# ELECTRICAL SPECIFICATION

# PW 371-B

**EDITION 2.2**

Department:
Public Works

REPUBLIC OF SOUTH AFRICA

# CONSTRUCTION WORKS: SPECIFICATIONS

## PARTICULAR SPECIFICATION

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# Particular Specification

(read with PW371-A)

This specification falls under the Scope of Work as defined in *Standard for Uniformity in Construction Procurement,* published by the Construction Industry Development Board (CIDB), and is based on national or international standards, where such exist.

## Ntshongwe Satelite Police Station

Works: ……..Ref no: …….

# TABLE OF CONTENTS


**1 EARTHWORKS ..... 1-1**

1.1 Site clearance ..... 1-1
1.2 Earthworks (general) ..... 1-1

**2 CONCRETE WORKS ..... 2-1**

2.1 Structural works (SANS 2001-CC1) ..... 2-1
2.2 Minor works (SANS 2001-CC2) ..... 2-2
2.3 Foundations (SANS 2001-CM2) ..... 2-2
2.4 Concrete floors and paving on the ground ..... 2-3
2.5 Strongrooms ..... 2-3

**3 MASONRY ..... 3-1**

3.1 Masonry Walling (SANS 2001-CM1) ..... 3-1
3.2 Glass blockwork ..... 3-2
3.3 Stone masonry ..... 3-3
3.4 Masonry-type facings ..... 3-3

**4 STRUCTURAL TIMBERWORK ..... 4-1**

4.1 Structural timberwork (flooring) (SANS 2001-CT1) ..... 4-1
4.2 Structural timberwork (roofing) (SANS 2001-CT2) ..... 4-2
4.3 Structural laminated timber (SANS 1460) ..... 4-2

**5 STRUCTURAL STEELWORK ..... 5-1**

5.1 Structural steelwork (SANS 2001-CS1) ..... 5-1
5.2 Sundry steelwork ..... 5-1
5.3 Coating ..... 5-1
5.4 Fire protection ..... 5-2

**6 INSULATION, SEALANTS, SEALS ..... 6-1**

6.1 Thermal insulation ..... 6-1
6.2 Vapour barriers ..... 6-3
6.3 Sound absorption ..... 6-3
6.4 Joint fillers/sealants ..... 6-3
6.5 Architectural seals ..... 6-3

**7 ROOF COVERINGS, CLADDING ..... 7-1**

7.1 General ..... 7-1
7.2 Tile roofing/cladding ..... 7-1
7.3 Profiled sheet roofing/cladding ..... 7-2
7.4 Fully-supported metal sheet roofing and cladding ..... 7-4
7.5 Thatch roofing ..... 7-4
7.6 Flashings, trim ..... 7-5
7.7 Fascias and barge boards ..... 7-5

**8 WATERPROOFING ..... 8-1**

8.1 Materials ..... 8-1
8.2 Preparation ..... 8-1
8.3 Application ..... 8-2
**1.5** Waterproofing surface finishes/protection ..... 8-2

**9 CEILINGS, LININGS, PARTITIONS, ACCESS FLOORING ..... 9-1**

9.1 Brandered ceilings ..... 9-1
9.2 Suspended ceilings ..... 9-2
9.3 Partitions, linings ..... 9-3
9.4 Raised access flooring ..... 9-5

**10 WINDOWS, DOORS, CURTAIN WALLS, SKYLIGHTS, SOLAR CONTROL....10-1**

10.1 Performance....10-1
General requirements....10-1
10.3 Steel frame units....10-2
10.4 Cold-rolled steel frame units....10-3
10.5 Aluminium frame units....10-3
10.6 Adjustable glass louvre windows....10-4
10.7 Wood frame units....10-4
10.8 PVC-U frame units (SANS 1553)....10-4
10.9 Polymer concrete frame units....10-4
10.10 Wood doors (SANS 545)....10-4
10.11 Fire doors and fire shutters (SANS 1253)....10-5
10.12 Garage doors....10-5
10.13 Roller shutter doors....10-5
10.14 Strongroom/record room doors, ventilators....10-6
10.15 Solar control....10-6

**11 PLASTER, SCREEDS, TOPPINGS, TERRAZZO....11-1**

11.1 Plaster....11-1
11.2 Screeds, toppings, terrazzo....11-1

**12 TILING....12-1**

12.1 Materials....12-1
12.2 Tiling....12-2
12.3 Jointing....12-2
12.4 Movement joints....12-2

**13 FLOOR COVERINGS, WALL LININGS....13-1**

13.3 Thermoplastic and similar flexible floor covering....13-1
13.4 Wood flooring, solid and laminate, on solid substrates....13-2
13.5 Textile flooring....13-3
13.6 Epoxy flooring....13-4

**14 PAINTING, PAPERHANGING....14-1**

14.1 Materials....14-1
14.2 Preparation of surfaces....14-2
14.3 Colours....14-2
14.8 Paint systems for on-site application....14-2
14.9 Paperhanging....14-2

**15 FURNITURE, EQUIPMENT, STAIRS, ARCHITECTURAL METALWORK....15-1**

15.1 Joinery....15-1
15.2 Commercial kitchen cupboards (SANS 1385)....15-4
15.3 Commercial steel furniture (SANS 757)....15-5
15.4 Metal counters, balustrades, cladding, signs, street furniture....15-5
15.5 Stairs and ramps....15-6

**16 HARDWARE....16-1**

16.1 General....16-1
16.2 Fasteners....16-1
16.3 Locks, latches, catches, bolts....16-1
16.4 Hinges....16-2
16.5 Door closers....16-2
16.6 Pelmets, curtain rails, rods, blinds....16-3
16.7 Edge, feature, dividing strips....16-3
16.8 Sunken door matting....16-3
16.9 Number/name plates, safety signs....16-3
16.10 Drawer runners/slides....16-4

**17 GLAZING ..... 17-1**

17.1 MATERIALS ..... 17-1
17.2 GLAZING ..... 17-1
17.3 MIRRORS ..... 17-2

**18 DRAINAGE, SEWERAGE, WATER AND GAS SUPPLY, FIRE EQUIPMENT, SANITARY PLUMBING ..... 18-1**

18.1 ROOF EAVES DRAINAGE ..... 18-1
18.2 FLAT CONCRETE ROOF, BALCONY AND FLOOR DRAINAGE ..... 18-2
18.3 STORMWATER DRAINAGE ..... 18-2
18.4 SEWERAGE ..... 18-3
18.5 WATER SUPPLY ..... 18-5
18.6 ELECTRIC GEYSERS AND SOLAR WATER HEATERS ..... 18-6
18.8 FIRE EQUIPMENT ..... 18-6
18.9 SANITARY PLUMBING ..... 18-7

**19 ELECTRICAL WORKS ..... 19-1**

19.1 EARTHWORKS (SANS 2001-DP1) ..... 19-1
19.2 CABLE DUCTS (UNDERGROUND) (SANS 2001-DP3) ..... 19-1
19.3 MATERIALS AND INSTALLATION ..... 19-1

**20 MECHANICAL WORKS ..... 20-1**

20.1 INSTALLATION ..... 20-1
20.3 LOCATION AND ACCESS ..... 20-1

**21 EXTERNAL WORKS ..... 21-1**

21.1 PAVING ..... 21-1
21.2 CONCRETE CULVERTS, KERBS, CHANNELS ..... 21-2
21.3 CONCRETE RETAINING BLOCKS ..... 21-2
21.4 GABIONS ..... 21-3
21.5 FENCING ..... 21-3
21.6 PRECAST CONCRETE PLANK WALLING ..... 21-4
21.7 SWIMMING POOLS ..... 21-4
21.8 TIMBER DECKING ..... 21-4
21.9 LANDSCAPING ..... 21-5

# 1 Earthworks

## 1.1 Site clearance

*Applicable standard*: SANS 2001 – Construction Works Part BS1: Site clearance

*Specification data:*

### ▪ Areas to be cleared and grubbed

- The following areas shall be cleared or grubbed (or both):

a) the borrow areas,
b) the designated areas on which excavations are to be carried out and embankments and structures are to be constructed, and
c) the areas on which material is to be stockpiled.

- The general shape, profile, and levels of the areas that are cleared or grubbed shall not be materially altered during clearing and grubbing operations.

- Unless otherwise specified in the specification data (see annex A), the designated areas in roadworks shall comprise the portions of the road reserve that fall within the limits of the road prism.

### ▪ Clearing

- Clearing shall consist of any of the activities described in table 1, as specified in the specification data.

**Table 1 -Site clearing activities**

| 1 | 2 |
|---|---|
| **Activity number** | **Description of activity** |
| 1 | The removal and disposal of all trees and bushes (complete with roots), other vegetation, rubbish, hedges, fences, and all other material that might interfere with the construction of other works. |
| 2 | The demolition, breaking up and removal of buildings, walls, structures and all superficial obstructions on the site affected by the works down to original ground level. |
| 3 | The demolition, breaking up and removal of underground structures, such as foundations and chambers of masonry or concrete construction to a depth specified in the specification data. |
| 4 | The demolition, breaking up and removal of underground structures, such as septic tanks and soak pits. |
| 5 | The removal of all litter, building rubble, rocks and boulders that are lying on the surface to be cleared, or exposed during the clearing operations. |
| 6 | The removal and stacking of reusable materials as specified in the specification data. |
| 7 | The breaking up and complete removal of all pavement layers and concrete haunching, which would normally entail the use of mechanical break-out equipment. |
| 8 | The breaking up and complete removal of sidewalks, ramps, parapets, paving slabs, blocks, slate paving, brick paving, and the like. |
| 9 | The breaking up and removal of kerbs and channels or haunching (or both). |
| 10 | The scarifying, loosening and breaking up of hardened areas by ripping or excavation to a depth specified in the specification data such that the maximum dimension of any residual block is not greater than 200 mm. |
| 11 | The removal of disused foul water and stormwater sewers, drains and water mains. |

- The work associated with activities 2 and 3 (see table 1) shall include:

a) excavation to expose the obstruction, including the measures required to stabilize the sides of the excavation, and
b) the breaking out, removal and disposal of the material causing the obstruction.

- All incoming and outgoing pipes of abandoned underground structures or obstructions shall be sealed with

a) grade 15 concrete which complies with the requirements of SANS 2001-CC1 or SANS 2001-CC2, or
b) 230 mm thick masonry, using masonry units with a minimum compressive strength of 10 MPa, in accordance with the requirements of SANS 2001-CM1.

- The work associated with activity 11 (see table 1) shall include:

a) the breaking up of pavements and excavation to expose the sewer, drain or water main, including the measures required to stabilize the sides of the excavation;
b) either the reclamation of the pipe or the breaking up and disposal of the pipe together with any bedding and concrete haunching to such pipe(s) as specified in the specification data;
c) backfilling trenches in accordance with the requirements of SANS 2001-DP1;
d) the disposal of surplus and unusable material; and
e) the sealing of ends of sewers and drains in accordance with the requirements of abandoned underground pipes.

- Material obtained from clearing and grubbing and from the demolition of structures shall be disposed of in borrow pits or other suitable places, as specified in the specification data, and shall be covered with soil or gravel. Combustible material on site may be disposed of by means of burning, unless otherwise specified in the specification data.

- All tree trunks and branches of girth exceeding 0,5 m shall be stripped of secondary branches, sawn into transportable lengths and stacked at designated sites, as specified in the specification data.

- Fencing wire shall be neatly wound into rolls or coils and all such wire, together with all fence posts and other reusable material from structures, etc., shall be stacked at sites specified in the specification data.

- Materials other than fencing referred to in terms of the specification data, are to be reused, shall be stacked at sites specified in the specification data.

- The branches of trees that are to be left standing shall be so trimmed as not to encroach upon the space (of height at least 7 m) vertically above any carriageway, railway formation, or other designated area.

- Individual trees that, in terms of the scope of work, are identified to be conserved, shall be left standing, uninjured and protected against damage from all construction activities.

- Where required in terms of the scope of work, all turf, plants, bushes and shrubs that are identified to be conserved, shall be carefully removed, maintained and replaced and replanted on completion of the works.

- If during the period of construction vegetation should again grow on any portion of the site, borrow areas, or other areas that have been cleared in accordance with this part of SANS 2001 , re-clearing might be require. Such re-clearing shall include the removal and disposal of grass, shrubs and other vegetation, as in the first clearing operation.

- Where topsoil is required to be conserved in terms of the specification data, the topsoil together with any grass and other suitable vegetation shall be removed and placed in accordance with the provisions of the scope of work. If not used immediately, such topsoil shall be temporarily stockpiled for later use.

- When so required in terms of the specification data, certain designated flora encountered in areas to be cleared, including borrow areas, shall be conserved. Such designated flora shall be carefully removed, transplanted in a fenced-off protected area, maintained and replanted on the site or in the borrow areas (as relevant) in accordance with the scope of work.

## ▪ Compliance with the requirements

a) The required levels of compaction shall be established by means of the sand replacement or nuclear method in accordance with the requirements ofTMH1-A 1 O(a) and TMH 1-A 1 O(b), respectively.

b) The density of the backfilling may be compared to the density of the surrounding ground by comparing the number of blows required by a dcp, determined in accordance with TMH6-ST6 to penetrate each 100 mm of soil, provided that the materials that are compared do not comprise more than 10% gravel of size less than 10mm, and contain no isolated boulders. The backfilling shall require more blows to penetrate each 100 mm layer.

## 1.2 Earthworks (general)

*Applicable standard*: SANS 2001-Construction works Part BE1: Earthworks (general).

Specification data:

### a) Requirements

### a) Materials

a) The following materials shall, unless otherwise specified in the specification data (see annex A), be suitable for embankments and terraces:

f) material with a CBR of at least 3% at the minimum specified density (compacted at OMC) and a PI not exceeding 18; or
g) hard material or rock material with a maximum dimension of 300 mm; or
h) both clay or clayey material of a liquid limit that exceeds 40, or PI that exceeds 18 (or both), and rocks or boulders that have a maximum dimension greater than 300 mm, provided that they are not placed against structures, or embankments.

b) The backfill in overbreak for foundations shall be capable of sufficient compaction to avoid settlement and shall be capable of placement without significant voids.

c) The backfill shall not contain appreciable quantities of organic matter or stones of average dimension exceeding the lesser of 150 mm or two-thirds of the thickness of the layer being compacted. In addition, the backfill shall be graded material that has a PI not exceeding 10 and a CBR of at least 10% at the minimum specified density compacted at OMC.

d) The material placed as backfill or as fill within 500 mm of structures shall not contain more than 10% rock or hard fragments retained on a sieve of nominal aperture size 50mm.

e) The sub-ballast shall have a PI that does not exceed 10 and a CBR of at least 25 % at the minimum specified density compacted at OMC.

f) Where topsoil is required for later use on the site, the topsoil shall be selected and stockpiled.

g) suitable for backfilling, filling against the finished structures, or placement in embankments and fills shall be stockpiled in the vicinity of the structures, or if it cannot be placed directly in the embankment or fill, in the vicinity of the embankment or fill. All other material from excavations and cuttings shall be disposed of on the site, or in accordance with the scope of work, in such a manner that material can be placed with confidence in the correct position in embankments. Any material that is below the finished level of an excavation that is unsuitable, shall be excavated and disposed of. The resultant space shall be refilled with backfill and compacted.

### b) Methods and procedures

a) All areas in which excavation is to take place or that are to be covered by terraces, banks or structures shall be:
a) cleared in accordance with the requirements of SANS 2001-BS1 , or
b) cleared and stripped of all remaining vegetation and surface soil to a depth of up to 150 mm.

b) When there is suitable topsoil within the limits of the area to be cleared, the topsoil, together with any grass or other suitable vegetation that is removed, shall be conserved. If it is not used immediately or if it is not stockpiled in windrows clear of the working areas, the topsoil shall be conserved for later use in the manner specified in the specification data. Topsoil shall not be removed from any area in which the average depth of soil is less than 150 mm.

c) Where the removal of overburden and other unsuitable material to depths exceeding 150 mm is required, the details will be specified in the specification data.

d) Excavation work shall be so executed that material:
a) excavated and placed in accordance with the requirements of 1.2.1.1 and materials from excavations shall be used in preference to materials from borrow pits or other sources;
b) shall be transported directly to its final position without being stockpiled, and if stockpiling is unavoidable, materials intended for different uses shall be stockpiled separately.

e) After an area has been stripped, excavation shall be carried out first to any general levels to which the ground has to be reduced and then for foundations, footings, etc., to the depths indicated in the drawings or to such greater depths as may be required to reach a suitable founding stratum.

f) Except where otherwise shown in the construction drawings, required in terms of the specification data or dictated by the requirements for safeguarding excavations, excavation shall be so carried out and the excavated surfaces so prepared by trimming to the outline of the concrete work shown in the drawings, that the excavated surfaces will act as formwork for the concrete works.

g) Except where provision for working space has been made in the scope of work, each excavated surface on which, or against which, a permanent concrete structure will be placed shall be prepared by trimming to ensure that there is no projection outside the specified tolerance into the excavation profile. Such surface shall be cleaned by hand or by air or by other effective means to remove all loose material.

h) Immediately before any permanent construction is commenced, the bottom of each excavation shall be cleaned of all loose material, and soft material shall be rammed or removed, as required.

i) Excavated surfaces that will remain permanently exposed shall be trimmed in a neat and workmanlike manner and shall be graded to provide suitable drainage, as shown in the drawings.

j) Cuts shall be made and trimmed neatly to the side slopes, widths, levels, grades, and sections shown in the construction drawings.

k) Unless otherwise specified in the scope of work, the finished formation width of private sidings shall be at least that shown in figure 1, appropriate to the layout.

l) Where required in the specification data, the slopes of cuttings shall not be trimmed to a smooth surface but left as cut by a bulldozer or scraper to provide ledges to retain topsoil.

m) Shallow cuts and fills of depth up to 300 mm in private sidings.

n) Where the in-situ material at formation level is suitable, the top 200 mm or such other depth as may be directed shall be compacted to the density specified for the sub-ballast layer of embankments and finished to the correct level.

o) Unsuitable soil below formation level shall be removed by excavation to depths, widths, and lengths to permit the placing and compacting to the specified density of backfill.

p) Rocks shall be removed to a depth below the finished level of 200 mm and replaced by compacted material.

q) When borrow pits are required to obtain additional or selected excavated material, access to each borrow pit site shall be constructed and the surface of the site shall be cleared of all vegetation and rubbish. Topsoil and overburden shall be stripped and stockpiled separately, unless otherwise required in terms of the specification data. On completion of borrowing, all unused material, including overburden but excluding topsoil, shall be returned and the sides of the pits shall be graded 1 :2. The stockpiled topsoil shall then be spread evenly over the area of the borrow pit and, thereafter, any access constructed shall be scarified and the area reinstated.

r) Surplus and unsuitable material shall be disposed of in areas designated in the drawings, or as specified in the specification data. Spoil heaps shall be flattened to present a neat level or graded surface.

s) All timbering and sheeting shall, unless otherwise specified in the specification data, be removed from the excavation before completion of the work.

## a) Placing and compaction

a) Where material from excavations is insufficient to form designated embankments, additional material shall be obtained from borrow pits.

b) Only the following material shall be placed on embankments:
a) has been obtained from excavations or borrow pits (or both), and
b) is free of stumps, trees, rubbish and other deleterious materials
c) Only material of the same or better quality shall be placed in the upper portion of an embankment.

c) Where it is necessary to use clay or clayey material that complies with the project requirements such material shall be placed not less than 1 m and not more than 6 m below the finished surface.

d) Rocks with a maximum dimension exceeding 600 mm shall not be placed at the base of an embankment.

e) Before compaction, the material of each embankment shall be deposited in layers of thickness not exceeding 300 mm. The material shall be spread to form a layer that is of approximately uniform thickness, and graded over the whole area of the embankment.

f) Unless otherwise specified in the scope of work, each layer shall be compacted at OMC to a density of at least 90 % of modified AASHTO maximum dry density in the case of cohesive soil, or 98 % in the case of non-cohesive soil. Should the material be too wet, owing to rain or any other cause, it shall be harrowed and allowed to dry out to the correct moisture content before compaction is undertaken.

## b) Backfilling of excavations and backfilling against structures

a) Where filling is to be placed against or around a structure, such filling (whether it be backfilling or embankment) shall be placed and compacted simultaneously on both sides of the structure to minimize unequal loading.

b) All excavations outside structures shall be carefully refilled with suitable material in layers of thickness not exceeding 250 mm before compaction.

c) During the placing of each layer, the filling shall be well rolled and compacted, and sufficient water shall be added uniformly to ensure that the density specified for that particular zone is achieved or, where a density is not specified, that the density achieved is at least that of the adjoining undisturbed material. Each layer shall be completed before the next layer is added.

d) Filling shall not be deposited in water.

e) Where the use of conventional compaction equipment close to a structure is not possible, the material to be compacted shall be spread in loose layers of thickness not exceeding 250 mm and compacted by means of mechanical tampers to at least the density specified in the scope of work for that particular zone or, where a density is not specified, to at least the density of the adjoining undisturbed material.

## c) Finishing

a) On completion of earthworks to the finished level and of backfilling of all holes, trenches, etc., the whole surface shall be graded, shaped and compacted to final grades and levels.

b) Where required in terms of the specification data, topsoil shall be placed on level and slightly graded areas and shall be lightly compacted by wheeled vehicles or by tamping, and trimmed neatly to the required lines, grades and levels. The final thickness of topsoil after compaction shall be at least 75mm.

c) Where required in terms of the specification data, grass or other vegetation shall be planted after topsoiling has been completed. On completion of planting, the planted area shall be neatly trimmed and well watered and not allowed to dry out until it is established, or for the period required in the scope of work

d) Roadways through which trenches or other excavations have been made shall be reinstated and maintained. The road surface shall be restored to its correct level without any subsidence occurring at the site of such trench or other excavation.

