diagram of the complete installation showing circuit numbers, terminal strip numbers, conductor colours and numbers, etc.
- (b) A schematic diagram clearly showing the functions of all equipment.
- (c) An equipment schedule showing the make, model and characteristics of all components used including a recommended spare list.
- (d) Fully dimensioned 'as built' physical layout of the panel.

24. COMPLETION

The contract shall be regarded as incomplete until all tests have been conducted successfully and all drawings and manuals have been handed to the Department.

SECTION C35**C.35 11 KV NON-AUTOMATIC OIL SWITCHES, FUSED OIL SWITCHES AND RING MAIN UNITS****1. GENERAL**

This section covers the manufacturing and testing of indoor and outdoor non-automatic oil switches, fused oil switches and ring main units.

1.1 STANDARDS

All materials and apparatus shall be new and of the best quality and shall comply with the relevant current specifications of the SANS, BS or IEC and the Department's Quality and Installation Specifications.

The following standards may be used as a guide but must not be regarded as a complete list

DESCRIPTION	SANS	BSI	IEC
Air & Oil Switches	-	5483	265-A-C
Busbar & Busbar Connections	1195	159	
Busfittings	-	223	137
Cable Glands & Sealing boxes	-	542, 2662	
HV Fuses		2692	282-1
LV Fuses	172	88	269-1
Electrical Power Switchgear	-	5227	-
Galvanising	32&121	729	-
Insulating Oil	555	148	296
Isolators and Earthing Switches	-	5253	129
Oil Switches		5453	-
Protective Relays		142	255
Colours for specific purposes	1091		

2.1 Service Conditions

Frequency	50 Hz
Phases	3
Nominal voltage	11 kV
Rated Capacity	250 MVA
Impulse Level	95 kV
Highest System Voltage	12 kV
Atmospheric Temperature	-5°C to 40°C
Altitude	0mm minimum 1850m maximum
Lightning & Dust	severe
Average Power Factor	0,8
Maximum Humidity	95%

The system neutrals will be solidly earthed. All switchgear and auxiliary equipment shall be designed to withstand the stresses of an unearthed system.

2. CONSTRUCTION AND FINISH

- 2.1 The switches shall be totally enclosed, metal clad and of the bulk oil content type. Air break switches will not be acceptable. Switches shall be suitable for both indoor or outdoor use as specified.
- 2.2 The switches shall be self-supporting and free standing. At least four M20 high tensile steel holding-down bolts shall be provided with each switch. The holding-down bolts shall be suitable to be cast into the concrete base.
- 2.3 The switch shall be treated and painted in accordance with the requirements of clause 5.23 of SANS 763 as amended.
- 2.4 In the case of switches supplied for installation within 50km of the coast, in polluted industrial atmospheres or as specified, the total dry film thickness of the paint shall be increased to at least 0,125mm.

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- 2.5 The colour shall be "DARK ADMIRALTY GREY" to BS 381 C (Shade 632) or colour Q12 of SANS 1057. A tin of matching touch up paint (not smaller than 500ml) shall be provided with each consignment.

3. MECHANISM

- 3.1 The switch shall have three positions, namely "ON", "OFF" and "EARTH".
- 3.2 Except for removing the earth, the switch actuating mechanism shall have a positive action and shall be spring assisted to ensure that once the operation is initiated it becomes completely independent of the operator.
- 3.3 The fused oil switch shall close fully when making onto a fault to ensure full clearance of the fault by the fuses before tripping and opening the switch.
- 3.4 A blown fuse on any one of the three phases shall open all three phases of the switch and shall inhibit the closure of the switch pending fuse replacement.

4. INTERLOCKS

- 4.1 The mechanism shall be incapable of moving directly to the "EARTH" position from the "ON" position.
- 4.2 A time delay shall be built into the mechanism to prevent immediate opening of the switch after closure. This shall be achieved by means of non-reversible operating handles, mechanical sliding interlocking gates or a non-reversible movement.
- 4.3 Padlocking facilities shall be provided to prevent either operation.
- 4.4 Access to the testing facilities shall only be possible after the switch is in the "EARTH" position. With the testing devices fitted, operation to either the "ON" or "OFF" positions must be prevented.
- 4.3 Access to the fuse carriage shall only be possible with the switch in the "OFF" position.

5. CABLE TEST FACILITIES

- 5.1 Cable test facilities are required and must be easily accessible.
- 5.2 All units required for installation in miniature substations must be equipped with integral testing facilities. Testing by means of a separate test harness is not acceptable.
- 5.3 Refer to par. 4.4 regarding interlocking of the facilities.
- 5.4 Where a separate test unit is supplied for use in a substation (not mini substation) it shall be easily fitted and shall be supplied and stored in a suitable padlockable receptacle mounted in a convenient position on the switch.

6. RATINGS

- 6.1 Continuous rated currents (minimum):
- | | |
|---------------------------|------|
| Busbars | 400A |
| Oil switch contacts | 400A |
| Fused oil switch contacts | 50A |

7. FUSES

- 7.1 Fuse-links shall be of the striker pin type, shall be hermetically sealed and shall be suitable for use under oil.
- 7.2 The fuse-link carriage shall be suitable to accept either 254mm or 359mm long fuses both with a diameter of 63,5mm. The carriage shall be adjustable for this purpose and shall not necessitate additional parts.
- 7.3 Automatic shutters shall be provided to safeguard against inadvertent contact with live parts when the fuse carriage is removed.

- 7.4 Three spare fuses in addition to the three fuses supplied with the fused oil switch shall be supplied with each unit. The rating of the fuses will be specified in the Detail Technical Specification.

8. CABLE END BOXES

- 8.1 The switches must be supplied with cable end boxes suitable to accept armoured, paper-insulated cables as specified.
- 8.2 The cable end boxes shall be of the metal clad type suitable for indoor or outdoor use.
- 8.3 The boxes shall be equipped with armour clamps and brass or gunmetal conical wiring glands for lead covered steel tape or galvanised steel wire armoured cables.
- 8.4 The cable boxes shall comply with the Department's standard specification for "CABLE END BOXES AND COMPOUND", Section C6.

9. OIL FOR SWITCHES

9.1 OIL FILLING

Sufficient oil shall be supplied with the switchgear to fill the fuse and switch chambers.

9.2 BUSBAR CHAMBER

If the busbar chamber is designed to be filled with compound, sufficient compound shall be supplied with the switchgear for this purpose. If the chamber is not factory filled.

10. UNIT COMBINATIONS

10.1 A SINGLE OIL SWITCH OR FUSED OIL SWITCH

A single oil switch shall be supplied with a busbar end cap and insulating compound on one end. A castile end box shall be fitted to the opposite busbar end.

10.2 EXTENSIBLE OIL SWITCHES AND FUSED OIL SWITCHES

Extensible oil switches and fused oil switches shall be supplied complete with two busbar end caps, busbar coupling links, busbar band joints and filling compound for the end caps and joints.

10.3 EXTENSIBLE RING MAIN UNIT WITH FUSED OIL SWITCH TEE-OFF

An extensible ring main unit with a fused tee-off shall comprise two extensible oil switches and one extensible fused oil switch complete with equipment and material. (Refer to par. 10.2). The fused oil switch tee-off shall be located between the two oil switches.

10.4 NON-EXTENSIBLE RING MAIN UNIT WITH FUSED TEE-OFF

A non-extensible ring main unit shall comprise two oil switches and one fused oil switch tee-off combined in a compact single unit with no external busbar access.

The three switches shall preferably be housed in a common oil tank. The fused oil switch tee-off shall be located between the two oil switches.

11. LABELS

- 11.1 Labels shall consist of engraved plastic or ivory sandwiched strips. The labels shall bear white lettering on black background. Painted or printed labels are not acceptable.
- 11.2 Each switch shall have a label designating the circuit. All label designations shall be obtained from the Department and shall be confirmed in writing with the Department before manufacture.
- 11.2 Labels shall be secured by means of brass bolts, nuts and washers. Where this is not practicable cadmium-plated self-tapping screws may be used. The gluing of labels is not acceptable. Sufficient fixing screws shall be provided to prevent labels from warping.

12. INSPECTION AND TESTS

The Department shall be notified at least two weeks in advance of the completion of the switches and of the date of testing in order that an inspection may be carried out before delivery and that tests may be witnessed.

13. TECHNICAL INFORMATION

13.1 One copy of each of the following information shall be submitted to the Department together with the tender:

- (a) Type test certificates.
- (b) Complete technical details and drawings.

13.2 Immediately after the award of the contract, a detail drawing of the concrete bases showing concrete mixes, dimensions, cable entry openings, steel reinforcing details and holding-down bolt fixing shall be submitted to the Department. Three prints of each of the different drawings shall be provided.

*3.3 The following information shall be supplied together with the equipment:

- (a) One operating and maintenance manual.
- (a) Installation and commissioning instructions.
- (c) Two copies of the unit test certificates.
- (d) A test certificate stating the average breakdown voltage of the oil at the time of filling.

13.3 One operating handle of each type of switch shall be supplied.

14. COMPLETION

The supply contract shall be regarded as incomplete until the technical information, operating handles, filling compound, fuses, test units (if required) and all other items as specified have been supplied to the Department.

SECTION C.36**C.36 DISTRIBUTION TRANSFORMERS****1. GENERAL**

- 1.1 This specification covers the manufacture of distribution transformers for general reticulation and distribution systems in normal environmental conditions for 50 Hz, three-phase, 11 kV (nominal) primary and three phase four-wire 400 V (nominal) secondary systems.
- 1.2 The transformers shall be of the low loss type and shall comply with SANS 780.
- 1.3 The number of transformers required shall be as specified.

2. POWER RATINGS

The rated power of the transformer shall be as specified and shall be one of the standard values given below in accordance with SANS 780:

- 2.1 Single-phase Transformers (kVA): 16, 25,
- 2.2 Three-phase Transformers (kVA): 16, 25, 50, 100, 200, 315, 500, 800, 1250, 2000.

3. BREATHING

- 3.1 Single-phase transformers shall be of the sealed type, with the tank covers welded to the tank.
- 3.2 Three-phase transformers shall be of the sealed type up to power ratings of 500kVA. Transformers rated at 600kVA and above may be of the free-breathing or sealed type. Sealed transformers shall have welded tank covers. Rolled tank covers will not be accepted on sealed transformers.
- 3.3 Sealed transformers above 500kVA rating shall be fitted with a pressure relief device, secured to the welded tank cover.

4. CONSTRUCTIONAL DETAILS AND FITTINGS

The transformer shall be filled with the recommended standard fillings for transformers as specified in Table 1 of SANS 780 and as specified below:

- 4.1 An off-load tapping switch shall be provided on all transformers including miniature substation transformers.
- 4.2 A maximum indicating thermometer shall be provided on all transformers with a power rating of 1 000kVA and above to sense the oil temperature directly above a winding. One pair of alarm contacts shall be calibrated to close at 85°C one pair of trip contacts shall be calibrated to close at 95°C. These contacts shall not be easily adjustable without removal of a cover.
- 4.3 Gas-and oil actuated relays shall be provided on all transformers of power ratings of 1000kVA and above. One pair of alarm and one pair of tripping contacts shall be provided.
- 4.4 Single-phase transformers shall be fitted with pole clamps.
- 4.5 Longitudinal solid under bases shall be provided on all transformers of power ratings of 600kVA and above. Axles and wheels are not required.

5. BUSHINGS AND CABLE BOXES

- 5.1 Open bushings and outdoor terminals shall be provided on both the primary and secondary sides of the transformers unless specified to the contrary. The bushings on the low voltage side shall all be of the same size.

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4.2 If specified, cable boxes shall be provided. Cable boxes on the primary side of the transformer shall comply with the following requirements:

5.2.1 Cable boxes shall be of the metal-clad type suitable for indoor and outdoor use and suitable to accept armoured paper-insulated cables as specified.

5.2.2 The boxes shall be equipped with armour clamps and brass or gunmetal conical wiping glands for lead covered, tape or wire armoured cables.

5.2.3 The boxes shall comply with BS 2567.

5.2.4 The boxes shall be suitable for filling with bituminous or coal filling compound.

5.2.5 The boxes shall comply with the Department's standard specification for "CABLE END BOXES AND COMPOUND", Section C8.

5.3 Cable boxes on the secondary side shall comply with the following requirements:

5.3.1 The cable boxes shall be of the metal-clad type suitable for indoor and outdoor use and suitable to accept PVC-insulated and armoured cables as specified.

5.3.2 The boxes shall be air insulated and shall be equipped with the required number, sizes and types of glands and waterproofing gromets. Glands shall be equal or similar to 'PRATLEY' adjustable glands.

5.3.3 Where single core cables are used the base plate of the cable box shall be manufactured of non-ferrous material.

6. CABLE BOX FILLING COMPOUND

Where cable boxes are specified an adequate quantity of filling compound shall be provided. The filling compound shall comply with the Department's standard specification for "CABLE END BOXES AND COMPOUND", Section C8.

7. TERMINALS FOR THREE-PHASE TRANSFORMERS

7.1 Three terminals shall be provided on the primary side. Each terminal shall be fitted with the correct size and number of lugs, bolts, nuts, washers, etc. to accept the cables as specified. Bolted connections only are acceptable.

7.2 Four terminals shall be provided on the secondary side i.e. three phases and an insulated neutral. Each terminal shall be fitted with the correct size and number of lugs, bolts, nuts, washers, etc. to accept the cables as specified. Where parallel cables are specified bushing stud clamps or similar connectors of adequate size to accommodate the bolted cable lugs without overlapping of the lugs shall be provided.

7.3 Where busbars are specified on the secondary side, provision shall be made for the busbar enclosure to be made off on the transformer. Busbars rated at the transformer's full load current shall be accommodated. Adequate space shall also be allowed for busbar protection current transformers and allowance shall be made for the neutral to be brought out of the enclosure for external earthing.

8. CURRENT TRANSFORMERS

Current transformers are not required.

9. CORROSION PROTECTION

Corrosion protection shall comply strictly with SANS 780, clause 3.2.3. Where the transformers are required for installation within 50km of the coast the total dry film thickness of the paint shall be increased to at least 0,125mm.

10. METHOD OF COOLING

The transformers shall be of the ONAN type.

11. OIL

The transformers shall be supplied completely filled with oil. The oil shall comply with SANS 555. Sealed transformers shall be filled with passivated transformer oil.

12. TECHNICAL INFORMATION

All the relevant technical information (i.e. outline drawings, test cards, drawings of ralling plate, etc. as specified in SANS 780 shall be submitted to the Department.

In addition a test certificate stating the average breakdown voltage of the oil at time of filling shall be submitted to the Department.

SECTION C37**C.37 MINIATURE SUBSTATIONS****1. GENERAL**

- 1.1 This specification covers the manufacture and supply of miniature substations suitable for use on 11 kV (three-phase) and 400 V (three-phase and neutral), 50 Hz systems.
- 1.2 The substation shall comply with the requirements of SANS 1029 and SANS 1030 unless otherwise specified.

2. CONSTRUCTIONAL REQUIREMENTS**2.1 FIBREGLASS HOUSES**

Where specified and for all substations to be installed within 50km of the coast and in all corrosive industrial atmospheres, the roof, walls, and doors shall be manufactured of fibreglass in accordance with the following minimum requirements:

- 2.1.1 The laminate shall be constructed to SANS 141.
- 2.1.2 The Fibreglass shall comply with the minimum strength requirements of clause 3.4 of SANS 1029.
- 2.1.3 An outer isophthalic resin gelcoat with a minimum thickness of 0.4mm and ultraviolet absorption properties to prevent degradation of the surface from exposure to the sun shall be provided.
- 2.1.4 The gelcoat shall be backed by multiple layers of chopped strand mat glass rendering not less than 1.2kg/m². The strength shall be increased to 1.25kg/m² on all panels larger than 500 x 500mm.
- 2.1.5 The Fibreglass shall be thoroughly impregnated with polyester resin. The resin should preferably be clear.
- 2.1.6 The resin to fibreglass ratio shall not be less than 2.5:1 and not more than 3.0:1.
- 2.1.7 Air entrapped between the glass mat layers shall be thoroughly worked out. The laminate must be free of air bubbles and voids.
- 2.1.8 All edges shall be reinforced with an additional 700g/m² of fibreglass.
- 2.1.9 All large surfaces wider than 300mm, shall be reinforced or panelled to improve stiffness and rigidity.
- 2.1.10 A resin coat shall be applied to the inside of the panels to cover the fibre pattern.
- 2.1.11 Brass or steel locking plates shall be laminated into the Fibreglass at hinge points, locking mechanism, catch support areas, door restraint fixing points and all other points which will be subjected to mechanical stress.
- 2.1.12 Doors shall be adequately, reinforced, ribbed or double laminated with an air gap between the two layers of laminate to ensure rigidity.
- 2.2 FINISH AND COLOUR OF FIBREGLASS MINIATURE SUBSTATIONS**
- 2.2.1 The outside surface of the fibreglass shall have a glossy, smooth finish to ensure good weathering. To obtain this the manufacturer shall ensure that the moulds are smooth, free of voids, hairline cracks, pores or other defects.
- 2.2.2 Compound rubbing or sanding of the outside surface will not be permitted.
- 2.2.3 Pigments shall be added to the outer gelcoat to obtain a matching colour to "AVOCADO GREEN", colour C12 or "LIGHT STONE", colour C37 of SANS 1091.

2.2.4 Fibreglass panels shall not be painted.

2.3 SHEET STEEL HOUSINGS

2.3.1 Where specified, the roof, walls and doors shall be manufactured of steel.

2.3.2 The sheet steel concerned on shall comply with the minimum strength requirements of clause 3.4 of SANS 1029.

2.3.3 All welds shall be ground smooth and the joints welded with plumbers metal in order to provide a smooth finish.

2.3.4 All panels, the roof and doors shall be suitably braced and stiffened to ensure rigidity and to prevent warping.

2.3.5 The colour of the outer coat of paint on the outer surfaces of the substation shall be an acceptable match to "AVOCADO GREEN" colour C12 or "LIGHT STONE" colour C37 of SANS 1091. A tin of matching touch up paint (not smaller than 500ml) shall be provided with each mini-substation.

3. CONCRETE PLINTH

3.1 The mini-substation shall be mounted on a concrete plinth. Plinth shall be cast on site.

3.2 The Contractor shall issue to the Department a detailed plinth drawing suitable for each type of mini-substation supplied. (Refer to par. 11.1.1 (c)).

3.3 The top of the plinth shall protrude at least 200mm above the final surrounding ground level. The concrete plinth shall protrude approximately 100mm beyond the edges of the mini-substation to form an apron.

3.4 The concrete apron and plinth shall be wood float finished and shall slope from the base to permit rain water run off. A 3mm thick gasket of approved material shall be inserted between the mini-substation and the concrete surface. The gasket shall be as wide as the base.

3.5 Cable ducts shall be provided in the plinth to accommodate all the incoming and outgoing cables. The cable ducts shall be sealed to prevent entry of rodents. The sealing shall be easily removable in the event of future cable work and may consist of a layer of 10:1 sand and cement mix, approximately 10mm thick, and finished flush with the top of the concrete plinth.

4. BASE

Steel bases shall be supplied for the mini-substations. Bases shall be hot-dip galvanised and then epoxy top coated before being painted.

5. DOORS

5.1 Long pedestal type hinges with at least two fixing bolts per hinge or similar hinges shall be used to hang the doors. The pedestal hinges shall be arranged in opposed fashion so that doors cannot be lifted off. Piano hinges are not acceptable. The hinges shall be of brass or other corrosion resistant materials. Nylon or aluminium hinges are not acceptable.

5.2 At least three hinges shall be provided on doors higher than 1.2m.

5.3 Door restrainers shall be provided. Cloth or canvas straps are not acceptable. The fixing points of the restrainers at both the door and the door frame shall be reinforced.

5.4 Doors shall be fitted with brass or stainless steel lever locks equal or similar to the "BARKER & NELSON" type with a 180° movement. The locking mechanism shall have a catch on the rear which engages behind the frame or door entry surround. The locking mechanism as well as the catch support area shall be backed by brass or galvanised steel plates. The locking mechanism shall be padlockable. Padlocks will be provided by the Department.

- 5.4 Bypass bolts and nuts shall be used to fix the rings.

6. HIGH VOLTAGE COMPARTMENT

- 6.1 The high voltage compartment shall be equipped with a non-extensible bulk oil filled ring main unit with a fused lee-off unless otherwise specified. This unit shall be manufactured and supplied in accordance with the Department's standard specification for "11kV NON-AUTOMATIC OIL SWITCHES, FUSED OIL SWITCHES AND RING MAIN UNITS", Section C35.
- 6.2 All ring main units or other HV switchgear installed in miniature substations must be fitted with integral testing facilities. Testing by means of a separate test harness is not acceptable.
- 6.3 The minimum clearances between connecting cables and jumpers and any sharp metal edges or protrusions shall be at least 75mm.
- 6.4 "DELARON" or "THIOITE" resin bound synthetic wood or other suitable dielectric material shall be used to maintain the phase-to-phase and phase-to-earth spacing of the cables and jumpers. The surfaces of these spacers shall be treated to prevent surface tracking.
- 6.5 Stranded annealed copper conductors only shall be used for jumper cables.
- 6.6 All terminals shall be shrouded with "RAYCHEM", or similar heat-shrinkable shrouds. Taping is not acceptable.
- 6.7 The high tension connections between the fused switch unit and the transformer shall be suitably blanked off so that they cannot be touched.

7. TRANSFORMER COMPARTMENT

- 7.1 The transformer compartment shall be equipped with a transformer as specified and in accordance with the Department's standard specification for "DISTRIBUTION TRANSFORMERS", Section C36 and the requirements of SANS 1029.
- 7.2 An off-circuit tap switch shall be provided.
- 7.3 The transformer shall be sealed and shall not contain a silica-gel breather.

8. LOW VOLTAGE COMPARTMENT

8.1 EQUIPMENT

- 8.1.1 The specified equipment shall be installed in the low voltage compartment.
- 8.1.2 The equipment shall comply with the Department's standard quality specifications.
- 8.1.3 The low voltage compartment shall be of ample size to accommodate the specified equipment and provide space for future requirements as specified.

8.2 EQUIPMENT SUPPORT FRAME

- 8.2.1 A rigid angle iron or folded metal support framework shall be provided.
- 8.2.2 The frame shall be bolted down on the base by at least four M18 high tensile steel bolts.
- 8.2.3 A cable gland plate shall be provided at the bottom of the frame across the full width of the compartment. The gland plate shall be at least 100mm above the plinth height. A minimum distance as required by the bending radius of the cores of the outgoing cables shall be provided between the lowest terminals of major equipment and the gland plate.
- 8.2.4 The gland plate shall be suitably punched to accept the number and size of cables specified.
- 8.2.5 All steelwork shall be hot-dip galvanized in accordance with SANS 32&121.
- 8.2.6 A resin bound synthetic wood or other suitable dielectric material panel shall be provided for the mounting of all equipment and busbars. Impregnated hardboard or other treated or untreated wood

products are not acceptable.

- 8.2.7 Alternatively, all equipment and busbars shall be flush mounted within a purpose-made sheet metal frame enclosed by a machine punched removable front panel through which the operating handles of the equipment protrude. Care shall be exercised that the rear studs of circuit breakers are properly insulated from the steel chassis. Miniature circuit breakers may be installed in clip-in trays mounted on the frame.

8.3 BUSBARS

8.3.1 Application

- (a) Busbars shall be manufactured of solid drawn high conductivity copper with a rectangular cross section in accordance with SANS 1195 and BS 159 and AS 1433, where applicable.
- (b) Although SANS 1473 refers to overhead and rising busbars, busbars in miniature substations shall comply with applicable sections of this specification, especially as far as insulation and clearance values, creepage distance, joints, insulation resistance, dielectric strength, deflection test, absorption resistance and rated short time withstand current are concerned.
- (c) Busbars shall be supplied for the following applications:
- (i) Distribution of supply voltage.
 - (ii) Connecting of equipment with ratings exceeding the current rating of 70mm² conductors.
 - (iii) Connection of outgoing circuits with current ratings in excess of that allowed for 70mm² conductors (par. 8.4.1).
 - (iv) Collector bars for parallel cables.
 - (v) Connection bars for neutral conductors (par. 8.3.8).
 - (vi) Earth busbars (par. 8.3.8).
 - (vii) Connections to miniature circuit breakers.

- 8.3.2 See Section C15 for details.

8.4 WIRING

See Section C17 for details 8.4.1

8.5 MOUNTING OF EQUIPMENT

- 8.5.1 The mounting of equipment shall comply with SANS 1705 where applicable. Equipment shall be fixed to the support panel with nuts, nuts, washers and spring washers. Self-tapping screws will not be accepted.

- 8.5.2 Equipment shall be arranged and grouped in a logical fashion.

- 8.5.3 All equipment shall be flush mounted behind panels with only circuit breaker and isolator toggles and meter faces protruding. The front panels shall be secured in position by 6mm studs and hexagonal chromed brass dome nuts and washers or hex nuts fasteners. Self-tapping or similar screws are not acceptable.

- 8.5.4 Blanking plates shall be fitted over slots intended for future equipment. These plates shall be fixed so that fixing holes do not need to be drilled through the front panel.

8.6 ACCESS

All equipment, busbars and wiring shall be completely accessible with the front cover panel removed.

8.7 LABELLING

- 8.7.1 All equipment shall be fully labelled and accurate descriptions and safety warning notices shall be given in both official languages.

- 8.7.2 Engraved plastic or ivory sandwiched strips shall be used for labels. The labels shall bear white lettering on a dark background, painted or printed labels are not acceptable.

8.7.3 The following labels shall be supplied as a minimum requirement:

8.7.3.1 Designation of mini substation

CHURCH ST. MINI-SUB
E.g. KERKATR. MINI-SUB

(Lettering: At least 40mm high. Label on the outside in a prominent position on both the front and back of the substation).

8.7.3.2 Designation of circuit i.e. circuit breaker, isolator, meter, etc.

e.g. HOUSE 473
HOUSE 473

PUMP SUPPLY
POMPTOEVOER

(Lettering: At least 5mm high. One label installed directly below each item of equipment pertaining to the particular circuit shall be provided).

8.7.3.3 The main switch shall be labelled in accordance with the regulations.

8.7.3.4 The function and circuits of all other equipment shall be clearly identified. Flush mounted equipment within the front panel shall be identified by labels fixed to the front panel. The labels for all equipment installed behind panels shall be fixed to the support panel close to the equipment.

8.7.3.5 The labels shall be secured by means of brass nuts and bolts, self-tapping screws, pop-rivets or slotted label holders. Engraved labels shall be secured to facilitate a neat alteration of the designation of the labels. Labels shall not be glued to their mounting positions. Sufficient fixing points shall be provided to prevent labels from warping.

8.7.3.6 All label designations shall be confirmed with the Department before manufacture.

9. NOTICES

The notices in terms of clause 652 of the Occupational Health and Safety Act 1991 and labels as required on the outside of the mini-substation, shall be rivetted to the steel door or paneling so that they cannot easily be removed. Brass rivets shall be used. In the case of fibreglass housings, the notices shall be laminated into the fibreglass except for the designation label.

10. INSPECTION

The Department shall be notified at least two weeks in advance of the completion of the mini-substation in order that an inspection may be carried out before delivery.

11. DRAWINGS

11.1 DRAWINGS FOR APPROVAL

11.1.1 A set of three prints of the shop drawings of the mini-substations shall be submitted to the Department for approval before manufacture commences. The following information shall be presented:

- (a) Schematic and wiring diagrams
- (b) A complete layout of the internal arrangement of the mini substation showing all equipment dimensions and construction details. The positions and method of fixing of busbars shall be shown.
- (c) All labelling information in both the official languages on a separate sheet.
- (d) The makes, catalogue numbers and capacities of all equipment scheduled on a separate sheet.
- (e) A detail drawing of the concrete plinth showing concrete mixes, dimensions, opening sizes, steel reinforcing details and holding down bolts fixing details.

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11.1.2 The approval of drawings shall not relieve the Contractor of his responsibility to the Department to supply the mini-substations according to the requirements of this Specification.

11.2 FINAL DRAWINGS

A complete set of "as built" transparent drawings of the mini substations shall be submitted to the Department within two weeks after delivery. The information called for in par. 11.11 (a) to (e) above shall be provided.

11.3 COMPLETION

The supply contract shall be regarded as incomplete until all drawings have been handed to the Department.

SECTION C38**C.38 INSULATORS AND FITTINGS FOR OVERHEAD LINES****1. GENERAL**

- 1.1 This section covers the manufacture, supply and delivery of insulators and associated fittings for use on overhead lines with system voltages up to 22 kV and with a frequency of 50 Hz.
- 1.2 Insulators together with their metal fittings shall comply with the following standards:
 - (a) For system voltage up to 1 kV (Low Voltage) SANS 461
 - (b) For system voltages from 1 kV to 22 kV (High Voltage) SANS 60383.
- 1.3 All other non-current carrying accessories shall comply with SANS 51284.
- 1.4 Insulators shall be suitable for use with the size and type of conductor specified.
- 1.5 All low voltage and high voltage pin insulators shall be of glazed ceramic manufacture. Glass string insulators shall only be used in areas with abnormal air pollution and where specified. In all other cases glazed ceramic string insulators shall be used.
- 1.6 Insulators, complete with all fittings, shall not exhibit excessive or localised corona formation at voltages less than 1.3 times nominal phase-to-neutral voltage.

2. HV INSULATORS

- 2.1.1 Pin insulators shall comprise a ceramic insulator mounted on a steel pin.
- 2.1.2 Pin Insulator shall be of Class B in SANS 60383.
- 2.1.3 The insulators for nominal system voltages of 11 kV and 22 kV shall be designed to limit radio interference and the marking "RIF" shall appear on the insulator. A semi-conductive glaze coating applied to the live-end portion of the insulator and cemented-in metal thimbles in the pin hole may be employed for this purpose.
- 2.1.4 The pins of pin insulators shall be straight and shall be complete with washers and nuts. The shank and threaded lengths shall be as specified on the drawings or as required for the mounting application. Pins, nuts and washers shall be hot-dip galvanised in accordance with SANS 32&121.

2.2 STRING INSULATORS

- 2.2.1 String insulators shall comprise a single string insulator unit together with its metal fittings or multiple-string insulator units arranged in a single string together with their metal fittings.
- 2.2.2 String insulators shall normally be applied in tension positions. However they may be specified for suspension positions.
- 2.2.3 String insulator units shall be in accordance with SANS 60383 and shall be complete with gudgeon pins, washers and split pins.
- 2.2.4 Wherever string insulators are required, a single insulator shall be used on 11 kV systems and two insulators on 22 kV systems.
- 2.2.5 All metal parts shall be hot-dip galvanised in accordance with SANS 32&121 excluding the split pins for the securing of the gudgeon pin which shall be of phosphor bronze or stainless steel.
- 2.2.6 The insulators for nominal system voltages of 11kV and 22kV shall be designed to limit radio interference and the marking "RIF" shall appear on the insulator.

2.3 VOLTAGE RATINGS

2.3.1 The voltage ratings of pin insulators shall be as follows:

		SYSTEM VOLTAGE	
		< 1 kV	22 kV
(a)	Flashover voltage		
	dry	95 kV	110 kV
	wet	53 kV	80 kV
(b)	Puncture withstand voltage	95 kV	~ 30 kV
(c)	50% lightning impulse voltage		
	positive	140 kV	170 kV
	negative	165 kV	215 kV

2.3.2 The voltage ratings of string insulators shall be as follows:

(a)	Flashover voltage	
	dry	64 kV
	wet	51 kV
(b)	Puncture withstand voltage	~ 15 kV
(c)	50% lightning impulse withstand voltage	
	positive	152 kV
	negative	148 kV

3. LV INSULATORS

3.1 LV PIN INSULATORS

3.1.1 Low voltage insulators shall be of white glazed porcelain with top and side grooves. The groove sizes shall be suitable for the size of conductor used.

3.1.2 The insulators shall be internally threaded to accept "CORDEAUX" threaded spindles.

3.1.3 Insulators shall be supplied complete with mild steel straight spindles, fibrous or neoprene washers, washers and nuts. All steel parts shall be hot-dip galvanised in accordance with SANS 32&121.

3.2 LV SHACKLE AND REEL INSULATORS

3.2.1 All low voltage shackles and reel insulators shall be of white glazed porcelain with a side groove. The groove size shall be adequate to accept the conductor size used.

3.2.2, Where these insulators are specified for tension or angle points, hot-dip galvanised mild steel straps or "D" brackets and bolts, nuts and washers shall be provided. Two fibrous or neoprene washers shall also be provided for each insulator. Galvanising shall be in accordance with SANS 32&121.

4. STAY INSULATORS

4.1 Stay insulators shall be of brown glazed porcelain.

4.2 The minimum dry and wet flashover voltages shall be 35 kV and 30 kV respectively.

4.3 The ultimate breaking strength of the insulators shall be at least 110 kN.

5. FITTINGS

5.1 GENERAL

5.1.1 All fittings made of steel or malleable iron, including the threaded portions of bolts, shall be hot-dip galvanised in accordance with SANS 32&121 to prevent corrosion.

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- 5.1.2 Bolts and nuts shall be of steel with hexagonal heads. Where metal parts are secured by bolts and nuts, single flat mild steel washers shall be used at both the bolt head and nut sides.
- 5.1.3 Bolts shall be locked by means of locknuts or other approved methods.
- 5.1.4 All line, earth conductor and staywire fittings shall not employ screw threads loaded in tension with the exception of cross-arm eye bolts and lumbuckle type stay rods.
- 5.1.5 Adequate bearing areas between fittings shall be provided. Point or line contacts shall be avoided where possible without adversely affecting the flexibility of the fittings.
- 5.1.6 All split pins shall be of phosphor bronze or stainless steel and shall be backed by flat steel washers.
- 5.1.7 The mechanical strength of insulators and fittings shall provide a factor of safety of at least 2.5 based on the guaranteed minimum tensile load when they are subjected to the maximum design tension in the conductor or earth wire to which they are attached. The ultimate breaking strength of insulators and fittings specified for tension applications shall in any event not be less than 70kN.

5.2 TENSION CLAMPS

- 5.2.1 Tension clamps shall be of the bolted type "snail" clamps.
- 5.2.2 The clamps shall be made of malleable cast iron to BS 310 and manufactured in compliance with SANS 61284.
- 5.2.3 Tension clamps shall not permit slipping of or cause damage to or failure of the complete line conductor or any part thereof at a load less than 95% of the ultimate strength of the line conductor for which it is intended.
- 5.2.4 The tension clamps shall be designed so that relative movement between individual conductor layers shall not occur during assembly.
- 5.2.5 All bolts or U-bolts shall be provided with locknuts or an alternative locking manner approved by the Department. All nuts shall be backed with flat steel washers.
- 5.2.6 The clamps shall match the clevis and tongue string insulator units without additional adaptors and shall also be suitable for the specified conductor type and size.

5.3 THIMBLE CLEVSSES

- 5.3.1 Thimble clevsess shall be used with preformed dead-ends.
- 5.3.2 Thimble clevsess shall be made of malleable cast iron to BS 310.
- 5.3.3 The rods of the thimble clevis shall be suitably designed to accept the preformed dead-ends.
- 5.3.4 The thimble clevises shall match the clevis and tongue string insulating units without any additional fittings.

5.4 CROSS-ARM AND TOWER ATTACHMENTS, SHACKLES, LINKS, ADAPTORS AND YOKE-PLATES

- 5.4.1 These fittings shall be made of malleable cast iron to BS 310 and manufactured in compliance with SANS 61284.
- 5.4.2 The fittings shall match the specified immediate adjacent fitting or string insulator unit without the use of additional adaptors.

6. SURGE DIVERTERS

Surge diverters are surge protective devices for repeated operation to limit voltage surges on AC power circuits and to interrupt power follow current.

6.1 LOW VOLTAGE SURGE DIVERTERS

- 6.1.1 Surge diverters for installations with a rated voltage of up to 660V shall comply with SABC 171.
- 6.1.2 The voltage rating for these surge diverters shall be 250V, 500V or 660V with an insulation resistance of not less than 50 megohms.
- 6.1.3 Surge arresters for indoor use shall be clearly marked "INDOOR".

6.2 HIGH VOLTAGE SURGE DIVERTERS

- 6.2.1 Surge diverters for installations with a rated voltage above 660V shall conform to IEC 99-1 for "NON-LINEAR RESISTOR TYPE ARRESTERS FOR AC SYSTEMS" and shall be 10 kA Series A arresters of the heavy duty type.
- 6.2.2 The line and earth connections shall consist of terminal lugs complete with bolts, nuts, stainless steel washers and cable washers.
- 6.2.3 The mounting bracket which will be supplied with the surge diverter shall be hot-dip galvanised steel brackets complete with damping band, bolts, nuts and washers. The mounting bracket shall have the dimensions of and comply with the NEMA bracket 1. All the bracket accessories shall be hot-dip galvanised.

SECTION C39**C.39 STANDARD PAINT SPECIFICATION****1. FINISH REQUIRED**

Metalwork of electrical equipment such as switchboards, equipment enclosures, sheet steel luminare components, purpose-made boxes, etc. shall be finished with a high quality paint applied according to the best available method. Baked enamel, electrostatically applied powder coating or similar proven methods shall be used.

2. CORROSION RESISTANCE

Painted metal shall be corrosion resistant for a period of at least 168 hours when tested in accordance with SANS 166.

3. EDGES

Care shall be taken to ensure that all edges and corners are properly covered.

4. SURFACE PREPARATION

Surface preparation shall comply with SANS 10064. Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metallic finish. Sand or shot blasting or acid pickling and washing shall be employed for this purpose.

5. BAKED ENAMEL FINISH

- 5.1 Immediately after cleaning all surfaces shall be covered by a rust inhibiting, tough unbroken metal-phosphate film and then thoroughly dried.
- 5.2 Within forty eight (48) hours after phosphating, a passivating layer consisting of a high quality zinc-chromate primer shall be applied, followed by two coats of high quality alkyd based baked enamel.
- 5.3 The enamel finish on metal luminare components shall comply with SANS 783, Type III.
- 5.4 Other metal parts e.g. switchboard panels, etc., shall comply with SANS 783, Type IV with a minimum paint thickness after painting of 0,05mm. In coastal areas, the dry film thickness shall be increased to at least 0,1mm.
- 5.5 The paint shall have an impact resistance of 5,65 J on cold-rolled steel plate and a scratch resistance of 2kg.

6. POWDER COATED FINISH (NOT TO BE USED LESS THAN 50KM FROM SEASIDE)

- 6.1 Immediately after cleaning the metal parts shall be pre-heated and then covered by a microstructure paint powder applied electrostatically.
- 6.2 The paint shall be baked on site shall harden within 10 minutes at a temperature of 100°C.
- 6.3 The minimum paint thickness after baking shall be 0,05mm. The dry film thickness shall be increased in coastal areas. The paint cover shall have an impact resistance of 5,65 J on cold-rolled steel plate and a scratch resistance of 2kg.

7. TOUCH-UP PAINT

In the case of switchboards and larger equipment enclosures, a tin of matching touch-up paint not smaller than 1 litre shall be provided.

8. COLOURS

- 8.1 The colour of HV switchboards and HV switchinggear enclosures shall be "DARK ADMIRALTY GREY", colour G12 of SANS 1091.
- 8.2 The colour of LV switchboards and equipment enclosures in buildings shall be "LIGHT ORANGE", colour B2F of SANS 1091 as recommended in SANS 10140, Part II unless specified to the contrary.
- 8.3 The colour of LV distribution kiosks and miniature substations shall be "AVOCADO GREEN", colour C*7 or "LIGHT STONE", colour C37 of SANS 1091.
- 8.4 The standby power section of LV switchboards in buildings shall be coloured "SIGNAL RED", colour A1 of SANS 1091.
- 8.4 Switchboards for No-Break Power Supplies or sections of switchboards containing No-break power supplies, shall be coloured "DARK VIOLET", colour F06 or "OLIVE GREEN" colour H05 of SANS 1091.

SECTION C40**C.40 FIBREGLASS REINFORCED POLYESTER LIGHTING POLES**

The poles offered shall be of a filament fibreglass reinforced polyester type. The pole shall be cylindrical in shape and have a continuous taper of 15mm per metre. The poles shall be manufactured according to Quality System Assurance SANS 9000.

The material used must comply with the requirements of SANS 141.

The material shall be of glass filament wound manufacture, employing a filament winding process achieving optimum results for strength and rigidity. The surface shall be smooth tapered seamless.

The pole shall be coloured throughout in the standard colour grey.

The surface shall be of a special pure resin coat to achieve a weatherproof UV resistant fire retardant and impact resistant surface.

The mechanical strength of the pole shall be designed for a fluctuating wind load of 700 PA over a surface area of 0,25m². Under these circumstances a maximum deflection of 5% of the mounting height (height above ground) shall be permissible. The pole shall be designed with a safety factor of 3.

A cable entry of 80mm diameter shall be provided $\pm$ 800mm below ground level.

The pole shall have an access door of 250mm x 80mm. The door cover shall be an overlapping polycarbonate cover smaller in diameter than the pole to ensure a tight fit. The cover shall be secured to the pole by means of two capsize stainless steel ALLEN cap screws that are completely tamper proof and only accessible with an ALLEN key. The door cover shall be completely replaceable and interchangeable.

The poles shall have a minimum filament wall thickness of 8mm $\pm$ 20%.

The pole is to have a 300mm x 300mm hot dipped galvanised baseplate secured to the pole by means of 2 x M8 hook bolts.

The pole shall be supplied with a gland plate to accommodate 2 x 20mm glands, MCCB, 4x16 amp terminal block and earth stud. This gland plate shall be removable so that the work can be executed outside the pole.

A SANS certificate certifying the bending strength of the pole shall be enclosed.

Copy of Quality Assurance Certificate of SANS 9000 shall be enclosed.

A pamphlet furnishing full details of the pole offered, shall be submitted with the tender.

SECTION C41**C.41 GALVANISED STEEL LIGHTING POLES****1. GENERAL**

All poles supplied must be absolutely straight, have the same shape and shall be as described in this specification. The poles must have a well finished appearance and must not be twisted in any way due to manufacturing or as result of handling. The pole must be of sufficient strength that it will not undergo any permanent shape change as a result of normal or normal transportation, handling or erecting.

The pole as a whole, including all fittings shall be galvanised on the inside as well as on the outside in accordance with SANS 326:21. The welding work on the pole shall be smooth and neat. No splinter, slag or air bubbles shall be visible. The galvanising process shall be done after all welding and machine work have been done.

The pole diameter shall decrease gradually in 11 steps from the pole's base to the pole top and the pole shall be as slender as possible with an outer diameter of $145 \pm 5\text{mm}$ at the bottom. The minimum material thickness of the pole shall be 4,5mm. The pole shall be absolutely round.

The manufacturer shall provide acceptable ventilation holes in the pole to prevent condensation of moisture in the pole. The pole shall also be rain and bee-proof.

A rectangular access hole shall be provided at the bottom end of the pole $\pm 0,2$ above finished ground level.

The opening shall be provided with a rain proof cover plate with the same profile as the pole. The cover plate may only be removed by using special tools. The cover plate shall undergo the same galvanising process after forming, cutting and drilling. The thickness of the cover plate shall not be less than 4mm.

A back plate suitable for the mounting of equipment shall be bolted in the pole. A clip-tray suitable for mounting two circuit breakers shall be provided on the mounting plate as well as a Din track for terminal blocks of the clip on type and a 6mm earth stud with nut, washer and spring washer.

The poles shall be provided with foot plates of size of 350mm and thickness of 6mm attached to the pole with a least two hook bolts of sufficient strength.

The foot plate shall not be welded onto the pole and the same rust protection that is used on the pole shall be applicable on the foot plate and hook bolts. The thread of the hook bolts shall be cleaned after been galvanised.