## c) Compliance with the requirements

a) The material properties of fill and backfill shall be determined in accordance with the requirements of TMH1-A3, TMH1-A7 and TMH1-A8, as relevant.

b) The in-place dry density of the fill and backfill shall be determined in accordance with the requirements of TMH1-A10(a) by means of the sand replacement method, or where appropriate, by nuclear methods in accordance with the requirements of TMH 1-A 1 O(b).

c) The moisture content shall be determined in accordance with the requirements of TMH1-A7 where the sand replacement method is used, and TMH1-A10(b) where nuclear methods are used.

d) The earthworks shall be finished to within the limits given in table 1 for the degree of accuracy required in terms of the specification data.

e) Moisture content and density during compaction shall be within the limits given in table 2, appropriate to the degree of accuracy required in terms of the specification data.

# 2 Concrete Works

## 2.1 Structural works

*Applicable standard*: SANS 2001 – Construction works Part CC1 _ 2012: Concrete works (structural)

*Specification data:*

### 2.1.1 Materials

- Concrete shall be to the grade noted on the Drawings. The Contractor is responsible for the design of strength of concrete.
- Mixing of concrete on site shall not be permitted, unless approved in writing by the Engineer. All concrete shall be supplied to site from a ready mixed concrete commercial supplier.
- For all pre-cast concrete elements, the Contractor shall submit product specification data sheets.

### 2.1.2 Cementitious Binders

- To comply to clause 4.2.1 of SANS 2001-CC1.
- Provide waterproof storage.
- Use binder that was delivered first on site.
- Do not keep binders longer than eight weeks after being purchased from the supplier.
- If required by the Engineer, the Contractor shall provide certificates of tests showing that the cement on the site conforms to these Specifications and requirements. All cement used on the work shall at all times be subject to the approval of the Engineer and any cement rejected shall be immediately removed from the site.
- The Contractor shall render to the Engineer a daily return showing the quantities of cement and milled slag or pulverised fly ash received on site and used, and the balance in stock. The Engineer is to have access to the stores and records, at all times, for the purpose of checking such returns.
- No empty cement bags shall be removed or used for other purposes until authorized by the Engineer. If requested the Contractor shall immediately remove all such bags from the site

### 2.1.3 Water

- Water for mixing concrete should be clean and shall meet the requirements of clause 4.2.2 of SANS 2001-CC1.
- The quantity of water used in each batch of concrete shall be carefully adjusted to maintain the water cement ratio required for the particular mix.
- The quantity of water added to each batch shall be fixed by an automatic attachment on the concrete mixing machine and shall not be added by means of hand buckets, hoses or any other method by which the quantity is not accurately determinable.
- The water shall be carefully measured so as to ensure the same quantity being used in each batch of concrete.

## 2.1.4 Aggregates

### 2.1.4.1 Fine Aggregate

- To conform to the requirements of clause 4.2.3 of SANS 2001-CC1.
- Fine aggregate shall be entirely free from organic material or any other foreign matter.
- Samples of the proposed fine aggregate shall be submitted to the Engineer for his/her approval before use. The Contractor shall submit a sieve grading analysis to the Engineer for approval and, if unacceptable, the Contractor shall offer another sample and grading for approval or may blend aggregate from different sources and submit the blend for the Engineer's approval.
- Fine aggregate shall be stored on a concrete surface and washed sand shall be allowed to drain for at least twenty-four hours before use. The Engineer may require the Contractor to test the sand daily (or more frequently if necessary) for moisture content, impurities and grading before use.

### 2.1.4.2 Coarse Aggregate

- To conform to the requirements of clause 4.2.3 of SANS 2001-CC1.
- Single sized aggregates shall be stored on a concrete surface in separate stockpiles, according to size.
- The proportions of the various single sized aggregates required for the various portions of the work shall be submitted by the Contractor for the Engineer's approval.
- Samples of the proposed coarse aggregate shall be submitted to the Engineer for his/her approval before use.
- No sandstone aggregate will be allowed in slabs or surface beds, minimum Ordinary Portland cement (OPC) content 70% - mix designs to be submitted to Engineer for acceptance.

## 2.1.5 Admixtures, Air-Entrainment Agents and Curing Agents

- To comply to clause 4.2.4 of SANS 2001-CC1.
- Slagment or admixtures shall only be approved by the Engineer when it is proved that such admixtures, agents or agencies will not have deleterious effect on the essential qualities of concrete is supported by substantial evidence.

## 2.1.6 Steel Reinforcement

- To comply to clause 4.2.5 of SANS 2001-CC1.
- Reinforcing bars shall comply with the requirements of SANS 920 - latest edition.
- Welded mesh fabric shall comply with the requirements of SANS 1024 - latest edition.
- Welded joints in tensile reinforcing bars will not be permitted.
- The size, length and bending of the reinforcing bars shall be strictly in accordance with the bending schedules and drawings.
- All bending shall be done cold and in accordance with SANS 282 - latest edition.

- Starter bars that move during the preceding cast, they may not be bent back into position. The Engineer is to be informed in writing - the correspondence is to include sufficient digital photographs to show the problem.
- No reinforcement may be cut without written approval from the Engineer.
- Bars already bent shall not be straightened for re-use.
- All reinforcement shall be clean and free from scale, loose rust, grease, oil, mud and other coatings which may reduce the bond between the steel and surrounding concrete, affect durability of the concrete or initiate corrosion of the reinforcement.
- No tie-wire shall encroach on the specified minimum cover by more than a strand thickness.
- All reinforcement stored on the site shall be stacked under cover and off the ground.
- No structural alterations may be done without the written approval of the Engineer.

## 2.1.7 Grade of Concrete

- The grade shall be as specified by the Engineer, the minimum concrete strength at 28 days shall be as follows:
    - Blinding - 15 MPa / 19 mm
    - Mass Concrete - 15 MPa / 19 mm
    - RC Foundations - 25 MPa / 19 mm
    - Columns - 30 MPa / 19 mm
    - Surface Bed - 25 MPa / 19 mm
    - Beams - 30 MPa / 19 mm
    - Suspended Slabs - 30 MPa / 19 mm
    - Structural Screeds - 25 MPa / 13 mm
- Precast concrete grade to be at as specified on the drawings, all concrete notes apply to precast concrete members.
- Precast concrete and precast concrete connections that form part of the in-situ cast structure will be to degree of accuracy I (see Table 11 of SANS 2001-CC1).
- Concrete strength at 28 days, for precast concrete, will be 30 MPa unless noted otherwise.

## 2.1.8 Grout

- To comply with clause 4.2.7 of SANS 2001-CC1.
- To comply with SANS 50197-1.
- All grouts and epoxies to be used strictly in accordance with the manufacturer’s specification.
- Minimum strength to be 32.5 MPa.

## 2.1.9 Joint fillers, sealants, waterstops, bearings and accessories

- To comply with clause 4.2.11 of SANS 2001-CC1.
- Products different to those specified may only be used with written approval from the Engineer. Such approval is to be requested in writing.

## 2.1.10 Backing Material

- To comply with clause 4.2.11.3 of SANS 2001-CC1.

## 2.1.11 Deteriorated Material

- Deteriorated, contaminated and damaged materials shall not be used in concrete works and should immediately be removed from site.

- The Contractor shall ensure that waterproofing materials are not damaged during backfilling operations, fixing of steel etc. Any repair work for the Contractor's account.

## 2.1.12 Formwork

- To conform to the requirements of clause 4.3 of SANS 2001-CC1.

### 2.1.12.1 General

- The Contractor shall design, provide, install, maintain and subsequently remove all the necessary formwork, supports, falsework, shoring, templates, staging, etc. required for the placing of concrete and the cost of doing so shall be included in the tendered rate for formwork.

- All the formwork shall be well designed and accurately made, assembled and erected by the Contractor. For forms with a height exceeding 1,5 m, the design and drawings for formwork and falsework, including the design criteria and calculations, shall be submitted to the Engineer for review.

- Forms shall be made of sound material (damaged or distorted forms shall not be used) securely supported, braced and tied to prevent deformation or displacement due to any load, or combination of loads, which might be imposed thereon, including the mass and pressure of wet, vibrated concrete, vibration due to the movement of men, materials and equipment, wind loads, etc.

- All joints in formwork shall be sufficiently tight to prevent the escape of mortar, and where necessary shall be sealed with adhesive tape or other approved material.

- Surfaces of formwork that are to be in contact with fresh (wet) concrete shall be treated by coating with an approved non-staining material to ensure easy release and non-adhesion to the formwork during stripping.

- Steel forms shall be used for column shafts and heads. To prevent cracking and spalling of previously cast sections of column shafts, column forms shall be erected, aligned and securely stayed before the bolts clamping the forms to the previously cast concrete are tightened.

- All formwork shall be thoroughly cleaned before re-use.

- Formwork shall be designed to allow stripping without jarring or damaging the concrete.

- Any runways required for the placing of concrete shall be so constructed as to be entirely independent of the concrete forms.

- Formwork layout drawings prepared by the competent person are to be kept on site for inspection at any time.

### 2.1.12.2 Classification of Finishes

c) Formwork will be classified in accordance with the surface condition required on the finished concrete as classified in Table 1 of SANS 2001-CC and the treatments thereof adhered to.

### 2.1.12.3 Removal/Stripping of Formwork

c) To comply with clause 4.3.8 of SANS 2001-CC1.

d) Forms shall be removed carefully so as not to damage the concrete and shall not be stripped until the following periods have elapsed after concreting has taken place for the various portions of the work as listed in Table 2 SANS 2001-CC1.

e) The above periods may be reduced at the discretion of the Engineer provided it can be shown that the compressive strength of the concrete has reached at least fifty per cent (50%) of that specified for the twenty-eight (28) day works cube compressive strength.

f) When stripping slab and beam soffits, other than cantilevers, one prop in the centre of the span shall be left for a further period of seven (7) days.

g) In very cold weather the Engineer may order forms to be retained in position for periods at least fifty per cent (50%) longer than those given above.

h) The following elements or parts of the structure are to remain fully propped until the required design concrete strength has been reached:

- Beams
- Cantilevers
- Slabs supporting hanging structures (Note that the portions being suspended cannot support the floor directly above.)

i) Propping may only be removed once upstand beams have obtained their 28-day strength.

j) When full height concrete walls are cast on slabs or beams, they are to be fully propped until the wall and slab have reached their design strengths.

### 2.1.12.4 Chamfers

i) All arises shall be chamfered off to approved dimensions but not exceeding 25 mm wide on the splay, see drawings.

## 2.1.13 Construction Tolerance

d) The Contractor shall construct each of the various elements of the work within the limits of the applicable permissible deviation set out in Table 11 of SANS 2001-CC1.

- Internal concrete - not exposed: Degree of accuracy No. II (SANS 2001-CC1)
- External concrete - exposed: Degree of accuracy No. II (SANS 2001-CC1)
- Fairface / Architectural concrete: Tolerance specified by Architect

## 2.1.14 Reinforcement

c) To conform to the requirements of clause 4.4 of SANS 2001-CC1.

d) The reinforcing bars shall be placed accurately in the positions to give the minimum cover shown on the detailed drawings. The bars shall be wired together with 1,6 mm diameter wire at every second point of intersection and shall be fixed so as to prevent any displacement during concreting. Wire tie ends shall point away from the nearest formwork face.

e) All placing of reinforcement shall be done well in advance of the concrete and no concrete shall be placed until the reinforcement in position has been inspected and approved by the Engineer. The Engineer is to be notified at least 24 hours in advance.

f) All reinforcement shall be inspected and approved in writing by the Engineer before casting of concrete may commence.

g) No slab will be inspected unless the reinforcing and cables (if present) have been fully fixed; all other services have been installed and the deck has been cleaned properly.

h) No heat treatment of steel reinforcement shall be allowed.

i) No cutting of steel without the written approval of the Engineer shall be allowed.

j) Bending, aside of reinforcement to facilitate placing of concrete, shall be kept to a minimum and will be permitted only at certain points approved by the Engineer. Such reinforcement shall be accurately re-bent to its correct shape and position before the concrete is placed round it.

k) The permissible deviation for cover to reinforcement in the above-mentioned elements shall be - 0 +5mm irrespective of any Degree of Accuracy classification.

l) Unless shown on the drawings, reinforcing bars shall not be cut to accommodate holes for pipes or bolts etc., where such holes are required and if possible, the bars shall be moved to positions indicated only by the Engineer.

m) Where reinforcing bars project beyond sections of concrete which are about to be cast, such projecting bars shall be firmly supported and held in position to obviate possible damage to the newly cast concrete.

n) 75 mm kickers for columns and walls have been allowed for in the reinforcing lengths. They shall be cast with the same strength as the concrete elements below them and thoroughly compacted and cured.

o) Concrete cover blocks shall be manufactured in accordance with the requirements of SANS 10100 Part 2 (8.4.1.2). The blocks shall be the same in strength as the specified strength of the element being cast. Fixing wire shall be fully galvanised, Class A in accordance with SANS 675. Blocks shall be fully cured in water for 14 days before use.

p) The use of plastic, timber spacer blocks or any other material other than concrete will not be permitted.

q) Laps to be as detailed on the drawings.

r) Concrete cover to be as detailed on the drawings.

s) All concrete drawings to be read in conjunction with the relevant Architectural, Civil, Electrical, Mechanical and Structural Steel drawings and any discrepancy to be brought to the attention of the Engineer.

t) Embedded items (joint material, water-stops, pipes and conduits, etc.) to be accurately positioned and supported to ensure no displacements.

u) Voids to be temporarily plugged with removable material to prevent entry of concrete into the voids.

## 2.1.15 Embedded Items

b) To conform to the requirements of clause 4.6 of SANS 2001-CC1.

c) All sleeves, inserts, anchors and embedded items required for adjoining work or for its support shall be placed prior to concreting.

d) All Contractors, whose work is related to the concrete or must be supported by it, shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is poured.

e) The Contractor must co-ordinate all services drawings for details and positions of openings and sleeves required for stormwater, sewerage, drainage, electrical, mechanical and other services. Discrepancies to be brought to the attention of Engineer and other relevant parties.

f) The Contractor must obtain permission from the Engineer before any openings or services, which are not indicated on the drawings, may be introduced through any structural element or close to any column.

g) Any exposed threads shall be taped to prevent concrete or mortar adhering to the thread prior to concrete being poured.

h) Pipe Penetrations within Concrete Structures should be as shown on the construction drawings.

i) Drainage pipes to be clean.

j) Refer to the Civil Engineering and Architect's drawings for detail and positions of rainwater pipes (rwp's) in concrete and other cast-in items.

k) All cast-in items to be hot-dipped galvanized, clean and free of oil, dirt or any other material which may impair the bond with concrete.

l) Areas with congested cast-in items, such as electrical conduits, are to be approved by the Engineer prior to casting of concrete.

## 2.1.16 Quality of Concrete

h) The concrete mix for each portion of the work shall satisfy the strength and durability requirements.

i) The concrete mix for each portion of the work shall be specially designed by the Contractor to comply with the minimum cube compressive strength at twenty-eight days specified by the Engineer. The concrete mix design shall be subject to the prior approval in writing of the Engineer.

j) The slump shall not exceed the values listed in Table 4 of SANS 2001-CC1.

k) Prior to the beginning of the work, the Contractor shall submit a statement of the proportions for each grade of concrete, together with a report in detail from an approved testing laboratory showing for at least three different water contents the seven-day and twenty-eight-day concrete cube strengths obtained when using the materials proposed for the work.

l) Chloride and sulphate content not to exceed the applicable values in Table 5 of SANS 2001-CC1.

m) Ready mix concrete should be in accordance with SANS 878.

n) Concrete to be transported as per Clause 4.7.9 of SANS 2001.

o) Concrete shall be conveyed from the mixer to the point of deposition in grout-tight barrows, bottom-dump buckets, skips, chutes or other approved methods, in such a way as to avoid contamination, segregation or change in water content of any part of the batch. No pumping of concrete for structural sections will be permitted. The Engineer's decision in all matters concerning transportation of concrete shall be final.

p) Where segregation occurs during transportation, the concrete shall be re-mixed by hand before being deposited in position.

## 2.1.17 Placing of Concrete

c) To conform to the requirements of clause 4.7.10 of SANS 2001-CC1.

### 2.1.17.1 Preparation

d) No concrete shall be mixed until the foundations, ground water handling arrangements, reinforcement, joint treatment, clean up, formwork and concrete mixing, handling and placing equipment have been approved by the Engineer.

### 2.1.17.2 Placing

t) Concrete from containers shall be deposited as nearly as practicable directly into its final position and shall not be allowed to flow in any manner which might cause segregation.

u) All excavations and other contact surfaces of an absorbent nature shall be left damp, but no free water shall be permitted to remain on these surfaces. Wherever concrete is to be placed in wet ground the Contractor shall excavate shallow drains below the foundation surfaces connected to suitably placed sumps. The drains shall be filled with crushed rock and covered with site concrete which will form the foundation level for structural concrete. All the procedures for controlling water in the excavations shall be approved by the Engineer and the cost of any such measures shall be included in the rate for dewatering excavations.

v) No concrete shall be permitted to drop freely from a height in excess of 3 m.

w) The method of placing and all plant used shall be subject to written approval by the Engineer.

x) Chutes shall be inclined at least one-and-a-quarter vertical to one horizontal, shall not exceed 3 m in length, shall be maintained clean and in good condition and shall be fitted with an approved end control which will ensure a vertical drop of concrete from the end of the chute.

### 2.1.17.3 Compaction

c) To conform to the requirements of clause 4.7.11 of SANS 2001-CC1.

d) The concrete shall be placed so as to prevent segregation and shall be thoroughly compacted by hand tools and where the concrete is more than 130 mm thick, by approved internal vibrators of ample power to maintain a speed of at least 7 000 rpm when immersed. Supplementary hand spreading, tamping and spading shall be carried out as directed by the Engineer and in no case shall vibrators be used to cause flow of concrete after placing.

e) Vibration shall be systematically applied by competent workmen at intervals sufficiently close to ensure that the whole volume of concrete is fully compacted and shall continue for an ample but not excessive time at each insertion. The entire depth of each layer of concrete shall be vibrated, and the vibrator shall at each insertion penetrate approximately 50 mm into the layer below, or the strip adjacent, in order to provide a complete bond between successive layers or strips. Standby vibrators with an independent source of power shall be maintained on site ready for immediate use.

f) The method of compaction and the equipment used shall be approved by the Engineer.

g) The concrete shall surround the reinforcing bars completely. The reinforcing bars shall not be displaced when depositing or working the concrete.

h) All concrete shall be compacted before any initial set has taken place and in no case more than 20 minutes after having been discharged from the mixer. Overnight leavings shall not be used in any way but shall be discarded and immediately removed from the site.

i) The concrete shall not be disturbed or shaken while it is setting.

j) Workmen engaged in placing of concrete shall be provided with waterproof knee boots and oilskins shall be provided for all men employed on concreting and all other necessary protection to ensure satisfactory completion of any cast in wet weather.

k) Concrete which, in the opinion of the Engineer, is bleeding or has an excessive water content, due to over-vibration or any other cause, shall be removed and replaced with concrete of an approved consistency.

## 2.1.18 Adverse Weather

g) Weather conditions under which concrete should be poured must conform to the requirements of clause 4.7.14 of SANS 2001-CC1.

h) During cold weather no material having a temperature below 5°C shall be used for making concrete.

i) No concrete shall be placed when the ground or air temperature is below 5°C or if the ground or air temperature is likely to fall below 5°C within six hours of pouring the concrete.

j) During hot weather, the temperature of the concrete, as placed, shall not exceed 30°C.

k) The Contractor shall ensure that the placing temperature of the fresh concrete does not exceed the ambient temperature by more than 5°C. Where necessary, this shall be accomplished by shading aggregate stockpiles, shading or insulating water pipes and water storage tanks.

l) The Contractor is responsible for controlling storm water and dewatering on the site to prevent damage to the structure, banks, excavations, or any other works for the duration of the contract period.

## 2.1.19 Joints

d) All joints shall conform to the requirements of clause 4.7.12 of SANS 2001-CC1, in accordance with the scope of work.

## 2.1.20 Construction Joints

d) Construction joints will be permitted, only where shown on the drawings or approved by the Engineer, and shall be formed true to line on all formed or exposed surfaces. Horizontal joints shall be formed by casting against a timber or metal former. Recesses shall be formed as detailed on the drawings. Where detailed on the drawings, galvanized metal strips or water bars shall be cast into the joints.

e) For forming joints refer Table 7 of SANS 2001-CC1.

f) Immediately before the adjoining concrete is placed, the chipped surface shall be thoroughly cleaned by brushing and washing and then thoroughly wetted.

g) Proprietary joints shall be strictly in accordance with the manufacturer's instructions.

h) The methods of forming construction joints are to conform to Table 7 of SANS 2001-CC1.

## 2.1.21 Curing and Protection

f) To conform to the requirements of clause 4.7.13 of SANS 2001-CC1.

g) All concrete other than porous concrete, shall be maintained continuously saturated for at least 10 days after placement or after stripping formwork in the case of walls, by methods which shall receive the prior written approval of the Engineer, if different from the following:

i. Ponded water with a minimum depth of 30 mm,

ii. Saturated sand with a minimum thickness of 75 mm,

iii. Continuously saturated heavy jute sacking, or other approved absorbent material maintained in contact with the concrete surfaces by fastenings spaced at not more than 1 m centres,

iv. Continuous sprinkling of the entire area of concrete (periodical hosing down will not be accepted), or

v. Covering the previously saturated surfaces with approved plastic sheets maintained in contact with the concrete surfaces and with all edges and joints sealed by methods approved by the Engineer.

vi. <u>Specified Method (recommended)</u>

Within a maximum of 2 hours after the formwork has been removed the concrete element shall be wet cured by covering with an inner hessian membrane and an outer puncture-free plastic

membrane. The hessian membrane be kept continuously damp by an independent automatic sprinkler system. The hessian and plastic membranes are to be firmly secured and kept flush to the concrete surface for a minimum period of 10 days.

h) Newly cast concrete sections shall not be used for supporting loaded wheelbarrows, monorails, material or scaffolding, etc., until permission is obtained from the Engineer.

i) The use of curing compounds will not be permitted, particularly on horizontal slabs, without the prior written approval of the Engineer. This should be used in strict accordance with the manufacturer's instructions.

j) “High Temperature Accelerated Curing” shall not be permitted.

k) The Contractor must ensure that all materials required for the curing process are on hand before stripping any formwork, and that these measures are implemented immediately after the formwork has been removed.

l) Surfaces that have not been formed against formwork (e.g. top surface of columns, beams, slabs, etc.) shall be protected as soon as it is possible, to do so without causing damage to that surface.

m) Should the Contractor wish to submit any alternative proposal it shall contain full details of methods and procedures, the Specified Method must however be priced in the Schedule of Quantities.

n) Curing shall continue for at least the minimum period of time given in Table 8 of SANS 2001-CC1.