Each pole shall be provided with a cable entry at the bottom end of the pole. When planted $\pm 600\text{mm}$ below finished ground level.

The cable entry shall be manufactured in such a way the cables will not be damaged by the sides of the hole. The minimum dimensions of the hole are 100mm x 60mm. The cable entry shall be at the back of the pole.

Pole extension and pole stubs shall comply with this specification.

A pamphlet furnishing full details of the pole's extensions and stubs offered shall be submitted with the tender.

2. STANDARDS

2.1 The poles to be provided in accordance with this specification shall comply fully with all the requirements of this specification. Any deviations from this specification shall be clearly indicated.

2.2 The poles to be provided in accordance with this specification shall comply with the relevant subdivisions of the following standard specification:

2.2.1 SANS 62 Steel pipes and pipe fittings with a nominal bore of 150mm, suitable to be

2.2.2	SANS 557	-	screwed to ISO R7 - pipe thread.
2.2.3	SANS 57&121	-	Steel tubes for general engineering purposes - oil-dip (galvanised) zinc coatings, (Other than on continuously zinc-coated sheet and wire.)
2.2.4	SANS 10160	-	General procedures and loading to be accepted for the design of buildings.
2.2.5	BS 4360	-	Weldable structural steel

3. ENVIRONMENTAL CONDITIONS

3.1 The poles to be provided in accordance with this specification shall be suitable for outdoor use in the varied weather conditions prevailing in the Pretoria area during the various seasons. The following conditions are of special import:

3.1.1	Altitude above sea-level	1 530m
3.1.2	Maximum environmental temperature	43 EC
3.1.3	Minimum environmental temperature	-5 EC
3.1.4	Wind velocity	40m/s

4. DESIGN REQUIREMENTS

4.1 GENERAL

4.1.1 The poles shall be manufactured in accordance with the attached drawing:

SLP-1 Streetlight pole for Townships.

SLP-2 Streetlight pole (Double bracket)

SLP-3 Streetlight pole (Single bracket).

4.1.2 The poles can take on any of the following shapes:

- Round, tubular (pole diameter decreases step by step from pole base to pole top).
- Round, tapered.
- Octagonal, tapered.

4.1.3 The poles shall be properly finished and shall not be skew in any respect because of the manufacturing process or the handling thereof.

4.1.4 The poles shall be strong enough in order that no permanent deformation shall take place as a result of normal transportation, handling or erection or after the luminaires has been mounted and during the life span of the pole.

4.1.5 The poles shall be provided complete with mounting plate for the terminal blocks, clip plate for a miniature circuit breaker, pole base plate, cable access hole, inspection hole and lantern-mounting piece.

4.1.6 The Tenderer shall provide a complete design, including all calculations and drawings. This design shall be approved and certified by a registered professional mechanical engineer as being suitable to the proposed operating conditions.

4.2 MEASUREMENTS

4.2.1 Every pole shall be manufactured in accordance with the measurements indicated on the applicable drawing.

4.2.2 The following measurements are of special import and may not be a text:

- a) Mounting height and overhang,
- b) Minimum inside diameter of access opening,
- c) Outside diameter at end of pole,
- d) Position and size of holes in flange,
- e) Mounting braces (see paragraph 4.7.4).

4.3 CABLE INLET

- 4.3.1 Each pole shall be provided with a cable inlet of 100mm x 60mm at the bottom end of the pole, as indicated on the applicable drawing.
- 4.3.2 The cable inlet shall be manufactured in such a manner that the sides of the opening will not damage the cable.

4.4 POLE BASE PLATE

- 4.4.1 Each pole shall be provided with a square steel base plate with a diameter of 350mm and shall be at least 4mm thick,
- 4.4.2 The pole base plate shall be welded to the base of the pole.

4.5 PROVISION FOR CONTROL EQUIPMENT

- 4.5.1 A rectangular access opening shall be provided at the bottom end of the pole, as indicated on the drawing. The opening shall be covered by a rain-proof cover plate with the same profile as the pole and shall be kept in position by means of one heptagonal 10mm brass nut. The cover plate shall be manufactured from the same material as the pole and shall endure the same galvanising process after it has been shaped, cut and drilled. The thickness of the cover plate shall be at least the thickness of the pole.
- 4.5.2 A mounting plate suitable for the mounting of equipment shall be welded into the pole. Two dip-on mounting rails for Hagermann circuit breakers, as well as a rail for a Klippon terminal block shall be provided on the mounting plate. The clip plate shall be mounted after the pole has been galvanised.
- 4.5.3 Two rectangular holes shall be made next to the opening and each one shall be provided with a galvanised or plated 8mm x 25mm coach bolt.
- 4.5.4 Full particulars shall be provided if the Tenderers should offer an alternative with regard to the access opening and the cover plate of the control equipment.

4.6 FLANGE

- 4.6.1 Poles with flanges shall be delivered complete with bolts and nuts as indicated on the drawings. The strength of the flanges and the quality of the welding shall be such that the pole will show no signs of deterioration in its structure.

4.7 STREETLIGHT BRACKETS AND MOUNTING PIECES

- 4.7.1 The streetlight brackets shall be manufactured according to the attached drawings.
- 4.7.2 The streetlight bracket shall not be welded to the pole. Special care shall be taken to ensure that the bracket(s) will not rotate.
- 4.7.3 Provision shall be made at the end of the bracket(s) for the mounting of a streetlight luminaire.
- 4.7.4 The ends of the mounting pieces in which the luminaire will be secured shall be round with a outside diameter of $\varnothing 25 (+0, -1\text{mm})$ and a length of 125mm.

4.8 VENTILATION

- 4.8.1 The manufacturer shall provide ventilation holes in the pole in an acceptable manner so that no

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condensation of moisture will take place inside the pole. The pole shall also be rain- and insect-proof.

4.9 STREET LIGHT LUMINAIRE

4.9.1 The following requirements are applicable to poles manufactured in accordance with drawings

4.9.1.1 Each pole shall be used to carry a street luminaire with a mass of 20kg.

4.9.1.2 The projected lateral area of the luminaire shall be 0,1m²

4.9.2 The following requirements are applicable to poles manufactured according to drawing

4.9.2.1 Each pole shall be used to carry a street light luminaire with a mass of 10kg.

4.9.2.2 The projected lateral area of the luminaire shall be 0,025m².

4.10 INTERCHANGEABILITY

Spares for poles manufactured according to the drawings shall be interchangeable, whether for a single- or a double-bracket pole.

5. FINISHING

5.1 WELDING

5.1.1 Welding work on the poles shall be smooth and neat. There may be no spatters, slag or air bubbles.

5.2 GALVANISING

5.2.1 The galvanising process shall take place after all welding and machining have been completed

5.2.2 The poles, including all fittings, but excluding the circuit-breaker dip-on rail, shall be hot-dip galvanised inside as well as outside, in accordance with the latest edition of SANS 324121.

6 TESTS

6.1 The manufacturer shall personally and in the presence of a representative Engineer execute the following tests on five poles and shall make the results of such tests available for submission to the Engineer.

6.2 TESTING OF STREET-LAMP POLES

In order to ensure that the actual situation is simulated the vertical gravitational forces and horizontal wind forces (simulated) shall simultaneously act upon the lamp pole. The following testing methods shall be followed in order to simulate the combined loads, viz.

- (i) Place the lamp pole in the vertical position, as it would be mounted under normal circumstances.
- (ii) Determine the position of the end of the bracket (unloaded condition) to the nearest one millimetre from the pole base as reference A (see Figure 1). This may be done by attaching a plumb to the end of the bracket. The method shall be sufficiently accurate for the purposes of the test provided that the tests take place in fine weather conditions.
- (iii) The resultant loading and angle of application obtained from the combined horizontal and vertical loading shall be applied by means of a nylon rope (minimum breaking force 500kg) put up from the top end of the lamp pole. The loading may be applied in various ways, for example by attaching weights to the rope, or by placing a turnbuckle or ratchet tensioner and spring scale in line with the rope.
- (iv) The loading shall be applied in increments of 4 kg. After each loading the momentary deformation of the lamp pole shall be measured (x1, x2 ... xn) and be plotted against the loading. A linear course of momentary deformation is considered to be normal, whilst a non-linear course will be an indication of a deterioration in the structure.

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- (vi) After the lamp pole has been loaded to the maximum, the loading shall be removed and the position of the plumb shall be measured (X_d) (permanent deformation).
- (vii) Steps (iii), (iv) and (v) shall be repeated three (3) times in order to determine an average value for the permanent deformation (X_d).
- (viii) The following table indicates the loading and application angle to be applied for each individual lamp pole. Details of calculations appear in paragraph 6.4.

Note that lamp-pole numbers refer to drawings in accordance with Council Specifications.

Lamp-pole number	Loading (N)	Equivalent load	Angle of application	Length of rope (m)
	224,7	24	40 E	10,9
	409,1	43	45 E	15,1
	353,3	40	49 E	12,2

- (viii) By comparing the unloaded condition (X_0) to the average of the conditions obtained after loading (X_d), the percentage permanent deformation can be determined by means of the following formula:

$$\text{Def \%} = (X_d - X_0) / X_0 \times 100.$$

If this permanent deformation exceeds the proposed 15%, the pole does not comply with the specification and does not pass the test.

The above mentioned test is based on the principles of SANS 10160 viz. the general procedures and loading to be adopted for the design of buildings.

6.4 DETAILED CALCULATIONS OF LOADING

All formulae refer to SANS 10160.

The wind pressure on the element, $F_n = C_f q_z A_e$ (refer SANS 10160 - p39-5 (c))

C_f = pressure coefficient

= 1,1 (refer SANS 10160-1 - p68 Table 1-5)

q_z = free current wind pressure at height z (N/m²)

= $k_p V_z^2$ (refer SANS 10160 - p49, 5(d))

k_p = constants with a view to allowance for altitude above sea-level

(refer SANS 10160-p19)

V_z = characteristic wind velocity at altitude z

Take a site category 3 with a design wind velocity of 20m/s (refer SANS 10160 - p123, Table C-1).

$$q_r = k_p V_z^2 = 0,5 (20)^2 = 200 \text{ N/m}^2$$

$$C_f q_z = 1,1 (200) = 220$$

A_e = Total effective frontal area

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Lamp pole number	Total frontal area A_F (m ²)
	$(0,14 \times 1,3) + (0,09 \times 8,7) = 0,785$ $(0,1651 \times 2) + (0,1143 \times 8,7) = 1,325$ $(0,1651 \times 2) + (0,1343 \times 7,2) = 1,153$

The following represents the resultant force with the angle at which it shall be applied:

Lamp-pole number	Vertical loading (N) F_v	Horizontal loading (N) F_h	Resultant loading (N) F_r	Application angle θ	Rope length (m)
	143,7	177,7	229,7	40 E	10,9
	287,4	291,6	406,4	45 E	15,1
	287,4	253,7	383,3	49 C	12,2

(Gravitational force = 9,58 for the PWV.)

NB. The vertical loading provides for the mass of the light luminaires with a safety factor of 1,5.

- 6.5 The Tenderer shall include in his tender all measurements and results of tests in the form of a table for submission to the Department of Public Works.

7. DELIVERY

- 7.1 The successful Tenderer shall timeously notify the Engineer in writing before the delivery of the poles in order that they may be inspected upon receipt. No payment shall be made for poles, which have not been inspected or certified by the Engineer as being in order.

General Specification

General Engineering

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1 Scope

1.1 Application

This specification serves as an introduction to the standard engineering specifications.

The specifications in this document form the basis of the quality guidelines for this project and serve to set the standards to which individual components as well as the complete installation must adhere. If any deviations from or additions to these specifications should occur, it is detailed in the relevant standard technical specification. In all cases the latest available update of the specifications mentioned, applies to this contract.

All material supplied must be new and undamaged and SABS mark-bearing material shall have preference.

Works testing and commissioning of equipment is dealt with under the requirements listed in other Engineering Specifications pertaining to the relevant equipment, Engineering Standards and Particular (or Project or Detail) Specifications.

1.2 General

The following definitions are used in these Specifications:

- (a) The term "Employer" shall mean the person named as employer in the Appendix to Tender and the legal successors in title to this person;
- (b) The term "Contractor" shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.
- (c) The term "Engineer" shall mean the person appointed by the Employer to as the Engineer for the purposes of the contract.

2 Standards

2.1 Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site specific requirements will be found in the Project Specification and its accompanying Technical Data Sheets, which shall be read in conjunction with this Specification and any other applicable Standard Specification documents.

The decreasing order of precedence of these requirements shall be as follows:

- (a) Statutory requirements
- (b) Employer's requirements
- (c) Project Technical Specifications:
 - (i) Drawings
 - (ii) Technical Data Sheets
 - (iii) Aurecon Standard Engineering Specifications
- (d) National and international standards

Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

The Contractor shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the Installation.

2.2 Regulations, Specifications and Standards

The complete installation shall comply with all the latest editions (current at the time of Tender) of all relevant documents listed in the tables below, including:

- (a) Construction Regulations 2003 issued in terms of Section 43 of the Act;
- (b) Local Fire Regulations; and
- (c) Regulations of the Local Supply Authority.

Table 1: National Statutory Regulations

ACT No. / Year issued	Description
41	Electricity Act
85/1993	Occupational Health and Safety Act
29/1996	Mines Health and Safety Act
50/1991	Minerals Act
73/1989	Environmental and Conservation Act
31/1963	Fencing Act
122/1984	Forest Act
63/1970	Mountain Catchment Areas Act

Table 2: Guidelines and Recommended Standard Codes of Practices

No. / Year Issued	Description
SAIC/1990	SA Steel Construction Handbook
NWP 3109	Standard Drawing Practice
TMH1/1986	Standard Methods of testing Road Construction Materials
CSRA / 1987	Standard Specification for Road and Bridge Works
SANS 0157	Quality Management System
SANS 03	Code of Practice – Protection of structures against lightning
SANS 0292	Code of practice for the application of CNE on low voltage distribution systems
NRS 023/1991 (DTS 0090)	Overhead Reticulation; Recommended practice for low cost urban reticulation
SANS 10142-1	Standard Code of Practice for the Wiring of Premises - Low Voltage
DTS 0060	Power line crossings of proclaimed roads, railway lines, tramways and important communication lines
SANS 10280	Code of Practice for Overhead Power Lines for Conditions Prevailing in South Africa

3 Signage, Notices and Labelling

3.1 Danger Notices and Phase Identification Disks

Approved danger notices shall be mounted at all structures fitted with transformers, remote mechanically operated switchgear, distribution boards, capacitors, reactors, open cables or other live apparatus, and at other positions as may be decided by the Engineer. They should be written in the appropriate official languages of the Region. The internationally approved electrical warning sign (black lightning beam on a yellow background) shall also be clearly visible on the notice. Notices shall be mounted on the wooden poles, at a height of three meters above ground level and on steel structures and fences at a clearly visible height. Writing must be easily discernible letters.

All transformers, drop-out fuses, gang-operated links, terminal and T-off structures and busbars must be equipped with phase identification disks on the high voltage side. These must be red, white and blue, corresponding to the phases and be fixed around the connecting studs of the transformer bushings or around the conductor where it terminates on the units in question.

3.2 Marking and Labelling

All equipment shall be labelled according to the table below. Trefolite shall be used for all indoor labels and Aluminium shall be used for all outdoor applications.

Table 3: Marking and Labelling

Item	Device	Language of Inscription	Colours	Plate Dimensions (mm)	Letter Height (mm)	Stroke width (mm)
1	Outdoor Labels					
1.1	Circuit/Busbar	English	Black on orange	200 high	150	15
1.2	Phase identification		Red/Yellow/Blue	100 dia	-	-
1.3	Yard gear, items	English	White on black	As required	70	10
1.4	Kiosks, junction boxes	English	Black on white	As required	15	2
2	Indoor Labels					
2.1	GIS	English	Black on orange	As required	As required	As required
2.2	Equipment labels	English	Black on orange	As required	15	2
2.3	Panel labels	English	Black on white	As required	25	3
2.4	Panel equipment labels	English	Black on white	As required	5	1
3	Danger, Caution	English and Afrikaans	Red on white	As required	25	3

3.3 Labelling of Cables

Labelling of cables should be in English and be unambiguous, durable and legible. Labels should be attached directly to the cable to which they refer. Labels must be attached to cables using appropriate corrosion resistant, mechanical fixings.

The cable should be labelled on both ends indicating where it is running from and where it is going to. The fixing of the cables shall not affect the IP rating of the cable.

3.4 Paint Colours

Colours to be used for equipment shall be in accordance SANS 1091. Standard available colours and the typical equipment, to which they will be applied, are listed in the table below. All paintwork shall have a "Texture" finish and not a "Mat" or "Glossy" finish, unless specified otherwise elsewhere in the documentation.

Table 4: Paint Colours

Colour No.	Colour Name	Application
A11	Signal Red	Generator lincomer panels and eEmergency feeder panels
C12	Avocado Green	Outdoor Kiosks, Miniature Substations and Transformers
F11	Strong Blue	Bus-section Coupler
G12	Dark Admiralty Grey	3.3, 11 and 22 kV Switchgear
G29	Light Grey	3.3 kV Switchgear for Power Factor Correction
G35	Navy Light Grey	Steel Structures
C37	Light Stone	Miniature Substations, Transformers, MV Switchgear, Kiosks etc.
F06	Dark Violet	UPS Supply
B26	Light (Electric) Orange	LV DB's and MCC's

4 Clearances of Outdoor Busbars, Connections and Overhead Lines

4.1 Minimum Clearances of Outdoor Busbars and Connections

Minimum clearances of outdoor busbars and connections are summarised in the table below. In the case of the minimum clearance not complying with the requirements in the table below, insulation for the full operating voltage will be done with heat shrinkable insulation material suitable for outdoor application.

Table 5: Clearance distances in the table below are expressed in meters

	Rated System Voltage kV										
	≤ 12	24	36	72	100	123	145	245	300	362	420
Minimum clearance between live metal and earth	0.20	0.30	0.38	0.70	1.00	1.15	1.30	2.00	2.40	2.80	3.36
Minimum clearance between live metal of different phases	0.25	0.34	0.43	0.82	1.16	1.22	1.50	2.30	2.80	3.40	3.90
Minimum safety clearance between live metal and positions to which access is permissible with other equipment alive	2.60	2.80	2.90	3.00	3.50	3.60	3.80	4.50	4.80	5.30	5.50
Minimum clearance from ground level to base of insulation	2.5										

4.2 Earth Conductor Sizes

Table 6: Minimum sizes of Copper earth conductors (in mm²) are summarized in the table below

RATED SHORT CIRCUIT CURRENT (kA)		8,0	10,0	12,5	16,0	20	25	31,5	40,0
Minimum cross section area for a conductor required to carry full fault current									
3 s rating	mm ²	61	76	95	122	153	191	241	306
1 s rating	mm ²	35	44	55	71	88	110	139	176
Minimum cross sectional area for a conductor in a mesh system									
3 s rating	mm ²	40	51	63	81	102	127	160	204
1 s rating	mm ²	23	29	36	47	58	73	92	117

4.3 Overhead Line Clearances

Safety clearances of overhead lines are listed in the table below and will at all times be adhered to.

Table 7: Clearance (at maximum sag or swing as applicable)

1	2	3	4	5	6	7	8	9	10	11
	Outside Towns (m)	Inside Towns (m)	Above Railways and Main Roads (m)	Above Township Roads (m)	Along Roads Parallel with entry/exit (m)	Across Communal land (m)	Across Private property (m)	Telkom Insulated (m)	Buildings & structures (m)	Other Power lines (m)
MV										
24 kV	5,2	5,5	6,4	5,5	5,5	5,5	5,5	0,9	3,0	0,9
12 kV	5,1	5,5	6,3	5,5	5,5	5,5	5,5	0,9	3,0	0,8
7,2 kV	5,0	5,5	6,2	5,5	5,5	5,5	5,5	0,9	3,0	0,7
LV bare wire										
420 V/230 V	4,9	5,5	6,1	5,5	5,5	5,5	5,5	0,6	3,0	0,6
LV insulated										
ABC 420 V/230 V	-	3,3	5,1	4,7	3,5	3,3	3,3	0,2	3,0	0,6
Concentric 230 V	-		5,1	4,7	3,0	3,0	2,5	0,2	3,0	0,6

An LV or Telkom pole position at MV midspan is considered to be a separate structure, hence 3 m clearance required.

NOTES

- Column 2 is the minimum clearance of conductor to ground outside built-up areas.
- Column 3 is the minimum clearance of conductor to ground inside built-up areas.
- Column 4 is the minimum clearance to railway lines and proclaimed roads.
- Column 5 is the minimum clearance to unproclaimed roads used by vehicles such as delivery vans and buses.
- Column 6 is the minimum clearance to ground where lines run parallel to any road used by vehicles and vehicle entries/exits to the road cross underneath the line.
- Column 7 is the minimum clearance to ground in areas used by the community such as tracks or walkways.
- Column 8 is the minimum clearance to ground in an area owned by one owner.
- Column 9 is the minimum clearance to Telkom cable supported on the same structures.
- Column 10 is the minimum clearance to buildings and structures not forming part of the network, including a LV/Telkom pole installed midspan underneath a MV line.
- Column 11 is the minimum clearance to other power lines excluding the conditions listed in column 9.

5 Standard Insulation Levels for Windings and Connected Parts

All Transformers shall comply with the standard insulation levels as is summarised in Table 9 below.

Table 8: Standard insulation levels for windings and connected parts (SANS 780:2009)

1	2	3	4	5	
Highest r.m.s voltage U_m for equipment kV	Nominal System r.m.s Voltage U_n	Insulation level			
		Lightning impulse test voltage, peak kV		Power-frequency test r.m.s voltage kV	
		List 2 ^a	List 3 ^b	Separate source voltage withstand	Induced voltage withstand
≤1,0		25	30	2,5	Twice the rated voltage at principal tapping
3,6	3,3	40	60	16	
7,2	6,6	60	75	22	
12	11	75	95	28	
24	22	125	150	50	
36	33	170	200	70	
^a List 2 values apply to transformers designed for non-exposed installations (such as those connected to cable networks)					
^b List 3 values to apply to transformers designed for exposed installations					

Transformers shall comply with the standard insulation levels and Creepage distances as summarised in Table 10 below.

Table 9: Transformer Minimum Insulation, Fault and Creepage distances for power transformers (Extract from Eskom NWS Specification)

System highest voltage U_m (kV _{rms})	System nominal voltage U_n (kV _{rms})	System fault level (kA)	Lightning impulse voltage withstand level at sea level (BIL) (kV peak)	60 s power frequency voltage withstand level at sea level (60s 50Hz)	Bushings			Creepage (31mm/kV)	Tap changer				
					Line		Neutral						
			Line Terminal	Neutral Terminal	Separate source	Induced	BIL (kV peak)	60s 50Hz (kV _{rms})	BIL (kV peak)	60s 50Hz (kV _{rms})	System nominal voltage (U_n) (kV _{rms})	BIL (kV peak)	60s 50Hz (kV _{rms})
3.6	3.3	20	45	45	16	6.6	200	70	200	70	3.3	45	16
7.2	6.6	25	75	75	22	13.2	200	70	200	70	6.6	75	22
12.0	11	25	95	95	28	22	200	70	200	70	11	95	28
17.5	16	20	110	110	38	32	200	70	200	70	16	110	38
24	22	20	150	150	50	44	200	70	200	70	22	150	50
36	33	20	200	200	70	66	250	95	250	95	33	200	70
48	44	20	250	200x	70x	95	350	140	250	95	33	200	70
72	66	20	350	250x	95x	140	380	150	350	140	44	250	95
100	88	25	380	250x	95x	150	550	230	350	140	44	250	95
145	132	40	550	250x	95x	230	650	275	350	140	44	250	95
145	132	40	550	110+	38+	230	650	275	350	140	16	110	38
Non uniform insulation	+ Fully graded insulation x Partially graded insulation (see 4.9.6 Insulation tests, fault and creepage levels)												

NOTE 1: Phase-to-phase values specified in this table for all transformer windings shall be designed to withstand the appropriate test voltages, and shall be tested as specified in 5.2 Test by the Manufacturer.

NOTE 2: 145kV values specified in the last table are for Auto Transformers only.

General Specification

Training, Testing and Commissioning

Specification number: SPE-EE-0002

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1 Scope

1.1 Application

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

This Specification identifies the standard procedures and requirements for factory inspection tests, site testing, commissioning and training. The detailed requirements for each portion of equipment shall be found in the testing and commissioning subsection of the relevant equipment's standard specification. Further detailed requirements of the project or site specific requirements shall be found in the Particular Specification and its accompanying Data Sheets, which shall be read in conjunction with this Specification.

2 Factory Inspections

2.1 General

The Contractor shall provide Works, factory and manufacturers test information, including certificates of conformity to the Engineer. They shall be complete, accurate, in accordance with the specifications and approved by the Engineer prior to the equipment leaving the factory.

These tests include all the inspections required by the Engineer, or Manufacturer (with associated testing results/reports to prove it) during the Factory Construction process.

The Contractor (and relevant manufacturers) shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the industrial information and communications network.

The design, construction, inspection, testing and commissioning of the equipment shall comply with all relevant Statutory Regulations, and the latest editions (current at the time of Tender) of all relevant South African National Standards.

3 Site Testing and Commissioning

3.1 General

The full system testing of the electrical, instrumentation and control works are critical to the success of the project, therefore the Contractor shall execute it with the necessary diligence.

All new, refurbished or modified plant and equipment shall be thoroughly tested and commissioned prior to the handing over. Only plant and equipment that can be demonstrated to conform to the project specifications, relevant codes of practice and legislation, SANS, British, and IEC standards shall be handed over to the Employer.

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

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

Testing and commissioning activities shall be carefully planned, documented, and managed by the Contractor.

For details on the tests and inspections required for equipment refer to the relevant sub sections of the different equipment standard specifications

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

The Contractor shall

- (a) Demonstrate the functionality of the plant and all operator interfaces. This shall include demonstration that the control system can perform as intended by the designer, over the full range of foreseeable operating conditions.
- (b) Carry out full site tests on completion of installation work, irrespective of the extent of any previous partial or sectional tests or works tests that is specified in other standard specifications.
- (c) Provide method statements for tests and commissioning activities, together with the range of values and settings that are in accordance with the detailed design and demonstrate compliance with the specifications, for inclusion in the Commissioning Plan.

3.2 Testing Sequence

The testing to be performed on site is divided into two sections as follows:

- (a) Before official commissioning commences the Contractor shall test his equipment as described below to ensure that the plant has been installed correctly.
- (b) After the Contractor has been satisfied that the equipment is in working order, the commissioning of the plant will commence in the presence of the Engineer as described below

3.3 Site Testing of Equipment Prior to Commissioning

The Contractor shall timely inform the Engineer when he intends to perform his first tests and start-up of equipment in order to allow a representative of the Engineer to witness the tests if the Engineer deems it necessary.

Before starting up any section of the plant or equipment, the Contractor shall clean out the housings and equipment or structures, and, if necessary, make arrangements with other Contractors to remove their building rubble from the structures, check that all safety devices and alarms have been set and activated, all nuts and cable terminations have been tightened correctly, that all the equipment is complete and ready for start-up, that the plant has been installed correctly, and that three copies of the operating manuals have been handed over to the engineer.

Each section of the equipment shall be started up by the contractor. Before any equipment is started or energized, the contractor shall ensure that it is safe for personnel and equipment on site to do so. Allowance for these costs shall be made in his tendered rates and sums.

The Contractor shall conduct his own tests on the equipment and, only when he is satisfied that these tests meet the requirements of the specifications, shall he notify the engineer that he is ready to conduct the official tests on completion. The Contractor shall not conduct an official test without the

Engineer being present or his approval to do so. All equipment tested shall conform to the requirements specified.

The Contractor shall:

- (a) Perform and record the results of all testing.
- (b) At each stage carry out such preparatory testing and commissioning as necessary to ensure that equipment is ready for witnessing by the Engineer.
- (c) Retain all documentation generated during the testing and commissioning process, including all test and performance data as a commissioning record and issue four copies as part of the contract documentation.
- (d) At each stage of testing the results shall be checked by the Engineer.
- (e) Commissioning shall only proceed to the next stage if the results are approved by the Engineer. Any corrective measures shall be agreed by the Engineer.
- (f) Prerequisites for Commissioning

The Contractor shall provide Works testing, factory acceptance testing and manufacturer's routine testing information and certificates of conformity to the Engineer. The documentation shall be complete, accurate, in accordance with the specifications and approved by the Engineer prior to the start of the commissioning.

All instruments and equipment used for testing and commissioning shall be controlled by a quality assurance scheme acceptable to the Engineer, and their accuracy and suitability shall be demonstrated by the Contractor.

Operation and Maintenance Manuals for the whole works shall be provided before commissioning commences.

The comprehensive training programme, which shall include the training manual, shall be provided for the training that will take place during the commissioning period.

All labelling of equipment and cabling shall be completed and correct.

The Contractor shall ensure all warning notices, guards and safety devices are installed.

All pre-commissioning tests and checks shall be agreed with the Engineer prior to the commencement therewith.

When all the tests required before commissioning or tests before tests on completion, have been completed and accepted by the Engineer, the commissioning may proceed.

Testing and Commissioning activities shall be carefully planned, documented, and managed.

The Contractor shall provide the Engineer with full details of his testing and commissioning activities and programme for approval.

3.4 Final Commissioning

The Contractor shall be responsible for commissioning all sections of the works and shall perform all of the tasks set out below:

- (a) Prior notice of and proper arrangements for the commissioning shall be made with the Employer, Engineer, supply authority, and all Contractors and suppliers of equipment, which will be affected by the commissioning operation.
- (b) If plant and equipment, which has been supplied by others has to be commissioned, the relevant contractor's permission thereto, together with any specific requirements relating to commissioning shall be obtained prior to commissioning.

- (c) All sections of the works shall be carefully inspected by a responsible representative of the Contractor to ensure that all construction and installation work has been properly completed.

Commissioning and testing on site shall be carried out by experienced personnel under the Contractor's supervision.

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

At least three weeks before commissioning commences the Engineer will be requested to provide the Contractor with commissioning sheets for all the equipment installed by the Contractor. These forms shall be completed by the Contractor during the commissioning period and all items listed shall be entered. Final hand-over certificates will not be issued for equipment with incomplete commissioning reports. Information that is not available or applicable, or reasons for not performing certain tests shall be agreed with the Engineer.

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

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

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

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

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

3.5 Commissioning Report

A comprehensive commissioning test report shall be submitted by the Contractor prior to the issue of the Certificate of Completion and shall be inserted in the operations and maintenance manual.

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

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

4 Training

4.1 General

The Contractor shall conduct comprehensive training courses for designated personnel in the maintenance and operation of the plant during the commissioning period.

Electronic equipment operation and maintenance training shall form part of the overall training programme.

All equipment shall be in a complete working order before training shall commence.

The training shall be designed specifically for the works and shall take into account the skill and experience levels with the installed works of personnel.

Unless otherwise specified the training shall allow for at least 4 operational staff members and 4 engineering staff members.

Where the Contractor engages specialist services for sophisticated equipment, sufficient time shall be allowed in the contract to permit expert training to be given to plant operatives and maintenance personnel.

Where the Contractor presents portions of the course material by audio visual means, copies of those audio visual presentations shall be delivered to the Employer as part of the printed training manuals.

The Employer reserves the right to videotape the training sessions for later use.

During the installation phase, the Employer may wish to nominate a person who will be closely involved with the installation and commissioning process. The intention is not to interfere with the Contractors' installation team, but to co observation in order to obtain the maximum possible information regarding the installation, to enable efficient maintenance to be undertaken by the Employer after final hand-over and expiring of the guaranteed period.

4.2 Training Manual

Training and training manuals shall be based on the O&M Manuals.

Training manuals shall be delivered for each trainee with two additional copies which shall form part of the Operation and Maintenance Manuals. The manuals shall include an agenda, defined objectives for each course.

4.3 Training Schedule

A training schedule, together with the name and background of the person who will perform the training, shall be submitted to the Engineer for approval.

The training shall include operator training and technical/maintenance training.

The program for the training shall include instruction for at least one day instruction on-site.

The schedule shall at a minimum cover the following:

- (a) General system overview
- (b) Functional operation of the system i.e.:
 - (i) System start-up and shut-down procedures
 - (ii) Equipment operation
 - (iii) System access requirements
 - (iv) Alarms
 - (v) Fault Finding
 - (vi) Backup Power Procedure (If applicable)
 - (vii) Incident Reporting
- (c) Maintenance
- (d) Maintenance Schedule
- (e) Standard Maintenance Procedures
- (f) Spare Part Lists

Upon completion of the course, the operators should be fully proficient in the system operation and have no unanswered questions regarding the system.

4.4 Operations Training

This training shall be designed to teach operators how to operate the Electrical, Instrumentation and Control systems and shall include the following when applicable:

- (a) Start-up, shut-down and operating instruction for all operational modes for the works shall be provided. This shall be comprehensive and shall include actions to be taken in the case of all alarm conditions and basic fault finding.
- (b) A layout drawing of the installation, a process flow diagram, and a P&ID shall be provided for each Operator. The instructions described in (4.4.1a) above shall also be provided in printed form for each operator.
- (c) If a SCADA and Telemetry system is part of the control system the SCADA operations training as described in the SCADA and Telemetry standard specification shall be incorporated in the training.

4.5 Maintenance Training

This training shall be designed to teach maintenance personnel how to repair and maintain the electrical, instrumentation and control systems and shall include the following where applicable:

- (a) Control system software instruction.
- (b) Where and how to install spare parts
- (c) Detail list of where to obtain spare parts locally.
- (d) Detailed overview of 11 kV protection and switchgear settings
- (e) Training on setting of 11 kV protection.
- (f) Motor protection relay and settings

- (g) Overview of PLC programming for the purposes of making changes and re-loading programs if PLC's are replaced
- (h) If a SCADA and Telemetry system is part of the control system the SCADA maintenance training as described in the SCADA and Telemetry standard specification shall be incorporated in the training.

General specification

LV Switchgear and Controlgear Assemblies

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1 Scope

1.1 Application

This Standard Specification defines the requirements for the design, construction, installation, inspection, testing and commissioning of LV switchgear and controlgear assemblies (Assemblies), including distribution boards (DBs), motor control centres (MCCs), single standalone motor starters or controllers, control panels (either standalone or forming an integral part of the Assembly), control desks and consoles. Where this type of electrical equipment is incorporated within a plant supply package, the provisions of this Specification shall also apply.

1.2 General Requirements

An Assembly shall incorporate all components and equipment necessary to achieve the functionality defined in the Project Specification.

All materials, components, and equipment used in the manufacture of the Assembly shall be new and unused, shall be of current manufacture, and shall be free from any defects or imperfections.

2 Standards

2.1 Associated Documentation

This Specification contains standard amendments and requirements which shall be applied to the referenced statutory and national standards. The project-specific requirements are provided in the Project Specification, which shall be read in conjunction with this Specification.

The design, construction, installation, inspection, testing and commissioning of the Assembly shall comply with all relevant statutory regulations, and the latest editions (current at the time of Tender) of all relevant South African National Standards.

The manufacturer shall operate an approved, auditable quality assurance system covering the design, construction, inspection and testing of the Assembly.

2.2 Statutory Requirements

The Assembly as manufactured, and as installed on site, shall comply with the following:

- (a) Occupational Health and Safety Act of 1993
- (b) Manufacturer's specifications and installation instructions

2.2.1 Reference Standards

The Assembly and all its constituent components and equipment shall comply with the latest published edition of all relevant national standards, including the following:

Table 1: Reference Standards

Standard Number	Description
SANS 152	Low-voltage air-break switches, air-break disconnectors, air-break switch-disconnectors, and fuse-combination units
SANS 156	Moulded case circuit-breakers
SANS 172	Low Voltage Fuses
SANS 1091	National colour standards for paint
SANS 1973	Low-voltage switchgear and controlgear Assemblies
SANS 9000	Quality management systems
SANS 10108	The classification of hazardous locations and the selection of apparatus for use in such locations
SANS 10142	Standard Regulations for Wiring of Premises.
SANS 60044	Instrument Transformers
SANS 60204	Safety of machinery. Electrical equipment of machines.
SANS 60269	Low-voltage fuses.
SANS 60439	Low-voltage switchgear and controlgear assemblies
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 61558	Isolating transformers and safety isolating transformers.
SANS 60947	Low-voltage switchgear and controlgear
SANS 61000	Electromagnetic compatibility (EMC)
SANS 61643-1	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems

3 Construction Requirements

3.1 General

Assemblies shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance.

The arrangement of all circuit components / functional units shall be to the approval of the Engineer.

Where detailed in the Project Specification, spare compartments of a given size shall be provided within the enclosure. Each shall be equipped with a plain (i.e. un-punched) opening compartment door.

Every spare compartment shall be sized to house a triple pole and neutral incoming short circuit protective and isolating device, and shall be provided with a compartment earthing terminal.

Every spare compartment shall be provided with a gland plate or have access to an existing cable way within the enclosure.

3.2 Enclosures

All conductors and terminals that form part of the Assembly, including earth conductors and the Assembly earth bar, shall be enclosed within it. An earth stud may be provided as a part of a cable glanding facility.

Assemblies shall be constructed of materials capable of withstanding the mechanical, electrical and thermal stresses to which it may be subjected and the environmental and operating conditions likely to be encountered in normal service.

All boards, panels and cubicles shall be vermin and dust proof and the minimum degree of protection shall be:

Table 2: Minimum levels of ingress protection

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

Where heat is generated within the enclosure, it shall, where possible, be designed to dissipate naturally from the enclosure surface. Where this is not possible, ventilation openings shall be provided that maintain the highest practicable IP rating of the enclosure, subject to a minimum of IP42. Where cooling air is drawn into the enclosure, dust filters shall be provided where practicable.

For all variable speed drives and soft-starters (without bypass contactors) installed in indoor Assemblies, mini-extraction fans shall be installed inside the drive compartment to dissipate heat, without compromising the assembly's IP rating.

Particular attention shall be given to the ventilation of outdoor mounted boards, to eliminate build-up of excessive heat inside the boards caused by the solar radiation or internal heat generation.

Any internal partitions necessary to provide inter-compartmental segregation within the enclosure shall be of the same material as the sides of the enclosure.

All the surfaces of the enclosure, and of its constituent equipment and components shall be suitably protected against the effects of any likely atmospheric corrosion present at the operating location.

Purpose-made gland plates shall be protected against corrosion by electro-plating, galvanising, or be made of stainless steel and shall not be painted.

3.3 Construction of Free-Standing MCCs and DBs

Free-standing MCCs and DBs shall be constructed from steel with a structural frame permanently clad with side plates, so as to provide a multi-compartmented structure that is rigid with all doors and covers removed, and such that it will not deform during transport or installation. The enclosure doors and covers shall themselves be suitably braced so as to be rigid and not deform or flex when fully equipped and handled.

Each compartment formed within the enclosure for the purpose of housing components or equipment shall be provided with dedicated mounting plates for that purpose, which when removed do not expose any other compartment or live parts. Cabling shall only be terminated on or in the enclosure at gland plates provided for that purpose.

Horizontal wireways (top and bottom) shall extend through the width of each section.

The minimum metal thickness of the enclosure's constituent parts shall be as follows:

- (a) External cladding : 2 mm
- (b) Internal partitions: 1,6 mm
- (c) doors and removable panel covers: 2 mm

Free-standing Assemblies shall be mounted on and bolted to a rigid hot-dip galvanised steel 100 x 50 x 6 mm channel base.

The maximum height of any Assembly (including its base) shall be 2100 mm above finished floor level. No equipment other than bushbars and/or inter panel control wiring shall be installed higher than 1900 mm above finished floor height, neither shall any equipment, other than cable glands and inter panel control wiring be installed lower than 300 mm above finished floor level.

Compartment single doors shall have vertical hinges mounted on their left hand side, and all doors shall have an angle of opening that is limited to 95 degrees. Where specifically agreed with the Engineer, a compartment single door on a front access only Assembly may be hinged on the right hand side if this will reduce the number of dropper / cable way chambers required. Wide compartments with dual doors shall open in wardrobe style, such that the second door is interlocked with the first.

Any cover which is required to be removed for adjustment, access, or maintenance and exceeds 0.75 m² in area, shall be provided with supporting lips, 'lift-off' hinges, locating dowels, or handles, in order to facilitate safe removal and replacement.

Doors and any covers shall be fixed to the enclosure using captive bolt type fasteners, and each hinged door shall be capable of being removed, following disconnection of the electrical and earthing connections. Compartment doors shall be provided with securing catches which can be locked with a padlock, as follows:

- (a) door $\leq$ 400 mm high 1 No.
- (b) door > 400 mm high 2 No.
- (c) door > 1200 mm high 3 No.

The Assembly shall be constructed for front and rear access unless otherwise specified in the Project Specification. Where the Assembly shall be designed for front access only it shall be possible to gain access to every component, item of equipment, busbar and cable from the front (or for busbars, the top) of the enclosure, whether for maintenance or for replacement.

The form of internal separation (in accordance with SANS 60439-1) shall be as specified in the Project Specification. Form 3b or 4a as appropriate, shall be considered the minimum allowable internal separation for MDBs and MCCs.

Any apertures between compartments (including busbar compartments) through which the copperwork or cabling passes, shall be effectively closed off to minimise the possibility of an arc fault propagating between compartments.

Fixings for components, component mounting plates, etc. shall not penetrate another compartment containing live parts. Where self-tapping screws are used for component fixing they shall be of the thread forming or thread rolling type. Components, wiring, labelling, etc., shall only be located within compartments on a removable mounting plate, and in such a manner that facilitates easy inspection, maintenance, or removal and replacement, and without necessitating the removal or dismantling of any other components or wiring, or the use of special tools.

Unless detailed otherwise specified in the Project Specification, the Assembly shall be constructed so as to facilitate future extension by the addition of extra full height sections at either end. To accommodate this, any covers, fixings, etc. shall be flush with the end faces of the enclosure, and the end sections of busbars and earth bars shall be prepared for future extension.

The Assembly shall be constructed so as to permit it being split into sections in order to facilitate transportation and subsequent site erection. Each transportable section shall be labelled as to its shipping weight, shall be equipped with lifting eyes, which shall be removed on completion of the site erection.

All Assemblies shall have at least 15 % spare unequipped space complete with busbars, partitioning into compartments etc. for future extensions.

3.4 Power distribution within an Assembly

The power distribution and circuit protective arrangements within an Assembly shall be designed so as to co-ordinate with the characteristics of the electrical system(s) connected to the incoming terminals of the Assembly, including emergency or temporary supplies and specifically noting the following:

- (a) maximum prospective RMS short circuit current from all simultaneously available sources of supply, together with any fault contribution from large motors directly connected to the Assembly
- (b) type of system earthing (i.e. TN-S, TT, etc.), the maximum available earth fault current, and the maximum earth fault loop impedance
- (c) up-stream protective device ratings and settings

Where this information is not stated in the Project Specification, it shall be obtained from the Engineer before the design of the Assembly commences.

Where the maximum prospective RMS short circuit current from all simultaneously available sources of supply, together with any fault contribution from large directly-connected motors, exceeds 10kA, the Assembly a Type Tested Assembly with stated deviations in compliance with SANS 1973-1.

Where the maximum prospective RMS short circuit current is 10kA or less, the Assembly shall comply with the requirements of SANS 1973-3.

3.5 Functional unit short-circuit protection and isolation

The Assembly shall be provided with separate incoming isolation for every electrical power system (including emergency or temporary supplies) connected to it.

The connection from the Assembly power distribution system into every compartment shall be terminated on a short circuit protection device, which may also incorporate a compartment isolating device, for short-circuit protection of all the components within a functional unit.