## 2.1.22 Concrete Finishes and Defects

f) Finishes to conform to the requirements of clause 4.7.15 of SANS 2001-CC1.

g) Defects to be rectified and repaired.

h) Defective concrete work shall be reported to the Engineer without delay. The Contractor may not proceed with any remedial work or patching unless approved by the Engineer in writing.

i) Rubbing down of concrete surfaces to be done to the requirements of clause 4.7.20 of SANS 2001-CC1.

## 2.1.23 Testing of Concrete

e) To conform to the requirements of clause 5 of SANS 2001-CC1.

f) During the progress of construction, tests shall be made under the direction of the Engineer to determine whether the concrete being produced complies with the standards of quality and strength specified.

g) The Contractor shall be responsible for the mixing, curing and testing of all cubes and shall submit test results from an accredited and approved laboratory.

h) The laboratory should provide valid calibration certificates for concrete testing equipment every six months.

i) Test results sheets to quote serial number of equipment used for all tests.

j) At least one set of six cubes shall be taken for each casting and from at least every 50m³ of concrete for each grade placed (or part thereof should the total cast be less than 50m³).

k) 3 No. of the cubes shall be crushed at 7-day strength. 3 No. of the cubes shall be crushed at 28- day strength.

l) The results submitted to the Engineer must also contain the date on which the samples were taken and identification by which the results may be correlated with the section of work to which they pertain. Cubes shall be tested in a SANAS accredited testing laboratory.

m) Results shall be reported with statistical analyses to demonstrate their compliance with the acceptance criteria stated in SANS 2001, Clause 5.

n) As instructed by the Engineer, additional samples shall be randomly tested at an approved laboratory for correlation purposes.

## 2.1.24 Minor Works

*Applicable standard*: SANS 2001 – Construction works Part CC2 _ 2007: Concrete works (minor works).

### 2.1.24.1 Foundations

*Applicable standard*: SANS 2001 – Construction Works Part CM2 _ 2011: Strip Footings, pad footings and slab-on-the-ground foundations for masonry walling.

a) Form and cast all foundations as detailed. Foundations are to be cast against formwork on each side unless otherwise approved by the Engineer. Where approval is given to cast against ground, an extra 25mm thickness of concrete will be required on each unformed face to provide additional cover.

b) Foundation trenches shall be cleaned prior to placing concrete. All foundations shall be free and clear of loose material and debris prior to pouring concrete. All reinforcing shall be cleaned prior to pouring concrete.

c) All excavations must be inspected and approved by the Engineer before placing of any concrete foundation, blinding, and waterproofing or geo-fabric membrane. The Engineer shall be advised in at least 24 hours.

d) Where excavation levels have to be lowered, the top level of the base should be kept as shown and the blinding layer thickened, size and reinforcing may be altered by the Engineer if required.

e) Founding levels determined on site is to be forwarded to the Engineer.

f) The Contractor is to refer to the geotechnical investigation report for geotechnical information/profiles.

g) All foundation excavations shall be thoroughly prepared to the approval of the Engineer prior to placing of steel and casting of concrete.

h) The Contractor is to allow for equipment to keep excavations dry.

i) No foundation shall be cast on either non-engineered fill or backfill material. Portions that are over-excavated beyond the depth required by the Geotechnical Engineer, to be filled with mass concrete (10 MPa / 19 mm) at Contractor's expense.

j) All foundations are placed symmetrically below columns and brickwork unless otherwise shown.

k) All bases to be reinforced concrete, unless otherwise specified by the Engineer.

l) Strip footings are as shown on drawing D848-6000-001.

m) Retaining wall and column foundations shall be cast directly against the vertical faces of the excavation, unless indicated otherwise on drawings.

n) No backfilling behind retaining walls is to be done before the Engineer gives written approval.

o) Where applicable, backfilling shall be done simultaneously on both sides of walls to minimize the relative height difference in soil levels.

p) All backfilling to surface beds and behind retaining walls to be compacted to MOD AASHTO densities as indicated on drawings (sand compacted to 93% MOD AASHTO) in layers not exceeding 150 mm in thickness.

q) The maximum net allowable soil bearing capacity underneath foundations is 100 KPa.

r) Imported gravel to comply with SANS 2001-BE1. It is to be approved. Backfill with no cohesion compacted to minimum 93% mod AASHTO or a minimum of four passes with a 10-ton vibratory roller, unless indicated otherwise.

s) The Contractor shall allow for the removal of spoil and / or breaking up of boulders.

### 2.1.24.2 Concrete Floors and Surface Beds

a) Floor: direct finished one course slab as specified below, or as designed and constructed to SANS 10109 under direction of a competent person (Structural Engineering) when specified.

b) No brick or block walls are to be built on floor slabs before the slabs have reached their 14-day strengths. Propping underneath slabs and beams shall be completely removed before brickwork is built. All bricks required for brick walls on a specific slab panel should be stacked evenly onto that specific slab panel before walls are built. The Engineer is to approve the maximum stacking height.

c) All layer works are to be compacted in layers not exceeding 150 mm and to MOD. AASHTO densities as indicated on the relevant drawings.

d) Method statement for pouring of surface bed panels to be submitted to the Engineer.

e) Surface bed to be cast on 250 µm-plastic sheeting.

### 2.1.24.3 Blinding Layer

a) A nominal minimum blinding layer should be 50 mm thick and 15MPa strength, to level the area before pouring concrete foundations. Refer to concrete drawings for specific blinding layer thicknesses.

### 2.1.24.4 Damp-proof membrane

a) Material: polymer film SANS 952 type C 0,25 mm thick.

b) Cutting: straight and square or to shape; use sharp instruments.

c) Joints: minimum, lapped and sealed with pressure sensitive tape.

### 2.1.24.5 Fabric reinforcement

a) Welded steel fabric: SANS 1024.

b) In large mats, overlap 300 mm, place near top surface, refer to drawings.

c) Do not cross over construction or saw cut joints.

### 2.1.24.6 Placing

a) Place, compact, level, strike off, and wood float concrete floors to thickness, level, and/or gradient as specified.

### 2.1.24.7 Finishing

a) Direct finish by means of delayed floating technique:

   i. Leave surface undisturbed until bleeding has ceased, and surface has stiffened so that foot pressure barely indents the surface (24 hours).

   ii. Remove bleed water and laitance.

   iii. Hand trowel using pressure, or power floating.

iv. Steel trowel or power floating to produce a smooth finish, or wood float to produce a slip-free surface.

v. Do not add water or neat cement.

vi. Sand-cement screeds: minimum 30 mm thick, 1:3 cement/sand mix, in accordance with SANS 10109- 2:2004, Concrete floors. Part 2.

### 2.1.24.8 Surface Regularity

a) Surface regularity: SANS 1055 Grade II.

### 2.1.24.9 Joints

Refer to the relevant Structural drawings for standard details for specifications for saw-cut, isolation & construction joints.

a) Saw Cut joints:

i. Spacing and pattern: < 3.0m in both directions (refer to drawings),

ii. Saw cut joints with a mechanical concrete saw to blade width and a depth of one quarter of the slab thickness (refer to standard detail),

iii. Saw only after concrete has hardened sufficiently but before shrinkage cracking can occur (usually between 6 and 18 hours after placement, depending on temperature).

b) Construction joints:

i. Cast at end of day's casting or where concreting has stopped for more than 45 minutes.

ii. Type: tongue-and-groove, dowelled, or reinforced butt joints as directed, or as specified.

iii. Tongue-and-groove: trapezoidal; coat joint face of tongue-and-groove with suitable debonding agent like lime wash or bitumen.

iv. Dowels: 16 mm diameter x 300 mm length plain round mild steel dowels to SANS 920, placed at mid-depth of the slab at 300 mm spacing; coat dowels for two-thirds of their length with a bond-breaking compound.

v. Round off all construction joint edges to a radius of 3 mm.

c) Isolation or movement joints:

i. Position: where floors abut fixed structures like walls, columns, sumps or inspection chambers, or in external floors or paving at spacing < 3.0 m in both directions (refer to drawings).

ii. Forming: 10 mm thick compressible material like polystyrene, refer to drawings.

iii. Provide 20 mm isolation joints around all concrete columns and 10 mm isolation joints against brick walls.

iv. Sealing: leave joints open or seal as specified; seal with suitable elastomeric material; ream sawn joints to width and depth as required and according to the sealant manufacturer's instructions.

### 2.1.24.10 Strongrooms

Strongrooms: SANS 10052, of fire rating, burglar resistance and wall thickness class as specified. Refer to drawings.

## 2.1.25 Drawings

a) All building work must comply to the Local and National Building Regulations.

b) All structural concrete and steel reinforcement drawings to be read in conjunction with the relevant Architectural, Civil, Mechanical & Electrical Engineers' drawings and the specifications in the Bill of Quantities. Any errors, omissions & discrepancies to be brought to the attention of the Engineer immediately.

c) Where conflicting specifications between the drawings & Bill of Quantities occur, the drawing specifications will take preference over the specifications in the Bill of Quantities.

d) It remains the main Contractor's responsibility to compare drawings and notify the relevant parties of any discrepancies within a reasonable time frame.

e) The Contractor is to keep a full set of drawings on site.

f) The Contractor shall check all project dimensions on site beforehand. All dimensions are also to be checked against the Architect's drawings. Any discrepancies shall immediately be reported to the Engineer.

g) The Contractor is responsible for correct setting out of building on site with particular reference to boundary and building lines. Contractor is to provide the as-built co-ordinates of all bases and columns at each top of base and each successive top of floor level. Deviations in all direction (X, Y & Z) from the design dimensions to be indicated as well. The information is to be superimposed on the Engineer's drawings in CAD. The survey is to be performed by an independent registered surveyor.

h) Scaling off drawings is not allowed.

i) All notes are general unless otherwise shown on the drawing.

j) All SANS specifications mentioned in the notes, on the drawings and in the project specifications should be available on site, at all times.

## 2.1.26 Design loads

a) Design loads given below are for concrete once 28-day strength has been achieved.

b) All loads during execution/construction that exceeds these specified loads or are applied prior to 28-day strength, will require back propping.

c) Design loads are:

**Surface Beds**

- Imposed Loads (Conference rooms) - 4.0 kN/m²
  (SANS 10160-2:2010, Edition 1, Table 1 – C2)
- Imposed Loads (Storage areas) - 5.0 kN/m²
  (SANS 10160-2:2010, Edition 1, Table 1 – B5)
- Own Weight reinforced concrete - 25.0 kN/m²
- Additional DL (max. 75 mm screeds or partitions) - 1.5 kN/m²
- Brickwork - As shown on the Architect's layouts.
- Plasters - As shown on the Architect's layouts.

**Suspended Roof Slabs**

- Imposed Loads (for normal maintenance and repair) - 0.5 kN/m²
  (SANS 10160-2:2010, Edition 1, Table 5 – H2)
- Own Weight reinforced concrete - 25.0 kN/m²
- Additional DL (max. 75 mm screeds or partitions) - 1.5 kN/m²

**Timber Roofs**

- Roof sheeting - 0.2 kN/m²
- Roof truss - 0.8 kN/m²
- Imposed load - 0.5 kN/m²
- Ceiling and services - 0.2 kN/m²

**Ramps**

- Imposed loads (Access areas in public buildings) - 5.0 kN/m²
  (SANS 10160-2:2010, Edition 1, Table 1 – C5)

**Steel Roofs**

- Imposed loads - 0.5 kN/m²
- Wind loads - 1 kN/m²

# 3 Masonry

## 3.1 Masonry Walling (SANS 2001-CM1)

Specification data:

**masonry units**

- type: burnt clay
- masonry units to SANS 227 and SANS 1215

**burnt clay masonry units (SANS 227*[1])**

- nature of face unit: hollow / solid / contractor's choice
- Nominal compressive strength: to Table 1 of SANS 2001-Construction Works Part CM1,
- The minimum crushing strength of all load bearing brickwork shall be 14 MPa unless noted otherwise.
- The minimum crushing strength of all non-load bearing blockwork shall be 7 MPa unless noted otherwise.
- Uniformity of colour and texture of face units: provide sample of 20 units,
- Grade of efflorescence: normal for internal walls not exposed to damp; special for visible unplastered foundation walls, retaining walls and free-standing walls,
- Limits of water absorption: 6%-10%,
- Limits of irreversible moisture expansion: 0,05% max, and
- Required marking: designation on each dispatch or consignment note.
- class of face units: FBS / FBX
- nominal dimensions: 222 x 103 x 76 mm
- colour of face units: Allow for all facebricks to be (Value - TBC)

### Concrete paving units

- Concrete paving units: SANS 1215.
- Nominal compressive strength: SANS 2001-Construction Works Part CM1 Table 1,
- Average drying shrinkage: normal (0,06%), and
- Required marking: designation on each dispatch or consignment note.

### Cement

- Common cements shall comply with the requirements of SANS 50197-1.
- Masonry cements shall comply with the requirements of SANS 50413-1.

### Lime

- Lime for mortar shall comply with the requirements of SANS 523 and shall be of class A2P.

### Mortar

a) Sand: to SANS 1090 when specified, free from organic matter, and tested with the requirements of SANS 10164-1.

b) The minimum crushing strength of mortar shall be as for Class II mortar in accordance with Table 1 of SANS 10164 Part I, unless indicated otherwise on drawings.

### Reinforcement

a) Brick reinforcement in corrosive areas:

[1] Asterisk (*) denotes the preferred attribute or value.

i. In coastal regions: galvanized to SANS 935 or 121, or stainless steel,

ii. In tidal splash zones: stainless steel, and

iii. Non-metallic ties (engineered polymer) may be used instead of stainless steel.

b) Metal tie type: vertical twist wall tie or modified to the Engineer's requirements.

c) Continuous brick force is required in every layer for the first four layers above foundations as well as windows and over door openings. Minimum laps to be 300 mm.

d) All brick anchors, wall ties and straps shall be hot-dipped galvanized.

## Water

a) The water used shall be fit for drinking.

## Infill concrete

a) Infill concrete shall comply with the requirements of SANS 2001-CC2 and shall have a maximum size of 13mm nominal aggregate and be of the following grades:

i. Unreinforced cavities, cores, pockets or spaces: Grade 10 or higher.

ii. Reinforced cavities, cores, pockets or spaces: Grade 25 or higher.

## Damp-proof course material

a) Horizontal and vertical damp-proof course materials shall comply with one of the following standards:

i. SANS 248.

ii. SANS 298.

iii. SANS 952.

## Work

a) Brickwork and blockwork shall be built according to SANS 10164 and SANS 10400.

b) All brickwork to be set out according to the Architect's drawings.

c) All anchors, wall ties and straps shall be in accordance with the latest SANS 10400 and SANS 10164 specifications.

d) Single leaf bond: stretcher.
e) Multi leaf bond: stretcher and brickforce, or as specified.

f) Reference panel: required.

g) Position of control and articulation joints: as specified.

h) Degree of accuracy: II.

i) Refer to the Architect's drawings for general layout of brickwork / block work. All setting out to be done from the Architect's drawings.

j) V-joints are to be made right through plasterwork where brickwork / blockwork and concrete join.

k) Wall joints must be repeated in all tiled finishes.

l) Non-load bearing brickwork / blockwork may not be built closer than 10 mm from the soffits and sides of beams and slabs unless otherwise shown. The joint shall be soft board or similar approved and sealed on both sides with 2-part polysulphide. Any specific waterproofing requirements to the Architect's details. Any specific fire requirements to fire consultant's detail.

m) Refer to the Architect's drawings for positions of expansion joints in brickwork / blockwork.

n) All brickwork shall be fixed to concrete & steel columns by means of 30 x 1.2 mm galvanized hoop iron ties every fourth course and blockwork every second course. Fix the ties to columns with 2 Hilti shot studs each. Minimum horizontal length of hoop iron to be 300 mm.

o) In cavity walls, wall ties shall join the leaves and shall be embedded in masonry joints at right angles to the leaves as the work progresses.

p) Wall ties in cavity walls and brick retaining walls shall be of the vertical twisted type as in SABS 0164 part 1 - 1980 Figure 1 or similar approved type. Galvanised butterfly ties should not be used.

q) The number of wall ties per $m^2$ of walling shall be:

- 100 mm ≥ Cavity: Placed every fourth layer vertically and at 660 c/c horizontally.
- 100 mm < Cavity < 150 mm: Placed every fourth layer vertically and at 440 c/c horizontally.

r) Additional ties shall be provided at openings, discontinuities (for example control joints) spaced at intervals not exceeding 300 mm vertically, or, where deemed necessary or as shown on the drawings, such as at external angles.

s) For high-lift grouted walls, ties complying with the requirements of SANS 10164 Part 2 Annex A (14) shall be spaced at intervals not exceeding 900 mm horizontally and not exceeding 300 mm vertically, with each layer staggered by 450 mm.

t) Ensure that each tie is embedded to a depth of at least 50 mm in the mortar joint of each leaf.

u) For cavity widths not exceeding 75 mm. Ensure that the wall ties used comply with the relevant requirements of SANS 28 subject to the provision that ties of the single wire type shall not be used.

v) For cavity widths exceeding 75 mm but not exceeding 150 mm, ensure that wall ties used are of the vertical twist type, or any similar type having at least the equivalent strength and stiffness.

w) Tops of cavity walls to be ventilated for as long as possible.

x) Clay bricks to be wetted before being used. Concrete bricks and blocks to be kept dry before being used.

y) All planters built in brickwork are to be provided with 25 mm diameter weep holes above finished paving levels and at @ 1000 c/c.

z) Provide horizontal slip sheets between all concrete and non-load bearing brickwork surfaces.

## Additional Requirements

a) Wall ties in partial fill insulated cavity walls.

i. To have drip in centre of residual cavity.

ii. Tie spacing: SANS 10164 (2,5/$m^2$ or 600 mm vertical, 660 mm horizontal, staggered).

iii. Tie spacing around openings and construction joints:

b) Tie mortar cover: 15 mm minimum to outside face of mortar joint.

c) Ancillary fabricated components for masonry, e.g. ties, brackets, lintels, shelves, anchors, meshwork: galvanized to SANS 121 in coastal regions.

d) Clay facing units: obtain from manufacturer/supplier agreement on the following in writing:

   i. The required application e.g. type of building, finish etc.

   ii. The degree of exposure to weather conditions, proximity to the sea etc.

   iii. Track record of the preferred brick in the area of the building.

   iv. An undertaking or warranty that the bricks delivered will be suitable.

   v. Colour expectations in the case of face bricks.

   vi. Acceptable levels of breakage during delivery to site.

e) Common solid masonry mortar joints:

   i. Rake out for receiving plaster.

   ii. Flush off where walls are to be bagged or fair-faced.

f) Hollow masonry mortar joints:

   i. Do not rake out for receiving plaster.

g) Protection against damage:

   i. During construction, partially completed masonry, which is not enclosed or sheltered, shall be protected.

   ii. Masonry shall be temporarily braced or otherwise stabilized, as necessary, to resist wind and other lateral forces during construction, in such a manner that the structural integrity of the masonry is not impaired.

   iii. Completed masonry shall be suitably protected against surface contamination, construction damage, rain and rapid drying out for two (2) days, or until built upon or covered, whichever is the lesser period.

h) Cleaning of finished work:

   i. Completed masonry shall be free of stains, mortar, infill concrete droppings, debris, etc.

i) Roof anchors:

   i. To be provided in accordance with the requirements of SANS 10400 and SANS 10164.

**additional requirements**

- wall type: see drawings
  - Spec G08.
    - 230mm external Corobrick NFP clay bricks, 14Mpa to be laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints to be plastered on both exterior and interior faces. Brickwork to have gms wire ladder reinforcement every fourth course, of width to suit wall width. Brickforce for first 2 courses over openings.
    - On exterior walls: Outer face of inner skin to be bagged and finished with 2 coats brick sealed (ABE BRIXEAL) before outer skin is raised, in max 6 course lifts.

- All brickwork to be laid in panels of maximum 12m length between vertical expansion joints. Joint positions to be agreed with architects prior to installation, if not indicated on drawings. Joints to be through inner and external bwk skins.
- Joint formed per *installed over backing cord,* ABE Duracord polyethylene backing cord / bitumen impregnated soft board and sealed per spec *ABE Durakol G LM, gun grade poly-sulphide sealant,*
- Reference panel of brickwork required for approval prior to commencement.