Every motor starter compartment shall be provided with a door interlocked isolation device, which shall isolate all sources of supply that enter the motor starter compartment. Where a functional unit, e.g. a motor starter etc., comprises a group of interlocked compartments, the isolation device shall be located in the compartment receiving the supply.

Every compartment containing a distribution board or low voltage transformer shall be provided with an isolation device, which may be located in an adjacent compartment. For some compartments housing power monitoring equipment or instrumentation and process control equipment, it may be appropriate to provide a means of isolation within the compartment.

Unless separate fuses are used as the short circuit protection device, the isolation device and short circuit protection device shall be combined. Fuses may only be used to limit fault currents if approved by the Engineer.

Separate isolating devices shall be switch-disconnectors suitable for un-load switching. They shall be capable of being padlocked in the isolated / 'off' position at the compartment door, and at the isolating mechanism with the compartment door open. Any isolator mechanism extension shafts shall be provided with guide brackets as necessary to prevent excessive shaft deflection.

The compartment door shall be mechanically interlocked such that it shall not be possible to open the door when the isolating device is in the 'on' / 'closed' position or when the operating handle is padlocked in the 'off' / 'open' position. Where the means of isolation is only accessible from within the compartment, it shall be protected to a level of IP2X.

The following types of devices may be used:

- (a) Air circuit breaker (ACB) or moulded case circuit breaker (MCCB)

- (b) Fuse switch-disconnector
- (c) Switch-disconnector with separate fuses

All field circuits connected to a functional unit (e.g. valve actuators, limit switches, etc.) shall be provided with isolation either by or within that functional unit.

Where safety interlock keys are provided, e.g. to control device operation or to restrict access, they shall only be released in the safe condition, and shall be unique across that Assembly and any other Assembly installed at the same site.

4 Electrical Components

4.1 Circuit Breakers (CBs)

Circuit breakers shall be either air circuit breakers (ACBs) or moulded case circuit breakers (MCCBs), as indicated on the single-line diagram for the Assembly.

CBs shall have a rated service short-circuit breaking capacity not less than that of the maximum prospective fault current at the point of connection in the power system, which shall be taken to be the busbar rated short-time withstand current specified for the Assembly. Incomer CBs shall have a rated short-time withstand current and time not less than that of the busbars.

CBs with rated currents over 100 A shall have built-in protection, that will discriminate with both up-stream and down-stream protective devices, as appropriate to the application.

ACBs for incomer and feeder applications shall be fitted with adjustable electronic protection. MCCBs for incomer applications shall be fitted with adjustable thermal-magnetic or adjustable electronic protection.

An ACB shall incorporate padlockable cover(s) to permit the securing of the open, close, and trip actuators against inadvertent or unauthorised manual operation.

Where an ACB or MCCB has electrically operated control circuits; e.g. opening, closing, tripping, spring charging, indication, etc., they shall be provided with individual fuse or MCB protection.

All ACBs and selected MCCBs (as indicated on the single-line diagrams) shall be of a withdrawable pattern with the number of poles indicated on the single-line diagram.

A withdrawable ACB or MCCB shall be provided with clearly visible carriage position indication (connected/disconnected/test), and shall be capable of being locked in each position. Mechanical interlocks shall be provided that only permit movement of the carriage whilst the main circuit contacts are in the 'OFF' position. It shall be possible to test the control circuits of an ACB with it partially or fully withdrawn.

As a withdrawable ACB or MCCB is being withdrawn, padlockable safety shutters shall automatically cover over the supply side and the load side fixed connections. These shutters shall be capable of independently being opened for testing purposes.

One (only) handling truck shall be provided suitable for each type of withdrawable ACB or MCCB supplied as a part of the Assembly, or as a part of any other Assembly supplied to the same building housing the Assembly.

Special maintenance tools, where required, shall be provided with each breaker.

Cables connected directly to CB terminals will generally not be permitted. Adequately sized cable/busbar adapters shall be provided.

4.2 Switch-disconnectors

The switch shall be suitable for the continuous rated duty of the circuit it controls.

The utilisation category of the switch-disconnector shall be AC23 for motor switching duties, and AC22 for switching of mixed resistive and inductive loads, with an appropriate utilization category (A for frequent switching and B for infrequent switching).

Rotary switch-disconnectors shall be provided with a 'break-before-make' operation for each pole. The rotary switch, or changeover switch formed by the proprietary interlocked interconnection of two switch-disconnectors or fuse switches, shall incorporate a centre 'off' position.

Switch-disconnectors for motor starter or variable speed drive duties, that incorporate a test position, shall enable the control circuit supplies while ensuring isolation of the main supply.

4.3 Fuse switches

Fuses and fuse bases shall comply with the requirements of SANS 172, and shall be provided with an indicating device to show the 'blown' state of the fuse.

Only Motor circuit fuse links as defined in BS 88 shall be permitted on motor starting circuits.

Fuse current ratings shall be indicated on engraved 20 x 12 mm white black-white triaffolyte labels in 4 mm figures. The labels are to be fitted at the fuse bases and shall not be obscured by wiring.

This shall comprise a moulded carriage accommodating either HRC fuses or solid links, and shall provide for a switched neutral where required.

Provision shall be made for the following:

- (a) Double break contacts on each pole.
- (b) Arc barriers on each pole.
- (c) IP2X protection in either state.
- (d) Silver plated copper contacts.
- (e) Neutral link where required.
- (f) Mechanically operated ON/OFF indicator.
- (g) Auxiliary switch facility.
- (h) Full interchangeability of equivalent rated units

The continuous thermal rating and the circuit fuse rating shall be indicated adjacent to the switch.

The minimum utilisation category of the fuse switch shall be AC23 for motor starting duties, and AC22 for power distribution on y duties

All fuses used on LV circuits shall be HRC cartridge type fuse links complying with both SANS 60269 and BS 88 Part 6 / BS 88 Part 2 Section 2.2 (fuse links with bolted connections), except as follows:

- (a) semiconductor protection fuses recommended or provided by the manufacturer of any power electronics incorporated into the Assembly;
- (b) sub-distribution fuses for extra-low voltage control circuits in ICA equipment compartments.

The sub-distribution fuses for control circuits (mentioned above) shall be miniature ceramic cartridge fuses complying with BS 2950. They shall be mounted in knife-edge ('swinging blade') disconnected type DIN rail mounted terminals. Knife-edge disconnect type terminals shall similarly be used for neutral links.

Neutral and earth link holders shall be non-interchangeable with fuse holders, and fuse and link holders shall be segregated according to circuit voltage.

Where HRC cartridge type fuse links do not form an integral part of an item of equipment such as an enclosed transformer, a fuse switch, etc., they shall be mounted in all-insulated fuse carriers fitted into fuse holders. An associated neutral circuit shall be provided with a solid copper link, which shall be mounted in an identical manner adjacent to the phase circuit fuse holders.

Fuse and link bases shall contain insulating shrouds, that can only be removed using a tool. A fuse or link shall only be capable of insertion into its base using the appropriate carrier. Fuse and link carriers and holders shall be coloured as follows:

- (a) fuse links: black
- (b) neutral links: white
- (c) earth links: green

A spare set of all fuse types and ratings used within a functional unit shall be mounted within each functional unit.

Combination fuse switches shall comply with SANS 152 and shall be of the independent manual operation type and shall afford minimum protection of IP21.

4.4 Switch operator

Switch operating mechanisms shall include operators for fuse switches, switch-disconnectors, moulded case circuit breakers and motor protection circuit breakers for Assemblies.

Switch operating mechanisms shall be door mounted and the switches shall be fixed mounting.

Switch operating mechanisms shall positively engage with the switch shaft when the door is fully closed and shall be so interlocked with the door so that:

- (a) It shall not be possible to gain access via a cover or door to any live points unless the switch is in the open position,
- (b) It shall not be possible to re-close the door or cover unless the switch is in the open position, Operation of the switch with the door open is permissible.

Clear indication shall be given, both with the access cover or door open or closed, as to whether the switch is in the open or closed position. Colour indication alone will not be acceptable.

Operating handles shall be pad lockable in the "off" / "open" position. The mechanisms shall accept not less than two padlocks each having a shackle diameter of 8 mm.

Any isolator mechanism extension shafts shall be provided with guide brackets as necessary to prevent excessive shaft deflection.

4.5 Contactors, Relays and Timers

Contactors and relays shall be selected so as to be suitable for the foreseeable operating duty (utilisation category) and operational frequency. They shall operate reliably under reduced voltage conditions by closing (i.e. pulling in and holding) at 85 %, and remaining closed at 60 %, of the rated coil voltage, and shall be suitable for continuous operation at 110 % of the rated coil voltage.

Contactors shall comply with SANS 60947-4-1, and shall be electro-magnetically operated air-break multi-pole block type construction. They shall readily accept a wide variety and configuration of auxiliary contact blocks, which shall have their terminals protected to IP2X.

Relays and timers shall be totally enclosed plug-in devices. The bases shall be keyed in order to differentiate between different relays and timers, and their differing coil / electronics operating

voltages, and to prevent incorrect insertion. Bases shall be fitted with retaining clips, and each relay / timer shall have its pin configuration printed on the side of its casing.

Relay / timer bases shall have screw clamp type terminals protected to IP2X, which shall be accessible with a screwdriver whilst the relay / timer is plugged in.

Relays shall be provided with a transparent enclosure, visual indication that the relay is in the energised and closed state, and a manual test button.

Timers shall operate electronically or be synchronously driven, and shall be provided with linearly calibrated time interval scales. The smallest indicated time interval shall be 10 % (or less) of full scale, with a repeatability of $\pm 1\%$ (or better) of full scale. Timers shall be provided with 'energised' and 'timed out' indicators.

Where timers require to be viewed by operators, they shall be flush front of panel mounted behind a transparent lockable cover.

Contactors shall be satisfactorily withstand the thermal and dynamic effects arising from the magnitude and duration of through fault currents dictated by the characteristics of the associated protective devices and shall be selected in accordance with the kW/current rating.

Contactors shall be tripole-pole electromechanically operated air-break type, hand in or latched pattern as specified.

Contactors shall be classified as utilisation category AC3 uninterrupted duty for motor starting and as utilisation category AC1 intermittent duty, Class 1, 60 % for heater duty.

Contactors shall be fitted with the required auxiliary contacts. These shall be rated at not less than 6 A and shall be positively driven in both directions.

Auxiliary relays for control purposes shall be of the multiple pole type and shall preferably possess the feature of field convertible contact configuration.

Plug-in type relays shall have:

- (a) Positive-acting mechanical retaining clips. Contact friction alone as a retaining method is unacceptable.
- (b) A keyed member on plug and socket sides to prevent incorrect insertion.
- (c) Clear and indelible markings on both the relay and its base indicating the circuit reference in conformity with the associated circuit and connection diagrams.

Auxiliary time delay relays shall be of electronic or synchronous motor-driven type and the time setting shall be infinitely adjustable over the range of 5 - 100 % of the maximum delay. Timing relays deriving the delay function by thermal or pneumatic means will not be acceptable.

Auxiliary relays shall have a minimum of 4 individual contacts and shall preferably have the facility to add an extension block with an additional four (4) individual contacts.

4.6 Control switches and pushbuttons

Control selector switches shall be of a rotary spring loaded type, with an AC11 rating, and shall have clearly identified switch positions. Where switches are lockable, the key shall be held captive in the abnormal or over-ride position.

Pushbuttons shall comply with SANS 60947-5-1 and shall be of a 22 mm diameter, flush base type.

Emergency stop pushbuttons shall be of a mushroom headed push to stop, stay-put, and twist-to-release type. Key type release buttons shall not be used.

Pushbuttons shall be coloured as follows.

Table 3: Pushbutton colours

Function	Colour
Start	Green
Stop	Red
Reset	Black
Emergency stop	Red
Lamp test	Black
Close / Down	Green (or black)
Open / Up	Green (or white)
On	White (or green)
Off	Black (or white)
Forward	Green (or white)
Reverse	Green (or black)

Pushbuttons shall be of the one-hole fixing, oil tight pattern.

Operators (and the mating holes) shall be keyed to prevent rotation of the assembly in the panel.

Contacts shall be adequately rated for the circuit duty but shall not be less than 10 A, 230 V AC or 120 V DC rating.

In addition the operator shall carry an internationally acceptable symbol indicating its function or shall have mounted immediately above it a clear legend of its function or action.

Operators initiating a motion or circuit closure shall be flush with the surrounding bezel, while operators stopping a function or opening a circuit shall project beyond the bezel.

Operators providing a selective function e.g. local/remote or auto/manual, shall operate in a semi-rotational manner with equal angular displacement about an imaginary vertical centre line.

4.7 Indicating lamps

Indicating lamps shall be suitable for use on either 230 V AC or 24 V DC control supplies, and shall be light emitting diode (LED) type. Lamps suitable for use on 230 V AC shall incorporate a step-down transformer. Indicating lamps shall be continuously rated for a voltage of 10 % in excess of the rated voltage.

Lamps shall comprise 22 mm diameter units incorporating either a multi-cluster array of LEDs or a single high intensity surge protected LED; replaceable from the front of panel without any special tools.

Indicating lamps shall render good visibility under conditions of an ambient illumination level of 400 Lux.

Lamps shall be provided with one of two indicator lamp colour coding schemes as follows:

- (a) a primary colour coding scheme, in compliance with IEC 60073, or
- (b) a secondary colour coding scheme; which although not standard, is required in order to harmonise with existing operational equipment.

Unless detailed otherwise in the Project Specification, the Assembly shall be provided with indicating lamps coloured in accordance with the primary colour coding scheme, which shall be as follows:

Table 4: Primary colour coding scheme

Function	Colour
Dangerous condition	Red
Emergency / hazardous condition	Red
Emergency stop operated	Yellow
Impending critical condition	Yellow
Alarm / abnormal condition	Yellow
Tripped / fault condition	Yellow
Warning	Yellow
Normal condition	Green
On	Green
Running	Green
Closed condition	Green
Mid position / mid travel	Green + White
Open condition	White
Available / auto available	White
General indication / monitoring	White
Mandatory operation required by operator	Blue

Where specified in the Project Specification, the manufacturer shall supply an additional number of loose indicating lamps (or their coloured lenses) of a specified type and coloured in accordance with the primary colour coding scheme, and shall retrofit these to specified existing assemblies.

Where an Assembly is provided that incorporates lamp colours in accordance with the secondary colour coding scheme, the manufacturer shall also supply an additional quantity of loose indicating lamps. There shall be a sufficient quantity of the required types and colours; coloured in accordance with the primary colour coding scheme, to permit a third party to retrofit them the Assembly at a later date in order to bring it into compliance with the primary colour coding scheme. In addition, the final drawings for the Assembly shall not detail the colour of any indicating lamp that does not comply with the primary colour coding scheme.

4.8 Power measuring instruments and current transformers

The Project Specification states which functional units shall be provided with power/current and voltage measuring instruments, the type, and the facilities required.

Display instruments used to indicate voltages and currents shall normally be analogue instruments, shall comply with IEC 60051, be of the low-impedance type and have an accuracy class of 1.5. They shall be flush front of panel mounted with a 90° quadrant minimum scale length, and be DIN96 size for power distribution functional units, and DIN96 or 72 sized for motor starter functional units.

External zero adjustment shall be possible on all indicating instruments to facilitate adjustment without dismantling the instrument.

Instruments shall be scaled to 120 % of the anticipated designed indication. Ammeters shall be provided with compressed scales to accommodate motor starting or other in-rush currents, and

ammeters monitoring motor currents shall be provided with an adjustable red pointer to indicate full load current

Meters and relays shall be capable of withstanding, without damage, the secondary currents associated with the maximum available through fault current.

Instruments shall be provided with shrouded connections to their rear, and ammeter circuits with a full scale deflection in excess of 25 A shall be connected via current transformers (CTs). Apart from CT and ammeter circuits, instrument circuits shall be fused.

Instruments used in power distribution circuits shall be flush front of panel mounted and shall provide selectable front of panel digital display of at least the following measurements:

- (a) voltage between phases and between phases and neutral
- (b) current in each phase
- (c) power (kW)
- (d) kVA
- (e) power factor
- (f) consumption (kWh)

They shall provide data output signals for presentation to PLC, SCADA, telemetry, etc.

Where the Project Specification indicates that instruments shall provide fieldbus communication with a control system, this shall be via an open protocol compatible with the proposed control system.

Run hour meters shall be of a 5 digit minimum non-re-settable odometer type, with visual indication of operation, and a minimum resolution of one hour.

Current transformers (CTs) shall be air insulated, shall comply with SANS 60044, and shall have short circuit ratings in excess of those prevailing at the point of connection. They shall bear individual rating plates, which shall clearly identify the winding polarities (primary or secondary), together with the connection details of any multi-ratio windings.

Current transformer accuracy classes shall be selected as follows unless otherwise indicated on single-line diagrams:

Table 5: Transformer accuracy classes

Type of circuit	Class	Comments
Indication	3 or 5	To match the % accuracy of the instrument
Measurement	0.5 or 1	To match the % accuracy of the instrument
Motor protection	10P10	Or as required by protection device manufacturer
Power system protection (e.g. IDMTL)	10P20	Or as required by protection device manufacturer
Power system unit protection (high accuracy; e.g. REF, generation, unit protection)	PX	As specified by protection device manufacturer

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

Current transformers shall be of the low-impedance type and shall, where ratio, class and output requirements permit, preferably be of the ring-type bar-primary design.

Current transformers shall be rated to withstand the thermal and magnetic stress resulting from the maximum available through fault current.

Bridging terminals for current transformers shall be provided at the outgoing terminals where external connections are required. In addition, terminal blocks shall be provided to permit secondary injection tests on protective relays.

4.9 Control-circuit and auxiliary supply transformers

Voltage transformers shall be designed, constructed and tested in accordance with the requirements of SANS 60044.

Voltage adjustment over the range 95 - 105 % of nominal ratio shall be provided by off-circuit tappings.

Transformers shall be provided with isolating switches on the HV side and with protection on both the HV and LV sides.

Voltage transformer primary and secondary windings shall be protected by fuses.

The protection on the HV side shall be rated sufficient to withstand inrush currents.

Control transformers shall be rated as follows:

- (a) Sum of sealed-in burden of all contactors, relays, timers and lamps fed from that unit; plus
- (b) Pickup burden of largest Contactor fed from that unit; plus 10 %.

The regulation on closing the largest circuit with all the loads except that of the largest load, or if there is more than one, one of the largest loads, imposed on the transformer, shall not exceed 5 %.

One side of the transformer secondary winding, or the star point thereof, shall be connected to earth via a removable bolted link.

Voltage transformer nameplates shall be fixed in a position so that details can easily be read when fitted in the cubicle.

4.10 Capacitors

Capacitors shall be of the non-toxic, dry, self-healing, metallised film type, and comply with SANS 60831.

Capacitors shall be fitted with a means of electrical discharge to reduce the residual voltage to less than 60 V within 5 seconds of being switched off.

5 Motor Starter Functional Units

5.1 General requirements

Motor starter functional units shall be provided as indicated on the single-line diagrams and as detailed in the Project Specification, and all equipment, components, and wiring shall be included to achieve the required functionality. The following methods of motor starting shall be considered, where the selection is the Contractor's responsibility, to provide the required functionality:

- (a) direct on line (DOL)
- (b) star/delta (open/closed transition to suit application)
- (c) line reactor

- (c) auto-transformer (closed transition)
- (e) soft starters and variable speed drives using power electronics

Where specified in the Project Specification, integral direct on line starters complying with SANS 60947-8-2, shall be used for motor starters of less than 10 kW. The integral motor starter shall incorporate an isolation device, a short circuit protective device, a contactor and overload protection with Type 2 coordination.

Each motor starter shall be provided with an isolation and short circuit protection device.

Motor starter contactors, short circuit protective devices, and thermal overloads shall be selected so as to provide Type 2 Co-ordination in accordance with SANS 60439-4-1. The minimum starter contactor utilisation category shall be AC3.

Motor circuit residual current protection shall only be provided where necessary to discriminate with upstream protection, where the power supply is derived from a TT source, or where specified in the Project Specification.

Contactors used where simultaneous closure would be dangerous, e.g. in reversing, star-delta, or closed transition starters, shall be provided with both mechanical and electrical interlocks.

Where components with short time ratings are used, e.g. resistors, transformers, etc., they shall be provided with hardwired temperature monitoring circuits, arranged to trip the line contactor if their thermal limits are reached.

Withdrawable starters shall be provided with suitable interlocks to prevent chassis withdrawal or insertion when the starter isolation device is in the 'on' position.

5.2 Functional requirements

Every individual motor starter unit shall include all equipment, components and wiring necessary to safely and reliably operate the driven plant item. It shall be possible to manually operate plant item from the front panel of its functional unit, notwithstanding any failure or de-selection of any automatic control system, networking / communication facility, PLC, SCADA, or telemetry system. In order to achieve this, the appropriate push buttons / keypads and indicators shall be provided front of panel.

If the power supply fails whilst a motor is running, the line contactor shall open. On restoration of the power supply, the motor starter shall immediately be made available to re-start the motor without manual attendance or intervention on receipt of a start command (be it initiated manually or automatically). However, where a hardwired automatic control facility is available, a power-on delay timer (adjustable between zero and 60 s) shall be provided in the hardwired circuit.

Where a 'healthy' signal is required, it shall confirm that the functional unit isolation device is closed, the starter control supply is healthy, no fault condition exists, emergency stop(s) are released, the local isolator (where fitted) is closed. The 'healthy' signal shall be used to provide the 'drive available' input signal to any automatic control schemes or automatic duty selection routines.

Each functional unit shall provide any automatic control schemes (including auto duty selection routines) with the following status signals as a minimum, as well as all others as specified in the Project Specification:

- (a) Manual/auto mode
- (b) Running
- (c) Tripped
- (d) E/Stop activated

Each motor starter shall be provided with an emergency stop circuit, which together with its components shall comply with BS EN 418. A field 'twist to reset' emergency stop button shall be

provided. On operation of the emergency stop circuit, the motor line contactor shall immediately open, and the emergency stop circuit shall lock out until it is reset. A front of panel 'emergency stop operated' indication lamp and a status signal for PLC monitoring shall be provided. A composite starter may have a common emergency stop circuit controlling all of its constituent drives.

Where identified in the Project Specification, specific process or driven plant interlocks shall be hardwired into the motor starter, and when operated, shall stop and inhibit the drive.

Front of panel pushbuttons shall be provided for manual start (forward, and where applicable, reverse), and manual stop. A front of panel control selector switches shall be provided for 'Manual / Off / Auto' or 'Remote / Local' as specified in the Project Specification.

Front of panel indicator lamps shall be provided for 'running' and 'tripped', and an ammeter shall be provided for motor circuits; other front of panel indications e.g. specific fault indication lamps, hours run motor, number of starts counter, etc. shall be as specified in the Project Specification.

5.3 Motor protection

As a minimum, every motor starter circuit shall be provided with a thermal overload unit connected to monitor the current in each energised winding of the motor. Unless otherwise specified in the Project Specification, motors of over 30 kW shall be provided with electronic overload protection, and motors of over 75 kW shall be provided with electronic motor protection relays. Intelligent multi-function electronic relays shall be provided if specified in the Project Specification.

Thermal overloads shall be scaled and adjustable such that the motor rated current is mid-range, and shall provide a temperature compensated thermal element for each supply phase to the motor. The unit shall provide single phasing protection, and incorporate auxiliary tripping contacts with a manual test facility. The unit shall be capable of being manually or automatically reset (set to auto). Unless otherwise specified in the Project Specification, thermal overloads shall be trip class 10.

Electronic overload units shall incorporate the features required of a thermal overload, together with provision for the adjustment of tripping and reset times. In addition, stalled rotor protection shall be provided, together with integral thermistor protection where required. Where required, electronic overloads shall be suitable for use in conjunction with power electronics (soft starters or variable frequency converters).

Electronic underload protection shall be provided for all centrifugal pump, fan, or directly driven mixer motor circuits above 30 kW. When detecting underload, the device shall measure the true motor power (and not just the phase angle), shall be configured to detect an unloaded running motor condition, and shall incorporate start delay, motor trip, and manual / auto reset (set to auto) facilities. The unit shall incorporate a digital percentage load display.

Where required on drives of less than 30 kW, the underload unit shall be provided with overcurrent protection providing the same facilities as a thermal overload. Where required on larger drives, underload protection shall be provided as an integral part of an electronic overload or motor protection relay, and where applicable shall be suitable for use in conjunction with power electronics.

Motor thermistor and RTD (PT100) relays shall be provided for motors which have been specified to be fitted with thermistors or RTDs.

Motor starter functional units for immersible/submersible pumps shall incorporate all the standard integral motor and pump protection, such as water ingress, temperature of windings and bearings, vibration, etc.

All protection devices shall operate in a fail safe manner via electrically maintained relays which de-energise on a fault condition. On sensing a trip condition, the devices and relays shall electrically lock-out the emergency stop circuit, and shall be reset manually using a front of panel common fault reset pushbutton. In addition, they shall automatically reset on control supply switch on and upon power restoration in the event of a power loss.

Electronic motor protection relays and digital overload and underload devices which provide operator interfaces shall have front of panel mounted displays and controls.

5.4 Test circuits

The motor starter control circuit supply shall be provided with a functional test facility, whereby the functionality of the control circuit and its equipment and components can be fully demonstrated with the compartment door(s) open, but whilst the motor circuit supply remains isolated at the functional unit isolating device.

A control selector switch shall be provided for 'Normal/Test' selection inside the relevant compartment

The test supplies shall be arranged to be de-energised when the motor circuit supplies are energised. The test supply shall be provided with short circuit protection, and shall be capable of isolation.

6 Busbar and Busbar Trunking

The main distribution circuit through the Assembly shall comprise a main and distribution busbar system, comprising of 3 phase and neutral busbar system. The rated current of the busbar system shall match the rating of the main incomer

All main and distribution busbars, risers and droppers shall be air-insulated and shall be fabricated from hard drawn, high-conductivity copper. Aluminium busbars will not be permitted. Busbars shall be tinned for waste water treatment works (WWTW) applications. If pre-tinned copper work is provided, cut surfaces may remain bare, providing the current path is unaffected and suitable contact lubricants are used before tightening joints.

Main busbars shall be enclosed together within the top of the Assembly. No other conductors shall be run in the busbar compartment. Access to the busbars shall be through covers, requiring the use of a tool for removal. All internal fixings shall be held captive. No components shall be placed in a busbar compartment.

Main and distribution busbars shall be continuous over each section, extending to over the full length of the Assembly with the same current rating and cross-sectional area throughout their length.

Main busbars, distribution busbars and all flexible connections, shall be adequately sized, braced and supported to withstand any electromagnetic forces and thermal effects to which they may be subjected, including the occurrence of fault currents, up to the full fault levels specified.

The vertical riser buses shall be copper full height and rated for the section total load. Small openings in the vertical barriers shall permit the plug-on control unit contacts to pass through and engage with the vertical bus bars. Unused plug-on openings in the vertical barriers shall be equipped with plastic snap-in closing plugs.

All busbar connections shall use joints secured against loosening. Joints and Tee-off connections in busbars shall be made by means of high-tensile bolts, nuts and approved locking washers. A minimum of two such bolts shall be used per joint or tee. The joints shall not be taped in order to facilitate visual inspection and checking of bolt tensions. The joint contact areas shall be smooth, very flat and polished or tinned for dry jointing.

Busbars shall be provided with phase colour markers, red, white, blue (and black in the case of four wire systems). Such colour identification may take the form of coloured bands at intervals along the busbar run of not more than 800 mm. The combined width of the colour bands per phase shall not be less than 300 mm per 800 mm busbar length. The use of the convention, Red, Rear, Right shall be employed

The maximum length of any cable connections from a busbar shall be 1000 mm.

A cabled 'busbar' system of the specified radial or closed ring arrangement may be offered as an alternative to a conventional system if,

- (a) The Assembly has a rated short-time withstand current or rated conditional short-circuit current not exceeding 10 kA; or
- (b) The Assembly is protected by current limiting devices having a cut-off current not exceeding 17 kA at their rated breaking capacity.

This will generally mean that the rated current of such an Assembly will be less than or equal to 100 A.

7 Internal Wiring and Field Connections

7.1 General

All wiring within the Assembly shall run directly between terminals, without any joints or other connections. Wiring shall be carried out using multistrand, single-core PVC-insulated copper conductor, 660/1 000 V grade (minimum), to SANS 1507, sized and derated where required for the currents to be carried. Single-strand conductor shall not be used and no conductor shall be less than 1,5 mm² cross-sectional areas.

Field wiring connections will be identified by others using the field device tag references. This information will be provided by the Engineer, and the Contractor shall use these field identifiers when identifying the compartment field terminations.

Wiring layout shall permit alterations to individual circuits without requiring shut down of the complete Assembly.

7.2 Cable Ways inside Assembly

All bus wiring and interconnections between compartments within the Assembly shall be contained within the enclosure, and shall be segregated in wire-ways separate from other compartments. Where such wiring is terminated in a compartment, it shall be segregated from all other wiring in that compartment. All wiring and cabling entering or leaving a compartment or passing through a partition shall do so via a permanently fixed bush.

Wiring between components shall be:

- (a) carried out in a neat and systematic manner
- (b) contained in non-metallic trunking
- (c) Run to compartment doors in spiral wrapping.

Any wire containment system shall securely locate the wiring, and provide 25 % spare capacity on completion. Cableways shall have furthermore sufficient space to enable the installation and removal of any cable without the need to remove any other cable or component. Cableways shall incorporate adequate facilities to locate and support the cables.

Wiring on compartment doors shall be similarly supported, and shall be provided with support and protection across the door to compartment side wall transition, whilst permitting the door to be fully opened without straining the wiring. Wiring system accessories shall not deteriorate with heat or propagate flame.

Wiring shall be segregated according to need; circuits that enter the compartment without isolation shall be separately segregated and loomed with spiral wrapping and identified. Control circuits shall be wired in twisted pairs or screened cables, and together with data network cabling, shall be physically segregated from power circuits by barriers. If lightning and/or surge protection measures have been

used to protect individual circuits, these circuits shall be segregated from the wiring of other unprotected circuits.

Cable-ways or chambers shall not contain any equipment or components.

Where field cables are terminated other than in the base of the enclosure, cable-ways or cable chambers shall be provided to transport the cables through the enclosure to the compartment or cable box at which they are glanded or terminated. Careful thought should be given to the termination of power cables and their location within the assembly.

7.3 Gland Plates

All field cables and wiring shall enter the enclosure through gland plates, which shall be located so as to facilitate the spreading of cable cores.

Gland plates shall be rigidly supported and maintain the IP rating of the enclosure

Gland plates and cable boxes shall minimise the effects of eddy currents and be suitable for the type of cable used. Single core cable gland plates shall be made of non-magnetising material.

Gland plates for bottom access cabling shall be located at least 300 mm above the finished floor level.

Each compartment gland plate shall be an integral part of the construction of that compartment

7.4 Identification

All wires shall be identified at both ends using colour coded alpha-numeric ferrules. Within a compartment, a wire shall have the same identifier at both ends; and this identifier shall not be duplicated within a functional unit.

Components and wiring shall be installed such that the identification of every wire is clearly visible and readily accessible on completion of the Assembly installation at site. Horizontal wiring identifiers shall be read left to right, and vertical wiring identifiers shall be read bottom to top.

All conductors shall be identified in conformity with the approved circuit and connection diagrams. No number shall be used more than once in each panel except where electrically identical.

Wires/conductors shall have the same number on either end of the wire and all wires which are electrically identical shall have the same wire number

Circuit wiring shall be coloured in accordance with the following:

Table 6: Colour code for wiring

Wire colour	Function
Red (white, blue)	Red (white, blue) phase connections in current and voltage-transformer circuits or connections in red (white, blue) phase power circuits
Black	Neutral (star-point) connections whether earthed or unearthed insulated wires
Red / black	Connections in AC control circuits (black = neutral)
Red / black	Connections in DC control circuits (black = negative)
Green and yellow	Earth wires and earthing

Power-circuit conductors shall be coloured according to the phase to which they are connected.

7.5 Termination

Wiring shall be terminated using crimped cable ends, lugs or any other approved method that is appropriate for the conductor size and type of termination. All of the strands forming the conductor shall be connected at the point of termination. Soldered connections shall only be used on electronic equipment where it is not practicable to use any other termination method.

Wiring with a cross section area of less than or equal to 6 mm² shall be terminated in terminals mounted on DIN rail. Wiring with a cross section area of greater than 6 mm² shall be terminated in bolted terminals.

All wiring entering or leaving a compartment shall do so via terminal rails, with the exception of specialised signal or data circuits, which may be cabled directly to dedicated connections on electronic equipment located at the periphery of the component mounting plate.

The conductor shall be clamped in such a manner that the captive clamping screw does not come into contact with the conductor. Alternatively, screw-less spring clamp tensioning terminals may be used to terminate single conductors of up to 10 mm². Conductors of cross-section above 16 mm² shall be terminated using stud type terminals; similarly mounted and grouped on DIN rail.

No more than two conductors shall be connected to one side of a terminal. Where it is necessary to connect adjacent terminals together, proprietary shorting bars or combs shall be used.

Spare cores shall be terminated at both ends or tied back, but shall not be cut short.

All terminals shall be protected to IP2X, including stud type terminals; which shall be shrouded to achieve this. Terminals shall be segregated according to function and operating voltage; by grouping or by terminal rail mounted partitions or barriers. All stud type terminals shall be provided with individual segregating barriers.

All circuit terminal rails shall include 10 % spare space.

Terminals shall be grouped together and segregated according to operating voltage and function by terminal rail mounted barriers. Stud type terminals shall be provided with individual segregating barriers.

Terminals shall face the compartment door for ease of connection.

Terminals shall be located and spaced so as to enable the easy disconnection and reconnection of conductors, whilst providing sufficient space for the looming and spreading of cable cores. Where practicable, the layout of terminal rails shall be such that cores from the same field cable are not split between non-adjacent groups of terminals.

All wiring of external connections shall be brought out to individual terminals on a readily accessible terminal block.

All spare contacts are to be wired back to terminals.

8 Low Voltage Earthing

8.1 Main incoming earth terminal

The Assembly shall incorporate facilities for connecting to the main incoming earth terminal, subject to its location being clearly identified and easily and safely accessible with the Assembly energised. The Assembly earthing system may comprise either an earth bar extending the full length of the Assembly or, for Assemblies with less than or equal to two (2) functional units and a supply rating of less than 100 A, a stud arrangement.

Earth bars shall:

- (a) be manufactured from high conductivity copper (tinned for VWTW applications);
- (b) be located in a safe and easily accessible position;
- (c) have a minimum number of joints;
- (d) have at least one disconnecting link;
- (e) have facilities for connection to the main incoming earth terminal (the Supply Company earthing system and / or from a local earth electrode system) at each end of the bar, and
- (f) be rated and tested at a minimum of 60 % of the busbar fault withstand capacity
- (g) have a cross-sectional area of not be less than 500 mm², nor less than 50 mm in width.
- (h) be securely connected in each panel or cubicle to bare metal

Provision shall be made for the connection for the following connections to the fixed portion of the earth bar:

- (a) electrical installation main bonding conductors
- (b) functional earthing conductors external to the Assembly
- (c) equipotential bonding conductors external to the Assembly
- (d) other equipment protective conductors external to the Assembly
- (e) the Assembly main earth bar / circuit, which shall be terminated onto the fixed portion
- (f) an additional 2 No. spare terminations

All metallic non-current carrying parts of the Assembly shall be bonded together and connected to the Assembly earth busbar

8.2 Compartment earthing

Each compartment shall include an earth stud connected to the main earth bar or stud by separate connections or by a common vertical earth tape. Earth conductors to each compartment shall be sized to withstand the fault level, subject to a minimum cross-sectional area of 6 mm².

The following shall be directly connected to the compartment earthing terminal by earthing conductors with a minimum cross sectional of 4 mm² or braided straps of similar rating:

- (a) compartment door
- (b) any removable cover
- (c) component / equipment mounting rails and earth terminals

A compartment may contain subsidiary earth terminals or bars to which the following circuits may be specifically connected:

- (a) 'clean' earths from instrumentation circuits and equipment
- (b) functional earths; e.g. from telecommunications equipment
- (c) surge protection earths; e.g. direct connections from lightning protection units

These earth terminals or bars shall be separately connected directly back to the Assembly main earth bar with 6 mm² minimum cross-section conductor

Cable gland plates associated with a compartment shall be provided with an earth stud, which shall be connected directly to either the compartment earthing terminal, or to the main earth bar, with a conductor of 6 mm² minimum cross-sectional area.

Doors having components mounted on them shall be bonded to the main structure by means of flexible copper earth connection arranged so that it cannot be trapped as the door is opened or closed. Metal hinges shall not be considered sufficient to ensure electrical continuity.

Where cables carry low level high frequency signals, or are installed where there is a significant risk of high frequency interference; (e.g. in signal circuits connected to equipment containing power electronics), they shall where necessary have their screens / braids capacitively connected to earth in a proprietary manner, and proprietary means shall be included to provide 360° earthing for field cable braids / screens.

8.3 Intrinsically safe circuit earthing

If specified on the Project Specification, separate earth bars or studs shall be provided for connecting equipment requiring a clean earth or an intrinsically safe earth directly to the main incoming earth terminal. If required, such earth bars or studs shall be located adjacent to the equipment requiring a clean earth or an intrinsically safe earth, as appropriate.

Where zener diode safety barriers are contained within a compartment, they shall be separately and directly connected to the main earth bar via duplicate earthing conductors; each of 6 mm² minimum cross-section. These conductors shall be clearly identified as intrinsically safe earths.

9 Power Factor Correction

9.1 General requirements

Power factor correction capacitors shall be so selected and sized as to raise the lagging power factor due to induction motor loads; either individually or when summated across the Assembly, to a final corrected power factor of 0.97 lagging. When designing the system, the un-corrected power factor for each motor shall be taken as that quoted in manufacturers' literature for a high efficiency motor of equivalent rating operating continuously at its 75% duty point.

Capacitors shall be of the non-toxic self-healing dry metallised film type. Every capacitor or group of capacitors shall be provided with integral discharge resistors to reduce the residual terminal voltage to less than 50V within one minute of being disconnected from the supply.

Capacitors shall be suitable for continuous connection to a three phase low voltage industrial power supply. If the low voltage power system to which the Assembly will be connected has significant voltage waveform distortion or harmonic content, or has other capacitive or inductive networks (e.g. harmonic filters) connected to it, additional information must be obtained by the Contractor via site surveys.

9.2 Power factor correction for individual drives

Where power electronic soft starters are used, the sequence of the connection and de-energising of the capacitors shall be in accordance with the manufacturer's recommendations. Power factor correction shall not be applied to variable speed drive systems.

9.3 Bulk power factor correction

Where detailed in the Project Specification, bulk power factor correction shall be provided for the whole Assembly, in a purpose designed functional unit occupying one or more compartments within the enclosure.

Capacitors shall be arranged into banks, suitably sized to enable the incremental control of the power factor against a changing load. Each bank shall be automatically contactor controlled, in a manner that minimises switching surges, and capacitor bank status information shall be derived from the contactor auxiliary contacts. A proprietary multi-stage power factor controller, with a minimum of six steps, shall be used to monitor and sequence the switching of the capacitor banks.

Where there is provision to supply the Assembly from a generator, automatic means shall be included that will inhibit bulk power factor correction when the generator is in use.

10 Power Electronic Equipment

10.1 Soft starting equipment

Soft starters shall comprise a proprietary item of chassis mounted equipment, designed for installation within an Assembly. They shall be rated to continuously carry the intended motor full load current, and provide the required number of starts per hour.

The soft starter shall be thermally designed to carry the motor current until the motor protection operates, and where this cannot be guaranteed, high speed semiconductor fuses shall be provided to protect the power electronics. Where such fuses are used, a spare set shall be provided and fixed within the compartment.

Soft starters shall be of a digital energy optimising design and shall incorporate appropriate motor protection, and where pumping circuits are being controlled, soft stop features shall be included. When the soft starter has completed the ramped application of motor voltage, a 'top of ramp' signal shall be generated.

Soft starters shall incorporate a built-in by-pass contactor rated for the full load running current of the motor, such that on receipt of the 'top of ramp' signal, the by-pass contactor shall close and divert the motor current away from the power electronics. When running in the by-passed condition, the motor shall continue to be provided with the full protection and monitoring features afforded by the motor starter. When a controlled stop command is received, the by-pass contactor shall be de-energised, in such a manner that the control of the motor is transferred to the power electronics.

Facilities shall be provided for the emergency stopping of the controlled motor in the shortest possible time. The emergency stop facility shall not be dependent on any software functions within the soft starter or its associated equipment and shall disconnect the soft starter from the supply by means of a full load rated line contactor fitted between the compartment isolation / protective device and the soft starter.

Where specified in the Project Specification, connectivity between the soft starter functional unit and other equipment or systems within the Assembly shall be via an open field device network compatible with the proposed PLC control system. It shall preferably use an interface device integrated within the soft starter, so as to provide remote network access to the full range of the soft starter's control and monitoring facilities.

10.2 Variable speed drives (VSDs): General

The VSD motor starter shall comprise a variable frequency converter (VFC), phase shift transformer(s) (where required), and all other components necessary to provide the full speed and torque control of an a.c. cage induction motor over the specified operating speed range up to the motor's rated speed and full load current.

VFCs shall either be wall-mounted, housed within a motor control centre or free-standing units within their own enclosures as specified in the Project Specification.

Unless otherwise specified in the Project Specification, VFCs shall have uncontrolled rectifiers (i.e. diode front end) with the specified pulse number (6/12/18). Either a.c. line reactors or d.c. link chokes shall be provided with all 6-pulse VFCs to reduce input current harmonics.

Where a phase shift transformer is required to achieve the specified rectifier pulse number, the transformer shall be provided as an integral component of the VSD and, unless otherwise specified in the Project Specification, shall be of the dry type and housed in a dedicated section of the VFC enclosure.

VFCs shall be capable of operating under the service conditions specified in Clause 4 of SANS 61800 Part2, and any unusual environmental service conditions specified in the Project Specification. Functional features and performance requirements shall be in accordance with Clauses 3 and 6 of SANS 61800 Part 2 respectively as varied.

The output rating of the VFCs shall be selected to suit the associated motor and shall take into account the operating speed range.

Every VSD motor starter shall be provided with incoming supply isolation and short circuit protection as well as an input contactor if specified in the Project Specification.

The VSD shall provide the specified motor protection either as an integral part of the VFC or by way of a separate motor protection relay.

Where any semiconductor or special d.c. circuit fuses are used in the VFC power circuit, a spare set shall be provided. A list of all fuses, type, ordering code and supplier and supplier details shall also accompany the spare fuses.

The VSD control system shall incorporate comprehensive diagnostics to provide fault supervision and status indication in accordance with Clauses 3.2 and 3.3 respectively of SANS 61800 Part 2 and any additional requirements specified in the Project Specification.

Input/output devices and communication links shall be provided as specified in the Project Specification.

The Contractor shall ensure that the suppliers of the VFC and the associated motors confirm that their standard equipment is fully compatible and, if not, that the necessary equipment design changes (e.g. enhanced motor insulation) and/or supplementary equipment (output filters or reactors) is provided to ensure compatibility.

The Assembly shall permit adequate heat rejection from the VSD compartments and the Contractor shall provide estimates of the total heat rejection from the Assembly. The location of the Assembly and VSD panels, and the ventilation arrangement, shall be as specified in the Project Specification.

10.3 Variable Speed Drives (VSDs): EMC Requirements

All VSDs shall comply with the requirements of product standard SANS 61800-3 for Category C2/C3 as appropriate and an EMC filter shall be provided as part of a VFC if necessary to achieve the required electromagnetic compatibility.

The supply voltage distortion limits specified in the Project Specification shall be achieved through the use of diode front-end VFCs with higher pulse numbers, active front-end VFCs or harmonic filters. Documentary proof shall be provided with the Tender that the VFC input current harmonics will be limited to the required levels.

When specified in the Project Specification, the Contractor shall carry out a harmonic survey at the point of supply to measure background voltage harmonics. The Contractor shall repeat the survey after the commissioning of all VSDs to demonstrate that the actual harmonic performance of the VSDs under worst case operating conditions does not exceed the specified limits.

Any VFC input harmonic filters or line reactors and any output filters (i.e. dU/dt, common mode or sine filters) or reactors shall be provided as part of the VFC and shall be included in the supply price. Output filters shall be provided where required to ensure motor insulation compatibility and/or control of bearing currents. Output reactors shall be provided if motor supply cables exceed the allowable length.

The design of dedicated VFC input harmonic filters shall take account of the supply impedance provided in the Project Specification, any background voltage harmonics, any other reactances (e.g. transformers) or capacitors (e.g. power factor correction), or other filters connected to the power system, so as to avoid possible resonance problems.

10.4 Variable Speed Drives (VSDs): Control

The VSD control panel / operator interface shall be mounted in the face of the VSD panel / Assembly. Control parameter adjustment shall be easily achievable by menu-driven option selections, with engineering options protected from unauthorised changes by the use of multi-level password protection.

All operator controls and indications shall be available front of panel, either via an operator interface / keypad, or by using discrete push-buttons and lamps, etc.

The VFC shall incorporate on-board protection, control and monitoring features, which shall include, as a minimum, the following:

- (a) On
- (b) Unit Ready
- (c) Overload
- (d) Failure
- (e) Current limit
- (f) Over voltage
- (g) Manual start and stop
- (h) Raise and lower speed
- (i) Current operating status
- (j) Speed indication

The VSD shall be such that when set in the 'manual' mode, operation from the control panel / operator interface shall be as follows:

- (a) a start command shall cause a normal ramped start up to the pre-set speed
- (b) a stop command shall cause a normal ramped down stop and shutdown of the drive

All diagnostic and fault messages shall be stored, whether reset or not and it shall be possible to recall them from the operator interface/control panel.

All VFC function parameters shall be programmable from a dedicated keypad, or via a standard programming software package installed on a standard portable notebook. A serial communications port to RS232 / RS485 standard or other network communication port shall be provided for dedicated communication with the VFC, and via which all programmable, control, monitoring and diagnostic functions available locally at the VFC shall be accessible.

A copy of the configuration / standard programming software shall be provided with each VSD.

11 Control Circuit Supplies

11.1 Provision of control circuit supplies

Fixed pattern functional units shall incorporate individual control circuit supplies that are derived from within the functional unit.

Control circuit supplies shall be 230V AC (single pole and neutral) or 24V DC as specified in the Project Specification. They shall be separately derived from double wound transformers, which where practicable shall have 400V primary windings. Double pole primary winding protection shall be provided by fuses or a miniature circuit breaker.

The rating of each control transformer shall exceed the sum of the foreseeable maximum continuous load (which for an electromagnetic device shall be the 'hold-in' VA) plus the in-rush current of the largest or simultaneously operating load device(s) (e.g. the 'pull-in' VA).

Control circuit supplies shall comply with SANS 60204-1, and the neutral terminal of each transformer secondary winding shall be provided with a removable link, and shall be connected to earth. Secondary winding overcurrent protection shall be provided.

11.2 Control circuit features

One pole of every contactor and auxiliary relay coil, timer, etc. shall be connected directly to the neutral (i.e. earthed) side of the control supply. Each control circuit shall be sectionalised and arranged such that where practicable, discrimination is achieved under fault conditions.

Where possible, common controls and ICA compartment circuits shall operate at 24V DC, and shall interface with the functional unit 230V AC control circuits by means of 24V DC interposing relay(s) located in the functional units.

12 Signs and Labels

12.1 General

Safety signs and labels shall be provided wherever necessary in relevant languages so as to unambiguously communicate safety and functional guidance to any person who may operate the Assembly or otherwise come into contact with any part of the electrical system forming a part of the Assembly, and shall be provided for the specific identification of every component contained within the Assembly.

Signs and labels shall be located in such a manner that:

- (a) it is obvious as to the nature and location of the hazards or component(s) to which they relate
- (b) when mounted on any enclosure cover or plate, there is no possibility of that cover or plate being interchanged with any similar item on that Assembly or on any other Assembly supplied to the same site
- (c) they are not fixed to easily removable parts (e.g. trunking covers, etc.), unless their purpose is to warn of the consequences of removing a removable part
- (d) they are at all times adjacent to the item to which they refer, and accommodate situations where components could be moved along a DIN mounting rail
- (e) they will not be obscured by any equipment, components, or wiring, etc.

- (f) They are legible and will remain easily read throughout the life of the Assembly
- (g) Signs and labels shall be securely and permanently fixed using an appropriate number of corrosion resistant, mechanical fixings. The fixing of labels, safety signs and notices shall not affect the IP rating of the Assembly.

Short individually fixed labels covering several items only, shall be used in lieu of long multi-legend labels; e.g. above a row of indicator lamps.

Self-adhesive, vinyl safety signs may be used if there is no requirement for special legend and proprietary safety signs are available.

Safety signs and labels shall be of such size that the legend thereon is clearly legible from the operating position (or a 3m distance), and the pictograph and its accompanying text shall be chosen so as to provide the appropriate communication in an explicit and unambiguous manner.

Safety signs and labels fixed to the outside of the enclosure shall be manufactured from 1.5mm thick anti-reflective polycarbonate with the legend reverse screen printed, or alternatively from 3mm thick bevel-edged clear perspex rear engraved with black characters. Internal labels may be manufactured from a laminated plastic material which shall normally provide a black legend against a white background. Where specifically agreed with the Engineer, internally mounted labels and charts, e.g. for distribution boards, etc., may be of permanently printed plastic, plastic laminated thin card, or thin card protected behind perspex.

12.2 Safety Signs

As a minimum, safety signs shall be fitted to removable covers over busbars and live connections, and to doors of compartments containing:

- (a) incoming supply cable termination points
- (b) internal switching and isolation devices
- (c) incoming or internal means of isolation; stating the highest voltage controlled by the means of isolation
- (d) functional units incorporating capacitors
- (e) more than one supply or multiple control circuits originating elsewhere
- (f) equipment located in a 'safe area' but associated with certified apparatus located in a hazardous area; a sign shall also be fitted at the safe area cable termination rail.

A safety sign identifying the operating voltage shall be placed in any compartment where there is equipment, components, or wiring, that can be energised at above extra low voltage.

Where there is no suitable standard symbol or pictograph, an application specific sign may be produced using simple and appropriate symbols, pictographs, and text, to indicate the hazard in a simple and straight forward manner that is acceptable to the Engineer.

Multipurpose signs shall be used where there is a need to communicate multiple hazard messages.

12.3 Labelling

The text of every label, excluding individual internal component identification labels, shall be as agreed with the Engineer.

Every Assembly shall be provided with a name plate detailing the following

- (a) Manufacturer's name or trademark
- (b) Manufacturer's contact details

- (c) Manufacturer's type designation, serial / identification number
- (d) Date of manufacture
- (e) Rated operational voltages, frequencies, and number of phases
- (f) Continuous busbar rating
- (g) Short circuit withstand current and duration
- (h) IP rating

An application name shall be prominently displayed on the Assembly, as detailed in the Particular Specification.

Each compartment shall be identified with a designation label which shall include the full plant functional name and the alpha numeric tag number, kW rating, full load amp rating. For rear access Assemblies, a duplicate designation label, mounted adjacent to the gland box, shall also be provided at the rear of each compartment.

The material used shall be selected having regard to the size and fixing methods of the label and the label shall not warp in service. Labels mounted on the outside of the Assembly shall be rectangle in form and be manufactured of either:

- (a) Laminated plastic, engraved so as to produce black letters on a white background
- (b) Engraved sandwich board ("Trifoliate", "Darvic" or equal)
- (c) Reverse engraved acrylic material ("Perspex") with filled letters and reverse sprayed

For outdoor applications (where specified) labels shall be brass or aluminium (with letters filled in black), lightly sanded with fine grit paper and clear lacquered.

Labels for door mounted components and labels used inside the Assembly shall be to the same standard or may alternatively be printed using an approved, proprietary system.

Text characters shall be uniform in height, in upper case (except where standard abbreviations of units are used, e.g. kWh, kVA, etc.) and of the following minimum dimensions:

- (a) application labels 8mm
- (b) compartment designation labels: 6mm
- (c) information or warning labels: 6mm
- (d) component identification labels 3mm

All components shall be clearly labelled. Internal components shall be clearly identified by individual labels to indicate the equipment to which they relate. The component identification labels shall correlate with the Assembly drawings and documentation. If this is not practical due to space restrictions, common labels (e.g. diagrams may be used).

Current transformers shall be provided with separate and individual identification and rating plates.

Each distribution board shall be provided with a circuit chart laid out in a way that matches the orientation and layout of the protective devices in the distribution board.

A typed circuit chart shall be permanently fixed inside each Assembly or immediately adjacent to the distribution board. The chart shall be laid out in accordance with the physical arrangement of the protective devices that it is easy to relate the circuit chart details to the appropriate protective device. As a minimum, the chart shall be enclosed in a transparent protective cover attached to the inside of the compartment door.

13 Installation Requirements

13.1 Shipping

Assemblies shall be shipped in sections to facilitate field handling for transportation and installation. The shipped sections shall be joined together to form a complete unit assembly.

Preparation for shipment shall protect the Assembly auxiliary devices accessories, etc. against corrosion, breakage or vibration injury during transportation and handling.

Disassembly shall be into the largest components or sub-assemblies possible, consistent with packing, road transport and handling limitations.

All parts shall be clearly and lastingly match marked to facilitate field erection prior to disassembly and packing for transport. Instructions shall be provided for reassembly of sections in the field or accompanied by a qualified representative from the Assembly Manufacturer.

The Contractor shall be responsible for delivery including loading and unloading of all equipment to site.

The Contractor shall provide information (in time) regarding specialised handling and storage requirements/techniques for equipment on the site until finally installed in the operating location.

14 Local Control Panels

14.1 General requirements

The START/STOP pushbutton or control station shall be mounted adjacent to the drive.

The enclosure incorporating the pushbuttons, selector switches and indicating lights shall be fully water, weather and vermin-proof and shall have a minimum rating of IP65. The enclosure shall be manufactured from 3CR12 and shall be painted B26 to SANS 1091.

All pushbutton control station shall be pedestal mounted on a bracket at least 1 000 mm above ground/floor level.

All START pushbuttons shall be green and the operator shall be flush with the surrounding bezel.

All STOP pushbuttons shall be a red mushroom head latching push button and shall serve as an emergency stop.

All selector switches shall be rotary selector switches with black operators.

The control/pushbutton station shall be adequately designed to provide space for the following:

- (a) The required pushbuttons, selector switches and indicating lights complete with their appropriate labels.
- (b) Termination of all control wiring associated with the drive or group of drives. The minimum terminal strip length is 150 mm. A single multicore control cable shall be installed from the Assembly to the station, from where the required signals will be individually wired.
- (c) Stations for submersible equipment shall in addition of the required control cables, also provide for the termination of all the required power cables.
- (d) Sufficient space shall be provided for the glanding of the required cables.

All further requirements pertaining to the design, construction, installation and commissioning of control panels (e.g. Labelling, earthing, commissioning, etc.) shall be as specified in the relevant subsections of this Specification.

14.2 Start/Stop pushbutton stations

In addition to the above general requirements, START/STOP pushbutton station shall confirm to the following additional requirement:

- (a) One START pushbutton
- (b) One STOP pushbutton. The STOP pushbutton shall be twist to release.
- (c) Where reverse local control is required the reverse button shall not latch unless required.

15 Functional Design

15.1 Specification to the Contractor

The Engineer shall provide the Contractor with the following information, which will form the basis for the design of the Assembly:

15.1.1 The Particular Specification

The Project Specification will detail all project specific requirements.

15.1.2 MCC and Local Control Table

The MCC and Local Control Table will be a schedule of all external connections and their function, ratings, etc. It gives an indication of each load's kW rating and the relevant circuit breaker size that must be selected. Also stated will be the type of starting, the local visual indication and the requirements for manual, automatic and local control needed.

15.1.3 I/O Schedule

The I/O Schedule will detail all the input and output signals (analogue and digital) for the controller connections, and the relevant equipment part it connects to.

15.1.4 Technical Data Sheets

The Technical Data Sheets are intended for use as standard templates, which will be completed and inserted into the Project Specification documents, so as to detail the project and product specific requirements for each Assembly as a whole, and for its constituent functional units.

Project specific configuration of the Technical Data Sheets will take the form of a 'YES' 'NO', insertion of a value or , together with the provision of an associated Particular Specification clause, cross-reference, or stated requirement, etc., as appropriate. When compiling a Project Specification document, only those Technical Data Sheets applicable to the required functional units will be included.

One set of Technical Data Sheets will be prepared per Assembly, unless therein detailed otherwise. Individual Technical Data Sheets may be duplicated if applicable, in order to accommodate the extent of scheme specific information.

15.1.5 Control Philosophy

The Control Philosophy will detail the functionality of all control and automation systems.

15.1.6 Cable Block Diagram

The cable block diagram is a schematic that shows how the components of the Assembly is connected to the equipment and motors that it controls. It also indicates starting method, cable and circuit breaker sizes.

15.1.7 Assembly general arrangement drawing

A proposed layout shall be provided for the Contractor as indication of the relevant size constraints for the Assembly. It shall also indicate the number of functional units (e.g. motor starters, feeders, etc.) that is required for the Assembly.

15.1.8 Building arrangement drawing

A drawing indicating the Switchgear-room layout shall be used for functional considerations of the Assembly design. This drawing could be provided under the Civil part of the project.

16 Testing and Commissioning

16.1 General requirements for testing

On completion of manufacture, the Assembly shall be subjected to a factory acceptance test (FAT), comprising the Manufacturer's in-house tests, and the repeat tests witnessed by the Client and the Engineer.

Once the witnessed FAT has been carried out, signed off, and any remedial works have been completed and re-tested, the Assembly is ready for delivery to site. Once erected in position, the Assembly shall be subjected to a witnessed site acceptance test (SAT).

Once the SAT has been carried out and signed off, any remedial works shall be completed and re-tested. Plant installation and site cabling will then be carried out by others, and on its completion, witnessed commissioning shall commence.

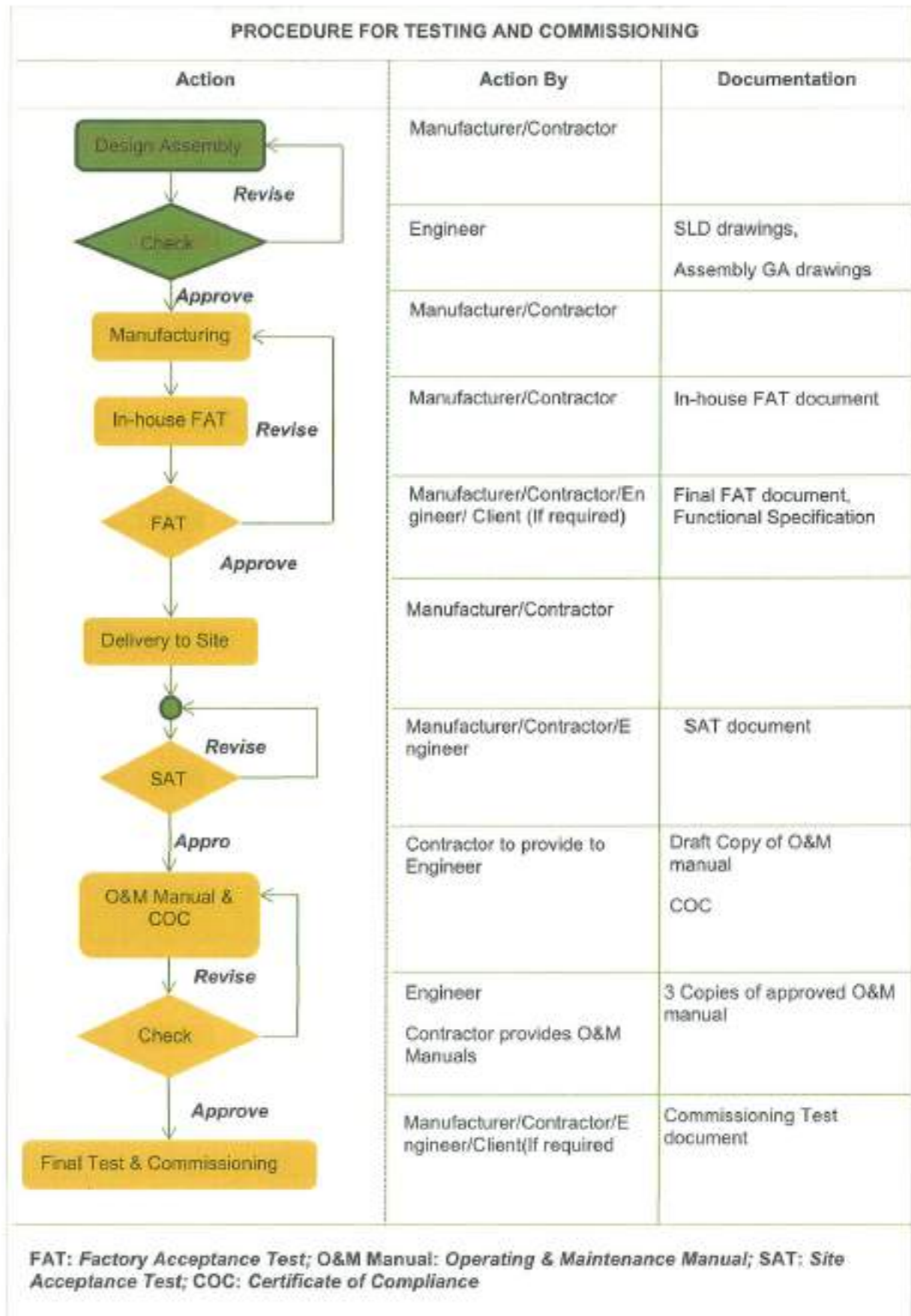
The manufacturer shall allow for each test (apart from in-house tests) to be witnessed by both the Client and the Engineers simultaneously. An individual testing activity shall not be considered to have been completed until any results have been recorded, and it has been signed off by the Engineer.

The manufacturer shall provide the Client and Engineers with all reasonable facilities, including testing staff and test equipment, to carry out the inspections and tests, and to check the Assembly for compliance with all of the Client's requirements.

The manufacturer shall ensure that all testing is carried out in a safe manner, and shall protect those witnessing from danger, in accordance with the Occupational Health and Safety Act.

In order to demonstrate the functionality of each circuit, external devices shall be simulated in a representative manner. A small motor shall be used as a test load where motor starters incorporate power electronics. During development, software may be electronically verified away from the Assembly using a simulation / diagnostic package; notwithstanding this, control systems shall be witnessed tested with the software loaded into the programmable devices, and with simulation of the physical I/O devices.

Where the Assembly incorporates equipment requiring special testing facilities or procedures, the manufacturer shall ensure that appropriate resources are available; including where necessary, representatives from the equipment Manufacturer.



16.2 Factory acceptance tests (FATs)

The manufacturer shall perform his in-house works tests in accordance with the proposed FAT procedures, and shall satisfy himself as to the accuracy and quality of the manufactured Assembly in accordance with the accepted design. Once the in-house FAT has been carried out, signed off by the manufacturer, and any remedial works have been completed and re-tested, the tests shall be repeated and witnessed by the Client (if required) and the Engineer.

The in-house and the witnessed FATs shall check compliance with SANS 60439-1, and shall include the following:

- (a) A thorough external and internal visual inspection.
- (b) Confirmation of adequate earthing
- (c) Secondary injection testing of all protective circuits shall be carried out, except where discrete current transformers are used; in which case sufficient primary injection testing shall be carried out to prove the ratio and the polarity.
- (d) Meggar tests shall be performed across all main and distribution busbar joints.
- (e) All busbars shall be subjected to a single witnessed reduced voltage dielectric 'flash' test; the in-house test shall also be at a reduced voltage.
- (f) All power circuits shall be subjected to insulation resistance tests.
- (g) The operation of every mechanical device and interlock shall be verified.
- (h) All circuits and their functionality shall be tested as detailed in the Control Philosophy and MCC and Local Control Table.
- (i) Any other test necessary to verify satisfaction with the requirements of Table 7 of SANS 60439-1.

When testing the performance of any software, it shall be demonstrated using the hardware intended to be incorporated within the Assembly, and where this is not possible appropriate operator interfaces, programming units, and terminal units, etc. shall be provided. Where it is necessary to demonstrate an interface with a piece of unavailable equipment to be supplied by others, appropriate means to replicate that equipment and simulate the interface shall be provided.

The Engineer reserves the right to cancel and postpone tests if he finds that the Contractor has not made reasonably sure that the test will be successful. Any extra costs incurred shall be borne by the Contractor.

16.3 Site acceptance test (SAT)

All equipment and every circuit that was altered or disturbed subsequent to the completion of the FAT, or for shipping and site erection, shall be specifically re-tested for integrity and functionality.

During the SAT, all busbar joints that are re-tightened on site shall be subjected to a further Meggar test, and all busbars shall be subjected to a single witnessed full voltage dielectric 'flash' test.

The process functionality of each aspect of the control system and its operator interface shall be demonstrated, including the correct operation of all I/O and network links external to the Assembly or not otherwise tested during the FAT.

A COC shall be provided to the Engineer, before final Testing and Commissioning can start.

16.4 Commissioning and other tests

The manufacturer shall provide attendance during the commissioning of the Assembly, whereby the functionality of the Assembly and its control system and software shall be proven. During commissioning the manufacturer shall make such adjustments, software modifications, and circuit changes, as are deemed necessary to provide the level of plant functionality and performance specified by the Client. All such changes shall be immediately incorporated into the 'as installed and tested' documentation and the Operating and Maintenance Manual, by the Contractor.

The manufacturer shall provide an acceptance document, to detail and record the tests and their anticipated results, and the acceptance document shall have provision for recording and signing off the results.

17 Documentation and Training

17.1 General

All drawings, information, and documentation shall be in English, and each item shall be identified with:

- (a) the Client's name and contact details
- (b) Client's project / scheme / contract reference title and numbers
- (c) the Engineer's name and contact details
- (d) Engineers reference numbers
- (e) Contractor's works / contract / order references.

Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

17.2 Drawings for Approval by the Engineer

The following documentation and drawings shall be submitted to the engineer prior to the procurement or manufacturing of Assemblies and related equipment:

- (a) Cable block diagrams.
- (b) General arrangement and elevation drawings, compartment door layouts, typical component mounting plate layouts, and foundation plans.
- (c) Electrical schematic diagrams showing all equipment and components incorporated into the Assembly. Known circuitry outside of the Assembly and connected to it, shall be shown on all drawings. Drawings shall be cross-referenced using a grid / line reference system.
- (d) Protective device grading for overcurrent, short circuit, and earth fault / leakage devices incorporated within the Assembly, together with a schedule of proposed settings that will ensure discrimination.
- (e) PLC software and configuration documentation; including ladder logic diagrams and HMI display screens, etc. The documentation shall be complete and annotated with purpose, function, duty, cross-references, and descriptions, etc.; sufficient to guide an unfamiliar person through the operation of the software.

17.3 Testing Documentation and Reports

The FAT and SAT shall be according to BS EN 62381.

A factory acceptance test (FAT) document shall be provided to the Engineer prior to the witnessed FAT. This documentation shall show the manufacturer's in-house test procedures and results for all items of equipment: components, hardware, and software. The document shall show hardware checks, the software simulation procedures, and their combined functional testing. It shall comprehensively and clearly show the test results of the in-house testing. The subsequent report of the FAT witnessed by the Engineer shall be appended to this documentation.

The Contractor shall provide his own testing report template to document the FAT witnessed by the Engineer. This shall be to the satisfaction of the Engineer.

A site acceptance test (SAT) document shall be produced, which shall detail all tests necessary to demonstrate the functionality of the Assembly following its final erection on site. This shall include details of tests and checks on all circuits disconnected for shipping, together with any equipment, components, wiring, or software altered or incorporated into the Assembly; following the completion of the witnessed FATs.

All drawings, schedules, listings, and other design documentation for acceptance shall be supplied as a comprehensive and integrated package and collated into folders; unless otherwise agreed with the Engineer. Three copies of appropriate documentation shall be submitted on each occasion that agreement is sought.

A Certificate of Compliance (COC) shall be provided for all new Assemblies. For all refurbished Assemblies, a letter shall be provided listing all the repairs and stating that the Assemblies are still deemed to be reasonably safe.

The FAT, SAT, and COC shall each have been submitted and agreed with the Engineer, prior to the commencement of final testing and site commissioning.

17.4 Certificate of Compliance

A Certificate of Compliance (COC) shall be provided for all new Assemblies. For all refurbished Assemblies, a letter shall be provided listing all the repairs and stating that the Assemblies are still deemed to be safe.

The original COC shall go to the client's electrical representative.

A copy of the COC shall be included in the O&M Manual.

17.5 Operating and Maintenance Manual

One copy of the draft operating and maintenance manual and spare parts list shall be provided at an agreed date, in advance of the date of the start of the final testing and commissioning SATs, for acceptance by the Engineer. Three copies of the final editions shall be provided to the Engineer by an agreed date before successful completion of final testing and commissioning.

The Operating and Maintenance Manual shall be bound into a suite of hard-backed ring binders, and shall be provided with an index of all drawings pertinent to the Assembly. The index shall include each drawing's origin, number, issue, status, and the Client's drawing number (where issued by the Engineer).

The Operating and Maintenance Manual shall include the following:

- (a) All design drawings and documentation relating to the Assembly; as delivered and tested.
- (b) As installed and tested records showing verification against stated design and installation criteria, including a schedule of all the final settings for all user adjustable equipment and components, and copies of all documentation presented and completed during the FATs, the SATs, and any other specified tests on completion.

- (c) Schedules of plant and equipment for each compartment / circuit; including a listing of the applicable standards, manufacturer, settings, type number, or order code, etc., for each item of equipment and component included within the Assembly.
- (d) Manufacturers' contact details, technical information sheets for all items of equipment and components included within the Assembly. Manufacturers' catalogues may be provided subject to clear identification of the relevant components. All individual manufacturers' equipment / component test certificates and certificates of conformity, shall be included.
- (e) Inspection, testing, and maintenance recommendations, including detailed and specific operation, maintenance, and diagnostic data, and safe isolation information suitable for use by maintenance personnel, shall be provided for all equipment, components, and systems incorporated into the Assembly.
- (f) Schedule of spares provided with the Assembly, including manufacturer, description, part number, order code, and quantity.

The Operating and Maintenance Manual shall include detailed descriptions for use by the Client, on how the controlled plant and its management systems are intended to operate and be operated; under both manual and automatic control. Clear and detailed descriptions for each element of the Assembly shall be provided; and shall include system objectives, controlled plant start-up and shut-down procedures, automatic control, manual intervention, primary and secondary control routines, plant selection including duty and standby options, local and remote selections, operational and safety constraints, status information, alarms and control interfaces with control systems, fault routines, etc.

The Operating and Maintenance Manual shall include 'as-installed and tested' information on both the hardware and software for each programmable device incorporated within the Assembly, including:

- (a) Overview of system operation in relation to the controlled plant.
- (b) System configuration.
- (c) Manufacturers' literature on operation, maintenance and testing of hardware and ancillaries, programming instructions, and diagnostics.
- (d) Hard copy program; with listings fully documented.
- (e) Listing of the final settings of all process dependent variables.
- (f) Permanent back-up copies, licensed in the name of the Client, shall be provided for all software, including operating programmes, application programs, and configuration software for all configurable devices.

Any interconnecting leads, protocol conversion modules, connectors, etc. necessary to connect and communicate with each programmable / configurable device to a standard portable Notebook.

Manual format shall be A4 size on the filing side which shall be vertical with 20 mm margin for filing.

17.6 Training

17.6.1 General

- (a) The LV switchgear and Control Gear training shall form part of the overall training programme.
- (b) The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the Assemblies.
- (c) The Assemblies shall be in a complete working order before training shall commence.
- (d) A training schedule, together with the name and background of the person who will perform the training, shall be submitted to the Engineer for approval.

- (e) Training and training manuals shall be based on the O&M Manuals
- (f) Training manuals shall be delivered for each trainee with two additional copies delivered for archival at the project site. The manuals shall include an agenda, defined objectives for each course
- (g) Where the Contractor presents portions of the course material by audio-visuals, copies of those audio-visuals shall be delivered to the Employer as part of the printed training manuals.
- (h) The Employer reserves the right to videotape the training sessions for later use.
- (i) The training shall include operator training and technical/maintenance training.

During the installation phase, a person will be designated by the Employer to be closely involved with the installation and commissioning process. The intention is not to interfere with the Contractors' installation team, but to do observation in order to obtain the maximum possible information regarding the installation, to enable efficient maintenance to be undertaken by the Employer after final hand-over and expiring of the guarantee period

17.6.2 Operations & Maintenance training sessions

- (a) There shall be training sessions for the operation and maintenance of the Assemblies
- (b) The program for the training shall include instruction for at least one day per Assembly (8 hours) instruction on-site.
- (c) The program shall at a minimum cover the following:
 - (i) General system overview
 - (ii) Functional operation of the system i.e.:
 - System start-up and shut-down procedures
 - System access requirements
 - Alarms
 - Fault Finding
 - Backup Power Procedure (if applicable)
 - Incident Reporting
 - (iii) Maintenance
 - Maintenance Schedule
 - Standard Maintenance Procedures
 - Spare Part Lists

Upon completion of the course, the operators should be fully proficient in the system operation and have no unanswered questions regarding the system

General specification

Low Voltage Cables

Specification number: **SPE-EE-0011**

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1.0 Scope

1.1 Application

This document specifies the standard requirements for the design, supply, delivery to site, site installation, site testing, commissioning and handover of low voltage cable systems for voltages up to 1000 Volts AC or 1500 Volts DC.

The primary intention of this specification is to ensure the provision of LV cable system, which has been designed and constructed to ensure safe, reliable, operation and to facilitate safe inspection, testing and maintenance.

Note, however, that this specification only covers such installations (or sections of installations) that are covered by SANS 10142-1. Note also that certain provisions of this specification are inappropriate for direct application to installations where additional measures (such as earthing, intrinsic safe equipment, etc.) are required by SANS 10142-1 and SANS 10108 (i.e. medical and hazardous locations). For these types of installations, SANS 1411,

1.2 Electrical System Characteristics

The design of the installation shall comply with SANS 10142-1.

The design of the installation shall consider the following supply characteristics:

Voltage, frequency and number of phases

Maximum prospective short circuit current (phase to phase and phase to neutral)

Type of system, e.g. TN-S, TN-C-S

Maximum earth loop impedance of the earth fault path external to the installation

Type and rating of the cut-out or switch device

Load capability of the supply source, particularly the effects on the supply voltage of the starting of new equipment

The installation of protective devices shall be correctly co-ordinated within the installation and with respect to existing installations. Discrimination studies shall be performed to validate the co-ordination of the installation.

All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and adequate working space for such activities

Where additions or alterations to an existing installation are to be performed, the rating and condition of existing equipment, including that associated with the supply, shall be verified to confirm its suitability to carry any additional load. The earthing and equipotential bonding arrangements shall also be verified. No addition or alteration shall have an adverse effect on the existing installation.

2 Standards

2.1 Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site-specific requirements will be found in the Particular Specification and its accompanying Technical Data Sheets, which shall be read in conjunction with this Specification.

Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

The Contractor shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the installation.

2.2 Regulations, Specifications and Standards

The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:

- (a) Occupational Health and Safety Act (Act 85 of 1993)
- (b) Construction Regulations 2003 issued in terms of Section 43 of the Act
- (c) Local Fire Regulations; and
- (d) Regulations of the Local Supply Authority

and the latest editions (current at the time of Tender) of all relevant South African National Standards, as well as International Standards, including but not limited to:

Table 1 Reference Standards

Standard Number	Description
SANS 1213	Mechanical cable glands
SANS 1411	Materials of insulated electric cables and flexible cords
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
SANS 10199	The design and installation of earth electrodes
SANS 10225	The design and construction of lighting masts
SANS 10142-1	Wiring of Premises Part 1: Low Voltage Installations
SANS 60614-2	Conduits for electrical installations - Particular specification for conduits
IEC 50086	Conduit systems for cable management

The installation shall also comply with:

- (a) This Specification, including all Technical Data Sheets; and
- (b) Any documentation issued by, or on behalf of, the Employer in respect of the installation.

3 General

3.1 General

Cables shall be manufactured strictly in accordance with SANS 1507.

Cables shall be delivered within 12 months of manufacture and shall be delivered to site on cable drums or coiled with protective wrappings.

Cables shall be delivered, stored and handled in accordance with the manufacturer's instructions. Where the performance of the cable is likely to be adversely affected by the ingress of moisture, it shall be adequately sealed at both ends.

The end protruding from the drum shall be protected against mechanical damage.

Cable selection and sizing should comply with SANS 10142-1. Cables and their wireways shall, where required by SANS 10400 Part T to be protected against the effects of fire, be selected and installed in accordance with the provisions of such code.

Cables shall have copper or aluminium conductors according to SANS 1411-1. Cores of cross sectional area greater than 1,5 mm² shall be stranded or flexible.

Where neutral conductors are to be provided, they shall be of the same cross sectional area as the associated phase conductor, unless otherwise specified in the Particular Specification and drawings.

4 Low Voltage Cables

4.1 Types of Low Voltage Cables

Unless otherwise specified, all LV cables shall have copper conductors to SANS 1411-1. Cores of cross sectional area greater than 1,5 mm² shall be stranded or flexible. Where neutral conductors are to be provided, they shall be of the same cross sectional area as the associated phase conductor, unless otherwise specified in the design documentation and drawings.

All LV cables used in an electrical installation shall be as specified in the Particular Specification (or cable schedule as part of the Particular Specification) and shall comply with either of the following:

- (a) PVC/AWA/PVC and PVC/SWA/PVC
 - (i) Cables shall comply with SANS 1507-3 and be rated at 600/1000 V.
 - (ii) Single core cables shall have aluminium wire armouring.
 - (iii) Multicore cables comprising five conductors and above shall have each core individually coloured, or, where not available, be coloured white with phase identification in black numerals.
- (b) XLPE/AWA/PVC and XLPE/SWA/PVC
 - (i) Cables shall comply with SANS 1507-4 and be rated at 600/1000 V.
 - (ii) Single core cables shall have aluminium wire armouring.
- (c) PVC/PVC
 - (i) Cables shall comply with SANS 1507-3 and be rated at 600/1000 V.
- (d) XLPE/PVC
 - (i) Cables shall comply with SANS 1507-4, and be rated at 600/100 V.

- (e) **Single Core PVC**
 - (i) Cables shall comply with SANS 1507-2 and be rated at 600/1000 V.
 - (ii) The insulation shall be phase coloured, and, where used in single phase systems, line cables shall be red, neutral cables black and earth cables yellow and green.
- (f) **Flat Twin and Earth PVC**
 - (i) Copper conductors shall comply with SANS 1411-1, PVC insulated to SANS 1411-2, laid up with a bare copper earth continuity conductor between them, with PVC bedding to SANS 1411-2.
 - (ii) Cables shall be rated at 300/500 V.
- (g) **Fire Resistant Cables**
 - (i) Cables requiring protection against the effects of fire shall be of fire-resistant construction (note here that "fire-rated" cables are not the same as "fire-resistant" cables).
 - (ii) Fire-resistant cables shall thus comply with SANS 60331-21 and / or BS EN 50200.
 - (iii) Except where prior approval in this regard has been granted by the Engineer, increasing the resistance to fire of normal (i.e. non-fire resistant) cables through the application of a coat of fire-resistant compound will not be accepted.

4.2 Cable Accessories

4.2.1 Cable Markers

Where specified in the Project Specification concrete markers for the indication of cable or trench routes shall be placed at a minimum of 50 m intervals, changes in trench or cable direction and at road crossings. The markers shall protrude by 25 mm above finished ground level, except where they are likely to cause obstruction, when they shall be laid flush with the finished ground level.

5 Installation of Cables

5.1 General

The cable installation shall comply with the requirements of SANS 10142-1.

Cables shall be installed strictly in accordance with cable route drawings.

Cables installed in groups shall run in straight lines and not cross over each other, except where transposing of cables is required to reduce capacitive or inductive effects.

Cables installed above ground shall, as far as possible, run parallel with the lines of building construction. Cables and wireways shall then only be installed in horizontal and vertical runs, and the installation shall be as visually unobtrusive as possible.

Cables buried below ground shall, as far as possible, follow features of the site such as roadways and building lines.

Where a redundant cable installation is required, the cables shall not be installed along the same route, and their routes shall be through separate fire compartments (except where no separation occurs, as may be the case in the vicinity of the source and load).

Cables and their support systems shall not be fixed to protective barriers, guards or directly to guard-rails.

Cables shall not be exposed to direct sunlight after installation. If there is not alternative to running cables in direct sunlight, the Contractor shall ensure cables are covered with a suitable cover of the same material as the support system (tray). Cables shall be installed strictly according to the manufacturer's requirements pertaining to:

- (a) Maximum tensile or compressive stresses (e.g. due to pinching or squashing)
- (b) Minimum bending radii
- (c) Temperature of installation; and
- (d) Operating environment

No joints or repairs to outer sheathings or insulation shall be allowed in low-voltage cables without the prior approval of the Engineer.

Propriety (i.e. suited to and manufactured for such use) cable support systems shall be used.

Unarmoured cables shall only be used where there is no risk of mechanical damage.

Fire resistant cables shall only be supported by fire resistant cable support systems.

After cable installation, the open end of all cable sleeves and the openings in building structures specifically provided for the passage of cables (including unused openings) shall be fire sealed to SANS 10177 Part 2, thus preventing the ingress of harmful or flammable gases, liquid, smoke, fire and vermin.

5.2 Separation of Cables

Cables shall be classified as follows:

Table 2 Cable Classification

	AC	DC
High Voltage	> 1000 Vrms	> 1500 V
Low voltage (power, control, small power and lighting)	50–1000 Vrms	120–1500 V
Extra-low voltage (signal/instrument, data transmission and telecommunication)	< 50 Vrms	< 120 V

Except for reasons of electromagnetic compatibility, where larger separation will be required, the minimum separation distance between cables of different classifications shall be according to the following table.

Table 3 Separation distance

Separation (mm)	Extra Low Voltage	Low Voltage	Other Services (Above Ground)	Other Services (Below Ground)
Extra Low Voltage	-	As specified	150	500
Low Voltage	As specified	2 x cables above ground 100mm below ground	150	500
High Voltage Cables	500	300	300	500
Other Services (Above Ground)	150	150	-	-
Other Services (Below Ground)	500	500	-	-

Note:

1. The above figures need not to apply to the short lengths of cables near the equipment to which the cable are connected.
2. Clearances to power lines are excluded from above table as they are covered by the Electrical Machinery Regulations. Furthermore, clearances to traction lines are subject to the regulations of the relevant railway authorities.

The figures specified in the table above do not apply to cables that are installed in separate metal enclosures and/or cables on cable support systems (cable trays/ladders) that are separated with conductive partitions, provided such partitions are electrically bonded to earth.

Notwithstanding above, cables of different classifications and/or purpose (e.g. data, audio or power), shall not be installed in the same duct or wireway, and the minimum separation distance shall be kept even when their ducts or wireways are bonded (since radio frequency interference may then still be exhibited).

When cables have to cross, the crossing shall be at right angles.

5.3 Cable Trenches in Ground

5.3.1 General

The proposed trench route shall be surveyed for the presence of underground cables and/or services before digging commences.

The site shall be preserved as far as possible. Only the minimum of trees, shrubs, rocks, etc. shall be removed and cleared for the cable route.

Where surplus material has to be disposed of, the Contractor shall remove it from site and dispose of it in a location of his choosing in accordance with statutory environmental regulations.

5.3.2 Excavation

The cable trench shall be excavated along the routes indicated on the relevant drawings.

Should the Contractor, during the excavation operations, come across obstacles (or other interferences, e.g. soil drenched with hydrocarbon-based solvents such as spilt oil, which could adversely affect cable insulation), the Contractor shall report the matter to the Engineer, who shall then advise an appropriate course of action.

Trenches shall be dug to within the dimensional tolerances given by SANS 1200, parts DB and LC.

Where the Contractor cannot excavate by means of machines, due to limited access and the proximity of other services, excavations shall be by hand.

The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clean up the bottom of the trenches after he has completed the required excavation.

The Contractor shall remove all sharp projections, which could damage the cable where the trench is excavated through rocky formations, and shall remove all loose rocks, material, etc. from the bottom of the trench.

- (a) No excavated material shall be left closer than 300 mm from the side of the excavation.

Once the excavations for cable trenches have been completed, the Contractor shall give the Engineer one working day notice to inspect the trench and to be present when the measurements are made.

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed.

5.3.3 Installation of Cables Directly in Ground

Dimensions of trenches for the installation of cables directly in ground

Trenches shall be excavated as follows:

Table 4 Excavation of trenches

	Width	Depth
Telecommunication Cable	450 mm	650 mm
LV Cable	450 mm	650 mm

However, the following minimum clearances shall be maintained:

Table 5 Minimum clearances

	Vertical	Horizontal
Data and Telecom Cables	300 mm	300 mm
Water pipes	300 mm	300 mm
Sewer pipes	300 mm	800 mm
Storm water pipes	300 mm	600 mm
LV cables on same route	100 mm	One cable diameter of larger cable

Where a cable will cross over other services, the cable shall not be installed at a depth less than 600 mm below ground level, and if this is not possible the cable shall be installed underneath the other service and shall be protected in the prescribed manner by means of concrete slabs. The depth of the cable shall be maintained for one metre on either side of the crossing.

If it is not possible to cross over or underneath a service in the prescribed manner, the matter shall be referred to the Engineer for a decision.

Where more than one cable need to be installed in a trench, the width of the trench shall be increased with a distance equal to the clearance required.

5.3.4 Sand bed and sand bed cover for cables

A sand bed layer of soft soil shall be installed and levelled at the bottom of each trench after the trench has been approved by the Engineer, and prior to cable laying.

If the excavated material is not suitable for the sand bed layer, then suitable soil shall be imported for this purpose. Quarried sand, man-made sand, sand clay and loam is usually suitable; sea sand, river sand, clay, chalk, unmixed oukflip, peat and mine sand may not be used. The cost of importing shall be included in the price for the excavation.

The minimum thickness of the sand bed layer shall be 50 mm.

If the soil for the sand bed and sand cover has to be sifted, a sieve with holes not larger than 6 mm shall be used.

The cable shall, after the completion of the trench, be laid as soon as possible so that the trench can be backfilled.

The sand bed cover for LV cables shall be 150 mm thick, of similar soil and shall be placed directly after the cable(s) has been inspected by the Engineer.

Only one cable shall be laid at a time and the Contractor shall take precautions that the cables which are already installed are not damaged.

5.3.5 Laying of cables

Cable rollers shall be used when cables are drawn into trenches. The cable rollers shall be placed so that the cable does not touch the bottom or the sides of the trench.

If the Contractor intends using a winch to draw the cable into the trench, a cable stocking shall be used or the draw wires shall be soldered to the cable, such that the tension is exerted on all the cores, lead sheath and/or steel wire armouring at the same time.

The maximum tension on a cable during laying operations shall not exceed the value specified by the manufacturer.