- Spec G10

  - 230mm plastered wall in Corobrik NFP clay bricks laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints. Exterior face of wall to have Flush struck FBX facebrick dado external skin to 1200mm above DPC level, and plastered and painted above. Plaster and paint to interior face.
  - Facebrick Dado up to 1200mm ht externally, FBX selection – Provisionally Corobrik Roan Satin.
  - Brickwork to have gms wire reinforcement every fourth course, of width to suit wall width. Brickforce for first 2 courses over openings.
  - Outer face of inner skin to be bagged and finished with 2 coats brick sealed (ABE BRIXEAL) before outer skin is raised, in max 6 course lifts.
  - All brickwork to be laid in panels of maximum 12m length between vertical expansion joints. Joint positions to be agreed with architects prior to installation, if not indicated on drawings. Joints to be through inner and external bwk skins. Joint formed per *installed over backing cord,* ABE Duracord polyethylene backing cord / bitumen impregnated soft board and sealed per spec *ABE Durakol G LM, gun grade poly-sulphide sealant,*
  - Reference panel of brickwork required for approval prior to commencement.
- Spec G12. Reinforced facebrick holding cell walls.
  - 230mm facebrick wall in Corobrick Roan Satin FBX clay bricks laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints to be plastered to the interior face. Each brickwork skin to have gms wire reinforcement every fourth course, of width to suite half brick wall.
  - **Steel mesh reinforcement per SAPS guideline: A high tensile steel mesh of 100mm x 200mm x 5mm thick laid between skins.**
  - Brickforce for first 2 courses over openings. Outer face of inner skin to be bagged with a 1:6 cement to sand mix and finished with 2 coats brick sealed (ABE BRIXEAL) before outer skin is raised, in max 6 course lifts.
  - All brickwork to be laid in panels of maximum 12m length between vertical expansion joints. Joint positions to be agreed with architects prior to installation, if not indicated on drawings. Joints to be through inner and external bwk skins. Joint formed per *installed over backing cord,* ABE Duracord polyethylene backing cord / bitumen impregnated soft board and sealed per spec *ABE Durakol G LM, gun grade poly-sulphide sealant,*
  - Reference panel of brickwork required for approval prior to commencement.
- Spec G13. Half brick wall, plastered both sides.
  - 110mm Internal Corobrick NFP clay bricks, 14Mpa to be laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints to be plastered on both faces. Brickwork to have gms wire reinforcement every fourth course, of width to suit wall width. Brickforce for first 2 courses over openings. Reference panel of brickwork required for approval prior to commencement.

- Spec G15. Header course
  - Corobrick Roan Satin FBX (for measurement) clay brick, to match wall header course. To be laid as Brick on edge stack bond with 85mm gauge - 10mm Class 2 mortar joints. Brick in external skin only, with inner skin including pc concrete lintel, plastered. Outer face of inner skin to be bagged with a 1:6 cement to sand mix and finished with 2 coats brick sealed (ABE BRIXEAL). Stepped DPC (per H6) laid from inner skin to outer edge of window / door edge. 2 courses over lintel to include brickforce.
- Spec G16. Soldier course
  - Corobrick Roan Satin FBX (for measurement) clay brick, to match wall soldier course. To be laid as as brick on end, stack bond with 85mm gauge - 10mm Class 2 mortar joints. Inner skin including pc concrete lintel, plastered. Outer face of inner skin to be bagged with a 1:6 cement to sand mix and finished with 2 coats brick sealed (ABE BRIXEAL). Stepped DPC (per H6) laid from inner skin to outer edge of window / door edge. 2 courses over lintel to include brickforce.
- Spec G17. BOE external facebrick sill.
  - Corobrick Roan Satin FBX (for measurement) clay brick. To be laid as as brick on edge, stack bond with 85mm gauge - 10mm Class 2 mortar joints. Outer face of inner skin to be bagged with a 1:6 cement to sand mix and finished with 2 coats brick sealed (ABE BRIXEAL). DPC (per H6) laid from inner skin to outer edge below BOE sill.
- Spec G18. BOE External plastered and painted sill.
  - Corobrick NFP (for measurement) clay brick. To be laid as as brick on edge, stack bond with 85mm gauge - 10mm Class 2 mortar joints. Outer face of inner skin to be bagged with a 1:6 cement to sand mix and finished with 2 coats brick sealed (ABE BRIXEAL). DPC (per H6) laid from inner skin to outer edge below BOE sill.
- Spec G23. Facebrick 230mm width retaining wall.
  - 230mm retaining wall, Prov footing size 1200x400mm, reinforced concrete. Construction in two skins of Corobrick NFX clay bricks, laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints to be plastered on both exterior and interior faces. Each brickwork skin to have gms wire reinforcement every fourth course, of width to suite half brick wall.
  - Brickwork to have 3.15mm gms DPW wire butterfly reinforcement at 5 ties per sq.m, of width to suit.
  - Outer skin, where exposed to be constructed of FBX face bricks. Weep-holes created on 40mm pvc drain pipes protruding 20mm from the wall face and extending 200mm to the retained side of the wall. Distribution of weep-holes per str details, provisionally 6 per sq.m spaced at 500mm in each direction. Wall topped with Brick on edge course.
  - Retained face of wall to include application of waterproofing membrane, CG3 + CG4 per specification item G16 below, inclusive of agricultural drain and protection membrane.
- Spec G24. Concrete cavity retaining wall.
  - 340mm Reinforced concrete cavity filled retaining wall, per Str eng specification. Prov footing size 1800x400mm, reinforced concrete. Cavity brickwork construction in two skins of Corobrick NFX clay bricks, laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints to be plastered on both exterior and interior faces. Each brickwork skin to have gms wire reinforcement every fourth course, of width to suite half brick wall. Outer skin, where exposed to be constructed of FBX face bricks. Weep-holes created on 40mm pvc drain pipes protruding 20mm from the wall face

and extending 200mm to the retained side of the wall. Distribution of weep-holes per str details, provisionally 6 per sq.m spaced at 500mm in each direction. Wall topped with Brick on edge course.

- Retained face of wall to include application of waterproofing membrane, CG3 + CG4 per specification item G16 below, inclusive of agricultural drain and protection membrane.

- Spec G25. Screen wall – facebrick both sides.
  - 230mm clay Corobrick T.B.C. Satin FBX clay brick. To be laid in stretcher bond with 85mm gauge - 10mm Class 2 mortar joints. Brickwork to have gms wire reinforcement every fourth course, of width to suite one brick wall. All brickwork to be laid in panels of maximum 12m length between vertical expansion joints. Joint positions to be agreed with architects prior to installation, if not indicated on drawings. Joints to be through inner and external bwk skins.
  - Joint formed per *installed over backing cord,* ABE Duracord polyethylene backing cord / bitumen impregnated soft board and sealed per spec *ABE Durakol G LM, gun grade poly-sulphide sealant,*
  - Reference panel of brickwork required for approval prior to commencement.

- lintels in face work:
  - see detail drawings

- Lintels. prestressed concrete lintels in plastered walls
  - 105x75 pc concrete lintel/s to new opening. Wall to be supported per Str. Eng. specification above new opening. Opening size to suite installation of lintel + minimum of 3 courses of brickwork over, with ladder reinforcement each course.

## 3.2 Steel door and window frames

a) Steel door and window frames shall comply with SANS 1129 and SANS 727, respectively.

b) Near coastal areas the frames shall be hot dip galvanized with a thickening of not less than 450g/m2, as instructed by the Engineer.

c) When built into masonry, frames shall be set in position, securely braced, and strutted before being built in.

d) Articulation joints at doors shall be provided in accordance with the scope of work.

## 3.3 Stone masonry

- N/A

## 3.4 Masonry-type facings

- N/A

# 4 Structural timberwork

## 4.1 Structural timberwork (Roofing)

*Applicable standard*: SANS 2001 – Construction works Part CT2 _ 2011: Structural Timberwork (roofing).

*Specification data:*

a) Timber roof structures shall be design and supply.

b) All designs and drawings are to be submitted to and approved by the Engineer before construction of roof commences.

c) The Contractor will submit a final inspection certificate to the Engineer upon completion of the structure but prior to placing of any roof coverings.

d) Pole preservation treatment marking: metal identification tag with hazard class on each pole.

e) Exposed faces of sawn timber: planed, sandpapered, and are rounded to 3 mm radius.

f) Discontinue timber members on both sides of fire walls.

## 4.2 Structural timberwork (Roofing)

a) Nomenclature of timbers: Timber described as “softwood” is to be South African softwood of the relevant type, grade, etc. as specified. The names used for imported timbers are those given in Supplement No. 1 to SANS Code of Practice 12 under “Nomenclature of Standard Trade Names of Imported Commercial Timbers used in South Africa” and the Contractor is referred thereto.

b) *Timber sizes*: Sawn and wrot timbers are to be of the full sizes stated.

   i. Where ‘out of” sizes have been shown for wrot timbers on the drawings, an allowance of 4 mm.

   ii. For each wrot face off the sizes shown has been made.

   iii. Doors, fanlight, sashes, manufactured boarding, plywood, veneers, etc. must be of the full thickness specified.

   iv. Tolerances in nominal dimensions for imported timber shall not exceed the following:

   - For nominal dimensions up to 76 mm the actual dimension may be 2.5 mm under for each 25 mm.
   - For nominal dimensions 76 mm and over the actual dimension may be 1.6 mm under for each 25 mm.

c) *Storage of timbers*:

   i. Timber delivered to the site is to be properly stacked above ground, either on bearers or platforms under cover and protected from inclement weather.

d) *Orders*:

   i. For timber, orders are to be placed immediately after the Contract is signed, as the Contractor will be held responsible for any delay in delivery.

e) *Pre-treatment of timber*:

   i. Any surface subsequently exposed by cutting or planning must be touched up with the same preservative solution and rates are to include for all preservative required.

ii. All permanent timber installed in the buildings is to be treated against borer, cryptotermes, termites, and all wood destroying agencies with an approved preventative, all in accordance with SANS Code of Practice 05.

iii. The Contractor is to obtain a certificate from the merchants supplying the treated timber, to the effect that the timber has been treated against wood destroying agencies. The Engineer or Client Department has the right to remove samples of the treated timber to have tests carried out by the Division of Entomology or any other Authority.

iv. Temporary timber on the site, e.g. shuttering props, etc. must be free from wood destroying agencies. Any timber so affected is to be immediately removed from the site.

v. The moisture content of 10% of all timber brought to site shall be confirmed, in accordance with the relevant methods given in SANS 1783-1. (For all timber except poles, where SANS 457-2 or SANS 457-3).

vi. Materials which do not comply with the above requirements or are in any way damaged or discoloured by the pre-treatment must be replaced by the Contractor at his/her own expense.

f) *Stress grading of softwood timber*:

i. The Mechanical Stress Grading of Softwood Timber (Flexural Method) shall be in accordance with SANS Code of Practice 0149.

g) *Structural timber*:

i. For carpentry is to be South African softwood in accordance with SANS Specification 563 and, unless otherwise specified, of Stress Grade V4, and branded accordingly. If it is necessary to use sizes that have to be re-sawn, these shall be re-graded and stamped with the respective SANS stress grade mark. Unless this is done, timber which is re-sawn is no longer considered as complying with the specification and shall on no account be used.

ii. Nails shall comply with SANS 820.

iii. Nuts shall comply with the requirements of SANS 1700-14-1, SANS 1700-14-2, SANS 1700-14-3, and shall have a shank that is 20mm longer than the total thickness of the timber which is to be bolted together

iv. Bolts shall comply with the requirements of SANS 1700-14-1, SANS 1700-14-2, SANS 1700-14-3, or SANS 1700-14-4.

v. Nail plates shall be installed by means of a mechanical pressing device/carpenter's hammer.

vi. Nail plates, split rings, and shear plates shall comply with the requirements of SANS 10243.

h) *Brandering/battens*:

i. Battens of cross-sectional size 50 x 50mm and under shall be South African softwood (S.A. Pine), in accordance with SANS 1783-4 or SANS 1707-2, SANS 653 and branded accordingly.

i) *Joinery and shelving*:

i. Softwood for joinery and shelving shall be South African softwood (S. A. Pine) in accordance with SANS Specification 1359 and branded accordingly. All timber for joinery is to be air or kiln-dried to a moisture content of approximately 12 %. Shelving to linen stores to be timber slatted with wall bands or free-standing units as specified.

## 4.3 Drawings

a) All designs and drawings are to be submitted to and approved by the Engineer before construction of roof commences. The drawings are to include details of all roof assemblies, showing all members sizes required, connection details and bracing, where required.

## 4.4 Erections

a) All frameworks shall be carried up true and plumb, and temporary erection bracing shall be introduced wherever necessary to take care of all loads to which the structure may be normally subjected. Such bracing shall be left in place as long as may be required for safety.

b) The Contractor is to provide and maintain temporary support to all framework until it is adequately built into the final structure.

c) Upon completion, all trusses shall be checked for straightness, plumbness, and that they are level, and shall be adjusted, as necessary, on the wall plate. The remainder of the permanent bracing shall be fixed.

d) The Contractor will submit a final inspection certificate to the Engineer upon completion of the structure but prior to placing of any roof coverings.

## 4.5 Structural Laminated Timber

a) Structural laminated timber: SANS 1460.

b) Required marking on each piece: application, exposure class, type, appearance and finish, stress grade, e.g. S2GP5.

c) Timber sizes are to be of the sizes detailed, wrot on all faces and are to be manufactured by an experienced fabricator to the approval of the Engineer. Adhesives used must meet the requirements of the current SANS 1204 for external use.

d) *The surface appearance of members shall be Class C (Constructional) or Class S (Selected) as defined in SANS Specification 876 and as stated in the items.*

# 5 Structural steelwork

## 5.1 Structural steelwork

*Applicable standard*: SANS 2001 – Construction works Part CS1 _ 2017: Structural Steelwork.

*Specification data:*

### 5.1.1 Materials

a) Unless otherwise shown on the drawings or hereunder, all rolled sections shall be hot rolled mild steel, and all materials shall comply with one of the following:

   i. Weldable Structural Steels to SANS 4360,

   ii. Hollow sections to SANS 4848 Part 2 and SANS 6323,

   iii. Cold rolled sections to SANS 2994,

   iv. Black bolts and nuts to SANS 135,

   v. Precision bolts and nuts to SANS 136,

   vi. High-strength friction-grip bolts and nuts to SANS 1282,

   vii. Flat and tapered washers to SANS 1149, and

   viii. Electrodes for welding to SANS 455.

b) All structural steel material used shall be new and Grade as specified on the Construction drawings, steel in accordance with SANS 50025 / EN 10025 unless stated otherwise on the drawings. “Commercial” quality plate which does not meet the above standard shall not be used without the Engineer’s prior approval. The contractor shall, if necessary, satisfy the Engineer from his/her records that all materials meet the above requirements.

c) Steel grades shall be as follows:

   - Plates - GR S355JR
   - Hot rolled sections - GR S355JR
   - Hollow sections - GR S355JR
   - Cold formed sections - GR S355JR

d) The work, including design, shall be carried out in accordance with SANS 10162. The steelwork shall be supplied complete with all necessary cleats, brackets, connections, trimmers, packing, shelf angles, etc. as specified on the drawings.

### 5.1.2 Fabrication Drawings

a) The successful Tenderer shall prepare and submit a full set of fabrication drawings to scale including the design of connections to the Engineer’s approval and no fabrication shall be put in hand until the necessary approval has been given.

b) All dimensions and levels shall be checked on site before shop drawings commence. Any discrepancies shall be brought to the attention of the Engineer.

c) The Contractor shall be responsible for the consequences of discrepancies, errors or omissions in the shop details whether such drawings have been approved by the Engineer.

d) A complete set of shop drawings shall be submitted to the Engineer for approval one month before fabrication commences. Shop drawings will only be checked for compliance with design intent. No dimensional checks, or checks on cleats, bolts, welds and gussets will be done.

e) The Contractor shall check the Site dimensions and shall amend the drawings where necessary to suit the Site dimensions. Any errors in fabrication resulting from incorrect dimensions will be the responsibility of the Contractor.

f) All shop splices are to be indicated on drawings.

g) All structural steel drawings to be read in conjunction with the relevant Architectural, concrete drawings as well as the Bill of Quantities and any discrepancy to be brought to the attention of the Engineer.

h) The Contractor shall allow a period of two (2) weeks for the approval of any drawings.

### 5.1.3 Fabrication and Assembly

a) The Contractor shall prepare and submit a full set of fabrication drawings to scale including the design of connections to the Engineer's approval and no fabrication shall be put in hand until the necessary approval has been given.

b) The Contractor may use welded or bolted construction in agreement with the Engineer, unless a particular method specified either in writing or on the drawings. All structural steel both before and after fabrication shall be, within the tolerances specified and shall be flat, straight (unless required to be formed to another shape) and free from twists.

c) Tensile strength testing results must be provided for each batch of steel from which cold-formed sections are sourced.

d) A certificate from the steel manufacturer in which the grade of the structural steel is verified shall be handed to the Engineer for approval.

e) Fabricator to ensure that centres of gravity/centroidal axes of members intersect at node points, except where eccentricities are specified on Engineer's drawings.

f) The Contractor shall, at the commencement of the project, acquaint himself with the availability and delivery time of the products and steel profiles specified on the drawings so that such material can be ordered ahead of time.

### 5.1.4 Cutting

a) Cutting of rolled steel joists and channel sections shall be by sawing. Cutting of angles, flats and plates shall be by sawing, shearing or cropping. Flame cutting will not be permitted.

b) All edges shall be free from any defects of distortions and any notch or similar defect shall be removed by grinding.

### 5.1.5 Joints in Bearing

a) The abutting surfaces of a joint dependent on contact for the transmission of load are, in the opinion of the Engineer, in contact. Splice plates and bolts for this type of connection should be so designed that they are capable of transmitting 100% of the design load.

### 5.1.6 Welding

a) Welds shall conform to SANS 10167-1984 and 10044 specifications.

b) Where no weld sizes are shown, the minimum weld size shall be that of the thickest plate of the connecting plates / elements or 6 mm (whichever is higher). Unless otherwise shown, the intention of

connections is to transfer the full force that can be developed in connecting members through the connection.

c) Care should be taken that distortions due to welding are prevented by clamping and presetting or other acceptable procedures.

d) All welding shall be metal to metal arc welding with electrodes and operation suitable for the basic material in accordance with SANS 455. The Contractor shall, if required by the Engineer, produce evidence that each welder has satisfactorily completed tests appropriate to the work, and the Engineer is empowered to call for additional tests to be carried out under supervision.

e) When using electric arc welding, all electrodes shall be E7018. For any other welding process to be used, the Contractor shall apply, in writing, for the approval from the Engineer for the electrodes to be used.

f) All butt welds in tension members shall receive special attention and the Engineer has the right to call for 10% of such welds to be radiographically examined, with additional tests if the initial inspections prove unsatisfactory. The costs of these tests shall be included in the rates quoted. The welds shall be of Grade B Standards (SANS 10044 PT III).

g) All butt welds shall develop the full strength of the elements joined.

h) All splices shall develop the full strength of the elements joined.

i) The fusion faces of welds shall have close contact and shall be cleaned free of scale, rust, oil or paint or any substance, which might impair the quality of the weld.

j) All fettling shall be done by a method approved by the Engineer.

k) Welding shall only be performed by coded welders.

l) Suitably qualified and experienced welders using proper equipment in a good condition shall do all site welding. Welders to be certified and certificates with photos to be submitted to the Engineer.

m) The Contractor shall design all welds and, where necessary, gussets of sufficient strength shall be provided to obtain the required weld length to ensure the full strength of the connection.

n) Quality control on welding shall be as follows:

   i. All welds shall be inspected using visual aids.
   ii. All butt welds: 100% ultrasonic NDT.
   iii. All fillet welds: 20% MPI.
   iv. Crane / crawl beams: 100% ultrasonic NT

### 5.1.7 Fasteners

a) Diameter of fasteners shall be limited to M16, M20 and M24 unless specifically noted otherwise on the drawings.

b) Bolts shall be used for the connections in shear or bearing only. Each bolt shall be used with one standard or taper washer under the nut. Bolts when tightening shall project not more than 12 mm or less than 4 mm beyond the nut. All bolts shall be tightened by hand to the torque limit, which can be applied using standard lodging spanners. High strength (Grade 8.8) bolts shall be used with hardened washers under both the heads and nuts.

c) All structural bolts shall be grade 8.8 hot-dipped-galvanized, unless otherwise noted.

d) Where HSFG bolts are specified, the following shall apply:

i. All contact surfaces at HSFG bolt splices shall be free from oil, grease, rust, scale, paint or any other impurities at the time of bolting.

ii. The tightening of high strength friction-grip bolts shall be done according to the tum-of-the-nut method as specified in clause 5.3.1 (a) of SANS 1094-1982.

or

Where HSFG bolts have been specified, the Contractor shall use coronet-type load indicating washers in conjunction with such bolts.

e) Where slotted holes for bolts occur, the nut shall be hand tightened and a locknut be provided unless noted otherwise.

### 5.1.8 Holding Down Bolts, Plates, Etc.

a) The holding down shall be cast into the foundations. The Contractor shall check the setting and position and dimensions prior to final fabrication.

b) Where applicable, non-shrink grout shall be provided under base plates before any primary loads are applied to the structure.

### 5.1.9 Inspection of Fabricated Steelwork

a) The Engineer shall be advised as soon as the fabrication of steelwork is in hand so that he/she may inspect and examine the materials and workmanship during fabrication. The Engineer or his/her duly authorised representative shall have access to the sub-contractor's premises at all reasonable times for the purpose of inspection.

b) Contractor to arrange with Engineer for inspection of structural steel work during fabrication.

c) All steelwork shall be inspected at the maker's works by the Engineer's Representative before shot blasting or painting.

### 5.1.10 Surface Protection and Preparation for Structural Steelwork

a) *Degreasing*:

i. All oil, grease and other surface contaminants shall be removed by the application of a degreaser. Apply by brush, work into deposits and rinse with clean water. This shall be repeated until a water break free surface is obtained. Allow to dry.

b) *Abrasive Blasting of All Steelwork*:

i. All millscale, rust and weld scatter shall be removed by abrasive blasting to the Swedish Standard SIS 055900, grade ASA 22 with blast profile of 30-50 microns.

ii. Note: Before any painting is carried out the Engineer or his/her representative shall inspect all steelwork. Prime coat of painting shall be carried out within 4 hours of abrasive blasting.

c) All structural steelwork to be cleaned and de-rusted in accordance with SANS 10064.

d) All structural steelwork to be hot dipped galvanized.

e) Hot dipped galvanized coating to be to ISO 1461:1999 on fabricated iron and steel articles.

f) Paint with intumescent paint to achieve 1 hour fire rating.

g) Final finish to the Architect's detail.

h) Epoxy sealant to cover all bolt ends, nuts and washers to prevent rust incursion.