Sufficient lengths of cable shall be left at the beginning and end of the cable routes to allow for the termination of the cables. The Contractor shall take the necessary precautions to protect the cable ends until they are terminated. The cable ends shall be sealed by means of lead or heatshrink sealing caps to ensure that the cables are waterproof.

Where cables are drawn through sleeves, care shall be taken that they are not kinked or excessively bent.

The Contractor shall keep accurate records of each length of cable laid. The following information shall be recorded:

- (a) Cable drum number
- (b) Size of cable
- (c) Where the cable has been laid, i.e. the starting and finishing points
- (d) Length of cable
- (e) Date laid

The Contractor shall be liable for the repair of cables due to the faulty manufacture, should this information not be recorded directly after the cable has been laid.

The Engineer shall inspect all cable trenches before backfilling to ensure that the laying of cables complies with the specification.

5.3.6 Backfilling of trenches

When the cable has been laid, inspected and approved and the sand bed cover has been installed, the trench shall be backfilled with soil containing not more than 40 % rock or shale which shall be able to pass through a 100 mm sieve and which is approved by the Engineer.

Where more than 40 %, but less than 70 %, rock occurs, the Contractor shall replace the rock with imported soil. However, should more than 70% rock occur then all the backfilling material shall be imported.

The Contractor may import further stone-free material to the site or sieve the excavated material for sand bedding and cover but payment shall only be compensated for the actual quantity of imported material required as determined by the Engineer. The quantity of imported material required shall be calculated from the nominal trench width.

The excavated material shall be backfilled in layers of 150 mm and shall be wet compacted and consolidated to 90 % MOD AASH TO. Where the Engineer deems necessary, the Contractor shall use a mechanical vibrator to compact the trench.

The Contractor shall maintain the completed sections of the cable trench in a proper safe condition for the duration of the contract. The Contractor shall refill and compact the trench where subsidence occurs.

After completion of the work the route of the cable shall be neatly finished off and cleared. All stones bigger than 25 mm, as well as all loose organic material and rubble, shall be removed.

Electrical warning tapes, consisting of two tapes laid side-by-side and overlapping (such that their combined width is 150 % of a single tape width), shall be installed on all cable routes (LV and MV), 200 mm above the top cable layer. Where a cable route exceeds 600 mm in width, multiple warning tapes shall be run, in such a way that the space between adjacent warning tapes does not exceed 150 mm.

5.3.7 Installation of concrete slabs

Where cables cross other services such as water pipes, sewage pipes and other cables, or where the chance exists that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs. The slabs shall protect the cable for a distance of 500 mm on either side of the crossing.

5.4 Cable Sleeves

5.4.1 General

The construction of sleeves, draw pits and associated earthworks shall be in accordance with SANS 2001-DP3.

Sleeves shall be PVC unless otherwise specified.

The sleeves shall have a minimum wall thickness of 5 mm and mass not exceeding 45 kg per sleeve length.

Where a change of direction is required, draw pits shall be constructed. Bends may only be used where prior approval has been granted by the Engineer. Where such approval has been granted, the maximum angle of a single bend in a sleeve shall be:

- (a) 45°, when all cables have a diameter less than 35 mm; or
- (b) 22.5°, where any cable has a diameter greater than 35 mm.

All bends shall be of the long radius type.

5.4.2 Method of Laying

In order to facilitate future location of the sleeves, they are to be installed strictly in accordance with the relevant drawings.

The Contractor shall select the number and/or dimensions of sleeves such that an additional cable of outside diameter equal to 20 % of the sum of the outside diameters of the installed cables, can be pulled into the sleeve at a future date. Under roadways, this spare capacity shall be 50 %.

Notwithstanding above requirement, a minimum of two sleeves shall be installed under all roadway crossings.

When installed beneath roads, there shall be a minimum of 750 mm of cover above the crown of the sleeve, and the sleeve shall be extended to 1,5 m on either side of the road surface or kerb face.

Where sleeves are installed during road construction, the sleeve positions shall be marked with the letters "E" or "ESC" for electrical, and "TEL" for telecommunication sleeves, cut or cast into the concrete of the kerb (or concrete marker, should the road be without kerbs). The grooved letters shall also be painted red, to facilitate easy identification.

The sleeves shall be laid straight to within the dimensional tolerances given by SANS 1200 part LC.

After installation, all foreign matter in the pipe shall be cleared.

The sleeves shall be sealed with PVC plugs to prevent the entry of sand before backfilling.

Precautions shall be taken to prevent damage to the sleeves during future construction activities.

All sleeves shall be left with an 8 mm diameter nylon draw wire, or draw wire to SANS 2001-DP3, in place, anchored at each end.

5.4.3 Bore and Sleeve Jointing

The bore shall be accurate, smooth and without surface cracks, and the inside edges edged or rounded.

The edging or rounding shall be such that no ridge is formed when two sleeves are joined.

A suitable slip collar, or other simple device, shall be provided to maintain the 5 mm spacing after the installation of the sleeves.

Joints shall be carried out with suitable couplings to prevent movement between pipe ends.

Joints shall be flexible enough to allow angular adjustments of up to 5° between adjacent lengths of sleeves during installation and afterwards to allow for subsequent subsidence of the ground.

The joints need not be watertight, but shall stop sand and other materials entering the sleeves.

5.4.4 Draw pits and masonry

Where they are to be constructed in residential or commercial zoned areas, and where part of the draw pit will be visible above ground, the masonry units to draw pits shall be FBS (face brick standard). All other draw pit builds shall utilize solid concrete units.

Draw pits covers shall be of cast iron manufacture, or as specified in the particular specification.

6 Marking and Labelling of Cables

6.1 Low Voltage Cables

Conductors and/or cables shall be identified at both ends by cable markers, consisting of plastic sleeves with pre-printed, legible and indelible alpha/numeric element inserts. The plastic sleeves shall fully encircle the conductor and/or cable. The markers shall be suitable for the intended environment, for instance, UV resistant where installed in sunlight, etc. Reference character sizes shall not be less than 3 mm high.

The colours of conductor PVC insulation shall comply with SANS 10142-1, par. 6.3.3. The colours of conductors for sub-circuits shall as far as possible correspond with the colour of the supply phase. Except in the case of multi-way switching, the colour of a conductor may not change at any point along its run, starting from its point of origin at a circuit breaker inside the switchgear assembly. In other

words, where loop wiring is employed, the colour of conductor insulation shall be the same throughout the circuit.

7 Drawings and Documentation

7.1 General

All drawings, information, and documentation shall be in English, and each item shall be identified with:

- (a) The Client's name and contact details
- (b) Client's project / scheme / contract reference title and numbers
- (c) The Engineer's name and contact details
- (d) Engineers reference numbers
- (e) Contractor's work / contract / order references

Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

7.2 Documentation and Drawings for Approval

The following documentation and drawings shall be submitted to the Engineer prior to the installation of cables and wireways and before civil construction have started on the areas where cable routes are required:

- (a) Motor and equipment cable schedule
- (b) Detailed cable route layout drawings showing type and size of wireways, trenching, cable junction boxes.
- (c) Trenching
- (d) Cable junction boxes
- (e) Cable block diagram

7.3 As-built Drawings

The Contractor shall produce detailed "as-built" drawings, clearly labelled as such, and consisting of 3 sets of drawings printed to their original size. Where the original drawings were larger than A3, 3 sets of printed drawings scaled to A3 size will be supplied. The A3 drawings will not have any information omitted from the printed area. The drawings will indicate the positions of the following:

- (a) Motor and equipment cable schedule
- (b) Wireways (e.g. trenches, conduit, cables ladder/trays, power skirting etc.);
- (c) Cable routes (including any cable joints)
- (d) General arrangement drawings
- (e) Single Line Diagrams
- (f) Cable block diagram

7.4 Operating and Maintenance Manual

Three Operation Manuals, three Maintenance Manuals and three Certification copies shall be provided for all equipment supplied. The manuals shall be in A4 format.

The operating and maintenance manuals shall include at least the following:

- (a) A schedule of installed components and equipment, containing the following information:
 - (i) Manufacturers name and contact details
 - (ii) Circuit number (DB name, circuit breaker e.g. DB01-CB08); and
 - (iii) Function (e.g. switching lighting circuit DB03-L1)
- (b) A schedule of all installed cables, with the following information:
 - (i) Circuit number (DB name, circuit breaker e.g. DB01-CB08)
 - (ii) Size
 - (iii) Installed length; and
 - (iv) Function (e.g. "Feeding Submersible pump IW-SP-01")
- (c) Description and details of:
 - (i) Detailed description of the function of all operator controls
 - (ii) Procedures for fault finding
 - (iii) Maintenance instructions for all components and including repair, overhaul, change-out and installation procedures
 - (iv) Inspection schedules; and
 - (v) Spare parts information and recommended spares

8 Testing and Commissioning

8.1 General

The installation shall be inspected and tested in accordance with SANS 10142-1.

Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision for all inspection and testing activities.

The Contractor shall provide all necessary safety equipment and test instruments. All test instruments shall comply with SANS 61010 and have an up-to-date test and calibration certificate.

The Contractor's safe working arrangements shall comply with the safety management systems and procedures prevailing on site. Where there may be a risk of injury to personnel, the Contractor shall submit a risk assessment and method statement for approval, prior to starting work.

Unless otherwise specified in the Particular Specification, all inspection and test results shall be recorded using proforma documentation (test certificates and schedules) complying with SANS 10142-1.

The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified in the Particular Specification, the period of notice for witness testing shall be 5 working days.

Where most of the inspection and testing activities are not witnessed, the Contractor shall allow for 10 % of the inspection and testing activities to be repeated for witness testing.

If there is a requirement for additional inspection and test activities to be performed as part of the commissioning process, this shall be specified in the Particular Specification.

Unless otherwise agreed by the Employer, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.

8.2 Test Sequence

8.2.1 Inspections before testing:

Before testing, inspections shall be performed to verify

- (a) All equipment and material is of the correct type and complies with applicable SANS and IEC standards
- (b) All parts of the installation are correctly selected and erected
- (c) No part of the installation is visibly damaged or otherwise defective
- (d) The installation is suitable for the environmental conditions; and
- (e) The installation complies with this Specification

8.2.2 Testing of Installation

On satisfactory completion of the inspections specified in 8.2.1 the tests shall be undertaken as per SANS 10142-4

General specification

Cable Support Systems

Specification number: SPE-EE-0012

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0	2015/06/25	First Issue	E Biesenbach	C Reeder	O Fair
Signature					

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1 Electrical Systems

1.1 Application

This document specifies the standard requirements for the design, installation, testing and commissioning of electrical installations operating on voltages up to 1 000 Volts AC / 1 500 Volts DC.

The primary intention of this specification is to ensure the provision of an electrical installation, which has been designed and constructed to ensure safe, reliable, operation and to facilitate safe inspection, testing and maintenance.

Note, however, that this specification only covers such installations (or sections of installations) that are covered by SANS 10142-1. Note also that certain provisions of this specification are inappropriate for direct application to installations where additional measures (such as earthing, intrinsic safe equipment, etc.) are required by SANS 10142-1 and SANS 10105 (i.e. medical and hazardous locations). For these types of installations, thorough reference must be made to the relevant statutory documentation.

1.2 Electrical System Characteristics

The design of the installation shall comply with SANS 10142-1.

The design of the installation shall consider the following supply characteristics:

- (a) Voltage, frequency and number of phases
- (b) Maximum prospective short circuit current (phase to phase and phase to neutral)
- (c) Type of system, e.g. TN-S, TN-C-S
- (d) Maximum earth loop impedance of the earth fault path external to the installation
- (e) Type and rating of the cut-out or switch device
- (f) Load capability of the supply source, particularly the effects on the supply voltage of the starting of new equipment and any fault contributions from new equipment

The installation of protective devices shall be correctly co-ordinated within the installation and with respect to existing installations. Discrimination studies shall be performed to validate the co-ordination of the installation.

All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and adequate working space for such activities. Similarly, the positioning of equipment shall not impede access to, or working space at, non-electrical equipment and services for operation and maintenance activities.

The installation shall be suitable for access and use by electrically unskilled persons.

Where additions or alterations to an existing installation are to be performed, the rating and condition of existing equipment, including that associated with the supply, shall be verified to confirm its suitability to carry any additional load. The earthing and equipotential bonding arrangements shall also be verified. No addition or alteration shall have an adverse effect on the existing installation.

2 Standards

2.1 Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site-specific requirements will be found in the Particular Specification and its accompanying Technical Data Sheets, which shall be read in conjunction with this Specification.

Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

The Contractor shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the installation

2.2 Regulations, Specifications and Standards

The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:

- (a) Occupational Health and Safety Act (Act 85 of 1993)
- (b) Construction Regulations 2003 issued in terms of Section 43 of the Act
- (c) Local Fire Regulations; and
- (d) Regulations of the Local Supply Authority

and the latest editions (current at the time of Tender) of all relevant South African National Standards, as well as International Standards, including but not limited to:

Table 1: Reference Standards

Standard Number	Description
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
SANS 156	Moulded-case circuit-breakers
SANS 164	Two-pole and earthing-pin plugs and socket outlets
SANS 475	Luminaires for interior lighting, streetlighting and floodlighting - Performance requirements
SANS 767	Earth leakage protection unit
SANS 950	Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations
SANS 1063	Earth rods, couplers and connections
SANS 1085	Wall outlet boxes for the enclosure of electrical accessories
SANS 1088	Luminaire entries and spigots
SANS 1091	National colour standards of Paint
SANS 1195	Busbars
SANS 1213	Mechanical cable glands
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes
SANS 1266	Ballasts for discharge lamps (excluding tubular fluorescent lamps)
SANS 1411	Materials of insulated electric cables and flexible cords
SANS 1431	Weldable structural steels
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)

Standard Number	Description
SANS 1700	Fasteners
SANS 1777	Photoelectric control units for lighting
SANS 1783	Sawn softwood timber
SANS 1973	Low-voltage switchgear and controlgear Assemblies
SANS 10155	Accuracy in buildings
SANS 10199	The design and installation of earth electrodes
SANS 10225	The design and construction of lighting masts
SANS 10177	Fire testing of materials, components and elements used in buildings Part 2: Fire resistance test for building elements
SANS 10142-1	Wiring of Premises Part 1: Low Voltage Installations
SANS 10400	The application of the National Building Regulations
SANS 60269	Low-voltage fuses
SANS 60309	Plugs, socket-outlets and couplers for industrial purposes
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60614-2	Conduits for electrical installations - Particular specification for conduits
SANS 60669	Switches for household and similar fixed-electrical installations
SANS 60947	Low-voltage switchgear and controlgear
SANS 61000	Electromagnetic compatibility (EMC)
SANS 61010	Safety requirements for electrical equipment for measurement, control, and laboratory use
SANS 61048	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General and safety requirements
SANS 61238	Compression and mechanical connectors for power cables for rated voltages up to 30 kV(Um = 36 kV)
SANS 61643	Low-voltage surge protective devices
Other Standards	Description
ARP 035	Guidelines for the installation and maintenance of street lighting
BS 88	Specification of supplementary requirements for fuses of compact dimensions for use in 240 / 415 V industrial and commercial electric installations
IEC 157	Low voltage switchgear and control gear
IEC 408	Low voltage air-break switches, air-break disconnectors, air-break switch disconnectors and fuse combination units
IEC 12373	Aluminium and aluminium alloys. Anodizing. Method for specifying decorative and protective anodic oxidation coatings on aluminium
IEC 50086	Conduit systems for cable management
IEC 60898	Specification for circuit-breakers for overcurrent protection for household and similar installations

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

- South African National Standards (SANS, VC, etc.)
- South African Sectoral Standards and Specifications (NERSA, CKS, ARP, NRS, PIESA, etc.)
- ISO Standards

- (d) IEC Standards
- (e) Harmonized British Standards (BS EN)
- (f) Other Harmonized European National (EN) Standards (CEN, CENELEC, ETSI)
- (g) Non-Harmonized British Standards (BS)
- (h) Other international standards

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

The installation shall also comply with:

- (a) This Specification, including all Technical Data Sheets; and
- (b) Any documentation issued by, or on behalf of, the Employer in respect of the Installation.

3 Installation of Cable Supports

3.1 Cable Trays, Mesh and Ladders

3.1.1 General

Cable management systems (cable trays, cable ladders and cable mesh) shall be selected and installed strictly in accordance with their manufacturer's guidelines, with a safety factor of 1.5 after taking into account maximum permissible loading and all external factors (not limited to wind, snow and thermal expansion). Upon demand to do so, the Contractor must furnish all data and calculations he used to derive the type and spans of the systems to the Engineer.

Notwithstanding above, the deflection of a cable management system due to installed cable weights shall be, in accordance with IEC 61537, limited to 1/100th of the span.

Except where it is to be installed in locations with corrosive atmospheres, cable management systems shall be manufactured of galvanized and/or epoxy-powder coated steel. In locations with corrosive atmospheres, systems shall be manufactured from stainless steel (316 Marine Grade) or aluminium.

All clamps, clips, hinges screws, bolts, nuts and support fittings used for fastening cable trays or cables shall be of the same material as the cable management system itself.

Over and above the requirements of SANS 10142-1, all cable tray and ladder systems that will support telecommunication and / or control wiring shall be bonded in accordance with NRS 083-2 (gives details of bonding methods that provide enhanced protection against the effects of electromagnetic cross-interference).

Cable management systems shall be selected and installed such that spare capacity (weight as well as height and width) of 20 % will be available for the addition of future services (the cable management system to still exhibit a 1.5 safety factor after services were added).

3.1.2 Perforated Cable Trays

Heavy or medium duty trays may be used, while ensuring that the trays are suitable for the loading as per manufacturer's specification. Metal cable trays shall be manufactured from base-perforated (in excess of 30 % of the surface area, in accordance with SANS 10142-1, in other words, class D according to Table 4 of IEC 61537) rolled steel. Metal trays manufactured to the following standards shall be used:

- (a) Less than 150 mm wide: 1,2 mm minimum thickness with 12 mm minimum upstand

- (b) 150 mm to 450 mm: 1,2 mm minimum thickness with 19 mm minimum upstand
- (c) Above 450 mm (heavy duty): 2,5 mm minimum thickness with 76 mm upstand

The edges of cable trays are to be turned up on both sides to improve rigidity (return flange cable tray), and, where necessary, the sides of trays shall be reinforced with galvanised steel angles, minimum 25 x 25 x 3 mm, with 25 x 3 mm cross-braces at 600 mm centres.

Cable trays shall be hot-dip galvanised only after the perforation and bending processes have been completed.

3.1.3 Cable Ladders

Heavy or medium duty cable ladders may be used, while ensuring that the cable ladders are suitable for the loading as per manufacturer's specification.

Metal cable ladders shall have side rails with 2 mm minimum thickness. Cross rungs shall be spaced at maximum intervals of 300 mm (measured between the centres of rungs). Where cables of 10 mm² or smaller are installed on cable ladders, the spacing of cross rungs shall be reduced to 125 mm.

Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring only after approval by the Engineer.

3.1.4 Wire Mesh Cable Trays

Heavy or medium duty trays may be used, while ensuring that the trays are suitable for the loading as per manufacturer's specification.

Wire mesh cable trays shall be manufactured from wire resistance butt welded on all wire intersections. The tray shall be hot dip galvanised after completion of the manufacturing process.

Medium duty trays shall be manufactured from wires not less than 4mm diameter thick. The tray shall have a side upstand of no less than 50mm. The aperture sizes for the base shall not exceed 50 x 75 mm and 25 x 50mm for the side upstand.

Heavy duty trays shall be manufactured from wires not less than 5mm diameter thick. The tray shall have a side upstand of no less than 75mm. The aperture sizes for the base shall not exceed 50 x 50 mm and 25 x 50mm for the side upstand.

3.1.5 Cable Tray and Ladder Connections

Cable tray and ladder connections shall be suited to and of the same manufacture as the linear sections that they connect.

The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected.

The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radii of cables are not exceeded.

Sharp angles shall be 45° mitred

3.1.6 Installation of Perforated Cable Trays, Cable Ladders and Wire Mesh Cable Mesh

Horizontal cable ladders and trays shall be suspended from the overhead structure, such as slab soffit or roof trusses/ purlins with hangers and 41x41mm or similar catalogue product as cross supports, at distances not exceeding 1,2m unless otherwise specified by the manufacturer. The hangers shall be galvanised threaded rods or steel cables, which shall be arranged to support the trunking rigidly in both directions. Where fixed to a concrete slab the hanger shall be fastened by a suitably sized expandable drop-in anchor, as specified and recommended by the manufacturer. Hangers fixed to an overhead steel roof structure, shall be fastened by supplier recommended standard catalogue product hanger brackets/ beam clamps, designed for this purpose. Make-shift and or self-manufactured brackets/ beam clamps will not be accepted. No cutting, drilling or any other modification may be done to the existing overhead steel structure, to accommodate and of fasten hanger brackets/ beam clamps to the said structure.

The use of wall mounted cantilever brackets for horizontally mounted cable trays shall be approved by the engineer, prior to installation.

The spacing between tiers of ladders, trays and/or mesh shall be 300 mm minimum. Furthermore, they shall be installed such that a minimum separation of 300 mm exists between ceilings and the top of a tray or ladder (where the latter is installed horizontally) and 50 mm between the nearest sides of trays or ladders and the finished surfaces of walls, floors and ceilings for other configurations.

Fixing materials shall be compatible with cable management system materials, and offer resistance to corrosion.

Cuts in trays shall not pass through perforations, except where practically impossible to implement.

Cable trays and mesh shall be mounted with a minimum air gap of 25 mm between the underside of the tray and the mounting surface.

3.1.7 Installation of Cables on Cable Trays, Ladders and Mesh

Under no circumstances shall the cable support systems be used as ladders, walk ways or any other form of support for people. This can lead to personal injury and possible damage to the cable support system and installed cables.

Electrical MV and LV cables shall be installed on suitably sized cable ladders. MV and LV cables shall not share the same cable tray.

Cables for instrumentation, communication and or other electronic services shall be installed on wire mesh cable trays. Cables shall be neatly bunched together by means of cable ties. Only cables of the same service (i.e. smoke detection, CCTV, audio, etc) shall be bunched together. Perforated cable trays may also be used in lieu of wire mesh cable trays. Electrical and electronic services cables shall not share the same cable tray.

Cables shall be supported to avoid damage during installation, prior to dressing and fixing.

Depending on the overall diameter, single cables and groups shall be secured according to the following.

Table 2: Installation of cables

Fixing Method	Overall Diameter of Cable
Nylon UV Protected Cable Ties	< 35 mm
Metallic cable straps	> 35 mm
Metallic cable clamps	Single core in trefoil

Metallic cable ties and clamps shall be similar to the material used for the cable support.

In outdoor applications, where the installation may be subject to ultra-violet light, PVC covered aluminium tape shall be used instead of nylon cable ties.

Cables installed in groups shall be installed in straight lines and not cross over each other, except where single core cables need to be transposed.

Where cables exit ladders, trays or mesh, the latter shall be formed or covered with PVC to ensure a smooth surface.

Single core cables shall be installed in trefoil formation by means of non-magnetic type trefoil cable clamps. Only single core cables originating the same feeder shall be grouped together in the same trefoil formation.

4 Drawings and Documentation

4.1 General

All drawings, information, and documentation shall be in English, and each item shall be identified with:

- (a) The Client's name and contact details
- (b) Client's project / scheme / contract reference title and numbers
- (c) The Engineer's name and contact details
- (d) Engineers reference numbers
- (e) Contractor's works / contract / order references.

Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

4.2 Drawings for Approval

The following documentation and drawings shall be submitted to the Engineer prior to the installation of cables and wireways and before civil construction have started on the areas where cable routes are required:

- (a) Cable route layout drawings showing
- (b) Type of wireways
- (c) Trenching
- (d) Cable junction boxes

4.3 As-built Drawings

Detailed "as-built" drawings, clearly labelled as such, and consisting of 3 sets of drawings printed to their original size, and, where the original drawings were larger than A3, 3 sets of drawings printed (with reduced scaling, but without omitting any information from the printed area), to A3, shall be provided by the Contractor, indicating positions of the following:

- (a) Wireways (e.g. trenches, conduit, cables ladder/trays, power skirting etc.); and
- (b) Cable routes (including any cable joints)
- (c) General arrangement drawings
- (d) Single Line Diagrams

4.4 Operating and Maintenance Manual

Three Operation Manuals, three Maintenance Manuals and three Certification copies shall be provided for all equipment supplied. The manuals shall be in A4 format.

The operating and maintenance manuals shall include at least the following:

- (a) A schedule of installed components and equipment, containing the following information:
 - (i) Manufacturers name and contact details
 - (ii) Circuit number (DB name, circuit breaker e.g. DB01-CB08); and
 - (iii) Function (e.g. switching lighting circuit DB03-L1)
- (b) A schedule of all installed cables, with the following information:
 - (i) Circuit number (DB name, circuit breaker e.g. DB01-CB08)
 - (ii) Size
 - (iii) Installed length; and
 - (iv) Function (e.g. "Feeding Submersible pump IW-SP-01")
- (c) Description and details w.r.t:
 - (i) Detailed description of the function of all operator controls
 - (ii) Procedures for fault finding
 - (iii) Maintenance instructions for all components and including repair, overhaul, change-out and installation procedures
 - (iv) Inspection schedules; and
 - (v) Spare part information and recommended spares

5 Testing and Commissioning

5.1 General

The installation shall be inspected and tested in accordance with SANS 10142-1.

Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision for all inspection and testing activities.

The Contractor shall provide all necessary safety equipment and test instruments. All test instruments shall comply with SANS 61010 and be covered by a current test and calibration certificate.

The Contractor's safe working arrangements shall comply with the safety management systems and procedures prevailing on site. Where there may be a risk of injury to personnel, the Contractor shall submit a risk assessment and method statement for approval, prior to starting work.

Unless otherwise specified in the Particular Specification, all inspection and test results shall be recorded using proforma documentation (test certificates and schedules) complying with SANS 10142-1.

The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified in the Particular Specification, the period of notice for witness testing shall be 5 working days.

Where most of the inspection and testing activities are not witnessed, the Contractor shall allow for 10 % of the inspection and testing activities to be repeated for witness testing.

If there is a requirement for additional inspection and test activities to be performed as part of process commissioning, this shall be specified in the Particular Specification.

Unless otherwise agreed by the Employer, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.

5.2 Test Sequence

5.2.1 Inspections before Testing

Before testing, inspections shall be performed to verify:

- (a) All equipment and material is of the correct type and complies with applicable SANS and IEC standards
- (b) All parts of the installation are correctly selected and erected
- (c) No part of the installation is visibly damaged or otherwise defective
- (d) The installation is suitable for the environmental conditions; and
- (e) The installation complies with this Specification

5.2.2 Testing of Installation

On satisfactory completion of the inspections specified in 5.2.1, the following tests shall be undertaken in the sequence listed as per SANS 10142-1:

- (a) Continuity of conductors
- (b) Resistance of Earthing conductor
- (c) Continuity of ring circuits Earth fault loop Impedance at main switch
- (d) Elevated voltage on supply neutral Earth Resistance
- (e) Insulation resistance
- (f) Voltage, main distribution board - no load
- (g) Voltage, main distribution board - on load
- (h) Voltage at available load
- (i) Operation of earth leakage units
- (j) Earth leakage test button
- (k) Polarity at points of consumption
- (l) Switching devices

General specification

Wiring and Outlets

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i Scope

1.1 Application

This document specifies the standard requirements for the design, installation, testing and commissioning of electrical installations operating on voltages up to 1 000 Volts AC / 1 500 Volts DC.

The primary intention of this specification is to ensure the provision of an electrical installation, which has been designed and constructed to ensure safe, reliable, operation and to facilitate safe inspection, testing and maintenance.

Note however that this specification only covers such installations (or sections of installations) that are covered by SANS 10142-1. Note also that certain provisions of this specification are inappropriate for direct application to installations where additional measures (such as earthing, intrinsic safe equipment, etc.) are required by SANS 10142-1 and SANS 10108 (i.e. medical and hazardous locations). For these types of installations, thorough reference must be made to the relevant statutory documentation.

1.2 Electrical System Characteristics

The design of the installation shall comply with SANS 10142-1.

The design of the installation shall consider the following supply characteristics:

- (a) Voltage, frequency and number of phases
- (b) Maximum prospective short circuit current (phase to phase and phase to neutral)
- (c) Type of system, e.g. TN-S, TN-C-S
- (d) Maximum earth loop impedance of the earth fault path external to the installation
- (e) Type and rating of the cut-out or switch device
- (f) Load capability of the supply source, particularly the effects on the supply voltage of the starting of new equipment and any fault contributions from new equipment

The installation protective devices shall be correctly co-ordinated within the installation and with respect to existing installations. Discrimination studies shall be performed to validate the co-ordination of the installation.

All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and working space for such activities. Similarly, the positioning of equipment shall not impede access to, or working space at, non-electrical equipment and services for operation and maintenance activities.

The installation shall be suitable for access and use by electrically unskilled persons.

Where additions or alterations to an existing installation are to be performed, the rating and condition of existing equipment, including that associated with the supply, shall be verified to confirm its suitability to carry any additional load. The earthing and equipotential bonding arrangements shall also be verified. No addition or alteration shall have an adverse effect on the existing installation.

2 Standards

2.1 Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site-specific requirements will be found in the Particular Specification and its accompanying Technical Data Sheets, which shall be read in conjunction with this Specification.

Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

The Contractor shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the Installation.

2.2 Regulations, Specifications and Standards

The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:

- (a) Occupational Health and Safety Act (Act 85 of 1993)
- (b) Construction Regulations 2003 issued in terms of Section 43 of the Act
- (c) Local Fire Regulations; and
- (d) Regulations and by-laws of the Local Supply Authority

and the latest editions (current at the time of Tender) of all relevant South African National Standards, as well as International Standards, including but not limited to:

Table 1: Reference Standards

Standard Number	Description
SANS 32	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
SANS 97	Electric cables – Impregnated paper insulated metal-sheathed cables for rated voltages 3,3/3,3kV to 19/22kV (excluding pressure assisted cables)
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
SANS 156	Moulded-case circuit-breakers
SANS 164	Two-pole and earthing-pin plugs and socket outlets
SANS 475	Luminaires for interior lighting, streetlighting and floodlighting - Performance requirements
SANS 767	Earth leakage protection unit
SANS 950	Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations
SANS 1063	Earth rods, couplers and connections
SANS 1085	Wall outlet boxes for the enclosure of electrical accessories
SANS 1088	Luminaire entries and spigots
SANS 1091	National colour standards of Paint
SANS 1195	Busbars
SANS 1213	Mechanical cable glands
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes

Standard Number	Description
SANS 1266	Ballasts for discharge lamps (excluding tubular fluorescent lamps)
SANS 1411	Materials of insulated electric cables and flexible cords
SANS 1431	Weldable structural steels
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
SANS 1700	Fasteners
SANS 1777	Photoelectric control units for lighting
SANS 1783	Sawn softwood timber
SANS 1973	Low-voltage switchgear and controlgear Assemblies
SANS 2001	Construction Works
SANS 10155	Accuracy in buildings
SANS 10199	The design and installation of earth electrodes
SANS 10225	The design and construction of lighting masts
SANS 10177	Fire testing of materials, components and elements used in buildings Part 2: Fire resistance test for building elements
SANS 10142-1	Wiring of Premises Part 1: Low Voltage Installations
SANS 10400	The application of the National Building Regulations
SANS 60269	Low-voltage fuses
SANS 60309	Plugs, socket-outlets and couplers for industrial purposes
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60614-2	Conduits for electrical installations - Particular specification for conduits
SANS 60669	Switches for household and similar fixed-electrical installations
SANS 60947	Low-voltage switchgear and controlgear
SANS 61000	Electromagnetic compatibility (EMC)
SANS 61010	Safety requirements for electrical equipment for measurement, control, and laboratory use
SANS 61048	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General and safety requirements
SANS 61238	Compression and mechanical connectors for power cables for rated voltages up to 30 kV(U _m = 36 kV)
SANS 61643	Low-voltage surge protective devices
Other Standards	Description
ARP 035	Guidelines for the installation and maintenance of street lighting
BS 88	Specification of supplementary requirements for fuses of compact dimensions for use in 240 / 415 V industrial and commercial electric installations
IEC 157	Low voltage switchgear and control gear
IEC 408	Low voltage air-break switches, air-break disconnectors, air-break switch disconnectors and fuse combination units
IEC 12373	Aluminium and aluminium alloys. Anodizing. Method for specifying decorative and protective anodic oxidation coatings on aluminium
IEC 50086	Conduit systems for cable management
IEC 60898	Specification for circuit-breakers for overcurrent protection for household and similar installations

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

- (a) South African National Standards (SANS, VC, etc.)
- (b) South African Sectoral Standards and Specifications (NERSA, CKS, ARP, NRS, PIESA, etc.)
- (c) ISO Standards
- (d) IEC Standards
- (e) Harmonized British Standards (BS EN)
- (f) Other Harmonized European National (EN) Standards (CEN, CENELEC, ETSI)
- (g) Non-Harmonized British Standards (BS)
- (h) Other international standards

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

The installation shall also comply with:

- (a) This Specification, including all Technical Data Sheets; and
- (b) Any documentation issued by, or on behalf of, the Employer in respect of the Installation.

3 Components and Equipment

3.1 General

All equipment and components shall be suitable for their operating environment, particularly with respect to the following:

- (a) The degree of ingress protection against dust and moisture (IP rating)
- (b) The corrosion resistance of the materials of construction; and
- (c) Mechanical properties (especially impact strength)

3.2 Power Outlets

3.2.1 Commercial Socket Outlets

All socket outlets with switches shall fully comply with SANS 164 and SANS 60669-1.

Units for flush mounting shall be suitable for a 100 x 100 x 50 mm deep flush wall box. Surface mounted patterns shall be housed in heavy pressed steel boxes. Shutters shall be included on the live and neutral socket holes.

All socket outlets with switches shall be continuously rated at 16A and shall be suitable for operation on a 250V, 50 Hz, AC system.

Cover plates shall have bevelled edges which overlap the box.

Socket outlets and their cover plates must adhere to the following colour and earth pin convention:

- (a) White, with round earth pin, where outlets are protected by an earth leakage sensing device;

- (b) Red, with shaved earth pin, where outlets are not protected by earth leakage sensing device (which outlets shall be referred to as "dedicated").

3.2.2 Industrial Socket Outlets

- (a) Plugs, couplers and socket outlets shall conform to the requirements of SANS 1239.
- (a) Where pilot connections are required, they shall disconnect before the main phase connectors disconnect.
- (b) 3-Phase Socket Outlets
 - (i) 400V socket outlets shall be five poled (three phases, one neutral and one earth), incorporating isolation mechanically interlocked with the plug.
 - (ii) The equipment enclosures shall be at least IP 55 to SANS 60529.
 - (iii) All welding plugs and socket outlets shall be 5 poled (3-phase, plus neutral, plus earth).
- (c) Single Phase Outlets
 - (i) 16 A, 250 V socket outlets shall be two pole and earth, incorporating isolation mechanically interlocked with the plug.

3.2.3 Local Isolators (Switch-disconnectors)

Local isolators shall be selected from the following:

- (a) Isolator in accordance with SANS 60947-3, complete with additional late-make, early-break auxiliary contacts as required
- (b) Plug and socket assembly to SANS 60309-1 and SANS 60309-2, incorporating isolation mechanically interlocked with the plug; or
- (c) Plug and socket assembly to SANS 60309-1 incorporating a de-contactor arrangement or additional late-make early-break auxiliary contacts.

4 Installation of Components and Equipment

4.1 General

Final positions of equipment shall be agreed with the Engineer on site, prior to installation.

All equipment shall be securely mounted using propriety (i.e. suited to and manufactured for such use) fixtures and fittings.

The method of equipment installation shall not adversely affect the function or structural integrity of the structure to which the equipment is attached.

Equipment terminals and covers shall be readily and safely accessible after installation.

The method of equipment installation shall not adversely affect the IP rating of the equipment.

No horizontal chasing shall be allowed into brick or concrete work.

It is the Contractor's responsibility to work closely together with the relevant parties responsible for the civil construction work to establish coordination in the installation program of components and conduits, as well as to establish a neat installation showing no indication of 'last minute changes'.

Modification to existing structures shall be approved by the Engineer.

4.1.1 Framework and Brackets

Site-fabricated framework and brackets shall not be used.

Framework and brackets shall be positioned so as not to adversely affect the removal and replacement of equipment.

Where it is necessary to modify on site any pre-fabricated galvanised mild steel framework, the cut edges shall be dressed and treated immediately with an approved cold-galvanizing paint to prevent corrosion.

4.1.2 Fasteners

Fasteners securing equipment to framework and brackets shall be independent of those securing framework and brackets to walls and floors.

No electroplated fasteners will be allowed. Only hot dipped galvanised or stainless steel fasteners will be allowed.

4.1.3 Positioning of Equipment

Equipment shall be positioned with due regard to the aesthetics of the installation.

Equipment (e.g. outlets, switches, distribution boards, etc.) shall be installed plumb. If an imaginary line is drawn from the vertical side of any such component, the deviation of such imaginary line from the vertical shall not exceed ± 5 mm for every 1 m increase in height, with a maximum deviation from the vertical of ± 10 mm.

The permissible deviation from the mounting heights indicated for equipment covered by this document shall be ± 10 mm, with a maximum of ± 5 mm deviation from the horizontal between adjacent outlets, isolators, luminaires, assemblies and / or switches.

Where a group comprises a number of items at different mounting heights, with not more than one item at any one height, then all items shall be sited on a common vertical centre line.

Where a group comprises a number of items mounted at the same height, then all items shall be sited on a common horizontal centre line.

Where a group comprises a number of different sized items they shall be arranged with the largest item at one end of the group and a progressive reduction in size of the remaining items.

Where a group comprises a number of items at different mounting heights with more than one item at any height, then a common vertical centre line shall be established and the items arranged on, or symmetrically about, this centre line.

Where a group comprises a number of items at the same mounting height with more than one item at the same position, then a common horizontal centre line shall be established and the items arranged on, or symmetrically about, this centre line.

4.1.4 Mounting height of Components

Mounting heights shall be as follows unless otherwise specified:

Table 2- Mounting height of components

Distribution boards	Top frame 2000 mm above finished floor level, except where the board may be accessible to infants, where then the bottom frame shall be 1200 mm above finished floor level
Switches	All security controls and light switches shall be horizontally aligned with door handles and other fixtures and fittings (other than socket outlets) between 900 mm and 1,2 m above the finished floor level
Socket outlets	See b)
Telephone outlets	Underside 500 mm above finished floor level

All distribution boards, switches and socket outlets shall be of the flush mounted type.

4.2 Installation of Socket Outlets

4.2.1 General

The Contractor should only start installation of power outlets in the conduit outlets after plasterers and painters have completed their work in the vicinity of the outlet.

Socket outlets shall be installed at the following heights above finished floor level, measured to the underside of the outlet:

- (a) 500 mm above finished floor level for general applications
- (b) 500 mm above fixed ground level where they are to be installed outside buildings
- (c) 1200 mm above finished floor level in kitchens
- (d) 300 mm above counter tops

4.2.2 Connections to geysers

Each geyser shall be connected to a separate circuit with a separate earth conductor.

The conduit from the distribution board shall terminate in a 100 x 100 x 50 mm outlet box within 1 metre of the geyser. A suitably rated double pole isolator shall be installed in the outlet box. A flexible length of conduit shall be installed between the isolator and the geyser.

4.2.3 Connections to heaters, fans, air conditioners and hand blowers

A suitably rated double pole isolator shall be supplied and installed within 1 metre of heaters, fans and air conditioners. Where the equipment is out of reach the isolator, which must then be of the type capable of being locked in the open position, shall be installed 1,5 m above floor level, and a sign indicating location of the isolator shall be fixed onto or next to the equipment that it switches. Flexible cords may be used for the final connection to the equipment, provided the cables are correctly current rated.

Where control units (for HVAC, BMS, etc.) are to be installed, the units shall be installed 1,5 m above the finished floor level.

4.3 Installation of Telecommunication Services and Accessories

4.3.1 Telephone distribution boards

Telephone distribution boards are to be installed with their bottom frames 1 200 mm above finished floor level.

All conduits and sleeves to telephone outlets or telephone sub-distribution boards in the buildings or elsewhere on the site, as well as the main incoming sleeves, shall terminate at the main telephone distribution board, as shown on the relevant drawing.

4.3.2 Separation of services

Wireways provided for telecommunication or other related services shall under no circumstances be used for any other purpose.

Power cables, conductors and accessories shall be installed at a minimum distance of 300 mm away from the routes reserved for telecommunication cables.

Conduits and other channels shall be installed in such a way as to avoid telecommunication cables from crossing power cables.

4.4 Telecommunication outlets

Telephone and / or data outlets in walls shall comprise of 100 x 100 x 50 mm deep wall boxes which shall be flush mounted in the wall, in the position shown on the relevant drawing, with the underside fixed 500 mm above the finished floor level. The wall box shall be fitted with a white coloured blank cover plate.

All outlet boxes shall align neatly with adjacent socket outlet wall boxes.

Outlets in floors fitted with floor ducting shall be of the same type as the floor outlets for power socket outlets, and shall be provided in the same outlet box.

Outlets in power skirting shall be provided at the positions indicated on the relevant drawing, and the Contractor need only provide a separate short length power skirting cover at these positions. The cover for the fixing of outlet shall not exceed 250 mm in length, and shall be secured in such a manner that adjacent cover plate sections can be removed without disturbing the telephone outlet.

5 Wireways

5.1 Conduit

5.1.1 Plain-end metallic conduit and accessories

Plain-end conduit shall be manufactured from mild steel having a minimum wall thickness of 0.9 mm and shall comply with SANS 60614.

Galvanised conduit shall be hot-dipped on both the internal and external surfaces, in accordance with SANS 121.

Epoxy powder-coated metal conduit may not be used in installations where bending of conduit will be required (unless prior approval of use has been granted by the Engineer).

Bending and setting of plain-end conduit shall be undertaken using the conduit bending apparatus as recommended by the manufacturer of the conduit. After the bending of galvanized conduit, cold galvanizing paint shall be applied.

5.1.2 PVC conduit and accessories

PVC conduit shall comply with SANS 950 and shall bear the SABS mark.

PVC conduit shall be constructed from rigid PVC. PVC conduit shall be white in colour and shall be non-flammable. The minimum softening temperature shall be 75 °C.

All PVC conduit accessories shall be fully in accordance with SANS 950 and shall bear the SABS mark.

5.1.3 Flexible conduit

Flexible steel conduit and adaptors shall comply with IEC 50086 where applicable.

Flexible steel conduit shall be of a galvanised steel construction. It does not need to be waterproof, but shall be vermin proof and suitable for protection of cables against mechanical damage.

In moist or damp areas, flexible steel conduit shall be of the plastic sheathed galvanised steel type.

Flexible polypropylene tubing shall only be fastened to PVC conduit installations.

5.1.4 Conduit Accessories

5.1.4.1 Earth clamps

Earth clamps shall comprise of copper strips having a minimum thickness of 1 mm and shall not be less than 12 mm wide. Earth clamps shall be provided complete with a 25 mm x 4 mm brass bolt, washer and nut and shall be constructed such that the clip can be firmly attached to the conduit without the need for any additional packing.

5.1.4.2 Flush mounted wall boxes

Flush mounted PVC wall boxes shall be manufactured from rigid PVC and shall be white in colour. All PVC wall boxes shall comply with SANS 950.

Flush mounted steel wall boxes shall be manufactured from heavy gauge sheet steel and shall be galvanneal. All steel wall boxes shall comply with SANS 1085.

The boxes shall be provided with the necessary mounting lugs to suit the units for which the box is intended and be provided with 20 mm knock-outs.

Facilities shall be provided for the fixing of earth terminals to the box.