## 5.1.11 Erection and Installation

a) Details of the method of erection shall be submitted to the Engineer for approval, prior to commencement of construction. All structural steel shall be stored, transported, handled and erected so as not to subject it to undue stress and damage.

b) During erection of a structure the steelwork shall be bolted, braced or otherwise secured so as to make adequate provision for all erection loads.

c) Each part of as structure shall be aligned as soon as possible after erection. Members shall not be permanently connected until sufficient of the structure has been aligned, levelled, plumbed and temporarily connected to ensure that it will not be displaced during the erection or alignment of the remainder of the structure.

d) Drift pins, jacking equipment and the like shall not be used to bring improperly fabricated members into place. A moderate degree of cutting ad reaming may be employed to correct minor misfits only if in the opinion of the Engineer this will not be detrimental to the appearance or strength of the structure. Burning of holes will not be permitted.

e) Steel wedges or packings or other levelling devices of adequate strength and rigidity shall be used to support the steelwork before grouting is done.

f) Where applicable, cementitious non-shrink grout shall be provided under base plates before any primary loads are applied to the structure. Laminated finger shaped hot-dip galvanized packing to be provided under base plates.

g) Immediately before grouting, the space and all pockets under the steel shall be cleared of all debris and free water.

h) As each part of the work is erected it shall be handed to the Engineer for checking and approval. Particular attention will be paid to accurate levelling, setting and alignment of the various parts, and the careful welding and/or bolting of site connections.

i) Gutters are to be water tested to ensure all joints are watertight.

## 5.1.12 Grouting of Column Baseplates

a) All necessary steel packs for the levelling and aligning of the steelwork shall be provided and properly positioned. All subsequent grouting of base plates, pockets and holding down bolt tubes shall be done by the Contractor after the framework has been approved by the Engineer. A non-shrink grout such as Five Star Grout 531 shall be used and shall be well rammed to eliminate voids.

## 5.1.13 Temporary Bracing

a) Where required, the Contractor shall design, provide, install, maintain and afterwards remove, sufficient temporary bracing to keep the structure plumb and in true alignment until other structural units provide the necessary permanent bracing. The steelwork shown on the drawings is that required in the design for the finished structure only and is not necessarily adequate for construction purposes. Any failure to make proper and adequate provision against damage during erection shall be the entire responsibility of the Contractor. The temporary guying and bracing should be capable of resisting all loading liable to be encountered on the structure during the erection period, including those loadings from erection plant and its operation, wind loads and other construction loads.

b) If splices in trusses are required due to transport, proposals of this shall be submitted to the Engineer at an early stage for written approval.

c) The Contractor shall submit to the Engineer for his/her review, his/her method of erection and of all assembly cleats and bolts, but such approval shall not limit the Contractor's responsibility to ensure the safety and alignment of the structure.

d) All connections for temporary bracing and members to be provided for erection purposes shall be made in such a manner so as not to weaken the permanent structure or to impair its serviceability. Bracing shall not be used to force the structural frame into its correct position. Tighten bracing only after the frame has been squared, aligned and plumbed or, if inserted at an earlier time, loosen to permit these operations and tighten on completion.

## 5.2 Additional items

a) Hot dip galvanized fasteners (M8 M64): SANS 10684.

## 5.3 Variations

a) Temporary fittings and holes for lifting: to be removed or filled up where visible after installation.

b) Cut edges: grind smooth and straight where prominent or as indicated.

## 5.4 Sundry steelwork

### 5.4.1 Material

a) Cold-formed commercial steel structural members: permitted if yield stress equals 200 MPa, tensile strength 365MPa (SANS 10162); obtain proof.

b) Structural steel tubes: SANS 657 part 1, and mark-bearing.

c) Steel wire rope (cables) SANS 2408.

d) Shackles: SANS 2415.

e) Thimbles: SANS 2262.

### 5.4.2 Welding

a) All visible welds: continuous, grind smooth.

b) Dress all cut edges and holes to remove dross, burrs and irregularities.

c) The Contractor shall forward to the Engineer a list of proposed welders and their welding certificates prior to any welding being carried out.

d) No welder shall carry out work for which he/she is not certified.

## 5.5 Coating

a) Preparation of steel surfaces: SANS 10064.

### 5.5.1 Hot dip galvanizing

a) Hot dip galvanized coatings on prefabricated iron and steel products: SANS 121 / ISO1461.

b) Steel composition: for industrial/mining purposes: Si 0,125 -0,30% with P < 0,02%; for architectural purposes: Si 0,03 with P < 0,01% or Si 0,15 -0,25% with P < 0,02%.

c) Do not bend or form articles after hot dip galvanizing.

### 5.5.2 Paint or varnish

a) Corrosion protection of structural steel of not less than 3 mm thickness by paint or varnish to SANS 12944:

   i. Source all paint from one manufacturer.

   ii. Paint system testing: laboratory tests to SANS 12944-6.

   iii. Discuss surface smoothness with all parties before commencing painting.

b) Paint specification for the bolts:

   i. 3 days before the erection of the structural steelwork, all bolts are to be cleaned and degreased.

   ii. Within 2 days of erection, all bolts are to be coated with 1 coat of Sigmadur Gloss or equivalent.

c) Contractor to submit method statement for paint repairs.

### 5.5.3 Fire Protection

a) Protect structural steel against fire to comply with the required fire resistance as set out in SANS 10400-T table 17, as specified on the drawings.

### 5.5.4 Light steel frame building

a) Light steel frame building: SANS 517.

b) Rational design to be done by a competent person

# 6 Insulation, sealants, seals

## 6.1 Thermal insulation

### 6.1.1 Materials

- type: bulk - fibre matts / reflective (foil)
- required R-value/thickness: SANS 204
- required fire performance classification of thermally insulated building envelope systems: SANS 428

**rigid board**

- material: EPS / XPS / EPU
- N/A

**fibre mats/batts**

- form: mats (flexible)
- 100mm Isover Aerolite over ceiling insulation.
    - Install 100mm thick flexible noncombustible lightweight “Aerolite” insulation material over brandering in a completed roof and ceiling system. Installation strictly in accordance with the manufacturer’s detail and specification.
    - Plain faced
- 100mm Isover Factorylite over purlin insulation
    - ISOVER, or other equal approved, Factorylite 100 mm thick, non-combustible flexible lightweight industrial fibreglass roof insulation with reinforced foil facing both sides and with thermal resistance of 2.56m2.K/W. Install as per manufacturer’s specifications concurrent with the roof covering with galvanised steel straining wires at 300mm centres and tied down top and bottom after tensioning with galvanized hoop iron ties with overlaps stapled together. Installation of insulation to be in accordance with roof sheeting manufacturer’s recommendation regarding roofing clip fixation details.
    - Metalised foil faced

**reflective foil**

- reflective foil class: A / B / C / D
- Super Sisalation Heavy Industrial Grade FR430 insulation, fixed onto straining wires per manufacturer’s specification
-

**metal faced insulation panels**

- N/A

**loose fill**

- N/A

### 6.1.2 Installation

- system: SANS 204 / rational design

**masonry cavity wall insulation**

- N/A

**masonry wall external face insulation**

- N/A

**pitched roof/ceiling insulation**

- system: foil + bulk
    - Add spec for foil
    - Add spec for bulk
- see drawings

**flat roof insulation**

- material: rigid EPS insulation density 32D
- flat roof insulation position: over waterproofing

**floor insulation**

- under floor slab insulation: NA

## 6.2 Vapour barriers

- N/A

## 6.3 Sound absorption

- N/A

## 6.4 Joint fillers/sealants

- joint filler type: *ABE Durakol G LM, gun grade poly-sulphide sealant*
- sealant colour: Mid Grey

## 6.5 Architectural seals

- type:
    - patent extruded aluminium carriers with flexible seal inserts of synthetic rubber, rigid PVC, nylon brush filaments, polypropylene pile, or silicone rubber / patent PVC, pile or neoprene door and window frame seals / patent silicone intumescent seals (fire and smoke) / patent external extruded aluminium threshold plate seals
- aluminium extrusion finish: mill / anodised / painted
- intended use of seal:
    - energy (draughts, dust, insects) /
    - intumescent (fire and smoke) /
    - acoustic (noise) /
    - finger-pinch protection (schools, day-care centres) /
    - threshold plate /

    - access (mobility, disabled persons)
- duty level: light / medium / heavy
- mounting: fully morticed / semi morticed / surface mounted / grooved.

# 7 Roof coverings, cladding

## 7.1 General

- type of cover, cladding:
    - Concealed fix colour-coated aluminium profiled metal roofing.
- roof pitch: see drawings, varies 5º, 15º

**underlay**

- underlay type: Radiant barrier. Sisalation Heavy Industrial Grade FR430 insulation, fixed onto straining wires per manufacturer's specification

## 7.2 Tile roofing/cladding

### 7.2.1 Materials

- N/A

### 7.2.2 Roof tiling

- N/A

## 7.3 Profiled sheet roofing/cladding

### 7.3.1 Metal sheet

**metal**

- 0.8mm Aluminium Profile SAFLOK 700 concealed fix pre-painted aluminium roof sheeting with a G4 Colortech colour coated finish to one side with a Cool Grey backing coat to underside.
- single lengths per roof slope

**aluminium alloy**

- aluminium roofing sheet thickness: 0,8 mm sheeting gauge. 0.9mm to flashing materials to match sheeting in colour and finish spec.

**stainless steel**

- N/A

**copper**

- N/A

**weathering steel (Cor-ten)**

- N/A

**bullnosing**

- N/A

**roof ventilators**

- N/A

### 7.3.2 Fibre-cement sheet

- N/A

### 7.3.3 Glass-reinforced polyester sheet

- Type: 1 . See also SANS 141 GRP laminates.
- class: WF
- mass: 2,4 kg/$m^2$ (industrial)
- opacity: opaque
- colour: white
- profile: to match roofing

### 7.3.4 Polycarbonate sheet

- Colour: Opal 50
- thickness: 1,2 mm
- profile: to match roofing/cladding sheet

### 7.3.5 Fasteners and washers

- corrosion resistance class: 3
- type and size: roofing screw with washer to pierce fixed roofs *according to* roofing material *manufacturer's instruction*
- *type and size: drive screw for fixing straps to concealed fixed roofs suitable for fixing to timber purlins according per roofing material manufacturer's instruction*
- material: stainless steel.

### 7.3.6 Installation

**exposed fixing**

- To polycarbonate / GRP sheeting only.

**lapping**

- No end lapping permitted. Sheets to be supplied in full lengths to suite roof layout

## 7.4 Fully-supported metal sheet roofing and cladding

- N/A

## 7.5 Thatch roofing

- N/A

## 7.6 Flashings, trim

- 0.9mm G4 Colortec coated aluminium sheeting with a colour coated finish to one side with a Cool Grey backing coat (equal or other and approved). Formed and girth per spec below and secured in accordance with manufacturer's recommendation, incl clips and polyclosures. Colour to be confirmed by architect.
    - Headwall – Girth 462mm 1 x bent – 94x368mm. Fixed with broad flute closures + poly closures and sliding brackets (F10, 2-piece slider). Incl counter flashing. SB12 x 35 x 138. Girth 185mm. Sondor poly closers are to be fitted under the ridge capping.
    - Ridge – Girth 660mm 1 x bent – 330x330mm. Fixed with broad flute closures + poly closures and sliding brackets (F10, 2-piece slider)
    - Apex – Girth 660mm 1 x bent – 330x330mm. Fixed with broad flute closures + poly closures and sliding brackets (F10, 2-piece slider)
    - Barge – Girth 660mm 2 x bent – 330x292x38mm. Fixed with sliding brackets (F10, 2-piece slider)

- Under – over flashing – Girth 660mm 1 x bent – 330x330mm. Fixed with sliding brackets (F10, 2-piece slider)
- Valley flashing – Girth 660mm 1 x bent – 330x330mm. Fixed with stiffener bend ($158^0$ angle)
- Sidewall flashing Girth 462mm 2 x bent – 94x330x38mm. Fixed with sliding brackets (F10 or clip on)
- Hip Cap – Girth 660mm 1 x bent – 330x330mm. Fixed with blank closures, notched + poly blocks

## 7.7 Fascias and barge boards

- Type: Flashings to metal roofs should be similar to roof material to ensure same life to first maintenance and avoid electrolytic corrosion.
- Counter flashings with an anti-capillary fold avoid electrolytic corrosion.
- Barge – Girth 660mm 2 x bent – 330x292x38mm. Fixed with sliding brackets (F10, 2-piece slider)
- size / positions: see roofing drawings.

# 8 Waterproofing

## 8.1 Materials

**reinforced bitumen membrane (RBM)**

- Surface preparation
    - Substrate Concrete walls are to be smooth off-shutter (board-joints rubbed smooth and ferrule holes filled) and to be free of voids and honeycombing. Care is to be taken to remove shutter release oils and all remnants of curing compounds. The concrete is to be cured and dry - generally accepted when the bituminous prime coat achieves full adhesion. Brickwork is to be dry and smooth either bagged or plastered so as to achieve a uniform finish free of voids and protrusions.
- finish: plain
- Waterproofing to be one layer of ***Derbigum SP4 waterproofing membrane***, with 100mm side laps and 150mm end laps, sealed to primed surface by “torch-fusion”. Surface preparation. Concrete slab / screed topping laid to min 1:60 fall. fillets, coves and chamfers: where horizontal and vertical surfaces meet. Moisture <7%.
- Take up waterproofing at least 150 mm above roof level or to the level of the damp proof course if present, tuck into grooves where provided, and counter-flash.Dress down waterproofing into stormwater and other outlets.
- Testing - horizontal surfaces: a flood test of 48 hours or a spark, vacuum or air pressure test, using approved testing apparatus
- Material Guarantee – 10 years back to back with installer.
- Installation guarantee - Waterproofing to be installed under a ten year guarantee.
- Approved applicators – Installation to be carried out by an Approved Derbigum Contractor.
- Waterproofing to be overcoated with reflective aluminium paint where indicated on detailed sections:
    - Reflective bitumen based Aluminium paint finish for UV protection per Dulux Bituminous Aluminium Paint applied in accordance with manufacturers recommendation. Applied to areas of waterproofing.
- Where not overcoated, it is to be overlaid with insulation and stone ballast.
    - Drainage layer. Delta MS8 dimpled drainage layer installed per manufacturers recommendation
    - Insulation. 50mm Sagex EPS Hydroboard sheets. Properties 32D density. 0.032 W/ m.K anThermal conductivity.
    - Protective layer. Over insulation protection with Geofabric membrane, Kaytech Bidim geofabric, Grade A5.
    - Stone ballast. Geo-composite drainage layer having a minimum mass of 210 g/m2, laid on the waterproofing, followed by 40 mm thick layer of light coloured non-absorbent natural gravel of 19 mm nominal size. Keep gravel back from outlets, gutters and water shedding edges and bond gravel in these areas with a thinly applied cold dressing compound.
    - Treatment of exposed waterproofonh membrane. Reflective bitumen based Aluminium paint finish for UV protection per Dulux Bituminous Aluminium Paint applied in accordance with manufacturers recommendation. Applied to upstands and exposed edges of exposed waterproofing.

**self-adhesive plastic membrane (APM)**

- NA

**reinforced liquid membrane (RLM)**

- in situ reinforced liquid system:
- Sika Cemflex acrylic emulsion waterproofing additive. To be applied in accordance with manufacturer's specifications in two coat application totalling 1L Cemflex per sqm when mixed with water and Portland cement. Waterproofing membrane applied to full area of waterproofing, by setting on surface during first coat. Area of cover: full floor to all tiled rooms, turned up 300mm and to 2200mm in all shower rooms, full tiled area behind all basins/sinks.

**cavity drainage membrane**

- NA

**slip/protection layers, geomembranes**

- Delta MS8 dimpled drainage layer installed per manufacturers recommendation

**outlets**

- Full-bore stormwater outlet to waterproofed concrete roofs slabs. St Gobain cast iron full bore – 100mm id, with domical grating, top inlet.

## 8.2 Preparation

**Falls**

- Ensure minimum falls of concrete / screed to be 1:50.

**Balconies**

- NA

**outlets**

- NA

## 8.3 Application

- In strict accordance with manufacturer’s recommendations.
- Applicator to offer 10 year back to back guarantee with material supplier, and be approved applicator.

## 8.4 Termination

- N/A. Applies to winter rainfall areas

## 8.5 Waterproofing surface finishes/protection

- Waterproofing surface protection.
    - Reflective bitumen based Aluminium paint finish for UV protection per Dulux Bituminous Aluminium Paint applied in accordance with manufacturers recommendation.
    - Where stone ballast is used. Reflective paint to be applied to upstands and exposed edges of exposed waterproofing.
    - Where no stone ballast is used. Reflective paint to be applied to full waterproofed roof extent, upstands and exposed edges of exposed waterproofing.

### 8.5.1 Exposed non-trafficable areas

- Waterproofing to be one layer of ***Derbigum SP4 waterproofing membrane***, with 100mm side laps and 150mm end laps, sealed to primed surface by “torch-fusion”. Surface preparation. Concrete slab / screed topping laid to min 1:60 fall. fillets, coves and chamfers: where horizontal and vertical surfaces meet. Moisture <7%.
- type finish plain but overcoated with UV reflective paint / stone ballast.: see drawings

**paint**

- Reflective bitumen based Aluminium paint finish for UV protection per Dulux Bituminous Aluminium Paint applied in accordance with manufacturers recommendation. Applied to areas of waterproofing.

**crushed stone**

- Stone ballast. Geo-composite drainage layer having a minimum mass of 210 g/m2, laid on the waterproofing, followed by 40 mm thick layer of light coloured non-absorbent natural gravel of 19 mm nominal size. Keep gravel back from outlets, gutters and water shedding edges and bond gravel in these areas with a thinly applied cold dressing compound.

**tiled insulation panels**

- NA

### 8.5.2 Pedestrian traffic areas

- NA

**thermal insulation panels**

- NA

**tiles on waterproofing**

- NA

**paving slabs on adjustable pads**

- NA

### 8.5.3 Vehicular traffic areas

- NA

### 8.5.4 Basement, retaining walls

- NA

### 8.5.5 Planters, roof gardens

- NA

# 9 Ceilings, linings, partitions, access flooring

## 9.1 Brandered ceilings

To be published: SANS 2001- Construction Works Part EC1: Ceilings, partitions, access flooring.

### 9.1.1 Branders, grounds

- type: steel
- Supply and install 3600mm long Jumbo main tees at 1200mm cc and Jumbo cross Tees at 400mm cc perpendicular to main tees.
- Main tees suspended at 1200mm cc to superstructure with 25 x 25 x 0,6mm galv stee angle hangers.

**steel branders**

- perimeter trim: shadowline.
- Supply and install 3600mm long 20 x 20 x 0,5mm thick pre-painted white shadowline cornice trim to perimeter edge of room per Pelican Systems Econo shadowline cornices to all suspended ceilings

### 9.1.2 Fibre cement and gypsum board brandered ceilings

- External Type: fibre-cement per ceiling layout, external exposed nail up ceilings.
- Internal Type: gypsum to internal suspended ceilings per ceiling layout.

**fibre-cement board**

- Nutec Plain Medium Density (MD) Boards. 9mm. Product code 010-912 (3600x1200). Supporting structures at max 600mm cc. Fixings per manufacturers specification, at max 300mm cc. On steel substrate use self tapping counter sunk head screw, 35mmx5.5mm. Screw head to be filled over prior to painting. Screws to be min 20mm from sheet edges. Jointing with epoxy filler of 9mm width. (Product code 630-110)
- Nail up fixing to brandering to u/side of veranda rafters.
- Edge: square edge fibre cement board with cover strips. to all joints
  Ceiling perimeter and joints to be fitted with painted timber cover strips.
- joint cover strips: hardwood: meranti square profile, 32x9mm:

**gypsum board**

- type: standard to offices and common rooms, per ceiling layout as flush plasterboard surround with transition trim and suspended acoustic tile panel per ceiling layout.
    - Supply and install 3600mm Jumbo main tees at 1200mm centres in one direction and 1200mm (9mm) Jumbo cross tees at 400mm centres perpendicular to main tees. Main tees to be suspended at 1200mm centres by means of 25 x 25 x 0.6mm galvanised steel angle, hangers fixed to bulb of main tee with wafer tek screws/steel pop rivets and to slab with 6 x 30mm express nails and washers. Fit 9 mm Jumbo Plasterboard to the underside of grid system with tapered edge of board facing down with 25mm drywall screws at 150mm centres. Apply 50mm JUMBO tape to all joints and finish the entire ceiling with 3-5mm JUMBO Skimming Plaster.
- Type: moisture resistant to ablutions, per ceiling layout.
    - Supply and install 3600mm Jumbo main tees at 1200mm centres in one direction and 1200mm Jumbo cross tees at 500mm centres perpendicular to main tees. Main tees to be suspended at 1200mm centres by means of 25 x 25 x 0.6mm galvanised steel angle, hangers fixed to bulb of main tee with wafer tek screws/steel pop rivets and to slab with 6 x 30mm express nails and washers. Fit 12 mm Jumbo MR Plasterboard to the underside of grid system with tapered edge of board facing

down with 25mm drywall screws at 150mm centres. Apply 50mm JUMBO tape to all joints and finish the entire ceiling with 3-5mm JUMBO Skimming Plaster

- edge: tapered edge 9 or 12mm gypsum board.

**cornices**

- material, size: coved gypsum 75 mm wide to residential living and bedrooms
    - Supply and install Pelican JUMBO Cove Cornice GCD75036 or equal – Gyproc RhinoArt Cove cornice,
    - - Fix Gyproc RhinoArt cove cornice to structure using Gyproc RhinoBed.
    - - Bulkfill the void behind the cornice and the ceiling line using RhinoLite.
- .