5.1.4.3 Round group-type circular boxes

Steel round boxes shall be manufactured in accordance with SANS 1085 and shall be of the long spout pattern, constructed from either stove enamelled jet black or galvanised steel, or from malleable cast iron.

PVC round boxes shall be manufactured in accordance with SANS 950 and of the same dimensions, but having web-reinforced spools.

The two cover fixing holes of both steel and PVC boxes shall be diagonally opposite each other, and shall be drilled and tapped at 50 mm centres. Internal dimensions shall be approximately 60 mm in diameter by 50 mm deep for use in concrete work. Shallower boxes shall be used in open roof spaces.

The cover screw pillars shall be provided with tapped brass inserts and provision shall be made for a brass earthing terminal adjacent to one or both of the pillars.

PVC round box covers shall be of PVC and shall be secured by means of brass screws at 50 mm centres.

5.1.4.4 Draw wires

Draw wires for unused conduits shall either be galvanised steel wire or nylon, but shall have a minimum diameter of 2 mm.

5.1.5 Conduit Installation

5.1.5.1 General

The conduit installation shall comply with par. 6.5 of SANS 10142-1.

Where the conduit installation is surface mounted, space-bar saddles must be used in order to provide an air gap between the conduit and mounting surface.

The conduit system shall be mechanically continuous, secure and rewireable.

All unused, screwed entries shall be fitted with a blanking plug. Female PVC bushes shall be fitted to all free ends.

Conduits shall not be used to support the weight of fittings etc., except where specifically designed to do so. Conduit boxes supporting luminaires or accessory boxes shall be fixed to the fabric of the building independently of the conduit.

Sufficient conduit and drawing boxes shall be provided to facilitate cable installation and removal. In general, no more than 2 bends or off-sets or one coupling shall be permitted without a conduit box.

Steel conduit shall not be relied upon for earth continuity.

All PVC conduits shall be installed in accordance with Appendix C, SANS 950.

Draw boxes should be as far as possible be placed out of sight and shall be indicated on the "as built" drawings.

The edge of flush mounted puller boxes shall not be deeper than 10 mm from the final surface. Where necessary, spacer springs shall be used under screws.

Oversize cover plates shall be provided on all flush mounted round conduit boxes where required. Surface mounted boxes shall be provided with standard size cover plates.

5.1.5.2 Flexible conduit

In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors on equipment, for stove connection and where otherwise required, flexible conduit shall be used for the final connection to the equipment.

Flexible conduit shall be connected to the remainder of the installation by means of a draw box. (The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2 m of the junction and if the flexible conduit can easily be rewired.)

Flexible conduit shall consist of metal reinforced plastic conduit or PVC covered metal conduit with an internal diameter of at least 15 mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured from either brass or mild steel plated with zinc or cadmium.

5.1.5.3 Installation in concrete

In order not to delay building operations, the electrical Contractor shall ensure that all conduits and accessories which are to be cast in concrete are placed in position in good time. The Contractor or his representative shall be in attendance when the concrete is cast.

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep recessed type. In columns where flush mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

Sharp bends and elbows for conduits of 32 mm diameter will not be allowed in concrete slabs.

Draw boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate. The cover plate shall be secured by means of brass screws.

All conduits shall be installed as close as possible to the neutral axis of concrete beams, slabs and columns. The conduits shall be rigidly secured to the reinforcing to prevent movement towards the surface of the concrete.

All conduits, draw boxes, etc., shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Draw boxes and outlet boxes shall preferably be secured by means of a bolt and nut installed from the back of the box through the shuttering. Fixing lugs may also be used to screw the boxes to the shuttering where off-shutter finishes are required. Where fire glass shuttering is used by the builder, the equipment shall be fixed to the steel only and no holes shall be drilled or made in shuttering. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

As far as possible, conduits shall not be installed across expansion joints. Where this is unavoidable a conduit expansion joint shall be provided. The expansion joint shall consist of two draw boxes with an interlinking flexible conduit connection. Two draw boxes shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest to the joint. The one end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box. The circuit conduit passing through the sleeve shall be terminated 40 mm inside the draw box, and, in the case of metallic conduit, the conduit end shall be fitted with a brass huan. The gap between the sleeve and the conduit at the joint shall be sealed with TiC-TaC (Titanium Carbide / Tantalum Carbide) or equal sealing compound, to prevent the ingress of wet cement. The other end of the circuit conduit shall be secured to the draw box by means of a standard bushed adaptor for other PVC types. The cover plates shall be installed before the ceiling is painted. Where a number of conduits are installed in parallel they shall cross the expansion joint of the structure via a single draw box. A number of draw boxes adjacent to each other will not be allowed.

The installation of conduits in floor screed shall be kept to a minimum. Where conduits are installed in screed, the top of the conduit shall be at least 20 mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be

secured to the concrete slab at intervals not exceeding 2.0 m. The Contractor shall ensure that conduits are not visible above the screed where the conduits leave the screed.

All draw boxes, conduits, etc., which are installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occurred during the installation of the conduits, or any lost draw boxes or blocked conduits shall be reported to the Engineer immediately.

Where it is necessary to cut or drill holes in the concrete structure, prior permission shall be obtained from the Engineer in writing.

5.1.5.4 Installation in brickwork

Recessed conduits and accessories installed in brickwork shall be built-in. In order not to delay building operations the Contractor shall ensure that all conduits and accessories which are to be built-in are placed in position in good time.

Any conduit draw boxes, outlet boxes, etc., which have been damaged, lost or omitted, shall immediately be reported to the Engineer.

5.1.5.5 Surface and roof space installations

All conduits shall be installed horizontally or vertically as determined by the route. The electrical Contractor shall take all measures to ensure a neat installation.

Conduits shall be firmly secured by means of saddles and screws and in accordance with SANS 10142, par. 5.4.2(b). Conduits shall be secured within 150 mm before and after each 90° bend.

Only approved plugging materials, such as fibre plugs or plastic plugs, etc., and round head screws shall be used when fixing saddles, switches, plugs etc., to walls. Wood plugs are not acceptable, nor should plugs be installed in joints in brick walls.

5.1.5.6 Chasing and builder's work

Except where the project involves upgrading existing facilities, all flush mounted conduits, accessories, switchboard trays, bonding trays etc., shall be built-in and no chasing shall be allowed.

5.1.6 Installation of Cables in Conduit

The cable installation in the conduit shall conform to par 6.5.6 of SANS 10142-1 and other portions of SANS, where applicable.

Conduit shall be deburred and swabbed prior to cables being pulled in.

Cables of other classifications and purpose (e.g. DC, Fire Detection, Audio, etc.) shall be installed in separate conduits.

Circuits supplied from different distribution boards shall not be installed in the same conduit.

Final sub-circuits shall not be installed in the same conduit as sub-mains circuits.

5.2 Power Skirting

5.2.1 Construction

Power skirting must comply with all relevant parts of SANS 61084.

Except where room dimensions dictate shortening thereof, in which case only one length per wall may be trimmed, power skirting and covers shall be installed in their standard (manufactured) lengths.

The covers shall either snap on, or shall be fixed by means of toggle or swivel nuts.

Only socket outlets that are compatible for use with the particular type of power skirting may be used.

Proprietary internal and external bends, and off-sets of the same manufacture and product range, shall be used.

Over and above the requirements of SANS 10142-1, all conductive power skirting that will contain telecommunication and / or control wiring shall be bonded in accordance with IEC 60364-7 (details bonding methods that provide enhanced protection against the effects of electromagnetic cross-interference).

5.2.2 Installation

Conduits for the circuit wiring to the power skirting must terminate in flush conduit boxes behind the power skirting at the respective heights of the compartments for the telephone, power and other service compartments.

Notwithstanding the requirement to provide adequate capacity for the installation of data and telecommunication cables, conduits installed to power skirting installations shall have a minimum of 50 % spare capacity, to allow for future expansion.

The wiring shall pass through large diameter holes, suitably bushed, cut in the rear of the power skirting. Where metallic skirting is installed, the holes shall be provided with rubber grommets.

Where power skirting is interrupted by doorways, bridging conduits shall be installed for each of the service compartments.

To allow for the easy removal of plugs from outlets, in multi compartment installations the bottom compartment(s) shall be for telecommunication services and the top compartment(s) for power circuits.

5.3 PVC Cable Trunking

5.3.1 Construction

Cable trunking must comply with relevant parts of SANS 61084.

Cable trunking and covers shall be installed in their standard (manufactured) lengths, except at the end of runs as dictated by room dimensions.

The covers shall either snap on, or shall be fixed by means of toggle or swivel nuts.

Proprietary internal and external bends, and off-sets of the same manufacture and product range, shall be used.

5.3.2 Installation

All wiring exiting cable trunking shall pass through large diameter holes, suitably bushed, cut in the rear of the trunking.

5.4 Wiring inside wireways

5.4.1 General

All unarmoured conductors shall be installed in conduits, trunking or power skirting, and such conductors shall not be exposed to possible mechanical damage.

Any debris and moisture inside of wireways shall be removed prior to the installation of conductors.

In the event that lubrication of cables is required in order to facilitate their installation, the lubricant shall be suitable for use with the type of cable as well as the type of wireway. The Contractor shall take steps to ensure that only the minimum amount of lubrication is applied. Should any seepage of lubricants into building elements or fixtures occur, it shall be the responsibility of the Contractor to remove the oil and fix the damaged building elements or fixtures, regardless of whether he installed the wireways or not.

5.4.2 Circuits

The circuits for the installation are indicated on the relevant drawings. Where not indicated on the drawings, the maximum number of points to be connected to each type of circuit shall be:

Table 3: Circuits

Light points per circuit	= 8
Single socket outlets per circuit	= 4
Extraction fan, Air conditioner points per circuit	= 2
Stove points per circuit	= 1

When determining the number of outlets per circuit, double socket outlets count as two single socket outlets.

In kitchens, the number of socket outlets per circuit shall be reduced to 2.

Where maintained emergency lighting are to be installed two live wires shall be installed to the luminaire:

- (a) The normal, switchable, circuit
- (b) An unswitched circuit, for battery charging only

For 20 mm or small diameter conduit only one circuit will be allowed, with the exception of the wiring from switch boards to fabricated sheet metal boxes located close to switchboards, in which case more than one circuit will be allowed. For larger conduit sizes the requirements of SANS 10142, par. 6.5.6, shall be met.

5.4.3 Looping and joints

A loop-in wiring system, where conductors are looped from outlet to outlet, shall be employed. Joints in conductors shall be avoided as far as possible, but where it becomes unavoidable, joints will be accepted in conduits. Joints shall be soldered or shall alternatively consist of approved ferruling, properly covered with propriety heat-shrink sleeves. The use of PVC insulation tape is not acceptable.

5.4.4 Grouping of conductors

In cases where the conductors of more than one circuit are installed in the same wireway, the conductors of each separate circuit, including the circuit earth continuity conductor, shall be grouped at intervals of at least one metre using plastic cable ties. The conductors of different circuits shall however remain separate in order to ensure that any given circuit may be withdrawn from the wireway. Conductors entering distribution boards or control boards shall be grouped and bound by means of plastic cable bands. The use of PVC insulation tape for grouping conductors will not be accepted.

5.4.5 Pulling-through of conductors

The Contractor shall take utmost care whilst pulling conductors through conduit to ensure that the conductors are not kinked, twisted or strained in any manner. Care shall furthermore be taken to ensure that conductors do not come into contact with materials or surfaces that may damage or otherwise adversely affect the insulation and durability of the conductor.

5.4.6 Earth continuity conductors

Only stranded copper conductors, which shall be bare or PVC insulated (coloured green/yellow), shall be used as earth continuity conductors. Although it shall be terminated such that it can fulfil this function (except where inappropriate, as will be the case of single core cable installations), under no circumstances shall the armouring and/or shielding of cables be relied upon to provide protective earth continuity.

When earth continuity conductors are looped between the earth terminals of equipment, the looped conductor ends shall be twisted together and then ferruled or soldered to ensure that continuity is maintained when the conductors are removed from any earth terminal.

Where bare copper earth wires are specified for circuits installed in power skirting and floor ducting, the Contractor shall provide a suitable length of PVC sleeving over the bare earth conductor where it passes behind or is connected to power outlets, to ensure that such an earth conductor does not come into contact with any live parts.

5.4.7 Wiring inside vertical wireways

Conductors installed in vertical wireways shall be secured at intervals not exceeding 5 m to support the weight of the conductors. Approved clamps shall be supplied and installed in suitable draw-boxes for this purpose.

5.4.8 Conductor sizes

The following minimum conductor sizes shall be used:

Table 4: Conductor sizes

Circuit	Minimum Conductor (Size)	
	Phase (mm ²)	Earth (mm ²)
Lighting	2,5	2,5
Socket outlet	2,5	2,5
Stove	6	6
Bell	1,5	1,5
Clock	1,5	1,5
Air conditioner	4	2,5
Control Wiring	1,5	1,5

5.4.9 Single pole switches

Single pole switches shall only be connected to the phase conductor (never the neutral conductor).

5.4.10 Three phase outlets

With the exception of three phase outlets, wiring to circuits connected to different phases shall not normally be present at lighting, switch or socket outlet boxes. Where this is unavoidable, barriers shall be provided between terminals or connections of the various phases and the box shall be suitably labelled internally to indicate the presence of line voltages.

A separate neutral conductor shall be installed together with each three phase circuit to outlets intended for equipment connection by means of isolators or socket outlets, irrespective of whether the particular equipment may require a neutral or not.

6 Drawings and Documentation

6.1 General

All drawings, information, and documentation shall be in English, and each item shall be identified with:

- (a) The Client's name and contact details
- (b) Client's project / scheme / contract reference title and numbers
- (c) The Engineer's name and contact details
- (d) Engineers reference numbers
- (e) Contractor's works / contract / order references.

Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

6.2 Drawings for Approval

The following documentation and drawings shall be submitted to the Engineer prior to the installation of cables and wireways and before civil construction have started on the areas where cable routes are required:

- (a) Cable route layout drawings showing
 - (i) Type of wireways
 - (ii) Trenching
 - (iii) Cable junction boxes

6.3 As-built Drawings

Detailed "as-built" drawings, clearly labelled as such, and consisting of 3 sets of drawings printed to their original size, and, where the original drawings were larger than A3, 3 sets of drawings printed (with reduced scaling, but without omitting any information from the printed area), to A3, shall be provided by the Contractor, indicating positions of the following:

- (a) Equipment (e.g. light fittings, draw boxes, outlets etc.)
- (b) Wireways (e.g. trenches, conduit, cables ladder/trays, power skirting etc.); and

- (c) Cable routes (including any cable joints)
- (d) General arrangement drawings
- (e) Single Line Diagrams

6.4 Operating and Maintenance Manual

Three Operation Manuals, three Maintenance Manuals and three Certification copies shall be provided for all equipment supplied. The manuals shall be in A4 format.

The operating and maintenance manuals shall include at least the following:

- (a) A schedule of installed components and equipment, containing the following information:
 - (i) Manufacturers name and contact details
 - (ii) Circuit number (DB name, circuit breaker e.g. DB01-CB08); and
 - (iii) Function (e.g. switching lighting circuit DB03-L1)
- (b) A schedule of all installed cables, with the following information:
 - (i) Circuit number (DB name, circuit breaker e.g. DB01-CB08)
 - (ii) Size
 - (iii) Installed length; and
 - (iv) Function (e.g. "Feeding Submersible pump IW-SP-01")
- (c) Description and details w.r.t:
 - (i) Detailed description of the function of all operator controls
 - (ii) Procedures for fault finding
 - (iii) Maintenance instructions for all components and including repair, overhaul, change-out and installation procedures
 - (iv) Inspection schedules; and
 - (v) Spare part information and recommended spares.

7 Testing and Commissioning

7.1 General

The installation shall be inspected and tested in accordance with SANS 10142-1.

Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision for all inspection and testing activities.

The Contractor shall provide all necessary safety equipment and test instruments. All test instruments shall comply with SANS 61010 and be covered by a current test and calibration certificate.

The Contractor's safe working arrangements shall comply with the safety management systems and procedures prevailing on site. Where there may be a risk of injury to personnel, the Contractor shall submit a risk assessment and method statement for approval, prior to starting work.

Unless otherwise specified in the Particular Specification, all inspection and test results shall be recorded using proforma documentation (test certificates and schedules) complying with SANS 10142-1.

The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified in the Particular Specification, the period of notice for witness testing shall be 5 working days.

Where most of the inspection and testing activities are not witnessed, the Contractor shall allow for 10 % of the inspection and testing activities to be repeated for witness testing.

If there is a requirement for additional inspection and test activities to be performed as part of process commissioning, this shall be specified in the Particular Specification.

Unless otherwise agreed by the Employer, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.

7.2 Test Sequence

7.2.1 Inspections before Testing

Before testing, inspections shall be performed to verify

- (a) All equipment and material is of the correct type and complies with applicable SANS and IEC standards
- (b) All parts of the installation are correctly selected and erected
- (c) No part of the installation is visibly damaged or otherwise defective
- (c) The installation is suitable for the environmental conditions; and
- (e) The installation complies with this Specification

7.2.2 Testing of Installation

On satisfactory completion of the inspections specified in 7.2.1 the following tests shall be undertaken in the sequence listed as per SANS 10142-1:

- (a) Continuity of conductors
- (b) Resistance of Earthing conductor
- (c) Continuity of ring circuit's Earth fault loop impedance at main switch
- (d) Elevated voltage or supply neutral Earth Resistance
- (e) Insulation resistance
- (f) Voltage, main distribution board - no load
- (g) Voltage, main distribution board - on load
- (h) Voltage at available load
- (i) Operation of earth leakage units
- (j) Earth leakage test button
- (k) Polarity at points of consumption
- (l) Switching devices

General specification

Lighting

Specification number: **SPE-EE-0014**

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1 Scope

1.1 Application

This document specifies the standard requirements for the design, installation, testing and commissioning of electrical installations operating on voltages up to 1 000 Volts AC / 1 500 Volts DC.

The primary intention of this specification is to ensure the provision of an electrical installation, which has been designed and constructed to ensure safe, reliable, operation and to facilitate safe inspection, testing and maintenance.

Note however, that this specification only covers such installations (or sections of installations) that are covered by SANS 10142-1. Note also, that certain provisions of this specification are inappropriate for direct application to installations where additional measures (such as earthing, intrinsic safe equipment, etc.) are required by SANS 10142-1 and SANS 10105 (i.e. medical and hazardous locations). For these types of installations, thorough reference must be made to the relevant statutory documentation.

1.2 Electrical System Characteristics

The design of the installation shall comply with SANS 10142-1.

The design of the installation shall consider the following supply characteristics:

- (a) Voltage, frequency and number of phases
- (b) Maximum prospective short circuit current (phase to phase and phase to neutral)
- (c) Type of system, e.g. TN-S, TN-C-S
- (d) Maximum earth loop impedance of the earth fault path external to the installation
- (e) Type and rating of the cut-out or switch device
- (f) Load capability of the supply source, particularly the effects on the supply voltage of the starting of new equipment and any fault contributions from new equipment.

The installation protective devices shall be correctly co-ordinated within the installation and with respect to existing installations. Discrimination studies shall be performed to validate the co-ordination of the installation.

All equipment which requires operation or attendance by a person, or requires cleaning or maintenance in service, shall be constructed and installed to allow adequate and safe means of access and working space for such activities. Similarly, the positioning of equipment shall not impede access to, or working space at, non-electrical equipment and services for operation and maintenance activities.

The installation shall be suitable for access and use by electrically unskilled persons.

Where additions or alterations to an existing installation are to be performed, the rating and condition of existing equipment, including that associated with the supply, shall be verified to confirm its suitability to carry any additional load. The earthing and equipotential bonding arrangements shall also be verified. No addition or alteration shall have an adverse effect on the existing installation.

2 Standards

2.1 Associated Documentation

This Specification identifies the Employer's standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site-specific requirements will be found in the Particular Specification and its accompanying Technical Data Sheets, which shall be read in conjunction with this Specification.

Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

The Contractor shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the Installation.

2.2 Regulations, Specifications and Standards

The design, construction, inspection and testing of the installation shall comply with all relevant Statutory Regulations and Directives including:

- (a) Occupational Health and Safety Act (Act 85 of 1993)
- (b) Construction Regulations 2003 issued in terms of Section 43 of the Act
- (c) Local Fire Regulations; and
- (d) Regulations of the Local Supply Authority

and the latest editions (current at the time of Tender) of all relevant South African National Standards, as well as International Standards, including but not limited to:

Table 1: Reference Standards

Standard Number	Description
SANS 32	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
SANS 97	Electric cables – Impregnated paper insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/22 kV (excluding pressure assisted cables)
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
SANS 156	Moulded-case circuit-breakers
SANS 164	Two-pole and earthing-pin plugs and socket outlets
SANS 475	Luminaires for interior lighting, streetlighting and floodlighting - Performance requirements
SANS 767	Earth leakage protection unit
SANS 950	Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations
SANS 1063	Earth rods, couplers and connections
SANS 1085	Wall outlet boxes for the enclosure of electrical accessories
SANS 1088	Luminaire entries and spigots
SANS 1091	National colour standards of Paint
SANS 1195	Busbars
SANS 1213	Mechanical cable glands
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes

Standard Number	Description
SANS 1266	Ballasts for discharge lamps (excluding tubular fluorescent lamps)
SANS 1411	Materials of insulated electric cables and flexible cords
SANS 1431	Weldable structural steels
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
SANS 1700	Fasteners
SANS 1777	Photoelectric control units for lighting
SANS 1783	Sawn softwood timber
SANS 1973	Low-voltage switchgear and controlgear Assemblies
SANS 2001	Construction Works
SANS 10155	Accuracy in buildings
SANS 10199	The design and installation of earth electrodes
SANS 10225	The design and construction of lighting masts
SANS 10177	Fire testing of materials, components and elements used in buildings Part 2: Fire resistance test for building elements
SANS 10142-1	Wiring of Premises Part 1: Low Voltage Installations
SANS 10400	The application of the National Building Regulations
SANS 60269	Low-voltage fuses
SANS 60309	Plugs, socket-outlets and couplers for industrial purposes
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60614-2	Conduits for electrical installations - Particular specification for conduits
SANS 60669	Switches for household and similar fixed-electrical installations
SANS 60947	Low-voltage switchgear and controlgear
SANS 61000	Electromagnetic compatibility (EMC)
SANS 61010	Safety requirements for electrical equipment for measurement, control, and laboratory use
SANS 61048	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General and safety requirements
SANS 61238	Compression and mechanical connectors for power cables for rated voltages up to 30 kV(Um = 36 kV)
SANS 61643	Low-voltage surge protective devices
Other Standards	Description
ARP 036	Guidelines for the installation and maintenance of street lighting
BS 88	Specification of supplementary requirements for fuses of compact dimensions for use in 240 / 415 V industrial and commercial electric installations
IEC 157	Low voltage switchgear and control gear
IEC 408	Low voltage air-break switches, air-break disconnectors, air-break switch disconnectors and fuse combination units
IEC 12373	Aluminium and aluminium alloys, Anodizing, Method for specifying decorative and protective anodic oxidation coatings on aluminium
IEC 50086	Conduit systems for cable management
IEC 60898	Specification for circuit-breakers for overcurrent protection for household and similar installations

Standards are often tailored to the conditions of their country or origin (in terms of permissible voltages, expected ambient temperatures, etc.). Therefore, and unless normatively referenced to the

contrary in a Standard of higher precedence, the decreasing order of precedence of Standards shall be:

- (a) South African National Standards (SANS, VC, etc.)
- (b) South African Sectoral Standards and Specifications (NERSA, CKS, ARP, NRS, PIESA, etc.)
- (c) ISO Standards
- (d) IEC Standards
- (e) Harmonized British Standards (BS EN)
- (f) Other Harmonized European National (EN) Standards (CEN, CENELEC, ETSI)
- (g) Non-Harmonized British Standards (BS)
- (h) Other international standards

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

The installation shall also comply with:

- (a) This Specification, including all Technical Data Sheets; and
- (b) Any documentation issued by, or on behalf of, the Employer in respect of the Installation.

3 Components and Equipment

3.1 Lighting and Accessories

3.1.1 Luminaires

- (a) Luminaires shall comply with SANS 60598 (relevant parts).
- (b) Luminaires shall be supplied complete with lamps of a type suitable for the luminaire design.
- (c) Upon the Engineer's request, simulation data files must be made available for each luminaire.

3.1.2 Control Gear and Enclosures

High frequency, electronic control gear shall be used for tubular (double capped) and compact (single capped) fluorescent lamps, and, where appropriate, for discharge lamps.

3.1.3 Switches

- (a) Flush mounted switches
 - (i) Flush mounted switches shall comply with SANS 60669-1 and shall bear the SABS mark.
 - (ii) All flush mounted switches shall be suitable for mounting in 100 x 50 x 50 mm galvanised steel or PVC wall boxes.
 - (iii) The switch mechanism shall be of the tumbler-operated micro-gap type with silent operation, and shall be rated for 16 A continuous loading at 50 Hz and 250 V.
 - (iv) Switches shall have protected terminals for safe wiring. Multi-lever switches shall be constructed so as to enable individual defective switches to be removed and replaced without having to remove the remaining switches.

- (v) The mounting lugs provided on the yoke strap shall be slotted to allow for easy alignment. A brass earthing terminal shall furthermore be provided on the yoke to ensure the positive earthing of the switch assembly.
- (b) Cover plates for switches
 - (i) Cover plates for flush mounted switches shall have levelled edges which overlap the wall box in order to conceal all wall imperfections.
- (c) Surface mounted switches
 - (i) Surface mounted switches shall comply with SANS 60669-1 and shall bear the SARS mark
 - (ii) Surface mounted switches shall consist of single or multiple switches not exceeding four, and shall be mounted in a pressed steel box of heavy duty construction.
 - (iii) The switch mechanism shall be of the tumbler operated micro-gap type with silent operation and shall be rated for 16 A continuous loading at 250 V and 50 Hz
 - (iv) A brass earthing terminal shall furthermore be provided on the switch construction to ensure the positive earthing of the switch assembly and enclosure.
 - (v) The covers of surface mounted switches shall have toggle protectors.
- (d) Photo-Electric daylight switches
 - (i) The unit shall comprise a photo-cell, thermal actuator and change-over switch. The cover of the unit shall be manufactured from a tough, durable material providing protection against tampering. The cover shall have good weathering properties. It shall be ultra violet resistant and shall not deteriorate when exposed to sunlight for prolonged periods.
 - (ii) The units shall be capable of operating in dusty conditions, and over an ambient temperature range - 15 °C to + 55 °C
 - (iii) The units shall be designed to withstand damage by hail and stones thrown by vandals. If the units do not possess this quality separate wire screens shall be provided for this purpose.
 - (iv) All parts shall be treated to be corrosion-proof.
 - (v) The operation level shall be factory pre-set for "ON" at a light level of 60 lux and "OFF" at 90 lux, with a permissible deviation of 12 lux either way. Voltage variations shall not materially affect the operational levels.
 - (vi) A time delay, of not less than 15 seconds, shall be provided to prevent the unit from functioning due short-duration changes in illumination, such as lightning.
 - (vii) The unit shall be effectively safeguarded against voltage surges by means of a suitable surge protector, which shall preferably form an integral part of the unit.
 - (viii) The unit shall be of the wall mounting type and shall be supplied complete with a suitable bracket.
 - (ix) The change-over switch shall be capable of switching 10 A AC at 250 V.
- (e) Dimmer modules
 - (i) Dimmer modules shall comply with SANS 60929.
 - (ii) Units shall be rated at 250 V, and capable of powering inductive (minimum power factor of 0.65 lagging) and capacitive (minimum power factor of 0.75 leading) loads.
 - (iii) The efficiency of modules may not be less than 95 %, and the harmonic current injection not more than 1 % THD, at full load (where such load is resistive).

- (iv) Furthermore, the units shall be provided with automatic over-temperature, over-current and short-circuit cut-out features. Where over current of short duration is expected (i.e. luminaire starting current), over-current protection may be by way of self-regulation (i.e. a reduction in output voltage).
- (v) Dimmer modules shall be sound-attenuated, such that audible noise is limited to 30 dB (all weightings) measured at a distance of 1 m from the module.
- (vi) The output of modules shall be controlled by propriety pushbutton-type switches. An additional switch, located in the same enclosure as the pushbutton, shall be provided for switching the input to the dimmer module.
- (vii) Unless prior approval in this regard has been gained from the Engineer, dimmer modules may not be paralleled.
- (viii) Dimmer modules shall be selected and installed such that 30 % spare capacity will be available for future additions to the output circuitry.

4 Installation of Components and Equipment

4.1 Installation of Lighting and Accessories

4.1.1 Mounting of light fittings

Surface mounted down light holders, such as the bayonet / screw-in type lamp holders used for incandescent fittings, shall be screwed to the ceiling by means of at least two 4 mm diameter self-tapping screws. Plastic expansion plugs, of good quality, are to be used where the surface is concrete, plaster or brick. For suspended and soft ceilings, a solid timber backing strip of at least 40 x 40 mm timber must be supplied and installed between supports, with the screws fixed to these backing strips.

Channelled fittings, such as fluorescent fittings, shall be firmly mounted to ensure close contact with the ceiling over the entire length of the fitting. On concrete slabs the fittings shall be mounted by means of two screws into the ceiling conduit box, as well as two round-headed 4 mm x 30 mm electroplated self-tapping screws and plastic expansion plugs, one at either end. Where fittings are to be installed underneath suspended ceilings, they shall be mounted in an equal manner, but timber backing strips of at least 40 x 40 x 450 mm (at both ends) shall be placed in position on top of the ceiling board and the end screws secured to these strips, such that the weights of the fittings distribute evenly.

To ensure the safety of people below, where fittings are clamped or bolted directly to trusses or other building elements (as in the case of some high bay and floodlight installations) they shall be provided with an additional safety chain or safety cable of appropriate corrosion-proof material. This safety cable / safety chain assembly shall be connected independently of the luminaire-supporting clamps or bolts, such that either assembly can be loosened and removed without affecting the other. The safety assemblies shall have a load safety factor not less than 3.

Specialized light fittings (i.e. types of fittings not mentioned in this specification) must be installed strictly in accordance with their manufacturer's requirements and guidelines.

5 Drawings and Documentation

5.1 General

All drawings, information, and documentation shall be in English, and each item shall be identified with:

- (a) The Client's name and contact details
- (b) Client's project / scheme / contract reference title and numbers
- (c) The Engineer's name and contact details
- (d) Engineers reference numbers
- (e) Contractor's works / contract / order references.

Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

5.2 Drawings for Approval

The following documentation and drawings shall be submitted to the Engineer prior to the installation of cables and wireways and before civil construction have started on the areas where cable routes are required:

- (a) Cable route layout drawings showing:
 - (i) Type of wireways
 - (ii) Trenching
 - (iii) Cable junction boxes

5.3 As-built Drawings

Detailed "as-built" drawings, clearly labelled as such, and consisting of 3 sets of drawings printed to their original size, and, where the original drawings were larger than A3, 3 sets of drawings printed (with reduced scaling, but without omitting any information from the printed area), to A3, shall be provided by the Contractor, indicating positions of the following:

- (a) Equipment (e.g. light fittings, draw boxes, outlets etc.)
- (b) Wireways (e.g. trenches, conduit, cables ladder/trays, power skirting etc.); and
- (c) Cable routes (including any cable joints)
- (d) General arrangement drawings
- (e) Single Line Diagrams

5.4 Operating and Maintenance Manual

Three Operation Manuals, three Maintenance Manuals and three Certification copies shall be provided for all equipment supplied. The manuals shall be in A4 format.

The operating and maintenance manuals shall include at least the following:

- (a) A schedule of installed components and equipment, containing the following information:
 - (i) Manufacturers name and contact details
 - (ii) Circuit number (DB name, circuit breaker e.g. DB01-CB08); and

- (iii) Function (e.g. switching lighting circuit DB03-L1)
- (b) A schedule of all installed cables, with the following information:
 - (i) Circuit number (DB name, circuit breaker e.g. DB01-CB08)
 - (ii) Size
 - (iii) Installed length; and
 - (iv) Function (e.g. "Feeding Submersible pump IW-SP-01")
- (c) Description and details w.r.t:
 - (i) Detailed description of the function of all operator controls
 - (ii) Procedures for fault finding
 - (iii) Maintenance instructions for all components and including repair, overhaul, change-out and installation procedures
 - (iv) Inspection schedules; and
 - (v) Spare part information and recommended spares

6 Testing and Commissioning

6.1 General

The installation shall be inspected and tested in accordance with SANS 10142-1.

Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision for all inspection and testing activities.

The Contractor shall provide all necessary safety equipment and test instruments. All test instruments shall comply with SANS 61010 and be covered by a current test and calibration certificate.

The Contractor's safe working arrangements shall comply with the safety management systems and procedures prevailing on site. Where there may be a risk of injury to personnel, the Contractor shall submit a risk assessment and method statement for approval, prior to starting work.

Unless otherwise specified in the Particular Specification, all inspection and test results shall be recorded using proforma documentation (test certificates and schedules) complying with SANS 10142-1.

The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified in the Particular Specification, the period of notice for witness testing shall be 5 working days.

Where most of the inspection and testing activities are not witnessed, the Contractor shall allow for 10 % of the inspection and testing activities to be repeated for witness testing.

If there is a requirement for additional inspection and test activities to be performed as part of process commissioning, this shall be specified in the Particular Specification.

Unless otherwise agreed by the Employer, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.

6.2 Test Sequence

6.2.1 Inspections before Testing

Before testing, inspections shall be performed to verify:

- (a) All equipment and material is of the correct type and complies with applicable SANS and JFC standards
- (b) All parts of the installation are correctly selected and erected
- (c) No part of the installation is visibly damaged or otherwise defective
- (d) The installation is suitable for the environmental conditions, and
- (e) The installation complies with this Specification

6.2.2 Testing of Installation

On satisfactory completion of the inspections specified in 6.2.1 the following tests shall be undertaken in the sequence listed as per SANS 10142-1:

- (a) Continuity of conductors
- (b) Resistance of Earthing conductor
- (c) Continuity of ring circuits Earth fault loop impedance at main switch
- (d) Elevated voltage on supply neutral Earth Resistance
- (e) Insulation resistance
- (f) Voltage, main distribution board - no load
- (g) Voltage, main distribution board - on load
- (h) Voltage at available load
- (i) Operation of earth leakage units
- (j) Earth leakage test button
- (k) Polarity at points of consumption
- (l) Switching devices

General specification

Trenching and Excavations

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Signature					

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1 Scope

1.1 Application

1.1.1 General

The following definitions are used in this Specification:

- (a) The term "Employer" shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person.
- (b) The term "Contractor" shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.
- (c) The term "Engineer" shall mean the person appointed by the Employer as the Engineer for the purposes of the contract.

2 Standards

2.1 Regulations, Specifications and Standards

The works shall be done in accordance with the latest editions (current at the time of Tender) of all relevant National and International Standards, including but not limited to:

Specification No.	Specification Title
SANS 10198-5	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil
SANS 10198-8	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 8: Cable laying and installation
SANS 1200 Part DB	Standardized specification for civil engineering construction: Earthworks (pipe trenches)
SANS 1200 Part LC	Standardized specification for civil engineering construction: Cable ducts

3 Technical Specification

3.1 General

All activities associated with excavations and trenching shall generally be carried out in accordance with SANS 10198-8 and SANS 1200 Part DB and SANS 1200 Part LC. Furthermore all activities shall be carried out to the satisfaction of the Engineer.

The following shall also be adhered to:

- (a) Prior to commencement of trenching, all "existing services" shown on the service drawings must be exposed by means of hand digging. This shall be done by labourers suitably skilled for this work.

- (b) Particular care must be exercised during all activities associated with excavations and labourers shall be fully alerted especially where "live" electric cables are to be exposed.
- (c) Any damage to existing services shall be reported to the Clerk of Works without delay.
- (c) Particular care must be exercised not to damage other services when excavating in close proximity. Reports to "known" existing services shall be for the Contractor's account and shall be repaired with new materials and in accordance with acceptable and correct repair procedures, as approved by the Engineer.
- (e) Where other services must be removed by the Contractor, prior written consent of the Engineer is required. Care shall be taken not to damage the removed services. Any damage shall be reported to the Clerk of Works.
- (f) Other services shall be replaced by a competent authority or Contractor.
- (g) Survey beacons or pegs may not be removed, altered or replaced by the Contractor. Where this is unavoidable the Engineer/Clerk of Works shall be advised in writing and appropriate action shall be taken at his instruction.
- (h) Beacons or pegs that are lost, removed or altered shall be replaced at the main Contractor's expense.
- (i) Where surplus material has to be disposed of, the Contractor shall remove it from site and dispose of it in a location of his choosing in accordance with statutory environmental regulations.

3.2 Trenching

Unless otherwise detailed on the drawings, the following minimum depths are required to the centre lines of cables or services:

(a) Telecommunication cables	: 600 mm
(b) Low voltage (0 – 1,000Vrms) service cables	: 600 mm
(c) Low voltage (0 – 1,000Vrms) feeder cables	: 750 mm
(d) Medium voltage cables (1,000 – 44,000Vrms)	: 1,000 mm

The width of trenches shall be in accordance with the Bill of Materials. If the contractor chooses to excavate wider than specified, he may do so at his own cost.

Should the Contractor, during the excavation operations, come across obstacles (or other interferences, e.g. soil drenched with hydrocarbon-based solvents such as spilled oil, which could adversely affect cable insulation), he shall report the matter to the Engineer, who shall then advise an appropriate course of action.

The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clear up the bottom of the trenches after he has completed the required excavation.

No excavated material shall be left closer than 300 mm from the side of the excavation.

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed.

3.3 Bedding of Cables

Bedding and selected fill material shall consist of graded sandy soil that has a thermal resistivity of 1.2 Km/W. The Engineer shall make the final decision of whether bedding is required or not.

Normal bedding requirements for electric cables will be as follows:

Cable and Ground Conditions	Under (mm)	Over (mm)
MV and LV cables in earth	-	-
MV cables in other conditions (Gravel / Hard Rock)	150	150
LV kiosk feeder cables in other conditions (Gravel / Hard Rock)	150	150
LV service connection cables in other conditions (Gravel / Hard Rock)	150	100
Note: Trenches shall be excavated such that the installation depths in Section 3.2 are maintained when bedding as per the above requirements need to be laid.		

If the soil for the bedding has to be sifted, a sieve with holes not larger than 6 mm shall be used.

3.4 Telecommunication Requirements

Special conditions as required by the telecommunication authorities must be studied carefully and fully complied with.

Suitable protection as per SANS 10198-8 shall be provided where the clearance between telecommunication cables and underground electric power cables is less than 600 mm even if the latter is installed in a duct (Road crossings excluded).

At road crossings where cables come together to enter pipe sleeves, concrete slabs shall be installed above electrical cables, such that they are adequately protected.

3.5 Cable Sleeves

All sleeves used for road crossings shall be straight and undamaged. They shall be laid straight across a road at a depth of approximately 800 mm from the top of the duct to the finished surface of the road.

All sleeves shall protrude approximately 1,000 mm beyond the kerb line. Adequate precautions must be taken to ensure the correct compaction of ground layers with a maximum thickness of 150 mm, to avoid undermining of the road or kerb.

One extra sleeve shall be installed at each road crossing for possible future use.

Sleeves for MV cables shall be laid in a straight line with the proposed trench approximately 1 m from the property line.

LV cable sleeves will be adjacent to the MV cable ducts but towards the splay of the road.

In certain positions, at least one pipe sleeve may be for use by the telecommunication authorities and the drawings must be checked before cables are drawn in.

All sleeves must be cleared by pulling through a loose fitting mandrel prior to the installation of cables.

After pipe sleeves have been installed by the contractor and before any backfilling may commence, a No. 10 gauge galvanised draw wire shall be left in the sleeve, prior to the ends of the sleeves being sealed by means of plastic plugs.

MV and LV cables shall not be drawn into the same sleeve. Cables shall be drawn into the ducts as follows:

Cable	Maximum Amount of Cables per Sleeve and Sleeve Size
MV Cables	1 Cable in a 160 mm sleeve
LV Feeder Cables (larger than 185mm ²)	1 Cable in a 160 mm sleeve
LV Feeder Cables (smaller than 185mm ²)	1 Cable in a 110 mm sleeve
Service Cables (16mm ² or smaller)	4 Cables in a 110 mm sleeve
Streetlight Cables (16mm ² or smaller)	4 Cables in a 110 mm sleeve

3.6 Backfilling

All loose stones or any other materials likely to cause damage to cables shall be removed from trenches, before backfilling commences. Similarly, as per the requirements in SANS 1200 Part DB, any remains in the backfill material that is likely to cause damage to cables, shall be removed prior to backfilling. Care should be taken that all backfilling material consists of a graded soil and sand mix that has a thermal resistivity of 1.2 K.m/W.

Backfilling of trenches in road reserves shall be in layers not exceeding 150 mm and the use of a suitable compacting device is essential in order to achieve an approximate 93 % MOD AASHTO density.

Backfilling across properties shall be in layers of 300 mm with the use of correct facilities. Careful removal and prompt replacement of plants, shrubs, grass, etc. including care of subject matter until growth is re-established, is essential and must be allowed for in rates quoted. After completion of the work the route of the trench shall be neatly finished off and cleared. All stones bigger than 25 mm, as well as all loose organic material and rubble, shall be removed.

Prior to handover and final payment, all cable trenches shall be checked and any subsidence shall be repaired.

Where trenches are across or in a permanent walkway, pavement or gravel road, etc. it shall be reinstated such that the final topping is similar to the surrounding material.

3.7 Joint Chambers

Joint Chambers shall comply with the requirements of SANS 10198-8. Special precautions must be taken at joints to ensure correct and secure support below cables and joints as well as for the subsequent backfilling.

3.8 Draw Pits

Where draw pits are to be constructed and where part of the draw pit will be visible above ground, the masonry units to draw pits shall be FBS (face brick standard). All other draw pit builds shall utilize solid concrete units.

Draw pit covers shall be of cast iron manufacture.

3.9 Protection

The Contractor shall take all necessary precautions to prevent trenching from being a hazard to the public.

The contractor shall safeguard all structures, roads, railways, other services, properties, etc., from any risk of subsidence and damage.

Trenches in front of occupied properties shall be closed by nightfall as far as possible or else suitable safe access must be provided for residents and vehicles. The trenches will be covered against accidental access.

3.10 Holding Points

No construction activities will commence until the site is officially handed over to the Contractor by the Project Manager or his representative.

No construction activities will commence prior to the submission of a detailed construction program and special tool calibration certificates, etc. by the contractor.

The employer's Clerk of Works will have the prerogative to execute a proper inspection on the condition of all construction tools, equipment and vehicles prior to the commencement of any construction activities.

Construction activities will only commence when the Clerk of Works gives a written instruction to the Contractor that:

- (a) All connections and joints have been inspected and that earth backfill may commence;
- (b) The excavation, earth tail connections to holding down bolts, reinforcement and shuttering have been checked and that concrete foundations may be casted.
- (c) A supplier checklist has been submitted and that the erection of isolators and breakers on the support structures may commence.
- (d) Backfilling of cable trenches may commence as per the holding points indicated Figure 1.

The contractor will be held responsible for any construction errors, defects, claims, etc. for continuing with the construction activities at the "hold point" stages without the written instructions from the Employers' Clerk of Works.

4 Standard Drawings

A schematic, indicating detail discussed in Chapter 3, is presented in Figure 1. Unless otherwise stated, all MV and LV cable trenches will comply with these minimum requirements.

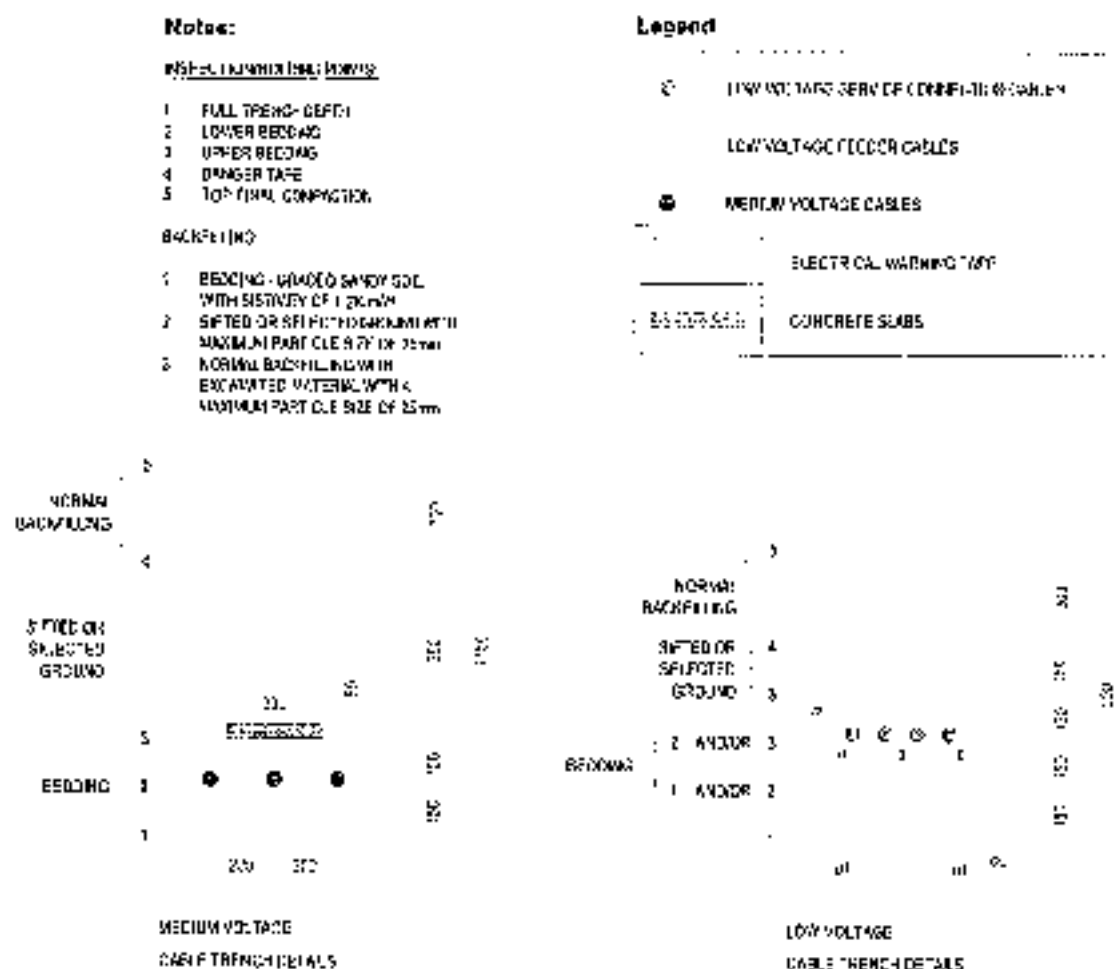
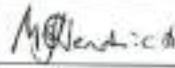


Figure 1: Standard Cable Trench details

General specification

MV & LV Earthing

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1 Scope

1.1 Application

This Standard Specification covers the materials, components and installation requirements for earthing systems of industrial medium- and low voltage electrical installations.

General standard requirements are dealt with in this specification, and the project-specific requirements are dealt with in the Project Specification.

This standard specification covers protective earthing and bonding, but not functional earthing and bonding which shall be provided in accordance with the specifications of electrical and electronic equipment suppliers.

This standard specification does not cover electromagnetic compatibility (EMC) earthing and bonding, which shall be provided as specified in the Project Specification if required.

Whilst this specification covers earth termination systems for a building lightning protection system (LPS), it does not cover the LPS itself and surge protection for equipment.

The following does not fall within the scope of this standard specification:

- (a) The earthing of outdoor open-terminal MV substations.
- (b) The earthing of electronic systems and equipment.

1.2 General Requirements

The completed earthing systems shall incorporate all materials and components necessary to provide the required protective earthing and bonding.

All materials and components shall be new and unused, shall be of current manufacture, and shall be free from any defects or imperfections.

2 Standards

2.1 Associated Documentation

This Specification contains standard amendments and requirements, which shall be applied to the referenced statutory and national standards. The project-specific requirements are provided in the Project Specification, which shall be read in conjunction with this Specification.

The design, construction, installation, inspection, testing and commissioning of the earthing systems shall comply with all relevant statutory regulations, and the latest editions (current at the time of tender) of all relevant South African National Standards.

2.2 Statutory Requirements

The earthing systems shall comply with the following:

- (a) Occupational Health and Safety Act of 1993 and Regulations
- (b) SANS 10142-1 The Wiring of Premises Part 1: Low-voltage Installations
- (c) SANS 10142-2 The Wiring of Premises Part 2: Medium-voltage Installations

2.3 Reference Standards

The following national standards shall be complied with as applicable:

Table 1: Reference Standards

Standard Number	Description
SANS 1063	Earth rods, couplers and connections
SANS 1411-1	Materials of insulated electric cables and flexible cords - Part 1: Conductors
SANS 10198-3	Power cables up to 33 kV: Earthing systems - General provisions
SANS 10198-12	Power cables up to 33 kV: Installation of earthing system
SANS 10199	The design and installation of earth electrodes
SANS 10200	Neutral earthing in medium-voltage industrial power systems
SANS 10292	Earthing of low-voltage distribution systems
SANS 62305-3	Protection against lightning: Physical damage to structures and life hazard

3 Earthing of Transformer and Generator Neutrals

3.1 Distribution Transformers

The neutrals of distribution transformers shall be either solidly- (directly) or resistively earthed as specified in the Project Specification.

Unless otherwise specified in the Project Specification, the earthing connection shall be made with 70 mm² bare copper earth conductor to the installation's main earthing bar(s) or to dedicated combined MV and LV earth electrodes in the case of remotely installed transformers or mini-sub (refer Clauses 6.2 and 6.3).

Where artificial neutrals are required for transformers with delta-connected secondary windings, neutral electromagnetic couplers /neutral earthing compensators (NECs) shall be provided as specified in the Project Specification.

Where neutral earthing resistors (NERs) are required to limit earth fault current, they shall be provided as specified in the Project Specification, either as separate units or in combination with NECs (and referred to as NECRs).

3.2 Standby Generators

LV standby generators shall be earthed in accordance with SANS 10142-1: The Wiring of Premises Part 1: Low-voltage Installations unless otherwise specified in the Project Specification.

The neutrals of MV standby generators shall be resistively earthed with NERs dedicated to the individual generators unless otherwise specified in the Project Specification.

Unless otherwise specified in the Project Specification, the earthing connection shall be made with 70 mm² bare copper earth conductor via the installation's main earthing bar(s).

4 Earth Electrodes

4.1 General

Earth electrodes shall be provided as specified in the Project Specification for power systems, electrical equipment and LPS earthing.

The earth electrodes shall be constructed in accordance with Sub-clauses 4.2 to 4.8 of this specification as relevant.

Earth electrodes shall be tested in accordance with Clause 9 of this specification and shall be extended as directed by the Engineer in writing if required to achieve a lower earth resistance.

4.2 Earth Grids

Earth grids for electrical equipment yards shall be constructed in the form of a large rectangular arrangement of conductors buried in trenches and divided by longitudinal and transverse conductors into a number of smaller rectangles having mesh dimensions as specified in the Project Specification.

The horizontal conductors shall be high-conductivity, annealed, stranded copper conductors with a cross-sectional area of 70 mm² unless otherwise specified in the Project Specification.

Where horizontal conductors cross each other they shall be joined by exothermic welding or oxy-acetylene brazing.

Horizontal conductors shall be buried directly in the ground at 500 mm below finished ground level (unless otherwise specified in the Project Specification), before any stone layer is put down, in 300 mm wide excavated trenches which shall be backfilled in well-compacted layers.

Supplementary earth rods shall be provided as specified in the Project Specification and shall comply with Clause 4.8 of the specification.

4.3 Ring and Foundation Earth Electrodes

A foundation earth electrode shall comprise a continuous length of bare copper earth conductor installed under the perimeter concrete foundation of a building, with the ends brought out to the main earthing bar to form a closed loop. The conductor shall be fixed to the top of the blinding layer just before the concrete foundation is poured to avoid theft of the conductor.

At each corner of the building a 2 m conductor tail shall be exothermically welded to the foundation earth electrode and buried in an accessible location to allow the electrode to be extended if required.

Supplementary earth rods shall be provided as specified in the Project Specification and shall comply with Clause 4.8 of the specification.

A ring earth electrode shall be similar to a foundation earth electrode, except that it shall be external to the structure and in contact with soil for at least 80 % of its total length. Unless otherwise specified in the Project Specification, the ring earth electrode shall be installed 500 mm below finished ground level and 1000 mm from external walls. Ring earth electrodes shall only be provided in place of specified foundation earth electrodes with the Engineer's written approval.

Horizontal conductors shall be as specified for earth grids in Clause 4.2.2 of this specification.

4.4 Array of Rods

An array of rods interconnected with horizontal conductor in the form of a "1" shall be constructed with horizontal conductor lengths and rod quantities and lengths as specified in the Project Specification to achieve the required earth resistance.

The horizontal conductor shall comply with Clause 4.2.2 of this specification.

The earth rods shall comply with Clause 4.8 of this specification.

The horizontal conductor and the tops of live earth rods shall be 500 mm below finished ground level.

4.5 Trench Electrodes (Cable-route Earth Electrodes)

Trench earth electrodes shall comprise buried horizontal conductor and supplementary earth rods installed in a linear arrangement in MV/LV cable trenches.

The conductor lengths and rod quantities and lengths shall be as specified in the Project Specification to achieve the required earth resistance.

The horizontal conductor shall comply with Clause 4.2.2 of this specification.

The earth rods shall comply with Clause 4.8 of this specification.

4.6 Earth Termination Systems for Lightning Protection

Earth termination systems (ETs) for lightning protection systems (LPSs) for structures shall be either Type A or Type B arrangements (defined in SANS 62305-3) as specified in the Project Specification.

Ring- and foundation earth electrodes as specified in Clause 4.3 of this specification meet the requirements for Type B arrangements and shall be provided where called for in the Project Specification.

Type A arrangements shall comprise horizontal and/or vertical electrodes (i.e. conductors and/or rods) installed outside the structure to be protected, connected to down conductors, and not forming a closed loop. The required arrangement for a particular structure shall be as specified in the Project Specification.

4.7 Earth Mats

Earth mats shall be provided as called for in the Project Specification where required to provide an extra protective measure to minimize the danger of exposure to high step or touch potentials for operators of outdoor electrical equipment.

Earth mats shall be constructed out of 70 mm² bare copper conductor in the form of a grid with outer dimension 1500 mm x 1500 mm and with longitudinal and transverse conductors spaced 100 mm apart. Crossovers shall be exothermically welded.

Earth mats shall be buried 500 mm below finished ground level.

4.8 Earth Rods

Earth rods used for the earthing system shall be of the "A" grade and shall have a 250 micron copper jacket. Unless otherwise specified in the Project Specification, the rods shall comply with the following:

- (a) The earth rods shall be extendible, copper clad, high tensile steel (500 MPa) rods and shall bear the SABS mark of approval. They shall be at least 16 mm in diameter and shall have hardened steel tips with crimping caps.

- (b) Individual rods shall not have a length of more than 1.5 m.
- (c) Connections between individual rods shall be by screwed joints in accordance with one of the following:
 - (i) The ends of the rods shall be externally threaded and be joined by a counter bored, threaded coupler designed to completely enclose the threaded section of the rod. The external threads shall be roll-formed with a minimum copper coating thickness of 0,05 mm at the root of the threads. Couplers shall be manufactured from high strength silicon or aluminium bronze; or
 - (ii) The ends of the rods shall be internally threaded and joined by a screwed phosphor bronze dowel. A corrosion inhibiting paste shall be applied to the threads before assembly.
- (d) A single earth rod assembly shall be not more than 6 m long and the separation between adjacent earth rod positions shall be not less than 1,25 times the length of the longest earth rod assembly.
- (e) The absence of any buried services, down to the maximum driving depth, shall be established before rods are driven into the ground.

5 Earthing Bars and Conductors

5.1 Earthing Bars

A main earthing bar shall be provided in every MV switchroom or in the main LV switchroom for installations with an LV bulk electricity supply. Supplementary earthing bars shall be provided in other electrical rooms as specified in the Project Specification.

All earthing bars connected to earth electrodes shall have one disconnecting terminal to allow for testing of the associated earth electrodes and shall be constructed in accordance with Standard Drawing for Earthing Bar (Figure 1).

Unless otherwise specified in the Project Specification, earthing bars shall be mounted on the side walls of cable trenches in the positions indicated on the layout drawings.

The earthing bar arrangement shall be as per the following detail sketch:

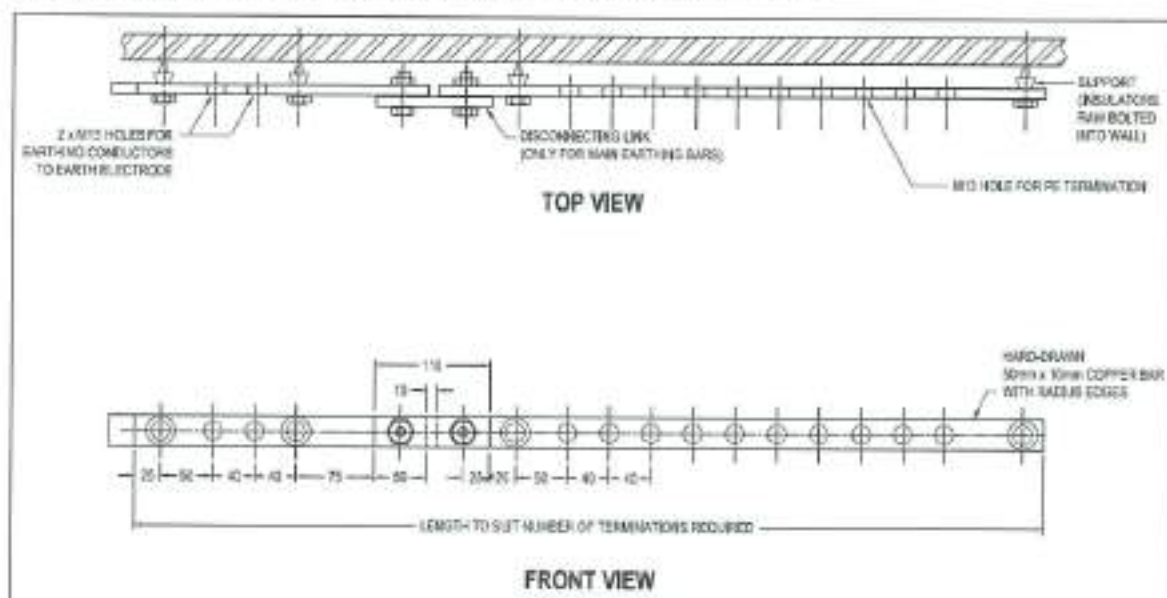


Figure 1: Earthing Bar

5.2 Earthing-, Parallel Earthing-, and Earth Continuity Conductors

Earthing conductors shall be provided to link earthing bars to earth electrodes, except where the conductor ends of ring- and foundation earth electrodes are terminated at the earth bars. Earthing conductors shall be bare 70 mm² annealed stranded copper conductors, unless otherwise specified in the Project Specification.

Parallel earthing conductors shall be provided as specified in the Project Specification to provide a low impedance connection between separate earthing arrangements. Unless otherwise specified, the conductors shall be laid along cable routes, and shall be bare 70 mm² annealed stranded copper conductors.

Earth continuity conductors (ECCs) shall be provided:

- (a) With supply cables to MV switchgear and to LV Assemblies
- (b) To earth the exposed conductive parts of all electrical equipment in accordance with SANS 10142: The Wiring of Premises.

ECCs for MV equipment shall be connected from the MV earthing bar and ECCs for LV equipment shall be connected from the earthing bars in the LV Assemblies from which the equipment receives supply.

ECCs shall be separate conductors or shall form part of the equipment supply cables as specified in the Project Specification. ECCs which does not form part of a cable shall be annealed copper stranded conductors of the specified cross-sectional area and shall be either bare or PVC-insulated as specified in the Project Specification.

6 Earthing of MV and LV Equipment and Electrical Yard Fences

6.1 MV Switchgear

The earthing bars of MV switchgear shall be connected to the main earthing bar by means of two 70 mm² bare copper earth conductors, unless otherwise specified in the Project Specification. These protective earthing conductors shall be taken from opposite ends of the switchgear earthing bars.

For ring main units (RMUs) in mini-sub, the RMU and cable termination enclosure earthing bars shall be bonded to the mini-sub's MV earth bar and to each other in accordance with SANS 1874: Metal-enclosed ring main units.

For RMUs in outdoor steel kiosks, the steel enclosure shall be bonded to the RMU earth bar with 70 mm² bare copper earth conductor.

6.2 Distribution Transformers

Outdoor ground-mounted distribution transformers shall be provided with an equipotential earth electrode in accordance with the Standard Drawing for Distribution Transformer Earthing (Figure 2).

Unless otherwise specified in the Project Specification, the transformer tank earthing terminal shall be separately connected to the closest indoor main earthing bar with a 70 mm² bare copper earth conductor.

Unless otherwise specified in the Project specification, remotely-installed transformers (i.e. which are not installed close to indoor main earthing bars) shall be provided with dedicated combined MV- and LV earth electrodes in accordance with the Standard Drawing for Distribution Transformer Earthing (Figure 2)

Transformer LV neutrals shall be bonded to the earthing terminal in the LV terminal box.

Distribution transformers shall be earthed and bonded in accordance with the Standard Drawing for Distribution Transformer Earthing (Figure 2);



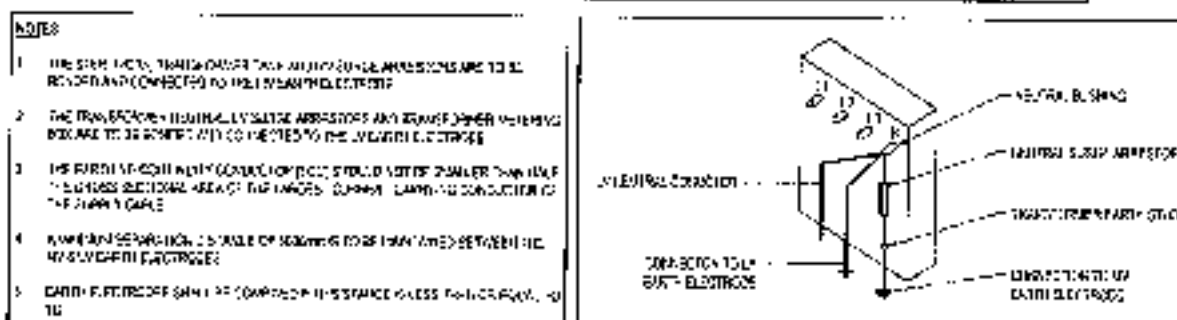


Figure 3: Earthing at MV/LV transformer pole mounted transformer

6.3 Miniature Substations (Mini-subs)

Minisubs shall be provided with an equipotential earth electrode in accordance with Figure 4.

Unless otherwise specified in the Project Specification, the mini-sub MV earth bar shall be separately connected to the closest indoor main earthing bar with a 70 mm² bare copper earth conductor.

The internal earthing arrangement of mini-substations shall be in accordance with SANS 1029: Miniature Substations as applicable to combined MV- and LV earth electrodes.

Unless otherwise specified in the Project Specification, remotely-installed mini-sub(s) (i.e. which are not installed close to indoor main earthing bars) shall be provided with a combined MV- and LV earth electrode, to which the mini-sub MV earth bar shall be connected, in accordance with Figure 4.

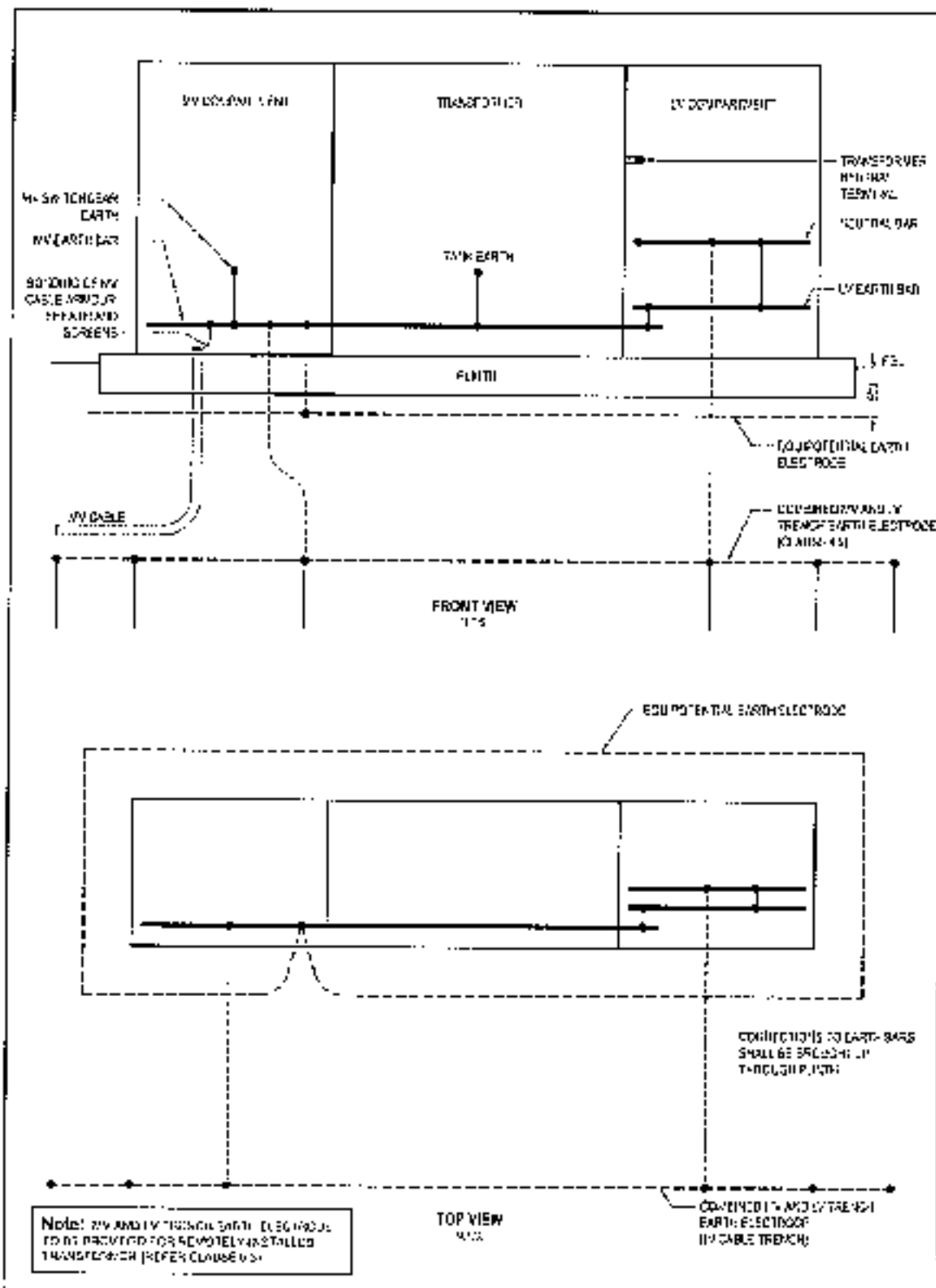


Figure 4: Mini Sub Earthing

6.4 Motors

Where the protective earth conductor forms part of the supply cable to an LV motor, it shall be connected to the earth terminal inside the motor terminal box.

Separate protective earthing conductors shall be connected to the external frame earth terminal of a motor and a jumper shall be provided from the frame terminal to the motor's terminal box. The jumper shall be crimped to the protective earth conductor and not separately bolted to the frame terminal.

Separate protective earthing conductors shall be PVC-insulated copper conductors with cross-sectional areas as specified in the Project Specification.

Earthing connections to converter-fed motors shall be in accordance with the Standard Drawing for Converter-Fed Motor Earthing.

6.5 PFC Capacitor Banks and Harmonic Filters

The capacitor casings and metal support frames of free-standing PFC capacitor banks shall be earthed in accordance with the supplier's installation instructions.

The support base/insulators of free-standing air-cored reactors shall be earthed in accordance with the supplier's installation instructions, with care being taken to not create closed loops within which currents can be induced.

Free-standing iron-cored reactors and filter resistors shall be earthed in accordance with the supplier's installation instructions.

Where equipment is installed indoors, the earthing connections shall be made with copper earthing continuity conductors to the main earthing bar.

Where the equipment is installed outdoors in a fenced yard, the earthing connections shall be made to the earth grid of the yard.

6.6 MV and LV Cables

The metal components of cables shall be earthed in accordance with the following standards:

Table 2: MV and LV Cable earthing standards

Standard Number	Description
SANS 10142-1	The Wiring of Premises Part 1: Low-voltage Installations
SANS 10198-9	Power Cables Up To 33 kV: Jointing and Termination of Extruded Solid Dielectric-Insulated Cables up to 3,3 kV
SANS 10198-10	Power Cables Up To 33 kV: Jointing and Termination of Paper-Insulated Cables
SANS 10198-11	Power Cables Up To 33 kV: Jointing and Termination of Screened Polymeric-Insulated Cables
SANS 10198-12	Power Cables Up To 33 kV: Installation of Earthing System

Unless otherwise specified in the Project Specification, metal sheaths, metal screens and armouring of single-core cables shall be earthed at both ends of the cables.

Unless otherwise specified in the Project Specification, metal sheaths, metal screens and armouring of single-core cables shall be earthed at both ends of the cables.

6.7 MV Surge Arresters

Surge arresters at MV overhead line supply points shall be earthed in accordance with the Standard Drawing for OHL Surge Arrester Earthing.

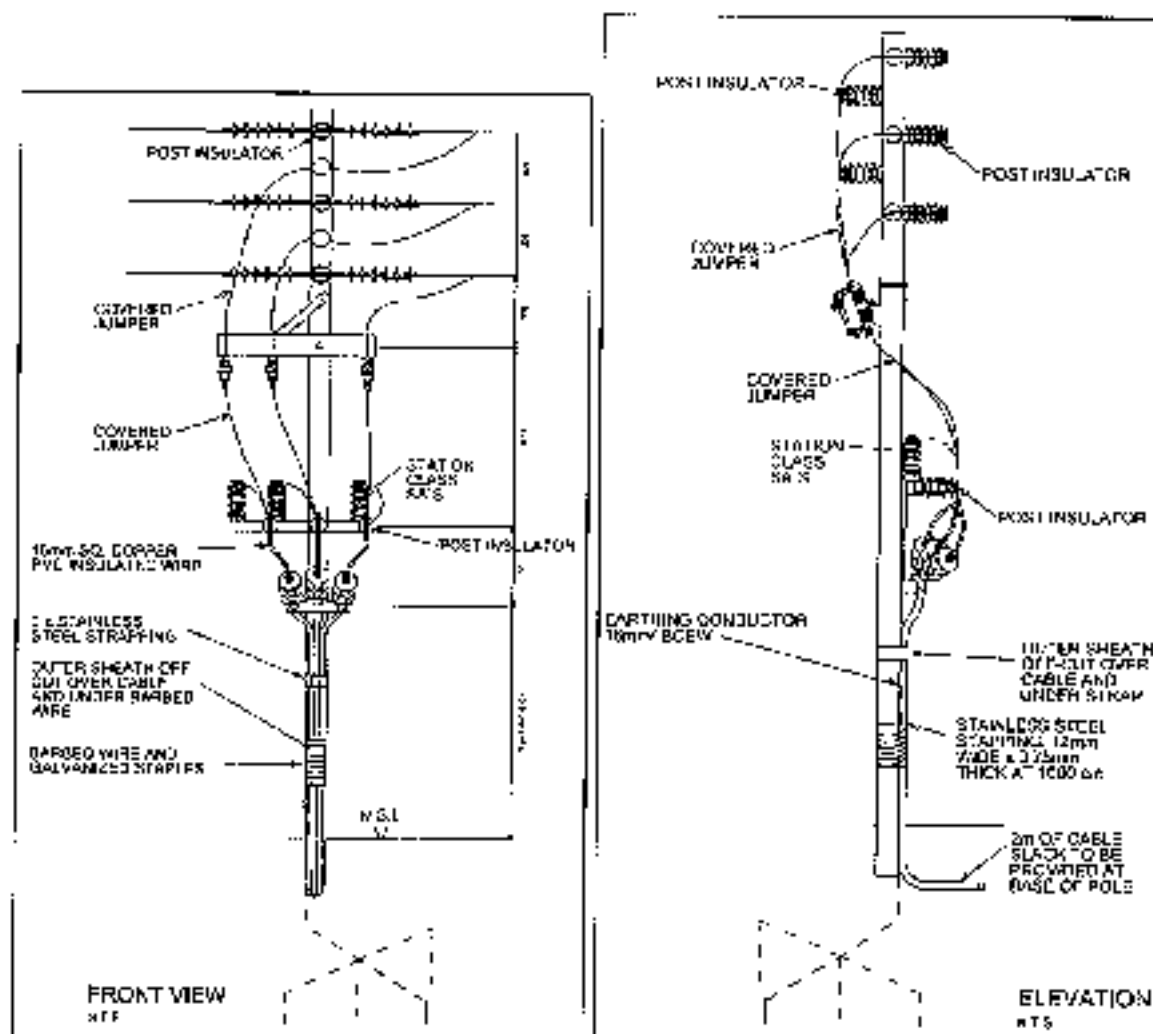


Figure 5: Earthing of MV Overhead Surge Arresters

6.8 Equipment Yard Fences

The enclosing fences of outdoor equipment yards for electrical equipment (switchgear, transformers, RFO capacitors, harmonic filters, etc.) shall be earthed in accordance with the Standard Drawing for Equipment Yard Fence Earthing.

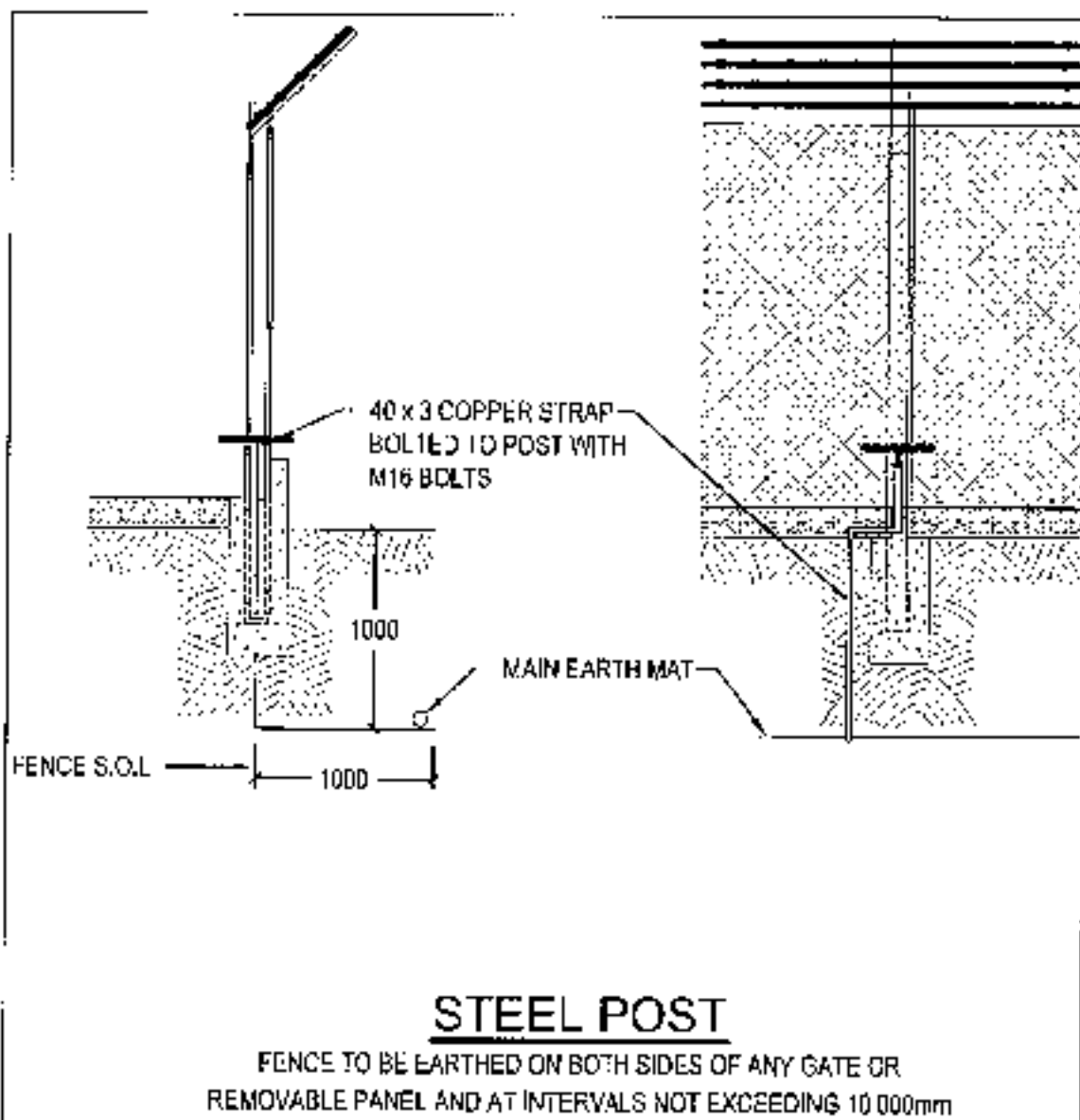
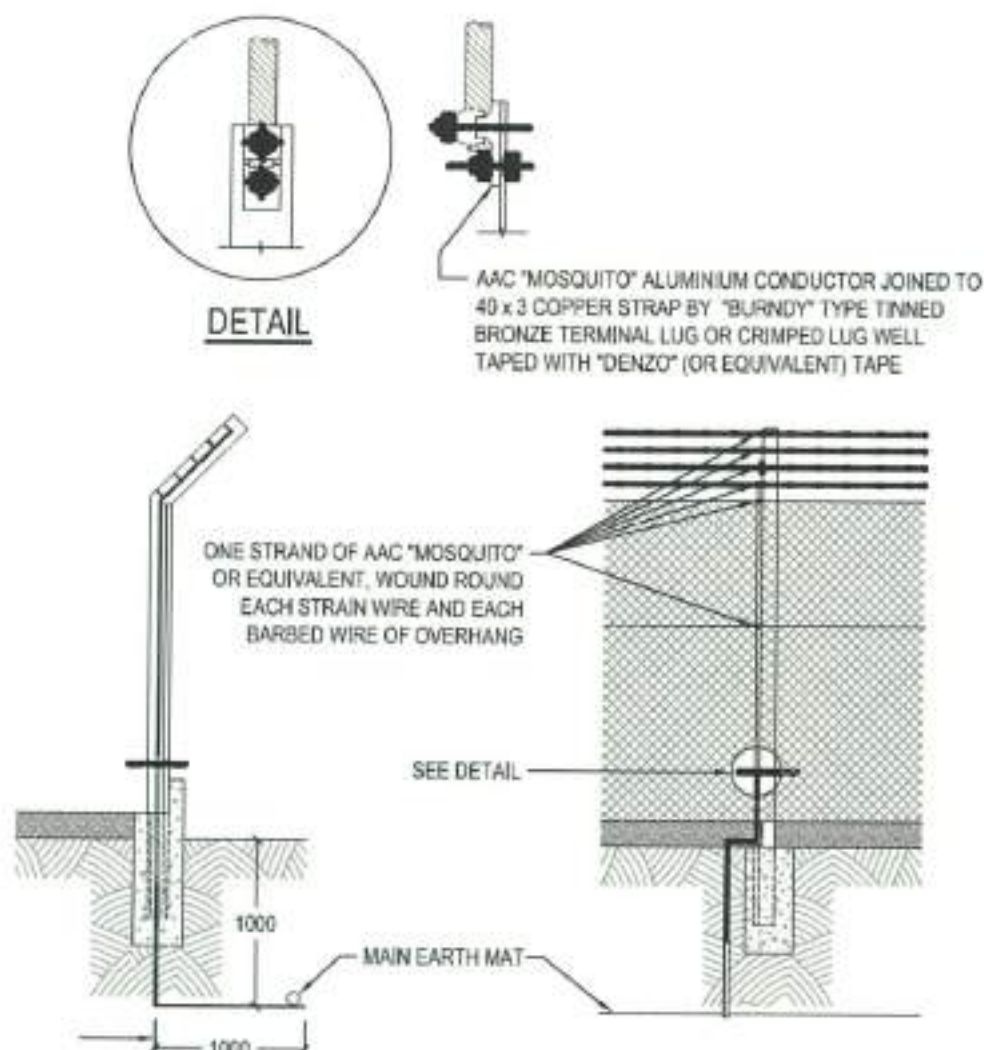


Figure 6: Earthing of Equipment Yard Fences



CONCRETE POSTS WITH ALUMINIUM WIRE FENCE

FENCE TO BE EARTHED ON BOTH SIDES OF ANY GATE OR REMOVABLE PANEL AND AT INTERVALS NOT EXCEEDING 10 000mm

6.9 LV Electrical Equipment

LV electrical equipment shall be earthed in accordance with SANS 10142-1: The Wiring of Premises Part 1: Low-voltage Installations.

7 Equipotential Bonding

7.1 Main Equipotential Bonding

Main equipotential bonding shall be provided in accordance with SANS 10142-1 from the main earth bar to the following extraneous conductive parts of an installation:

- (a) Hot and cold water systems
- (b) Antennas

- (c) Other services in conductive material

Main equipotential bonding conductors to the above shall be bare copper earth conductors with a cross-sectional areas as follows:

- (a) Water systems: 0,5 x installation earthing conductor (6 mm² min to 25 mm² max)
- (b) Antennas: 2,5 mm²
- (c) Other services: 2,5 mm²

7.2 Supplementary Equipotential Bonding

Mandatory supplementary equipotential bonding shall be provided in accordance with SANS 10142-1.

Supplementary equipotential bonding shall be provided between exposed conductive parts of the installation where these parts are 2,5 m or less apart. The bonding conductor shall be bare copper earth conductor and shall not be smaller than the smaller of the two earth continuity conductors to the items of equipment.

Supplementary equipotential bonding shall be provided between exposed conductive parts and extraneous conductive parts where these are 2,5 m or less apart. The bonding conductor shall be bare copper earth conductor and shall be at least equal to the half the size of earth continuity conductor to the electrical item of equipment.

Bonding conductors shall be connected to equipotential bonding terminals on equipment/devices or, if these are not provided, shall be bolted to the equipment/devices to the approval of the Engineer.

7.3 Bonding of Wireways

A 70 mm² bare copper earth conductor shall be installed along each cable ladder/tray and each third section shall be bonded to the earth conductor with 35 mm² bare copper earth bonding conductors and purpose-made earth clips. At least one end, but where practicable both ends, of the earth conductor shall be connected to the main earthing bar.

Rigid metal conduiting shall be bonded in accordance with SANS 10142-1.

8 NECR and NER

8.1 Neutral Electromagnetic Coupler/Resistor Combinations

Neutral electromagnetic couplers (NECs), also referred to as neutral earthing compensators, shall be provided as specified in the Project Specification to create artificial MV supply/transformer neutral points for earthing via a neutral earthing resistor (NER). The NEC and NER shall be a combined unit, referred to as an NECR.

NECRs shall comply with Aurecon Engineering Standard SPE-EP-0024: Neutral Electromagnetic Couplers (NEC) with NERs and Auxilliary Transformers.

8.2 Neutral Earthing Resistors

Standalone NERs shall be provided as specified in the Project Specification for resistive earthing of the neutrals of star-connected transformer secondary windings and MV generator windings.

NERs shall comply with Aurecon Engineering Standard SPE-EP-0024: Neutral Electromagnetic Couplers (NEC) with NERs and Auxilliary Transformers.

9 Testing

9.1 Soil Resistivity Survey

A soil resistivity survey shall be carried out in accordance with SANS 10199 if specified in the Project Specification.

The Wenner method of measurement shall be followed unless soil depths of greater than 20 m are to be investigated.

The survey shall be carried out in the area where the earth electrode will be installed and readings shall be taken in at least two different directions. Unless earth rods are to be installed to greater depths than 12 m, measurements shall be taken with at least the following electrode spacings: 1/2/3/5/10/15 m.

The results of the survey shall be submitted to the Engineer in the form of a table showing soil resistivity in ohm.metres for the various depths of measurement, as well as in the form of a graph. If the graph shows a significant variation in soil resistivity with depth, then a two layer soil model shall be constructed.

9.2 Earth Electrode Resistance Measurement

The earth resistance of an earth electrode shall be measured in accordance with SANS 10199.

The resistance curve and the calculated earth electrode resistance shall be submitted to the Engineer who will issue a written instruction if it is necessary to extend the earth electrode to lower its resistance.

9.3 Earth Surface Potential Measurement

Where called for in the Project specification earth surface potential measurements shall be made by measuring touch- and step potential contact resistance at specified outdoor equipment.

The proposed measurement method shall be approved by the Engineer and resistance readings shall be submitted to the Engineer for the calculation of touch- and step potentials.

9.4 Earth Continuity and Bonding

Earth continuity and bonding tests shall be carried out in accordance with SANS 10142: The Wiring of Premises Parts 1 & 2.

10 Documentation and Training

10.1 General

All Assembly drawings, documentation and reports shall be in English, and each item shall be identified with:

- (a) Employer's name and contact details
- (b) Employer's contract reference title and numbers
- (c) Engineer's name and contact details

- (d) Engineer's reference numbers
- (e) Contractor's works / contract / order references
- (f) Contractor's name and contact details

Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

10.2 Drawings for Acceptance by the Engineer

Where alternative earthing arrangement designs to those specified are proposed by the Contractor, drawings shall be submitted to the Engineer for his acceptance before construction commences.

10.3 Testing Documentation and Reports

Test reports for soil resistivity tests shall contain the following:

- (a) Methodology statement
- (b) Measurement results in tabulated form
- (c) Measurement results in graphic form
- (d) Overlay of measured graph on master graph as per SANS 10199
- (e) Calculated resistivity results for two layer model

Test reports for earth resistance tests shall contain the following:

- (a) Methodology statement
- (b) Measurement results in tabulated form
- (c) Measurement results in graphic form
- (d) Calculated resistance value for earth electrode under test

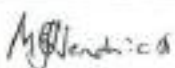
10.4 Operating and Maintenance Manual

As-built drawings and all test reports shall be included in the Operating and Maintenance Manual which must be provided under the Contract.

General specification

Lightning Protection for Structures

Specification number: SPE-EE-0021

Document control					
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Rev	Date	Revision details / status	Author	Reviewer	Approver
0	2015/06/25	First Issue	M Hendricks	E Biesenbach	O Fair
Signature					

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1 Scope

1.1 Application

This Standard Specification covers the materials, components and installation requirements for lightning protection systems for structures to provide protection measures to reduce:

- (a) Injury of living beings by electric shock
- (b) Physical damage to structures to be protected

General standard requirements are dealt with in this specification, and the project-specific requirements are dealt with in the Project Specification.

This standard specification covers external and internal lightning protection systems as defined in SANS 62305, but does not cover surge protection measures for the protection of electrical and electronic systems against lightning electromagnetic impulses.