**finish**

- finish to plaster board ceiling:
    - entire ceiling skimmed. Install boards with tapered edges facing down. Apply 50mm Jumbo Fibre Tape to all joints and finish the entire ceiling with 3-5mm Jumbo Skimming Plaster
    - Joints skimmed. Install boards with tapered edges facing down. Apply 50mm Jumbo Fibre Tape to all joints and finish with Jumbo jointing plaster.
- Paint finish per spec V21.
    - Dulux Trade alkali resistant plaster primer
    - Two Coats Dulux Trade 65 Matt Pva

### 9.1.3 Wood board brandered ceilings, linings

- N/A

### 9.1.4 Hatches

- position of ceiling hatches: see drawings
- Ifuba Ee-Zee ceiling access panel. Size 580x580, Matt white epoxy coated aluminium T Frame with 580x580mm white epoxy coated steel pan in a top hinged as supplied by Ifuba fitted flush to ceiling and including screw fixing through stalk of T Frame into 25x25mm gms angle support sub-frame per manufacturer's methodology.
- trap door: laid loose. NA

## 9.2 Suspended ceilings

- type: board / fabric / louvre / grid / bulkhead
- Ceiling tiles in exposed suspended grid
    - Supply and install Pelican Econogrid pre-painted white exposed tee grid system including fire safety punch outs. Main tees suspended by means of 19 x 0.5mm GMS strap/2.5mm wire hangers at 1200mm centres. Ceiling perimeter to be finished with prepainted shadow trims.
    - Vinyl faced Gypsum tiles to exposed suspended grid: 600x600mm suspended ceiling tiles, 12mm Foil backed, white vinyl faced gypsum ceiling tile, per Pelican Econotile
    - Vinyl faced Calcium silicate tiles to exposed suspended grid: 1200x600mm suspended ceiling tiles, Calcium Silicate Ceiling to comply with SANS 10177 Part 3. Supply and install Pelican Econocal Calcium Silicate ceiling tiles

- Skimmed bulkheads
    - Supply and install 3600mm Jumbo main tees at 1200mm centres in one direction and 1200mm Jumbo cross tees at 500mm centres perpendicular to main tees.

Main tees to be suspended at 1200mm centres by means of 25 x 25 x 0.6mm galvanised steel angle, hangers fixed to bulb of main tee with wafer tek screws/steel pop rivets and to slab with 6 x 30mm express nails and washers. Fit 12 mm Jumbo MR Plasterboard to the underside of grid system with tapered edge of board facing down with 25mm drywall screws at 150mm centres. Apply 50mm JUMBO tape to all joints and finish the entire ceiling with 3-5mm JUMBO Skimming Plaster.

Consult SABISA (South African Building Interior Systems Association, part of the AAAMSA group).

**performance**

- required fire resistance. NA
- required airborne sound insulation grading dB: NA

**board-** Vinyl faced Gypsum tiles

- type: plain
- material: gypsum
- edge: square
- size: see drawings
- 600x600mm suspended ceiling tiles, 12mm Foil backed, white vinyl faced gypsum ceiling tile, per Pelican Econotile,
- Colour: white
- texture: plain
- ceiling panels: removable and replaceable from below

**board-** Vinyl faced Calcium silicate tiles

- type: plain
- material: Calcium Silicate
- edge: square
- size: see drawings
- Calcium Silicate Ceiling to comply with SANS 10177 Part 3. Supply and install Pelican Econocal Calcium Silicate ceiling tiles size 600 x 600 x 6mm with White vinyl face finish and aluminium foil backing laid onto Pelican Econogrid pre-painted white exposed tee grid system including fire safety punch outs. Main tees suspended by means of 19 x 0.5mm GMS strap/2.5mm wire hangers at 1200mm centres. Ceiling perimeter to be finished with prepainted shadow trims.
- Colour: white
- texture: plain
- ceiling panels: removable and replaceable from below

**suspension fittings**

- suspension system:
    - Supply and install Pelican Econogrid pre-painted white exposed tee grid system

**installation**

- grid pattern: see drawings

**access**

- access: see drawings

## 9.3 Partitions, linings

- N/A

### 9.3.2 Drywall partitions, light weight internal walls

- N/A

### 9.3.3 Demountable partitions

- N/A

### 9.3.4 Cubicle partitions

- N/A

### 9.3.5 Operable partitions

- N/A

## 9.4 Raised access flooring

- N/A

# 10 Windows, doors, curtain walls, skylights, solar control

## 10.1 Performance

**mechanical performance**

- site category: 2 Outskirts of town, farmlands
- height above ground: 0 – 6m at roofing apex.
- Superstructure surrounds to windows.
    - PC Concrete lintels where openings < 3m
    - R.conc beam for wider openings.
    - Allow for plastic, shrinkage and creep deflection of floor slabs per structural engineers specification.

**thermal performance**

- fenestration unit conductance: see window schedule. 5.8 W/m$^2$K Unless specified
- fenestration unit SHGC: see window schedule. 0.7 Unless specified

**fire resistance**

- fire resistance: NA

**sound insulation**

- sound insulation: NA.

## General requirements

- type: see window schedule
    - Aluminium powder coated casements.
    - Aluminium powder coated shopfronts
    - GMS prison windows per SAPS 5 Star specification / drawings.
- type opening section: see drawings
- handing, whether viewed from inside or outside, including proportion of vertically pivoted casements that opens outwards: see drawings
- frame material: see drawings
- glazing from inside: see drawings
- shape and size: see drawings
- glazing bars: see drawings
- burglar bars: see drawings
- insect screens: see drawings
- glazing: see drawings
- sealants and seals: see drawings
- hardware and fixings: see drawings
- additional security devices: see drawings
- building in

## 10.3 Steel frame units

- factory finish:  hot dip galvanized . Prepared and painted per specification.

### 10.3.1 Hot-rolled steel framed units (SANS 727)

### 10.3.2 Cell windows

- Refer to window schedule.
- All manganese bars shall display the trade mark TISAT3030tm visible for identification on site.

### 10.3.3 Pressed steel clisco type window frames (SANS 1311)

- NA

### 10.3.4 Pressed steel door frames (SANS 1129)

- type: Single and double rebate surround. see drawings
- material of lock strike plate: chromium/cadmium plated steel / brass
- hinges: brass
- handing: see drawings
- size: see drawings
- type of profile: see drawings
- fanlight: see drawings
- type of lock/latch: see drawings

**additional clauses**

- Frames for screeded flooring unless otherwise stated.

## 10.4 Cold-rolled steel frame units

## 10.5 Aluminium frame units

- performance class: A2
- frame surface finish: powder coated
- 
- powder coating colour: Provisionally Charcoal
- gloss category/finish: satin

### 10.5.1 Windows and glazed doors

- colour of gaskets and weatherstrips: black
- weatherstrips: renewable.

### 10.5.2 Skylights

- N/A

### 10.5.3 Curtain walling

- N/A

## 10.6 Adjustable glass louvre windows

- N/A

## 10.7 Wood frame units

- N/A

## 10.8 PVC-U frame units (SANS 1553)

- N/A

## 10.9 Polymer concrete frame units

- N/A

## 10.10 Wood doors (SANS 545)

- type of door: see drawings / schedule
- dimensions: see drawings / schedule
- handing: see drawings / schedule
- exposure class: see drawings / schedule

**flush panel doors**

- performance class: 2. Semi exterior. see drawings / schedule
- any special properties: Heavy Duty solid timber core
- finish, and wood species when relevant: see drawings / schedule

## 10.11 Fire doors and fire shutters (SANS 1253)

- NA

## 10.12 Garage doors

- NA

## 10.13 Roller shutter doors

- NA

## 10.14 Strongroom/record room doors, ventilators

- type: see drawings

**strongroom and vault doors (SANS 949)**

- category strongroom doors: 2 ADM. 120Minute fire rated.
- dimensions: see drawings / schedule
- fittings: see drawings / schedule
- handing: see drawings / schedule
- factory finish: primer only with paint per project specification V25

**fire-resisting record room doors (SANS 1015)**

- type of lock if other than specified: …
- factory finish: primer only with paint per project specification V25

## 10.15 Solar control

- type: Fixed awning
- material: pre-painted, pierce fixed aluminium profiled sheeting on hot dipped galvanised steel frames to metalwork schedule.

# 11 Plaster, screeds, toppings, terrazzo

## 11.1 Plaster

- type: see drawings

### 11.1.1 Cement plaster (SANS 2001 EM1)

Specification data:
Cement plaster

- application: single coat unless specificed.
- finish to cement plaster: smooth plaster to interior walls, by steel trowel finish.
- finish to cement plaster: smooth plaster to exterior walls, by wood float finish.

### 11.1.2 Gypsum plaster

- NA

### 11.1.4 Insulating plaster

- NA
-

### 11.1.6 Accessories

- NA

## 11.2 Screeds, toppings, terrazzo

### 11.2.1 Screed - Materials

Refer: SANS 2001-EM2 Screeds and toppings.

Screed is a layer of a well-compacted mixture of cement and fine aggregate applied to a concrete base, *suitable* for receiving a floor finish.

Topping is a layer of high-strength concrete designed to provide a dense, abrasion-resistant surface on a concrete base.

Terrazzo is a hard-wearing decorative concrete finish in which crushed or uncrushed aggregate like marble and pigments is used, and of which the surface is generally ground and polished.

Specify screed or topping only where a direct-finished one-course concrete floor is impracticable.

**proprietary surface treatments**

- NA

**mesh reinforcement**

- NA

**water**

- water: SANS 51008

### 11.2.2 Mix

- NA

**topping**

- concrete grade: see drawings

### 11.2.4 Laying

- **Topping:** 1 part cement to 1½ parts sand to 1½ parts stone would produce a concrete strength of 25 – 30 MPa.
- Use concrete of grade 40 for floors for medium duty industrial and commercial purposes; 40 for ditto medium duty
- Method of laying as described here is known as "separate bonded construction", where the topping or screed is laid on and bonded to a hardened base. For other methods, for example monolithic construction, and separate unbonded construction, consult SANS 10109 part 2.
- Compaction of the mix is most important. Stiff semi-dry mixes not well compacted are a common cause of bond failure. Compact stiff mixes with power-operated equipment such as vibrating screed boards.
- Joints in screeds should be minimal. Screeds laid in large areas may crack, but this is more acceptable than curling at edges of small panels.
- screed thickness: see drawings. Min 30Mm unless specified
- topping thickness: see drawings. Min 50Mm unless specified
- edge/feature/dividing strips: see drawings.

### 11.2.5 Finishing

- type of finish: ordinary to areas finished with tiles.
- type of finish: Hard finish is *suitable* for surfaces that are not to be covered with flooring and for toppings that require high resistance to wear (grade 30 and higher).
- surface smoothness: smooth / non-slip

**pigmentation**

- NA

### 11.2.6 Joints

- type: isolation joint / intermediate sawn contraction joint
- pattern: see drawings. To match cut / movement joints in structural concrete surface beds.
- seal joints: not required
- patent movement joint system: not required.

### 11.2.7 Surface regularity

- degree of surface regularity: I (3 mm over 3 m in any direction)

### 11.2.8 External thresholds

- Grade II. Refer SANS 10155

### 11.2.13 Surface sealing

- seal floor surface with: epoxy per finishes schedule – to plant / refuse rooms
- Refer SANS 10109

# 12 Tiling

## 12.1 Materials

- type of tile: see finishes schedule / drawings

**Porcelain / ceramic wall and floor tiles (SANS 1449/13006)**

- group: B1 . Water absorption. <3%
- Tiles to floors - surface: unglazed, full bodied porcelain
- Tiles to walls - surface: matt glazed, ceramic tiles
- shape, pattern, colour:
    - Floors- Union Tiles, Doppio Unglazed, full bodied, rectified porcelain tiles, size 600 x 600mm. Anti-Slip resistance R10, per DIN 51130.
      Provisionally Colour Charcoal Grey - Tile Code 1OVEYZI6S27MAT600 - Matt
    - Floors (Non-slip)- Union Tiles, Doppio Unglazed, full bodied, rectified porcelain tiles, size 600 x 600mm. Anti-Slip resistance R11, per DIN 51130.
      Provisionally Colour Charcoal Grey - Tile Code 1OVEYGIV6S27A-S600 - Slip resistant
    - Walls- 600x300. Matt white. Union Tile code. UT4062

- nominal dimensions: see drawings
- grade: first grade
- glazed tile abrasion resistance class: 4 to SANS 13006:
- slip resistance value (coefficient of friction) : R10, Interior. R11, exterior
- acid and alkali resistance of glazed tiles: not required

**stone tiles**

- NA

**concrete tiles**

- NA

**mosaic**

- material: unglazed, full bodied porcelain
- appearance: unglazed
- colour: TBC – to match floor tiles

**grout**

- proprietary grout: cement-based

**profiled and decorative tiles**

- N/A

**accessories**

- Skirting tile to match floor tile.
    - External corner tile joints to be laid with uncut tile edges. Joint widths to be consistent with floor tiling spec.
    - Uncut tile edge required as top edge of all skirting tiles to not be plastered or painted over.
- Movement joints. Tiled in preformed joint, per M-Trim SMJ120 – 12mm Stainless Steel Movement Joint, Colour: Black
- Thresholds to doors at edge of tile extent to be finished with brass edge strip M-Trim item xx
- Perimeter edge trim under skirting tile,

- per M-Trim item PCJ100 – 10mm PVC Perimeter Movement Joint,

## 12.2 Tiling

**Bedding – floor preparation**

- All new concrete work and screeds must have a moisture content of 5% or less before tiling can be commenced. If 5% moisture content cannot be achieved, Tal X-Calibur X-Shield Vaporstop HB (vapour barrier) must be applied prior to tiling.
- The backs of all tiles must be clean and free from all traces of dust and contaminants.
- Ensure that the surfaces are clean and free of all traces of curing agents, laitance and any other surface contaminants, preferably by scarifying.
- Where the existing surface contains evidence of adhesives, bitumen, oil and grease etc these surfaces are to be prepared so as to remove 85% of the area of the exposed surface of such contaminants. By scarifying, chipping or other approved mechanical means. Surface to be cleaned down after with clean water and allowed to dry prior to assessment of adequacy for tile application.
- Floor levelness to be adequate for application of adhesive per adhesive manufacturer's recommendation. Any deviations to adequate level to be repaired by application of proprietary levelling compound, per TAL Rapidfix or equal approved.
- Allow all new screeds / surface beds to cure for at least 4 weeks before proceeding. All new screeds must have a moisture content of 5% or less before tiling can be commenced.
- The surface must be clean and dry and free of all traces of dust, debris, loose particles and surface contaminants.
- If the surface has been wood floated it is possible to commence tiling. However, if the surface has been power floated or steel floated it will be necessary to first key the surface with a slurry consisting of 1 part TAL KEYCOAT to 2 parts TAL KEYMIX powder or 2 parts TAL GOLDSTAR 6 adhesive powder (by volume), which is applied by block brush. Allow this slurry coat to dry for 4 – 6 hours before applying the adhesive.

**Application of adhesive**

- Apply TAL GOLDSTAR 6 Rapid-Setting Adhesive mixed 20kg with 5 litres of TAL BOND (replacing the water in the mix) to the background using a notched trowel.
- It is imperative that there is a solid bed of adhesive at least 6mm thick beneath each tile using a notched FLOOR TROWEL.
- At no time spread more adhesive than can be tiled onto in 10 – 15 minutes. Depending on atmospheric conditions, this will normally be around 1 square metre. This prevents the adhesive from drying or "skinning" before the tiles are applied.
- Bed dry tiles (do not soak) firmly into the wet adhesive with a twisting action to ensure full contact between the background, tiles and adhesive. Tiles should be well tapped home with a rubber mallet or the wooden handle of a trowel. It is sound practice to remove the occasional tile to ensure that good contact has been achieved.
- Clean off any surplus adhesive remaining on the face of tiles and between the joints with a damp sponge before the adhesive dries.

- external angles: see drawings
- internal sills in bathrooms: see drawings - sloping
- field, border, pattern: see drawings.

## 12.3 Jointing

- joint width: 3mm
- TAL Wall & Floor Grout

- Grouting must only be carried out after sufficient bond (1 to 3 days) has developed between the bedding mix and the tiles to preclude disturbance of the tiles during the grouting operation.
- 20kg of TAL Wall & Floor Grout mixed with 6 litres of TAL BOND (as replacement of the water) in the mix for filling floor tile joints .
- Particular care must be taken to clean the grout off the tile face before it hardens completely. This is especially important when an additive such as TAL BOND
- It is important to use the stipulated amount of liquid in the TAL Grout mixture. When cleaning, a damp, not wet, sponge must be used. Over hydration (too much water) of the mix, or in cleaning, causes colour variations in the grout joints, and also affects the integrity of the grout, resulting in a friable product.

## 12.4 Movement joints

- type: formed in situ / preformed strip / isolation joint / intermediate joint / structural joint
- Movement joints should be located in both directions at maximum 5 meters centres to surface beds and maximum 3 meters centres to suspended floors.
- Movement joints should also be located around the perimeter of all floors, in all internal corners and interfaces, against obstructions fixed to the structural background and over all discontinuities in building materials, e.g. at interfaces of concrete and brickwork.
- The joints must extend through the adhesive and tile layers.
- All construction / cold joints and structural joints in the background must be extended through the adhesive and tile layers to the surface in the form of tile panel movement joints.
- The full width of the structural joints must be respected and extended through the adhesive and tile layers to the surface.
- Movement joints should be located around any fixtures protruding through the tiled surface.
- Expansion joints between floor tiles to be M-Trim SMJ120 – 12mm Stainless Steel Movement Joint, Colour: Black. Installed as per Manufacturer's Specification. Supplier Kirk Marketing
- Movement joints around perimeter, internal corners and interfaces to be M-Trim PCJ100 – 10mm PVC Perimeter Movement Joint, Colour: Black. Installed as per Manufacturer's Specification. Supplier Kirk Marketing
- Transition strip at interface with concrete flooring to be M-Trim STICP120 to suite 10-11mm depth tiles. Brushed finish, Grade 430. Installed as per Manufacturer's Specification. Supplier Kirk Marketing

### preformed compression joint strip

- material, colour: M-Trim SMJ120 – 12mm Stainless Steel Movement

### isolation (perimeter) joints

- M-Trim PCJ100 – 10mm PVC Perimeter Movement Joint, Colour: Black

### structural joints

- material, colour: M-Trim SMJ120 – 12mm Stainless Steel Movement

In practice structural substrate joints are often not true. Ignoring this fact will result in a tiling joint not uniformly coinciding with the base joint, leading to cracks. Possible solutions are:

a) if the joint is out of line but straight, consider continuing the joint through the tiling (the joint will not be aligned to the tile joints, but will at least be straight), or

b) if the joint is irregular within a narrow straight band, consider installing a prefabricated flexible metal joint capable of spanning the irregularity, or

c) if the joint is out of line and irregular, consider leaving out the row(s) of tiles in which the troublesome joint occurs, and lay the row of tiles over an underlay or in a permanently flexible adhesive, or lay a different flooring material over the joint which is able to accommodate the expected movement, e.g. carpet, thermoplastic, wood or laminate. Reinforce the edges or, in the case of rigid materials, seal both sides of the strip covering the structural movement joint.

# 13 Floor coverings, wall linings

- type: see floor finishes layout.

## 13.3 Thermoplastic and similar flexible floor covering

- Server room – anti-static vinyl sheeting
- Service rooms – Epoxy on screed.

### 13.3.1 Materials

- type: see floor finishes layout.

**semi-flexible vinyl floor tiles**

- Supply and install semi-flexible vinyl tiles, in accordance with SANS 581. Laying in accordance with SANS 10070 and to manufacturers instructions.Cleaned and polished with two coats polymer floor dressing to SANS 1042. Movement joints in building to have aligned joints to detail in flooring. Flooring preparation to include levelling of substrate to class 1 in accordance with SANS 10070, using proprietary Self Leveller when require, removal of laitance.
- Supply and fix 2.5mm thick x 300x300 FloorworX Floorflex semi-flexible vinyl sheeting, manufactured in accordance with SANS 581 and laid in FloorworX No.62 acrylic adhesive which has been spread using a trowel fitted with an A2 notched blade at a rate of between 5.5m2 and 6.5m2 per litre on a previously prepared Class 1 sub-floor in accordance with SANS 10070, using FloorworX Self Leveller when required, including all cutting and waste. The sheeting must be rolled in both directions with an articulated 68kg three-sectional roller immediately after it has been laid into the adhesive. The newly laid floor must, after 48 hours, be stripped using Floorworx Stripper, scrubbed using a diluted solution of Floorworx Rinse and then sealed with 3 coats of Floorworx Silk Matt, or Gloss Sealer
- Colour: TBC.

**flexible vinyl flooring**

- Server room – anti-static vinyl sheeting
- Supply and fix 2.0mm thick x 2.0m wide FloorworX SD directional static dissipative vinyl sheeting, manufactured in accordance with EN 649 and laid over an earthed grid of aluminium tape in FloorworX No.27 conductive acrylic adhesive which has been spread using a trowel fitted with an A2 notched blade at a rate of between 5.5m2 and 6.5m2 per litre on a previously prepared Class 1 sub-floor in accordance with SANS 10070, using FloorworX Self Leveller when required, including all cutting and waste. The sheeting must be rolled in both directions with an articulated 68kg three-sectional roller immediately after it has been laid into the adhesive. Joins must be butted, grooved and heat welded using the manufacturer's welding rod, ensuring that the welding rod bonds to more than 70% of the sheet thickness. After completing the installation the floor must be electrically tested for resistivity in accordance with the requirements of SANS 6160.

**linoleum sheeting or tiles**

- N/A

**rubber sheeting or tiles**

- NA

**accessories**

- skirtings: extruded PVC

  - Supply and fix FloorworX Extruda Vinyl skirting, welded to floor sheeting, code Use MFE 5, incl MFE5 Int + MFE5 Ext / MC18C / MC F54, of size 100 mm Height x14mm Width. Colour to match adjoining flooring. Provisionally Ash Grey.
  - Supply and fix 100mm high Skirting using contact adhesive to the corner of the floor and wall, spread evenly and quickly with a brush onto both material and working surface. Allow both surfaces to become touch dry – approximately 15 minutes. Place material carefully into position at one end, then work gradually along its length. When completely positioned, apply firm pressure along whole length to ensure perfect contact between the two adhesive surfaces all to manufacturer's instructions.

- nosings: extruded PVC / rubber / extruded aluminium with non-metallic slip-resistant inlays / solid wood

### 13.3.2 Laying

- Method. laid in FloorworX No.62 acrylic adhesive which has been spread using a trowel fitted with an A2 notched blade at a rate of between 5.5m2 and 6.5m2 per litre on a previously prepared Class 1 sub-floor in accordance with SANS 10070, using FloorworX Self Leveller when required, including all cutting and waste. The sheeting must be rolled in both directions with an articulated 68kg three-sectional roller immediately after it has been laid into the adhesive. Joins must be butted, grooved and heat welded using the manufacturer's welding rod, ensuring that the welding rod bonds to more than 70% of the sheet thickness.
- pattern: see drawings / straight joints in both directions

**finishing**

- polymer floor dressing type: The newly laid floor must, after 48 hours, be stripped using Floorworx Stripper, scrubbed using a diluted solution of Floorworx Rinse and then sealed with 3 coats of Floorworx Silk Matt sealer

## 13.4 Wood flooring, solid and laminate, on solid substrates

- NA

## 13.5 Textile flooring

### 13.5.1 Materials

**textile flooring**

- N/A

## 13.6 Epoxy flooring

**application**

- Prime with Flowcrete Flowprime at @ 6m2
- Apply Flowcrete Flowcoat SF 41 @ 0.5mm thickness
- Finish: smooth finish.
- Epoxy coved skirtings. Prime substrate with Flowprime at @ 4m2/. Coved skirtings formed with coving mortar- Apply 2 coats of Flowtex HT F1 coving Resin in a 2 coat application, as per the chosen flooring system colour - as per manufacturer's instructions. Once cured, movement joints must be re-cut to original geometry and filled with Flowflex HM flexible joint sealant.

# 14 Painting, paperhanging

## 14.1 Materials

- SANS 10064: Preparation of steel surfaces for coating.
- SANS 10305: Painting of buildings:
    - Part 1: Paint and paint selection.
    - Part 2: Paint application and defects.
    - Part 3: Paint types.
    - Part 4: Painting of walls, ceilings and cladding.
    - Part 5: Painting of roofs and steel structures.
    - Part 6: Painting of wood.

**Primers**

- For steel substrate:
    - Remove all loose and flaking paint. Edges of tightly bonded paint are to be feathered with sandpaper to smooth them off and provide an even surface. The sanding will also serve to provide a profile.
    - All corrosion products must be removed from the bare steel. Rusted areas may be wire-brushed, scraped, chipped and sanded down to bright metal and a cleanliness standard of St2.
    - Clean bare steel patches with a solvent wash (rags dipped in lacquer thinner). Change rags frequently.
    - N.B. HAMMERITE NO 1 RUST BEATER may be used on small areas where hand cleaning is ineffective. Apply with a stiff brush, scrubbing it well into the surface. Use unthinned, or thin with water – it must be sufficiently liquid to penetrate into pits. Inspect after 2 hours and make a further application to any spots still showing unconverted red rust. Allow approximately 15 hours for reaction before top coating. Brush off any loose powdery deposit.
    - Sand sound previously painted enamel surfaces to provide a key and improve adhesion.
    - To clean, rust-free bare metal areas, apply COAT 1 as primer. Allow drying overnight
    - Window Frames: Remove defective putty from window frames. Clean the metal frames, and apply Dulux Steel Primer as a primer, allowing overnight drying. Then reglaze and allow putty to dry for approximately 7 days until a solid skin has formed.
    - Dulux Steel Primer

- For galvanised substrate:
    - To remove all dust and debris, as well as white rust, acid, and salts, bristle scrub the entire surface with DULUX GALVANISED IRON CLEANER thinned 20% with water. Before the DULUX GALVANISED IRON CLEANER dries, Remove residues with clean running water, preferably under pressure. To ensure that the surface is thoroughly clean, test for a "water-break" free surface (running water should not form droplets). The cleaning process with DULUX GALVANISED IRON CLEANER should be done in small areas as it is very difficult to remove DULUX GALVANISED IRON CLEANER from a substrate once it has dried. Galvetch or similar, approved cleaner for galvanised iron may used to remove white rust.
    - To clean, rust-free bare metal areas, apply COAT 1 as a patch primer. Allow drying
    - DULUX GALVANISED IRON CLEANER
    - DULUX PRIMER FOR GALVANISED IRON

- For timber substrate:
    - Ensure new wood is dry (less than 12% moisture content). Treat all knots and resinous areas to prevent subsequent staining of paint coatings. Ensure that all nails, pins and screws are embedded well below the surface, primed with Dulux Trade Steel Primer, and filled with appropriate wood filler.
    - On new timber apply full coat of primer. Allow overnight drying.
    - Dulux Primer For Wood

- For concrete / cement plaster / plasterboard substrate:
    - It is important to note that for optimum coating performance, fresh plaster should be allowed to dry and cure adequately, i.e. one week drying for every 5mm thickness, and longer in cold or damp weather.
    - Ensure surfaces are sound, clean and thoroughly dry - moisture content must not exceed 12%.
    - Brush down with a stiff brush to remove all loose contaminants.
    - Apply COAT 1 as a primer and allow overnight drying. Thinning not recommended. This is ready for use after thorough stirring.
    - Dulux Trade Alkali Resistant Plaster Primer

### undercoats

- universal undercoat to primed timber substrate:
    - Use Dulux Trade Universal Undercoat

- universal undercoat to primed steel / galvanised substrate
    - Use Dulux Trade Universal Undercoat to build-up flaked, primed patches on the steelwork

### finishing paints

#### alkyd

- alkyd high gloss finishing paint (SANS 630) grade: 1 required
- to primed, undercoated timber substrates.
    - Two coats Dulux Pearlglo Water-Based Eggshell Enamel
- to primed, undercoated steel / glavanised substrates.
    - Two coats Dulux Pearlglo Polyurethane Non-Drip Enamel
- to primed, cement plaster / concrete substrates.
    - Two coats Dulux Pearlglo Water-Based Eggshell Enamel
- decorative paint for interior use (SANS 515) type: semi-gloss

#### emulsion

- emulsion paint (SANS 1586)
- to plasterboard substrates.
    - Two coats- Dulux Trade 65 Matt Pva

- to plasterboard substrates in bathrooms.
    - Two coats- Dulux  Bathroom +

- to primed, cement plaster / concrete substrates.

  - Two coats Dulux Pearlglo Water-Based Eggshell Enamel

- textured emulsion wall coating (SANS 1227)

- fungus resistance: not required

**varnishes, varnish stains, stains, sealers**

- Application of decorative stain per specification, diluted p[er manufacturer's recommendation. Stained and finished sample to be supplied per timber substrate type / stain colour.
- varnish or varnish stains for interior use (SANS 887)
  - Ensure new wood is dry (less than 12% moisture content). Treat all knots and resinous areas to prevent subsequent staining of paint coatings. If nail holes or wood crevices need to be filled with wood filler, then fill and allow drying and sand to a smooth finish as part of the final sanding.
  - Remove dust with a clean lint free cloth dampened with water. Ensure that surface is smooth, free from dust, dirt, grease, oil and mortar splatter. Surfaces must be thoroughly dry, no more than 12% moisture content
  - Apply decorative stain if specified.
  - On new timber apply in an even thickness and finish in the direction of the grain. Thin the first coat up to 10% with Mineral Turpentine to aid penetration on raw wood
  - Allow to dry overnight and sand lightly with 320 grit sandpaper. Apply COAT 2 and allow overnight drying.
  - Apply second and third coats undiluted
  - Light sanding between coats is advised.
  - The ends of items are to be sealed by every coat to avoid moisture penetration.
  - 3 Coats - Dulux Woodgard Interior Double Life Timbervarnish

**bituminous and tar-based coatings**

- Bituminous and cement surfaces should be clean, dry, and free from loose gravel, sand, oil, grease, and other contaminants.
  - Smooth surfaces can be profiled by sand blasting to achieve a paintable surface. Sand of an appropriate quality should be used - river sand is not suitable.
  - Cement floors may be acid etched with a solution of hydrochloric acid to remove laitience, uncured cement, etc. as follows:
  - On steel or power floated concrete (very smooth), use one (1) volume hydrochloric acid to two (2) volumes water. More than one application may be necessary to achieve a paintable surface.
  - On wood floated concrete (rough), use one (1) volume hydrochloric acid to four (4) volumes water. Allow the acid solution to react for 15 minutes and then wash away all acid with copious amounts of clean water.
  - Remove excess water and allow thorough drying – no more than 12% moisture content.
  - Dulux Albertono Solvent Based Road Marking Paint
  - Apply One coat only. To achieve the required properties, ensure adequate film build of at least 380µm wet. (Approx 2.7sq.m / L in WFT. 25-30Lin Meters / litre for 100 mm wide stripe)

**specialized coatings**

Clear Lacquer to timber substrates

- Ensure new wood is dry (less than 12% moisture content). Ensure that all nails, pins and screws are embedded well below the surface, and filled with appropriate wood pellets.
    - All pre-sealed surfaces to be coated must be dry, clean and free from contamination. Prior to application the surface should be sanded to a smooth finish with fine sandpaper, working in the direction of the grain.
    - All sharp edges must be rounded off, ensure substrate is then free of dust by blowing with compressed air or making use of clean rags before application of coating.
    - 150 – 180 grit with raw wood & steel
    - 320 – 400 grit for intermediate lacquer sanding
    - Sand the surface fully
    - Apply decorative stain if specified.
    - Apply COAT 1. Plascon Base Coat Primer Lacquer. Plascolac EZN 1400 High Build Clear base Coat
    - Apply COAT 2 and 3. Plascon Lacquer Plascolac EZN 1000 Series. A two component, high solids, non-yellowing alkyd/urea formaldehyde acid catalysed clear lacquer. Finish type Satin with a Film thickness of 120-150 g/ sq.m / coat. Applied by spray application.
    - Sanding between coats. 320 – 400 grit for intermediate lacquer sanding
    - The ends of items are to be sealed by every coat to avoid moisture penetration.

## 14.2 Preparation of surfaces

- hardware etc.: remove, mark, store and refix / mask.

## 14.3 Colours

- identification colour marking (pipes etc.): required – refer to mechanical engineering drawings / specifications.

## 14.8 Paint systems for on-site application

- paint system: see paint schedule
- colour: see drawings.

### 14.8.1 Cement-based surfaces, brick and stone

**alkyd paint**

### 14.8.3 Wood

**transparent finish systems for wood (interior)**

### 14.8.5 Plastics

**paint on unplasticized polyvinyl chloride (PVC-U)**

- Ensure that surfaces are sound and free from dust, dirt, grease and oil. Surfaces must be thoroughly dry - no more than 12% moisture content. Do not apply during cold (below 10°C) or wet weather.
- Do not apply directly to bare metal surfaces.
- Not suitable for direct application to powdery or friable surfaces whether previously painted or not.
- Sand the surface fully
- Apply COAT 1. Dulux Supergrip Primer

- Finish with COATS 2 and 3, to obtain a closed film and solid colour.
- Dulux Pearlglo Waterbased Eggshell Enamel

### 14.8.6 Intumescent paint

- NA

## 14.9 Paperhanging

**wallpaper**

- NA

# 15 Furniture, equipment, stairs, architectural metalwork

## 15.1 Joinery

### 15.1.1 Solid wood

For wood doors and windows see Section 10.

**wood**

- type:
    - hardwood
    - softwood
    - laminated wood

**hardwood**

- Species: Meranti
- SANS 1099 includes requirements for preservative treatment. Annex C gives properties of 29 hardwood species, local or exotic.

**softwood**

- Species: SA Pine

**laminated timber**

- Wisa-ply, birch plywood

### 15.1.2 Wood board

- type:
    - plywood. Refer to material specification below
    - composite board - N/A
    - decorative melamine-faced boards (MFB) Refer to material specification below
    - fibreboard - N/A
    - particle board.Refer to material specification below
    - oriented strand board (OSB) - N/A

**plywood and composite board (SANS 929)**

- exposure class: 4
    - 1 (exterior); 2 (semi-exterior); 3 (humid interior); 4 (dry interior).
- type board: ply
- type plywood: commercial
- type composite board: laminated board
- thickness plywood: 15 mm
- number of plies or laminae: 7
- veneer: species…, rotary cut
- plywood grade: S
    - S (select, for decorative applications), A (furniture, for joinery where it may be reworked), B (standard, to be covered, coated or painted).
- Specification - 15mm WISA Multiwall coated plywood with exposed edges finished with 2mm ABS impact edging, factory applied with Jowat PUR hot melt glue. Doors/ drawers each fitted with 2 x 8mm diam nylon buffers, per Blum item 993.710

**decorative melamine-faced boards (MFB) (SANS 1763)**

- core: particle board
- thickness: 16 mm
- shelving edge: melamine
- surface finish: smooth matt
- moisture resistant board: required
- specification. 16mm PG BisonLam Superwhite Melamine faced particle board (MFB) per Bisonbord Moisture resistant (MR) substrate with Peen finish, carcass with factory applied Jowat PUR hot melt glue to carcass, and 2mm ABS edging to doors and drawer edges.

**fibreboard (SANS 540)**

- N/A

**particle board (SANS 50312)**

- type: P7 as required
    - P2 (general purpose, dry conditions); P3 (interior fitments, dry conditions); P4 (load-bearing, dry conditions); P5 (load-bearing, humid conditions); P6 (heavy-duty, dry conditions); P7 (heavy-duty, humid conditions).
- thickness: 16 mm

**oriented strand board (OSB) (SANS 472)**

- N/A

**Laminated hardwood counter**

- 32mm Laminated Saligna counter top with same downturn to all exposed ends, 100mm depth. Bullnosed corners. Finish in Lacquer per paint spec

### 15.1.3 Polymer laminate and solid surfaces

**high pressure decorative laminates (HPL) (SANS 4586)**

- N/A

**continuous pressed laminates (CPL)**

- Specification.
    - 32 mm 'Formica Lifeseal' post formed top - Size/ 32 mm thk, cut to length / 6mm Squareline profile / Colour – Plain colour TBC (NOTE: Cut edges to be sealed and exposed edges to be covered with matching laminate strip all according to Manufacturers spec)
-

**polymer solid surfacing material**

- N/A

### 15.1.4 Stone surfaces

**stone surfacing material**

- N/A

### 15.1.5 Steel tubes for furniture

**steel tubes for furniture SANS 657-4**

- material and grade:
    - mild steel 250 /
    - stainless steel grade 304
- size, profile: see drawings
- wall thickness: see drawings
- stainless steel finish: matt

### 15.1.6 Joinery

**general**

- wood sizes: see drawings
- exposed edges of veneered composite board: solid wood edging to match veneer and to full thickness of board

**grain, pattern**

- direction of grain or pattern: see drawings

**backs**

- backs to fittings: 4,8 mm hardboard, unless specified

**drawers**

- drawer construction: see drawings

**shop painting**

- delivery of joinery on site: finish as specified under Section 14, per specific substrate material type.

### 15.1.7 Fixing

**wood cornices, skirtings, quarter rounds, rails**

- material: solid hardwood
- size and profile: see drawings.

## 15.2 Commercial kitchen cupboards (SANS 1385)

- type of unit: see drawings

## 15.3 Commercial steel furniture (SANS 757)

- type of unit: see drawings

## 15.4 Metal counters, balustrades, cladding, signs, street furniture

- Signage per schedule.
- Metalwork elements per schedule.
  Finish as specified under Section 14, per specific substrate material type.

## 15.5 Stairs and ramps

- N/A

# 16 Hardware

## 16.1 General

- Ironmongery door / window / fire door hardware:
  see drawings / schedules. Ironmongery, door, window and finishes schedules.
    - lock
    - latch
    - handle
    - plate
    - closer
    - hook and eye
    - bracket
    - hinge
    - bolt
    - door stop
    - door knob
    - door knocker
    - sanitary
    - furniture
    - curtain rail
    - edge or feature strip
    - sunken door mat
    - signage
    - drawer runner
    - escape hardware
    - panic bars
    - locksets with thumb turns
    - fire bolts
- material: see drawings / schedules

**finish**

- finish: Stainless steel - finishes on metal see SANS 1171 Annex C.
    - Brushed / stain
- electroplating service condition:
    - Interior 1 (15 μm normal indoor)
    - Exterior 2 (30 μm outdoor)
    - appearance: satin.

## 16.2 Fasteners

- fastener type: bolt / screw / nut / washer / pin / rivet
- metal screws for wood, type: countersunk-head / round-head / raised countersunk-head / slotted or cross recess drive / hexagon-head / scant shank
- material and size: steel / brass / silicon-bronze / aluminium / stainless steel
- mild steel nails: type…; finish…

## 16.3 Locks, latches, catches, bolts

- Refer SANS 1700 for full list of fastener types.
- type lock: mortice & cylinder style - see drawings

- type handle: lever style - see drawings
- type latch: magnetic / ball / roller- see drawings
- type catch: barrel / flush / tower / stable / extension / size - see drawings

**padlocks**
- type: see drawings
- duty: medium duty – masterkeyed
- material: Stainless steel - see drawings
- size: 50mm - see drawings

**keys**
- master keys in zones of building complex.

## 16.4 Hinges

**hinges for lightweight doors**
- type: Butt hinges. see drawings

**hinges for medium to heavy doors**
- Pivot hinges. See schedules.
- material: see drawings

## 16.5 Door closers
- Type- overhead transom mounted: see drawings

## 16.6 Pelmets, curtain rails, rods, blinds

**pelmets**
- N/A

**rails with rollers or glides**
- N/A

**rods with rings**
- N/A

**tie backs**
- N/A

**indoor venetian blinds**
- slat width: 50 mm aluminium powder coated.
- type of ladder web: reinforced plastic

## 16.7 Edge, feature, dividing strips
- strip material: solid brass

## 16.8 Sunken door matting
- material: interlocking aluminium channels with plastic inserts

## 16.9 Number/name plates, safety signs
- type: changeable plate system
- materials: aluminium framing

**symbolic safety signs**

- Refer fire engineering drawings and specification.
- type: FB / GA
    - FB (informative, fire-fighting – square, red), GA (informative, general – square, green)
- Type of luminosity: self-luminous (radio luminescent)
- size: 150 x 150 unless otherwise specified

## 16.10 Drawer runners/slides

- type commercial ball-bearing runner: normal
- load capacity: 30 kg static
- extension: full

# 17 Glazing

## 17.1 Materials

**glass**

- All glazing to be installed in accordance with
    - SANS 10137 The installation of glazing materials in buildings.
    - SANS 1263 Safety and security glazing materials for buildings.
    - SANS 10400-N Glazing.
    - SANS 2001-CG1 Installation of glazing.
- Installation certification to be provided per SAGGA – South African Glass and Glazing Association and AAAMSA in respect of each type of glazing installation.
- Installers to be registered in the specific category of installation described in the drawings and schedules.
- types of glass: float, patterned, safety glass (laminated / toughened)
  – see drawings / schedules
- float glass thickness: – see drawings / schedules
- laminated safety glass interlayer strength class: NS / HPR / HI – see drawings / schedules
  NS (normal strength), HPR (high penetration resistance), HI (high impact).
  Safety and security glass is made by several local manufacturers. Laminated safety glass is made with a poly-vinyl butyral interlayer (0,38 mm for Normal Strength (NS); 0,76 mm High Penetration Resistant (HPR); 1,14mm High Impact (HI));
  SANS 1263 provides for three applications, i.e. human contact, burglary and firearms.
- bullet-resistant glass: class and level of attack: GA / GC / RA / RB / SB
  – see drawings / schedules
  See SANS 1263 for bullet-resistant glass classes and level of attack.
- pattern glass thickness: 4 / 6 mm – see drawings / schedules;
  colour: clear
  pattern: – see drawings / schedules
- tinted glass: heat-absorbing / heat-reflecting / glare-reducing – see drawings / schedules
- insulated glass units (SIGU's) : 6/12/6, low-e surface #2, dehydrated air filled gap - N/A
- coloured glass: N/A
- work on glass: obscuring / acid embossing - N/A

**polymer glazing**

- polymer glazing type: PC / PMMA / PVC clear / GRP / PS / PET – All N/A
  (polycarbonate (PC), polymethyl methacrylate (PMMA or 'acrylic'), polyvinyl chloride (PVC), glass-fibre reinforced polyester (GRP), polystyrene (PS), polyethylene teraphthalate (PET))

## 17.2 Glazing

### 17.2.2 Structural glazing

- design: by *competent person* (glazing) – N/A

### 17.2.3 Protection and cleaning

- Protection. All glazing to be plastic wrapped during construction and suitably protected against liquid / mortar splashing, abrasion, impact etc.

## 17.3 Mirrors

- type: silvered clear glass / stainless steel – refer sanitaryware schedule.
- size and position: see drawings

# 18 Drainage, sewerage, water and gas supply, fire equipment, sanitary plumbing

## 18.1 Roof eaves drainage

### 18.1.2 Gutters and downpipes

- gutter type: eaves and valley type - see drawings
- material: aluminium pre-painted, seamless
- profile: rectangular / square - see drawings
- size: 150x150mm
  Gutterfast or equal approved G4 Colortech seamless gutter of 448mm girth coil, incl brackets for afixing to sheet metal roofing and including leaf guard. Colour provisionally Marble White

**accessories**

- outlet drop boxes: funnel shaped
- overflow weirs in box gutters: required
- hail guards: N/A
- launders: N/A

**gutter brackets**

- type: as supplied by gutter manufacturer

**downpipes**

- material: PVC
- size: see drawings
- 110 mm ø uPVC Rain Water Down Pipe per SANS 11, fitted with Aluminium alloy brackets to brickwork walls, unless otherwise specified. Pipes fitted with solvent weld joints.
- Holderbats at 900mm centres, complete with all necessary swan necks, shoes and brackets, all sealed with mastic jointing compound and bolted together with M6 x 40 verandah bolts with flat and malthoid washers, discharging in positions indicated.