This standard specification does not cover the earth termination system for lightning protection, which is covered by Engineering Standard SPE-EE-0020 - "MV & LV Earthing", and which shall be read in conjunction with this standard specification.

1.2 General Requirements

The completed lightning protection installation shall incorporate all materials and components necessary to provide the required lightning protection systems.

All materials and components shall be new and unused, shall be of current manufacture, and shall be free from any defects or imperfections.

The lightning protection system shall achieve the class and hence protection level specified in the Project Specification.

2 Standards

2.1 Associated Documentation

This Specification contains standard amendments and requirements which shall be applied to the referenced statutory and national standards. The project-specific requirements are provided in the Project Specification, which shall be read in conjunction with this Specification.

The design, construction, installation, inspection, testing and commissioning of the lightning protection systems shall comply with all relevant statutory regulations, and the latest editions (current at the time of tender) of all referenced South African National Standards.

2.2 Statutory Requirements

The lightning protection systems shall comply with the following:

- (a) SANS 10142-1 The Wiring of Premises Part 1: Low-voltage Installations
- (b) SANS 10142-2 The Wiring of Premises Part 2: Medium-voltage Installations

2.3 Reference Standards

The following national standards shall be complied with as applicable:

Table 1: Reference Standards

Standard Number	Description
SANS 10313	Protection against lightning - Physical damage to structures and life hazard
SANS 61643	Low-voltage surge protective devices
SANS 62305-3	Protection against lightning Part 3: Physical damage to structures and life hazard
SANS 62305-4	Protection against lightning Part 4: Electrical and electronic systems within structures
SANS 62561	Lightning protection system components

3 Materials

3.1 Selection of Materials

Materials, configurations, cross-sectional area and recommended dimensions for air termination conductors and rods, down conductors and earth lead-in rods shall be in accordance with Table 1 of SANS 62561-2.

Material shall be selected to avoid corrosion of either the structure to be protected or of the lightning protection system. A conductor material shall therefore be selected that is compatible with the surface it is to be located on and that which it is to be connected to. For guidance in this regard, refer to Table 5 of SANS 62305-3.

Galvanic corrosion between two dissimilar metals in contact with each other shall be avoided, and combinations of metals with electrochemical potential differences exceeding 0,35 V are not permitted.

Tin-plated copper conductors may be connected to aluminium, steel, grey cast iron, cadmium and lead. Tin plating is not required for connections to stainless steel, tin or bronze.

Aluminium conductors may be connected to steel (including galvanized and stainless), cast iron, tin and zinc. Aluminium and copper are not compatible and bimetallic connectors shall be used to interconnect these two materials.

The aesthetics of longer term white corrosion of aluminium and green verdigris of copper shall be considered and PVC covering provided where specified in the Project Specification.

Materials and components shall comply with the requirements of SANS 62561 as applicable.

3.2 Installation and Fixing of materials

Aluminium shall not be installed in direct contact with plaster, cement, mortar, limestone or surfaces coated with alkaline-based paints. Stand-off fixings or PVC-covered aluminium shall be used in these contact situations.

Being prone to corrosion in marine environments, the aluminium in coastal environments shall be avoided. It shall also not be installed in locations where water may accumulate (e.g. in gutters or in locations where water may be retained) or where it will be exposed to water run-off from copper or copper alloy surfaces. PVC-covered aluminium may be provided with the Engineer's approval for these applications, except where part of the air termination system.

Copper shall not be installed where exposed to sulphurous atmospheres or above galvanized, zinc or aluminium parts where water run-off occurs. Copper shall also not be installed where there is a risk of theft.

Fasteners and connectors shall comply with the requirements of SANS 62561 as applicable.

Aluminium shall not be buried in the ground.

4 Air-Termination Systems

4.1 Metal Roofs

Air-termination systems shall only be provided on metal roofs if specified in the Project Specification, otherwise the metal roof and its metal support structure shall serve as a natural air-termination system.

If an air-termination system shall be installed (i.e. it is specified in the Project Specification because the thickness of the metal roof sheets does not meet the requirements of SANS 62305-3 and/or it is important to prevent puncture or hot spots), the air-termination system shall comply with the requirements of Sub-clause 4.2 below, except that fixing holes may not be drilled into metal roofs.

Where the metal roof and its metal support will serve as a natural air termination system, the lightning protection installer shall check that the roof and its support structure are electrically continuous. If supplementary electrical connections are required, the lightning protection installer shall submit a proposal for adding bridging braids/conductors to the Engineer for approval.

4.2 Non-Metal Roofs

An air-termination system comprising conductors and rods shall be provided on structures as specified in the Project Specification.

Edge conductors shall be installed as close to the roof edges to be protected as practicable, but preferably be out of sight from ground level to avoid theft.

Fixing and connecting components shall be proprietary items which comply with SANS 62561. The spacing of these components shall be in accordance with the manufacturer's specification.

Conductor holders shall be a combination of clamping and non-clamping type as appropriate to allow for conductor expansion/contraction.

Air-termination rods shall be mounted so as to withstand wind loading stresses. Rods along the roof edge shall be located not more than half the rod height from the edge.

Conductive rooftop fixtures shall be protected by the air-termination system, or bonded to it, or located a suitable separation distance from it. However, none of the aforementioned measures needs to be taken if the dimensions of a fixture do not exceed all of the following values:

- (a) Height above the roof level 0,3 m
- (b) Total area of the fixture 1,0 m²
- (c) Length of the fixture 2,0 m

4.3 Preferred Materials

Air-termination conductors shall be at least 50 mm² (8 mm diameter) solid round aluminium or alternative as approved by the Engineer.

Unless otherwise specified in the Project Specification, air-termination rods shall be 15 mm diameter, 500 mm high, aluminium/aluminium alloy rods or alternative as approved by the Engineer.

5 Down-Conductor Systems

5.1 Natural Components

Reinforcing steel (rebars) in the concrete columns of new structures shall be used as natural down-conductors when specified in the Project Specification.

Specific rebars in the main structural columns shall be selected as down-conductors and the lightning protection installer shall check that these are electrically continuous from top to bottom with a resistance of not more than 0,2 ohm. A 4-pole resistance measuring device shall be used for this purpose to eliminate the effect of instrument lead resistance. Proof of the measurement shall be submitted to the Engineer.

The upper connection (for air-termination system to down-conductor connection) shall be made with two clamps to two separate rebars, and the lower connection (for down-conductor to earth termination system connection) shall be made with a single clamp. Exothermically-welded connections may be made in the place of clamps.

The above-mentioned connections shall be brought out to terminals on the face of the column to provide points for bolted connections of the air-termination system and earth termination system respectively to the down-conductor (rebar).

The lightning protection installer shall arrange and carry out joint inspections with the building Contractor to check that planned rebar interconnections and the upper and lower connections have been properly made before concrete pours.

Steel columns shall be used as natural down-conductors when specified in the Project Specification. Connections from the columns to the air termination system and to the earth termination system shall be bolted connections which shall be pre-approved by the Engineer before cast in concrete or bricked up.

5.2 Dedicated Down-Conductors

Dedicated down-conductors shall be provided as specified in the Project Specification where natural components cannot be used for this purpose.

The routing of a down-conductor shall be straight and vertical to provide the shortest and most direct path, and loops shall be avoided unless the requirements for separation distances in SANS 62305-3 can be met.

Fixing and connecting components shall be proprietary items which comply with SANS 62561. The spacing of these components shall be in accordance with the manufacturer's specification.

Conductor holders shall be a combination of clamping and non-clamping type as appropriate to allow for conductor expansion/contraction.

The lower end of each down-conductor shall terminate at a test joint from which the final connection to the earth termination system shall be made. It shall only be possible to open the test joint with the aid of a tool for the purposes of taking electrical measurements. Test joints shall be numbered by permanent means and the numbers recorded on the as-built drawings.

Where there is a potential hazard due to touch and step voltages in the vicinity of the down-conductors, protection measures shall be implemented as specified in the Project Specification or, if not specified, in accordance with SANS 62305-3 and subject to approval by the Engineer.

5.3 Preferred Materials

Dedicated down-conductors shall be 50 mm² (8 mm diameter) solid round aluminium or alternative as approved by the Engineer.

Connections to rebars shall be made with 50 mm² stranded copper conductor.

6 Earth Termination System

6.1 General

The earth termination system shall be provided in accordance with the Project Specification and Engineering Standard SPE-EE-0020 - "MV & LV Earthing".

For structures requiring a Type A earth termination system, it shall be utilized for lightning protection only. For structures requiring a Type B earth termination system, it shall serve as a multi-purpose earth electrode. (Type A and Type B arrangements are defined in SANS 62305-3.)

6.2 Connections to Earth Electrodes

Earth lead-in rods shall be provided to connect down-conductors to earth electrodes when specified in the Project Specification. Earth lead-in rods shall comply with the requirements of SANS 62561-2 and shall be fixed to the structure to provide a mechanically stable connection to the earth electrode.

Connections from terminals that are connected to rebars in concrete columns (refer 5.1.3) to earth electrodes shall be made with PVC-insulated stranded copper conductor. The conductor shall be run in galvanised steel conduit from just below the terminal to 300 mm below finished ground level.

Connections from steel columns to earth electrodes shall be made with PVC-insulated stranded copper conductor. The connection to the column shall be a bolted connection to the base plate of the column and shall be pre-approved by the Engineer.

Connections of the PVC-insulated stranded copper conductor to earth lead-in rods and earth electrodes shall be of the exothermically-welded type.

6.3 Preferred Materials

Earth lead-in rods shall be solid round 16 mm diameter stainless steel and of a suitable length to reach from a down-conductor test joint to 300 mm below finished ground level.

PVC-insulated copper conductor shall be 50 mm² unless otherwise specified in the Project Specification

7 Internal Lightning Protection System

7.1 General

Dangerous sparking between the lightning protection system and metal installations, external conductive parts, internal systems, and electrical lines connected to the structure to be protected, shall be avoided by means of equipotential bonding.

Main earthing bars provided as part of earth termination systems shall also serve as bonding bars for lightning equipotential bonding unless otherwise specified in the Project Specification.

Where dedicated lightning equipotential bonding bars shall be provided, these shall be connected to the main earthing bars with stranded bare copper conductors with a minimum cross-section of 16 mm².

7.2 Lightning Equipotential Bonding

Lightning equipotential bonding shall be provided for external conductive parts (e.g. metallic pipes) at the point of entry into the structure to be protected by means of bare stranded copper conductors sized to withstand the part of the lightning current calculated to flow through them. If direct bonding is not acceptable, bonding shall be via isolating spark gaps as specified in the Project Specification.

Lightning equipotential bonding shall be provided for internal metal installations (where these are not already bonded to the main earthing bars for electrical protection/safety reasons) by means of 6 mm² bare stranded copper conductors. This shall include but not be limited to electric cable supports, rails in lift shafts, air ducts, water pipes and gas pipes.

The bonding of internal system cables and the provision of surge protection devices will form part of the provision of the internal services.

The bonding of electrical lines connected to the structure to be protected and the provision of surge protection devices will form part of the provision of the connections.

8 Inspection and Testing

8.1 Testing

Where steel reinforcing in concrete columns is used as natural down-conductors, the electrical continuity shall be checked by way of a resistance measurement as specified in Clause 5.1.2.

The earth resistance of the earth electrode shall be measured as part of the scope of work for the earth termination system which is separately specified.

All lightning protection system earthing and equipotential bonding connections shall be subjected to continuity testing.

8.2 Inspection

The complete lightning protection system shall be inspected in accordance with the checklist in SANS 62305-3.

9 Documentation

9.1 General

All drawings, documentation and reports shall be in English, and each item shall be identified with:

- (a) Employer's name and contact details
- (b) Employer's contract reference title and number
- (c) Engineer's name and contact details
- (d) Engineer's reference number
- (e) Contractor's works / contract / order references

(f) Contractor's name and contact details

Drawings shall be provided on A1 or A3 paper copies as specified.

9.2 Drawings for Acceptance by the Engineer

Where alternative arrangement designs to those specified are proposed by the Contractor, drawings shall be submitted to the Engineer for his formal acceptance before construction commences.

9.3 Inspection and Testing Documentation and Reports

Records of all inspections and tests shall be submitted to the Engineer for acceptance before taking over of the works.

An installation safety report shall be issued on completion of all inspections and testing as per the proforma in Annex A of SANS 10313.

9.4 Operating and Maintenance Manual

As-built drawings, inspection and test reports, and the installation safety report shall be included in the Operating and Maintenance Manual which shall be provided under the Contract.

General specification

LV Soft Starters

Specification number: SPE-EE-0024

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Specification no.		SPE-EE-0024			
Rev	Date	Revision details / status	Author	Reviewer	Approver
0	2015/06/25	First Issue	M Hendricks	K O'Kennedy	O Fair
Signature					

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1 Scope

1.1 Application

This standard specification (referred to hereafter as "this Specification") covers a.c. soft starters with rated output voltages up to 1000 V.

The soft starters covered by this Specification are for use with 50 Hz a.c. three-phase LV cage induction motors.

Soft starters are also referred to by certain manufacturers as "motor controllers". The IEC term for a soft starter as used in this Specification (i.e. a motor controller with overload protection) is "semiconductor motor starter".

1.2 General Requirements

Soft starters shall be rated to suit the characteristics of the motor-driven loads specified in the Project Specification.

Unless otherwise specified in the Project Specification, soft starters shall be installed in LV Assemblies which are covered by Engineering Standard SPE-EE-0010 "LV Switchgear and Controlgear Assemblies."

The PC boards of soft starters that are installed at waste water pump stations and treatment works, or in other corrosive environments, shall be protected with a conformal coating.

Soft starters shall be equipped with integral fans which operate automatically as required to maintain an acceptable operating temperature.

2 Standards

2.1 Associated Documentation

This Specification shall be read in conjunction with SANS 60947: Low-voltage switchgear and controlgear Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters.

This Specification contains standard amendments and additional requirements which shall be applied to the referenced statutory and national standards. Project-specific requirements are provided in the Project Specification, which shall be read in conjunction with this Specification.

2.2 Statutory Requirements

The soft starters shall comply with the following:

- (a) Occupational Health and Safety Act 85 of 1993 and Regulations
- (b) SANS 10142-1 The Wiring of Premises Part 1: Low-voltage Installations

2.3 Reference Standards

The following national standards shall be complied with as applicable:

Table 1: National Standards

SANS Number	Description
SANS 60947-1	Low-voltage switchgear and controlgear Part 1: General rules
SANS 60947-4-2	Low-voltage switchgear and controlgear Part 4-2: Contactors and motor-starters - AC semiconductor motor controllers and starters

3 Characteristics of Soft Starters

3.1 Type of equipment

The soft starters shall be semiconductor motor starters of the Form 1 type to provide any combination of manoeuvring, controlled acceleration, running or controlled deceleration of the associated motors as specified in the Project Specification.

Three-phase soft starters shall have three main poles, and all three shall be controlled by semiconductor switching elements so that all phases are controlled. However, two phase control may be used for motors rated 15 kW and lower unless otherwise specified in the Project Specification.

The interrupting medium of integral contactors shall be air.

The controllers shall be symmetrically controlled with anti-parallel thyristors so that controlled phases are fully controlled.

The method of control (automatic and/or manual initiation of start/stop) shall be as specified in the Project Specification.

Unless otherwise specified in the Project Specification, the soft starters shall be connected in-line (i.e. between the supply and the motors) and not inside the delta of the motor windings. Soft starters with two phase control shall never be connected inside the delta.

3.2 Rated and limiting values for main circuits

Rated voltages shall be as follows:

- (a) Rated operational voltage U_n : to match rated voltage of associated motors
- (b) Rated insulation voltage U_i : minimum $U_n + 10\%$
- (c) Rated impulse withstand voltage U_{imp} : 4 kV unless protected to a lower level

Rated currents shall be as follows:

- (a) Conventional enclosed thermal current I_{the} : to suit installation in MCC
- (b) Rated operational current I_e : to suit operational power requirement
- (c) Rated uninterrupted current I_u : shall be equal to I_e

Rated frequency: 50 Hz

Rated duty: Uninterrupted duty (non-bypassed) or periodic duty (bypassed) with duty cycle values to suit application

Rated conditional short-circuit current: to suit upstream short-circuit protection device

3.3 Utilization category

The utilization category of the soft starters shall be AC-53a.

3.4 Control circuits

The control supply voltage U_s shall be that of the LV Assembly in which the soft starters are installed.

The control circuit voltage U_c shall be that of the LV Assembly in which the soft starters are installed.

3.5 Protection of soft starters and motors

All soft starters shall have integral overtemperature/thermal protection.

Soft starters for motors up to 55 kW shall provide the following minimum protection, either integral to the soft starter or with the use of additional relays:

- (a) Electronic motor overload
- (b) Phase loss
- (c) Phase unbalance
- (c) Phase sequence

Soft starters for motors over 55 kW shall provide the following protection in addition to that specified in Clause 3.5.2, either integral to the soft starter or with the use of additional relays:

- (a) Overcurrent/short-circuit
- (b) Earth fault
- (c) Starts per hour
- (c) Stall (locked rotor under starting conditions)
- (e) Thermistor/RTD input to suit motor thermal protection requirements

The following additional protection shall be provided where specified in the Project Specification:

- (a) Underload (undercurrent)
- (b) Over- and Undervoltage
- (c) Jam (locked rotor under running conditions)

3.6 Co-ordination with short-circuit protective devices

Soft starters shall be protected by separate upstream short-circuit protective devices (SCPDs) as specified in the Project Specification.

The SCPDs shall be selected to provide Type 2 co-ordination with the soft starters and line and bypass contactors.

Where required for Type 2 co-ordination, semiconductor fuses shall be provided between circuit breakers and soft starters.

3.7 Control settings

The following soft starter control settings shall be provided as a minimum:

- (a) Initial start voltage

- (b) Start ramp time
- (c) Stop ramp time
- (d) Motor full load current
- (e) Current limit

Where specified in the Project Specification the following additional control settings shall be provided:

- (a) Kickstart (voltage/current boost)
- (b) Torque control

4 Line-, Bypass and PFC Contactors

4.1 Line contactors

Unless otherwise specified in the Project Specification, a line contactor shall be provided upstream of a soft starter to provide galvanic disconnection of the soft starter when in the OFF state.

Emergency stop devices shall be hardwired into the contactor control circuit in addition to providing a signal to the soft starter.

Where protection relays are provided to supplement the protection functions of a soft starter, the relays shall be wired to trip the line contactor and turn off the soft starter.

Type 2 co-ordination shall be provided between line contactors and upstream SCPDs.

Line contactors shall have an AC3 rating.

4.2 Bypass contactors

Unless otherwise specified in the Project Specification, a soft starter shall be equipped with an integral bypass contactor.

Where it is impracticable for a soft starter to have an integral bypass contactor, a separate bypass contactor shall be provided and the soft starter shall be configured to control the contactor as it would an integral one.

Integral and separate bypass contactors shall have an AC1 rating when a line contactor is provided, and an AC3 rating to allow emergency DOL starting in the event of a soft starter failure when no line contactor is provided.

All integral protection shall remain functional after a bypass contactor has closed.

4.3 PFC contactors

Where power factor correction (PFC) is provided per individual drive, the PFC capacitors shall be connected to the soft starter input circuit by means of a contactor.

The PFC contactor shall be controlled by the soft starter so that the PFC is only connected once the soft starter bypass contactor has closed on starting, and the PFC shall be disconnected when the bypass contactor opens and before ramp down starts.

PFC contactors shall have an AC6b rating.

5 Operator and Process Control Interfaces

5.1 Operator control interface

Soft starters with ratings larger than 30 kW shall be equipped with an integral operator interface in the form of an LCD or LED display and a keypad for functional settings and diagnostic messages.

A remote operator interface shall be provided in the door of the LV Assembly compartment housing the soft starter if specified in the Project specification.

Where a remote operator interface is not provided, a window shall be provided in the compartment door so that the soft starter's integral display and indicator lights can be viewed with the door closed.

Soft starters with ratings up to 30 kW shall as a minimum be equipped with rotary switches (potentiometers), DIP/slide switches and LED indicator lights for functional settings and diagnostic indication.

5.2 Process control interface

Soft starters with ratings larger than 30 kW shall provide a communication link via serial, parallel, network or fieldbus interface to a control system such as a programmable logic controller (PLC), motion control or drive control system. Preference will be given to soft starters that offer control interfaces and communications links with generic mappings to the various industry standard communications protocols.

When stated in the Project Specification, the soft starter shall support one or more of the following industry standard communications interfaces and protocols:

- (a) CANopen
- (b) EtherCAT
- (c) Ethernet
- (d) Powerlink
- (e) DeviceNet
- (f) ControlNet
- (g) EtherNet/IP
- (h) PROFIBUS
- (i) PROFINET
- (j) SERCOS

The data to be transferred between the control system and the soft starter via the communications link shall be specific to the application and shall be clearly documented in the control system functional design specification (FDS) to be drawn up by the Contractor. For process control applications the minimum data to be transferred and displayed on the HMI / SCADA shall be the following:

- (a) A unique soft starter identifier
- (b) State of operation
- (c) Values of selected inputs and outputs (as defined in the FDS)
- (d) Soft starter commands (when in remote control mode)

6 Installation

6.1 General

Unless otherwise specified in the Project Specification, soft starters shall be installed in LV Assemblies covered by Engineering Standard SPE-EE-0010 "LV Switchgear and Controlgear Assemblies."

Soft starter installation clearances and airflow requirements shall be provided to the LV Assembly designer to ensure that adequate cooling is provided to prevent a soft starter from overheating.

7 Testing and Commissioning

7.1 Manufacturer's tests

All models of soft starters provided under the Contract shall have been subjected to type tests.

All soft starters provided under the Contract shall have been subjected to routine tests.

7.2 Factory tests

All control and protection functions of soft starters shall be tested in the factory after installation in LV Assemblies.

Where soft starters are too large to be fully tested in the factory, site tests may be carried out instead with the Engineer's approval.

7.3 Commissioning tests

The functionality of soft starters shall be tested as part of the overall commissioning of completed electrical and control systems.

8 Documentation and Training

8.1 General

All drawings and documentation shall be in English, and each item shall be identified with:

- (a) Employer's name and contact details
- (b) Employer's contract reference title and number
- (c) Engineer's name and contact details
- (d) Engineer's reference numbers
- (e) Contractor's works / contract / order references.

Drawings submitted to the Engineer for review and/or approval as specified shall be A4 or A3 paper copies as appropriate.

8.2 Drawings for Review/Approval by the Engineer

The following soft starter design documentation and drawings shall be submitted to the Engineer:

- (a) General arrangement drawings
- (b) Electrical schematic diagrams showing all equipment and components incorporated into the soft starter
- (c) Cooling requirements and arrangements

8.3 Test Documents and Reports

Type and routine test certificates shall be provided for the soft starters if specified in the Project Specification.

The results of any site tests shall be included in site test reports.

8.4 Operating and Maintenance Manual

A draft operating and maintenance manual shall be submitted to the Engineer for approval within the specified time before site acceptance testing and commissioning may commence. The final approved version shall be submitted in accordance with the Contract.

The Operating and Maintenance (O&M) Manual shall include the following:

- (a) All design and manufacturing drawings and documentation relating to the soft starters
- (b) All test certificates, test procedure records and test result reports for factory and site tests
- (c) A components list and product data sheets for all soft starter major components
- (d) A spares list with parts' and suppliers' details
- (e) Operating instructions
- (f) Maintenance instructions and schedules
- (g) Protection setting records

8.5 Training

The following general requirements relating to training shall be met if training is specified as a requirement for specific soft starters in the Project Specification

- (a) The soft starter supplier shall conduct training courses on site for the Employer's staff in the maintenance and operation of the soft starters. The number of training courses and staff to be trained shall be as specified in the Project Specification
- (b) The training shall cover both theoretical and practical aspects of operation and maintenance, and the soft starters shall therefore be in complete working order before training may commence
- (c) A training schedule, together with the name and background of the person who will perform the training, shall be submitted to the Engineer for approval
- (d) Training and training manuals shall be based on the O&M Manual
- (e) Training manuals shall be issued to each trainee with two additional copies delivered for archiving at the project site. The manuals shall include an agenda and defined objectives for each course
- (f) Where portions of the course are in the form of audio-visual presentations, copies of those audio-visual presentations on DVD shall be provided to the Employer and hard copies of the visuals shall be included in the printed training manuals

(g) The Employer reserves the right to videolape the training sessions for later use

The training courses shall be split into training for operational staff and training for maintenance staff.

Upon completion of the courses the trainees' knowledge shall be formally tested to prove that an acceptable level of competency has been achieved

**ELECTRICAL INSTALLATION
DRAWINGS**

DRAWING TITLE

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IMPACT. ENGINEERED.



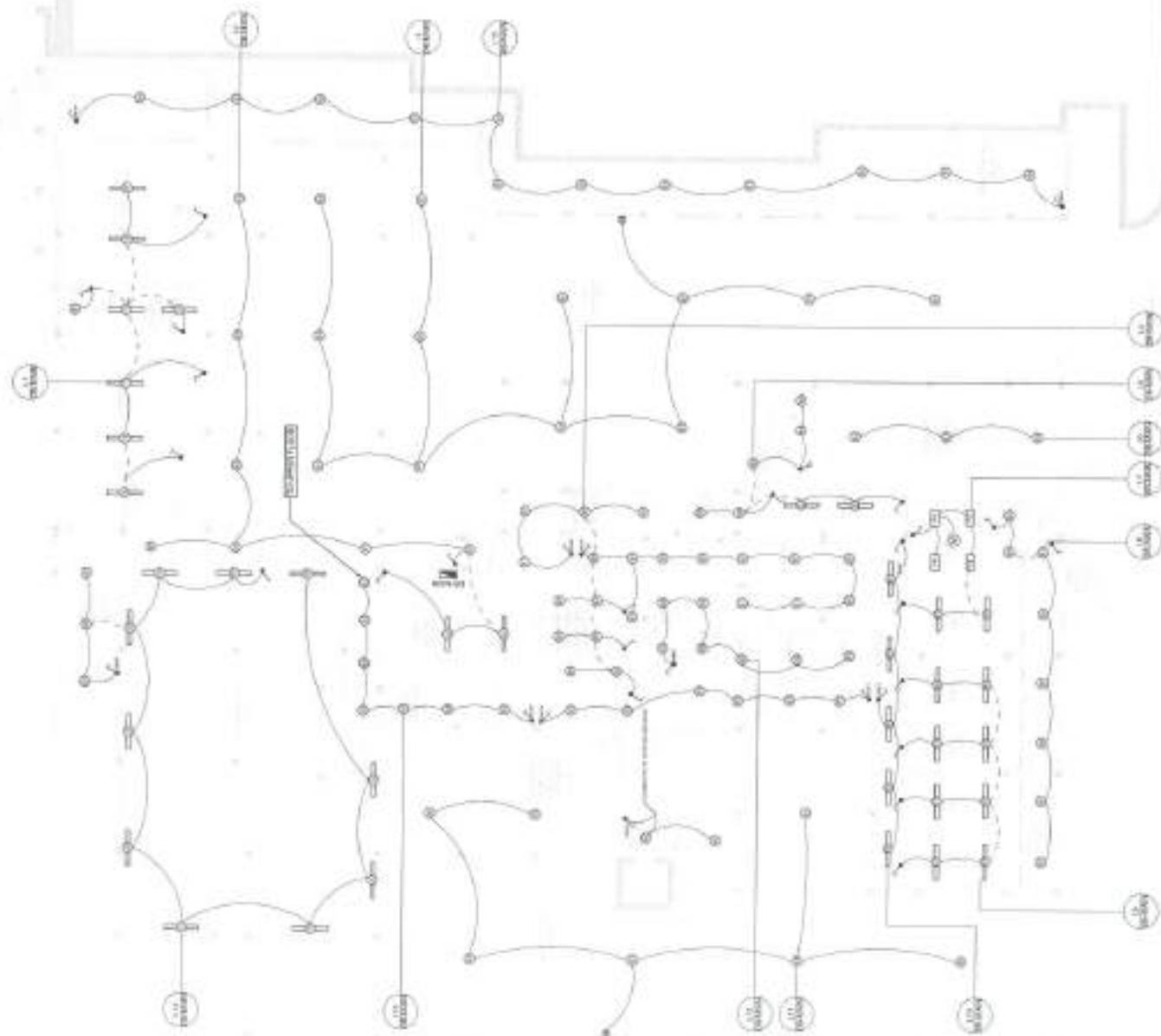
THE UNIVERSITY OF CHICAGO

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LIST OF DRAWINGS

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NEW MAGISTRATES COURT, JAM KEMPOUR
IN THE DISTRICT OF TIRUPATI

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- 2. MECHANICAL SYMBOLS
- 3. PIPING SYMBOLS
- 4. PLUMBING SYMBOLS
- 5. SANITARY SYMBOLS
- 6. AIR CONDITIONING SYMBOLS
- 7. LIGHTING SYMBOLS
- 8. FLOOR FINISHES
- 9. WALL FINISHES
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- 11. ROOF FINISHES
- 12. LANDSCAPE SYMBOLS
- 13. FURNITURE SYMBOLS
- 14. OTHER SYMBOLS

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LOCATION: JAM KEMPOUR

DATE: 10/01/2023

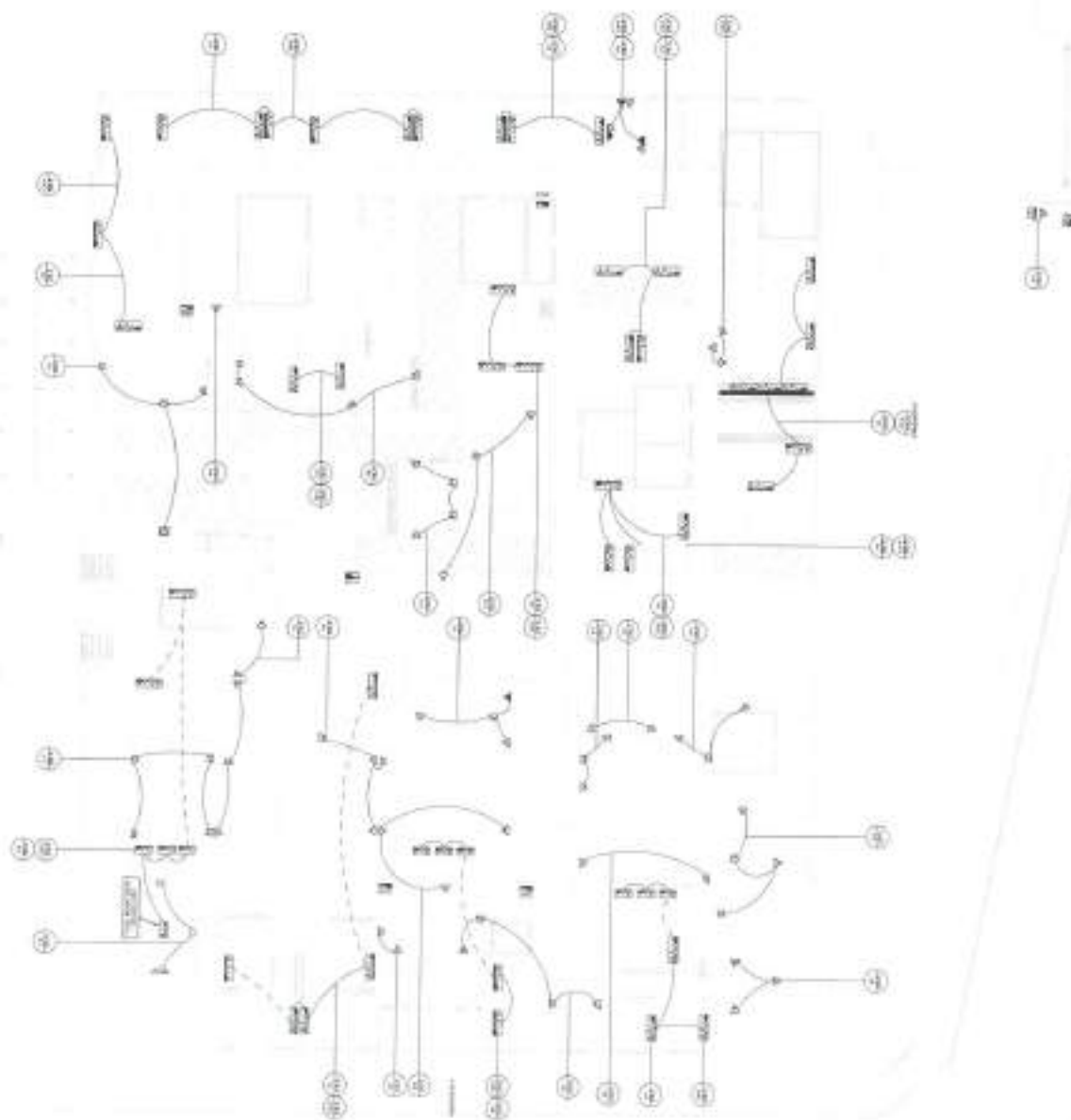
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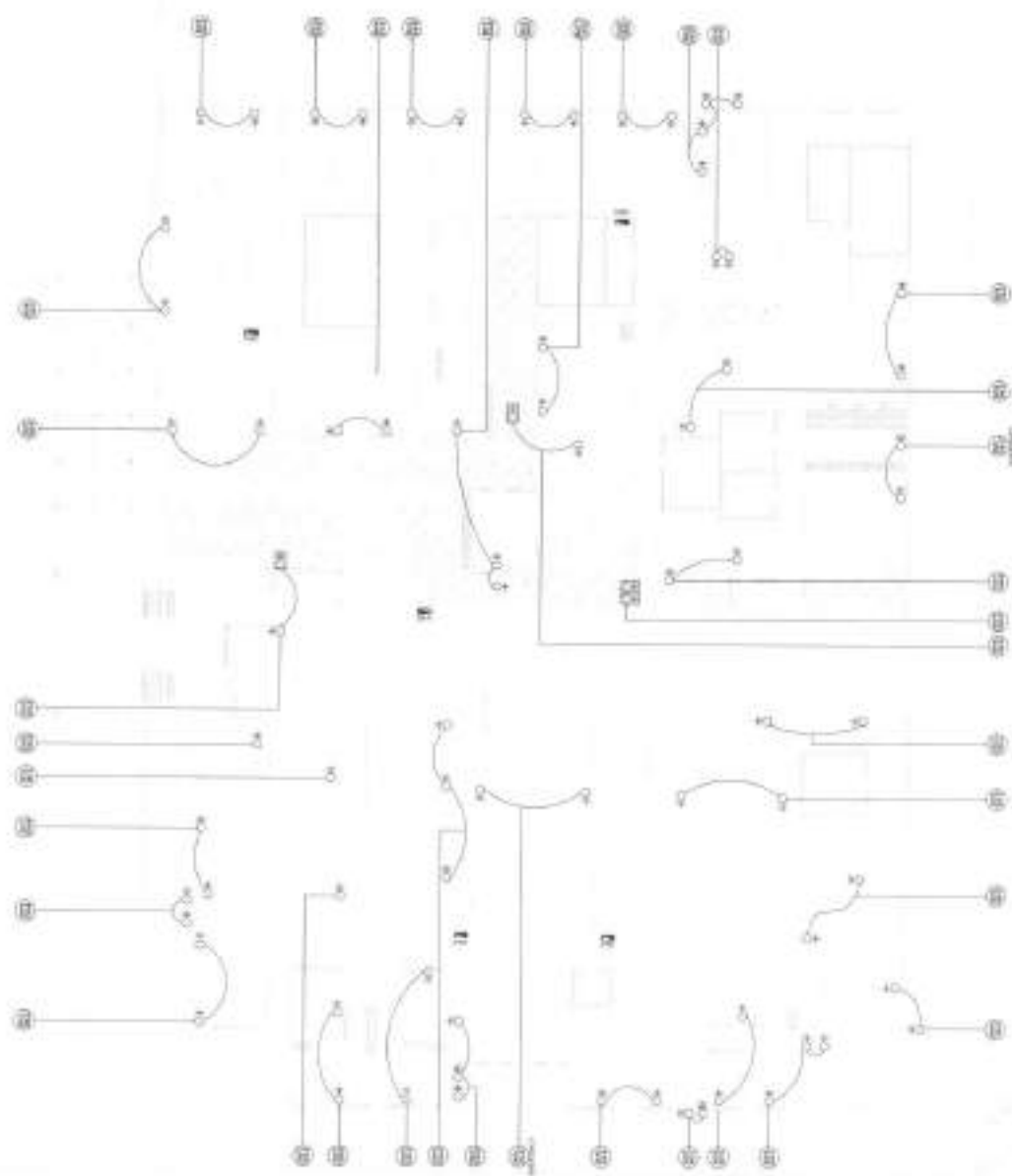
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NEW ADMINISTRATES COURT

JAN KEMP CORP.
COLUMBIEN, PA.

GROUND LEVEL
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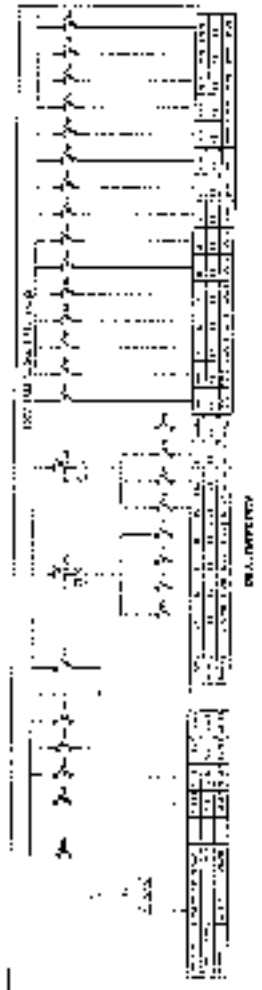
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ZUTARI
MIND YOUR NEEDS.

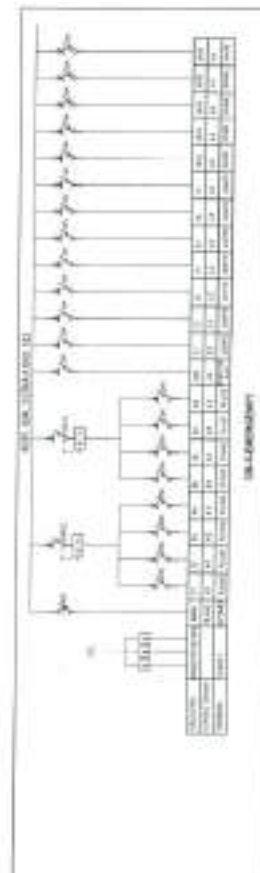
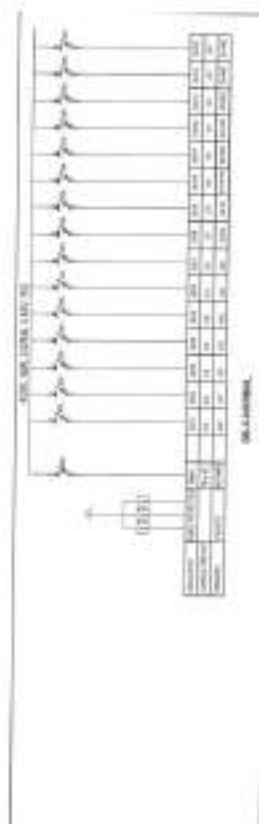
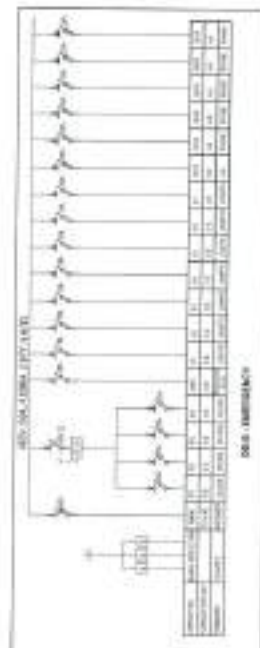


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| 28 | 10/1/87 | W. H. H. H. | W. H. H. H. | 28 |
| 29 | 10/1/87 | W. H. H. H. | W. H. H. H. | 29 |
| 30 | 10/1/87 | W. H. H. H. | W. H. H. H. | 30 |
| 31 | 10/1/87 | W. H. H. H. | W. H. H. H. | 31 |
| 32 | 10/1/87 | W. H. H. H. | W. H. H. H. | 32 |
| 33 | 10/1/87 | W. H. H. H. | W. H. H. H. | 33 |
| 34 | 10/1/87 | W. H. H. H. | W. H. H. H. | 34 |
| 35 | 10/1/87 | W. H. H. H. | W. H. H. H. | 35 |
| 36 | 10/1/87 | W. H. H. H. | W. H. H. H. | 36 |
| 37 | 10/1/87 | W. H. H. H. | W. H. H. H. | 37 |
| 38 | 10/1/87 | W. H. H. H. | W. H. H. H. | 38 |
| 39 | 10/1/87 | W. H. H. H. | W. H. H. H. | 39 |
| 40 | 10/1/87 | W. H. H. H. | W. H. H. H. | 40 |
| 41 | 10/1/87 | W. H. H. H. | W. H. H. H. | 41 |
| 42 | 10/1/87 | W. H. H. H. | W. H. H. H. | 42 |
| 43 | 10/1/87 | W. H. H. H. | W. H. H. H. | 43 |
| 44 | 10/1/87 | W. H. H. H. | W. H. H. H. | 44 |
| 45 | 10/1/87 | W. H. H. H. | W. H. H. H. | 45 |
| 46 | 10/1/87 | W. H. H. H. | W. H. H. H. | 46 |
| 47 | 10/1/87 | W. H. H. H. | W. H. H. H. | 47 |
| 48 | 10/1/87 | W. H. H. H. | W. H. H. H. | 48 |
| 49 | 10/1/87 | W. H. H. H. | W. H. H. H. | 49 |
| 50 | 10/1/87 | W. H. H. H. | W. H. H. H. | 50 |
| 51 | 10/1/87 | W. H. H. H. | W. H. H. H. | 51 |
| 52 | 10/1/87 | W. H. H. H. | W. H. H. H. | 52 |
| 53 | 10/1/87 | W. H. H. H. | W. H. H. H. | 53 |
| 54 | 10/1/87 | W. H. H. H. | W. H. H. H. | 54 |
| 55 | 10/1/87 | W. H. H. H. | W. H. H. H. | 55 |
| 56 | 10/1/87 | W. H. H. H. | W. H. H. H. | 56 |
| 57 | 10/1/87 | W. H. H. H. | W. H. H. H. | 57 |
| 58 | 10/1/87 | W. H. H. H. | W. H. H. H. | 58 |
| 59 | 10/1/87 | W. H. H. H. | W. H. H. H. | 59 |
| 60 | 10/1/87 | W. H. H. H. | W. H. H. H. | 60 |
| 61 | 10/1/87 | W. H. H. H. | W. H. H. H. | 61 |
| 62 | 10/1/87 | W. H. H. H. | W. H. H. H. | 62 |
| 63 | 10/1/87 | W. H. H. H. | W. H. H. H. | 63 |
| 64 | 10/1/87 | W. H. H. H. | W. H. H. H. | 64 |
| 65 | 10/1/87 | W. H. H. H. | W. H. H. H. | 65 |
| 66 | 10/1/87 | W. H. H. H. | W. H. H. H. | 66 |

Legend



ZUTARI
 IMPACT. ENG. - ERES.



PROJECT
 NEW MAGISTRATES COURT
 JAN HEBERD DRP

CLIENT
 THE STATE OF KENYA
 MINISTRY OF JUSTICE
 DEPARTMENT OF LEGAL SERVICES

DESIGNER
 ZUTARI ENGINEERING
 101-102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

RE-CONCRETE

SINGLE LINE DIAGRAM
 SHEET 1 OF 3