## 18.2 Flat concrete roof, balcony and floor drainage

### 18.2.1 Rainwater outlets

- Type: cast iron with grating – straight outlet. see drawings
  St Gobain ductile iron full bore – 100mm id, with domical grating, top inlet.

### 18.2.2 Floor outlets

- material: ductile iron with baked epoxy coating / stainless steel - N/A

### 18.2.3 Outlet downpipes

- material: PVC / galvanized steel
- 110 mm ø uPVC Rain Water Down Pipe per SANS 11, fitted with Aluminium alloy brackets to brickwork walls, unless otherwise specified. Pipes fitted with solvent weld joints.

## 18.3 Stormwater drainage

## Refer Civil engineering specification.

### 18.3.1 Earthworks

*Applicable standard*: SANS 2001-DP1:2011 – Earthworks for buried pipelines and prefabricated culverts.

*Specification data:*

- **Materials**

- Selected granular material shall, unless otherwise specified in the scope of work, be material of a granular, non-cohesive nature that is free-draining, has a maximum aggregate size of 20 mm and has a compaction fraction that does not exceed 0,3.

- Selected fill material shall, unless otherwise specified in the scope of work, be material that has a plasticity index (PI) that does not exceed 6 and that is free of vegetation, lumps and stones the largest dimension of which does not exceed 30 mm.

- Fine granular material is material all of which passes through a 6,70 mm sieve and not more than 10 % of which passes through a 0,15 mm sieve.

- Concrete shall, unless otherwise specified in the scope of work, be grade 20 or higher and shall comply with the requirements of SANS 2001-CC1 or SAN*S* 2001-CC2.

- Backfill material shall contain not more than 10 % of rock or hard fragments that are retained on a sieve of nominal aperture size 50mm, and shall not contain large clay lumps that do not break up under the action of compaction equipment.

Backfill material should:

- be excavated from trenches and used as backfill
- contain little or no organic material,
- exclude stone the average dimension of which exceeds 150mm and be able to be placed without significant voids and be so compacted as to avoid significant settlement.
- not be placed in areas subjected to road traffic.

- Backfill material for areas subjected to road traffic shall have a PI that does not exceed 12 and a minimum CBR of 15 % at specified density if the backfill is to be placed in the upper 150 mm of the subgrade, and a minimum CBR of 7 % if the backfill is to be placed lower in the subgrade.

- Materials for reinstatement of roads and paved areas (sub-base and base) shall comply with the requirements for the sub-base and base required in terms of the scope of work or, if no such requirements are specified, with at least the quality of the material which it replaces.

- Where trenches cross or run along gravel roads of which the surfaces are to be reinstated, the top 300 mm of the material excavated shall be separately stored for the purpose of reinstatement.

- Materials for bituminous construction shall comply with the applicable requirements of the appropriate of the following standards:
- Prime type: SANS 748 or SANS 749
- Cutback bitumens or emulsions: SANS 308 or SANS 309
- Coarse aggregate (stone chips): freshly crushed rock other than argillaceous rock and pedocretes that comply with the requirements of SANS 1083.

- Asphalt surfacing shall consist of either of the following mixes:
- 100 parts of 6,7 mm coarse aggregate (stone chips) by mass, plus 7 parts of RC 250 cutback bitumen by mass of emulsion; or

- 100 parts of 6,7 mm coarse aggregate (stone chips) by mass, plus 8 parts of premix grade 60 bitumen emulsion by mass of emulsion.

- Cement stabilized backfill, where required, shall comprise 100 kg of common cement, that complies with the requirements of SANS 50197, to one cubic metre of loose backfill.

## ● Methods and procedures

- Site clearance shall be in accordance to with the requirements of SANS 2001-BS1 and be completed in the demarcated project area.

- Where underground services either cross or are located adjacent to proposed infrastructure shall be exposed by hand ahead of completing bulk earthworks. Care shall be taken in exposing such services to avoid damaging them.

- Selective methods of excavation may be used to produce material suitable for the bedding, or the excavated material may be screened, washed or otherwise treated.

- Hard rock and boulders from excavations may be incorporated in the backfill provided that such material is suitably mixed with other backfill material and the required compaction is achieved.

- Selected excavated material shall not be wastefully disposed of, positive steps shall be taken to avoid burying or contaminating materials that would otherwise be suitable for use as
- selected fill for the blanket or selected granular material for the cradle
- topsoil, or
- road materials for reuse.

- Any shortfall in excavated material may be made up by obtaining suitable material from other excavations on the site, or by opening up borrow pits, or by importing from commercials sources.

- The widths of excavations shall be sufficient to allow the pipe laying, bedding and backfilling of pipelines and prefabricated culverts as indicated on drawings in accordance to Table 1.

- Material that is unsuitable as the bottom of a trench shall be excavated and the trench shall be refilled with suitable material and compacted to 90 % modified AASHTO maximum dry density. Any over-excavation of the trench shall be backfilled with selected fill material and compacted to 90 % modified AASHTO maximum dry density.

- The bottom of trenches shall be sufficiently straight (or true to alignment in the case of curved pipelines) to enable the pipelines or prefabricated culverts to be laid without reduction of the side allowances given in the scope of work. The trench bottom shall be kept sufficiently free from water to enable the bedding to be placed.

## 18.3.2 Stormwater drainage

*Applicable standard*: SANS 2001-DP5:2010 – Stormwater Drainage

*Specification data:*

### 18.3.2.1 General

- Earthworks for manholes, catch pits, inlet and outlet structures, and appurtenant works shall be in accordance with requirements of SANS 2001-BE1.

### 18.3.2.2 Materials

- Concrete pipes shall comply with the requirements of SANS 677.
- Heavy Duty Poly Vinyl Chloride pipes (HDPVC) shall comply with the requirements of SANS 791.
- All masonry structures (i.e. manholes, inlet and outlet structures) shall consist of burnt clay units FBS or NFP with a nominal compressive strength of 14MPa, in accordance with the requirements of SANS 227.
- All concrete structures (i.e. manholes, inlet and outlet structures) shall consist of solid units with a nominal compressive strength of 14MPa, in accordance with the requirements of SANS 1215.
- Mortar shall be a Class I mortar in in accordance with the requirements of SANS 2001-CM1.
- Plaster shall be an external plaster in accordance with the requirements of SANS 2001-EM1.
- Prefabricated chambers and shafts shall comply with the requirements of SANS 1294.
- Concrete shall comply with the requirements of SANS 2001-CC1 or SANS 2001-CC2 to the specified strength or grade.
- Step irons shall comply with applicable requirements of EN 13101 and shall be to the dimensions specified.
- Cast iron covers, grid inlets and frames for manholes shall comply with the requirements of SANS 558 for type 2B subjected to traffic loads and type 4 in areas not subjected to traffic loads. When installed all frames and covers will be free of warp and unevenness of seating.
- Covers and frames for manholes and grid inlets shall be supplied in matching sets. The cover and frame shall each bear a serial number to enable the set to be identified.
- Polymer concrete manhole, inspection covers and frames shall comply with the comply requirements of SANS 1882. Heavy duty units are required in areas subjected to traffic loads.
- Buried pipelines and culverts shall be laid, bedded in trenches, and backfilled in accordance with the requirements of SANS 2001-DP1.

### 18.3.2.3 Laying of pipes

- The size, length and materials of all stormwater pipes shall be strictly in accordance with the scope of works, relevant schedules, drawings and specifications.
- Pipes shall consist of the following materials and class:
- Heavy Duty PVC (HDPVC),Class 34 pipe (200, 315, 400, 500mm in diameter)
- Precast Concrete, Class 100D pipe (500mm.in diameter)
- Pipes shall be laid and bedded to the level and alignment specified in the scope of work.
- Each pipe shall be cleaned out and carefully examined for possible damage immediately before laying. Should any damaged pipe be laid, it shall be removed and replaced.
- Concrete pipes shall be laid hard up against each other longitudinally to obtain tight joints and they shall be supported evenly throughout their barrel lengths. Holes or grooves of adequate size to allow for jointing and for bedding thickness under joints, shall be cut in the bottom of the trench.
- All pipes and fittings shall be joined together strictly in accordance with the manufacturer's instructions.
- Pipe encasement shall be accordance with the requirements of SANS 2001-DP1 once the pipes have been tested.

### 18.3.2.4 In situ concrete stormwater channels

- The size, length and materials of all stormwater channels shall be strictly in accordance with the scope of works, relevant schedules, drawings and specifications.

- Channels shall consist of the following:
- 300 mm wide x 200 mm deep precast channel.
- 1000 mm wide x 250 mm deep trapezoidal channel.

### 18.3.2.5 Manholes, catch pits, and inlet and outlet structures

- The bottom of excavations shall be compacted to minimum 90% modified AASHTO maximum dry density and shall be kept free of water at all times. Where the material at the founding level is soft material, or hard material which deteriorates rapidly on exposure, excavation to the final level shall not be made until just before concreting takes place.

- The foundation and partial benching to the precast concrete ring manholes should be cast monolithically. Where pipes enter and exit the manhole, these shall be cast integrally into the concrete base and care shall be taken to ensure that there is a watertight joint between the manhole and the pipe.

- The first precast ring shall be bedded firmly into the wet concrete foundation and set true to level such that the completed manhole will be vertical. Care shall be taken in placing this ring to ensure that the joint is suitably mortared up on the outside to form a watertight joint. A minimum clearance of 50 mm shall be maintained between the bottom of the ring and the top of any built-in pipe.

- Each masonry manhole shall be built to the details specified in the scope of work. Unless otherwise specified in the scope of work, the walls shall be constructed in English garden wall bond, with the fair face on the inside. No false headers shall be built in and only whole units shall be used except where closures are required to form the bond.

- The walls of a manhole shall. if so required in terms of the construction drawings or specification data, be plastered with a single coat of plaster internally and steel-trowelled to a smooth and true surface free of sharp edges and corners A, salient angles and arises shall be slightly rounded, and all internal angles shall be finished true square and smooth.

- Where pipes enter masonry, they shall be thoroughly caulked into the wall and rendered with mortar.

- Covers and frames shall be set solidly onto the shafts and concrete surrounds in mortar and shall be finished off to suit surrounding surfaces.

- All benching shall be rendered in 20 mm thick mortar and finished smooth and true with a steel trowel and rounded at corners and edges.

- Cast-in-situ concrete headwalls shall be constructed in accordance with the details shown in the drawings and the concrete shall comply with the relevant requirements of SANS 2001-CC1 or SANS 2001-CC2, as applicable.

### 18.3.2.6 Tolerances and tests

- - Tolerances shall be determined on the basis of permissible deviations of inlet inverts from designated locations, alignment, grades, and levels. Each of the various parts of the works shall be constructed within the limits set out below.

- The permissible deviation of the location of manholes and catch pits (other than kerbside catch pits) from the designated positions shall be half a pipe length longitudinally and± 150 mm laterally, except where locations are measured from fixtures such as fences, kerbs, railway tracks, etc., in which case the permissible deviation in each direction shall be ± 50 mm.

- The permissible deviation of the level of the invert from the designated level shall be ± 25 mm (measured on the main flow culvert at the inlet to the manhole or catchpits, as relevant).

- The permissible deviation of the alignment and grade of each culvert and pipeline shall be± 20 mm from the designated line and level, or ± 20 mm from the line between culvert or pipe inverts at successive manholes or catch pits, as applicable, when measured over any 6m length. All such deviations shall be gradual.

- The following test will be required
- Water test
- Separate water tightness testing of manholes
- Straightness of alignment and obstruction testing
- Visual inspection

## 18.4 Sewerage

*Applicable standard*: SANS 2001 –Construction works Part DP7 – 2021: Sewers for Buildings

*Other referenced standards:*

t) SANS 2001-DP1

u) SANS 2001-DP4

v) SANS 10400-P

*Specification data:*

### 18.4.1 Materials

f) Backfill material shall:
b) contain little or no organic material (material produced by animal or plant activities)
c) exclude stones and rock fragments of maximum dimensions larger than 100mm.
d) not contain more than 10% rock or hard fragments of material retained in a sieve of nominal aperture size 50mm
e) not contain large clay lumps that do not break up under the action of compaction.

g) Bedding material
d) not be a predominantly clayey material
e) contain little or no organic material (material produced by animal or plant activities)
f) not contain any material retained on a sieve of nominal aperture size 20mm, and
g) not contain large clay lumps that do not break under the action compaction.

h) Pipes and fittings shall be of a suitable diameter.

i) Solvent cements, lubricants and cleaners shall comply with the recommendations of the pipe and fitting manufacturers.

j) Pipes and fittings shall be handled and stored in accordance with the manufacturers instructions.

k) Above and below ground ductile iron pipes, fittings, accessories and joints shall comply with the requirements of SANS 50598 or SANS 1835.

l) Below ground PVC-U pipes and fittings shall comply with the relevant specifications, be heavy duty pipes (Class 34) with one end plain and the other socketed, the plain end chamfered, and an integral socket of the rubber ring type.

m) Above ground pipes and fittings shall comply with the relevant requirements of SANS 967 and have plain ends.

n) Materials for manholes and chambers shall comply with the relevant requirements of SANS 2001-DP4.

### 18.4.2 Above ground installations

b) Pipe and fittings shall have a suitable diameter. Pipe and fittings shall not be dropped or thrown onto the ground. Solvent cemented pipes shall be provided with rubber ring joints at intervals not exceeding 3m to provide for extension.

c) Ducts shall be cleaned of rubble and combustible material before pipes are installed.

d) Suitable holder bats recommended by a pipe manufacturer and supplied from the same supplier shall be used to support pipe and fittings. These supports shall be fixed to a surface corresponding to those that are to be occupied by fittings and pipe end sockets. Additional pipe supports shall be fixed at the surface to support long lengths of pipe at centres not exceeding:

d) Vertical pipe runs: 2m and,
e) Horizontal pipe runs: 1.2m.

e) Pipe supports for vertical pipes runs shall be positioned by means of a plumb line. All pipes, fittings and supports shall be accurately aligned before the supports are fully tightened.

### 18.4.2 Below ground installations

#### 18.4.2.1 Excavation for sewers

b) Trenches shall not be excavated parallel to buildings within 1.5m of a building and shall not extend below a line drawing at 45° to the horizontal, as measured from the bottom edge of the foundation unless suitable precautions are taken to ensure the stability of the adjacent foundations.

c) Where sewer is laid underground horizontally next to a pipe conveying water, it should be at least 500mm away from the water pipe. If the sewer pipe crosses the water pipe it shall be laid at least 100mm below it. No sewer pipe shall be installed within 100mm of another service pipe or cable.

d) he sides and trenches from the bottom up shall be as nearly vertical as possible for at least the height of the bedding.

e) Trench depths shall be such that not less than 100 mm and not more than 200 mm of bedding material may be placed below pipes, except in cases where rigid pipes are placed directly on the trench bottom.

f) Where rigid pipes are to be laid directly on the trench bottom, the bottom shall be hand trimmed ensuring that each pipe will be fully supported throughout its length or barrel. Joint holes shall be formed in the trench bottom for pipe sockets and couplings on bedding over its full length.

g) trimmed ensuring that each pipe will be fully supported on bedding over its full length at the correct grades and levels. Except where the trench is in rock, hard objects and boulders that may adversely affect the uniformity of the foundation shall be removed to a depth of 100mm below the trench bottom.

h) Where the trench bottom has been loosened or over excavated during excavations, it shall be well compacted with bedding material and raised to the correct level prior to the placing of bedding and pipe laying.

i) Soft spots in the trench bottoms shall be removed and backfilled and compacted with a bedding material.

j) Trenches shall not be less than 450 mm wide.

k) The bottoms of trenches shall be sufficiently straight to enable pipes to be laid without significant reduction in trench side space.

l) Trenches shall be kept sufficiently dry to allow proper and safe bedding, laying, and jointing of pipes and kept dry until the pipeline has passed the required tests and construction of the selected fill blanket over the pipes has been completed.

### 18.4.2.2 Pipe bedding and backfilling

b) Backfilling and bedding shall be placed in layers not exceeding 100 mm. Each layer shall be well compacted before additional fill material is added.

c) Pipes, which are not laid directly on the trench bottom shall be bedded on a continuous bed of bedding material and protected so that the bedding extends from between 100 to 200 mm beneath the pipe bottom to 200 mm above the pipe and not less than 150 mm on each side of the pipes.

d) The joint holes beneath rigid pipes which are laid directly on the trench bottom shall be refilled with fine granular material and lightly compacted to prevent the migration of adjacent pipe bedding material into the holes and to obviate the production of hard spots under joints.

e) When placing bedding, all voids under the pipes shall be filled. Compaction shall be carried out simultaneously and uniformly on both sides of the pipe so as not to cause any lateral or vertical displacement of the pipe. Bedding shall be carried out as pipe laying proceeds and shall be completed before any acceptance test is carried out.

### 18.4.2.3 Laying of pipes in trenches

d) Pipes and pipe fittings shall have the nominal diameter stated in the scope of work. Pipes and pipe fittings shall not be dropped or thrown onto the ground. Pipes that are the subject of an Agrément certificate shall be installed in accordance with the provisions of that certificate.

e) Solvent cemented pipes shall be provided with rubber ring joints at intervals not exceeding 9 m to provide for expansion and contraction.

f) All solvent cement joints shall be made in a dry area outside the trench. Rubber ring jointing may be carried out in the trench.

g) Pipes shall be laid to in a straight line between points of change in gradient, either true to designated line and level or to a minimum gradient specified in the scope of work.

h) The method of laying shall be such that:
   iv. the barrels of the pipes bear evenly over their full lengths;
   v. no packing is used under the barrels; and
   vi. no sockets or couplings bear on the bedding.

i) Each pipe and fitting shall be thoroughly cleaned out and carefully examined for damage immediately before laying. Agrément certified pipes shall be laid within the scope, conditions and limitations prescribed in the certificate.

j) All pipeline openings shall be sealed to ensure that no water, stones or other foreign matter can enter the system during or after laying.

k) Rodding eyes shall, unless otherwise specified in the scope of work, be provided:

vi. where there is a change in direction of the sewer that exceeds 45° provided that where any bend which has a centre line radius of not less than 600 mm is installed such rodding eye may be omitted for not more than two such changes of up to 90° each between any two rodding eyes required in terms subsequent points below;

vii. at any point within 1,5 m of the connection of the sewer to a connecting sewer, septic tank or conservancy tank: provided that an inspection eye shall be installed immediately downstream of such point;

viii. at the highest point of the sewer; and

ix. at such intervals along the sewer that no rodding distance is more than 25 m measured along the line of such sewer from a rodding eye or other permanent means of access to such sewer.

l) Grade 15 concrete anchor blocks shall be provided in accordance with the provisions of SANS 2001-CC1 or SANS 2001-CC2 and where the pipe grade exceeds 1 in 10.

m) Steep drops in sewers shall be avoided where practical. The connection between two sections at different levels shall be executed in accordance with figure 5 of the specification.

### 18.4.2.4 Protection of below ground pipework

k) Where rigid pipes pass underneath buildings they shall be encased in concrete with the casing at least the width of the pipe diameter. Movement joints shall be provided at each pipe joint or at not more than 5m intervals in accordance with figure 6 of the specification.

l) Flexible pipes should not be encased in concrete but be protected from overload by means of a concrete slab laid over the pipe in accordance with figure 4 of the specification.

m) Where pipes pass through structural walls they shall be protected by lintels or arches and, in order to accommodate movement, shall:
   x. have a 50 mm clearance all around or be sleeved; and
   xi. built in; and
   xii. be connected on both sides of the wall to pipes with flexible joints, made in accordance with the pipe manufacturer's recommendations, located not more than 150 mm from the face of the wall.

### 18.4.2.5 Joining of pipes and fittings

d) Pipes shall be cut with suitable tools so as to obtain neat, square ends. The outer edge of such cuts shall be evenly chamfered and shall be free from swarf, burrs, channels and loose material. Allowance shall be made for movement of at least 6 mm in any rubber ring socket into which a pipe is to be inserted.

e) All pipes and fittings shall be joined together strictly in accordance with the manufacturer's instructions or, if applicable, the requirements of an Agrément certificate in such a manner that the continuity of bore is maintained and the flow in the interior of the sewer is not obstructed.

f) Solvent cements, lubricants and solvent cleaners shall be used in accordance with the manufacturer's instructions. Solvent cleaners shall not be used as adhesive thinners.

g) The surfaces of all areas to be bonded by means of solvent cement shall be dry and shall be cleaned with a solvent cleaner, a fresh piece of absorbent material being used to clean each joint. The joint shall be made while the cement is still wet by pushing the prepared parts

squarely together (without twisting or tilting). Excess solvent shall be wiped off and the components of the joint held together firmly until the solvent cement has set. The joint shall not be moved for a period of 30 min and shall not be stressed for at least 24 h.

h) All sockets and spigots shall be cleaned with a clean, dry cloth, immediately before the application of a thin film of lubricant to each rubber ring and socket. The joint shall then be made by pushing the spigot squarely into the socket until it bottoms. Care shall be taken to not displace the rubber ring. The spigot shall thereafter be withdrawn approximately 6 mm to allow for longitudinal movement.

i) Suitable adaptors and joints shall be provided where types of different materials are joined to each other.

j) Pipes shall be connected to toilet pans by means of a suitable moulded fitting incorporating a rubber sealing ring manufactured specifically for this purpose.

k) The welding of polyethylene and unplasticized poly(vinyl chloride) pipes, the thermofusion of polypropylene pipes and the hot welding of unplasticized poly(vinyl chloride) shall be in accordance with the requirements of SANS 2001-DP4.

### 18.4.2.6 Construction of manhole

Manholes shall be constructed in accordance with the relevant provisions of SANS 2001-DP4.

### 18.4.2.7 Compliance with requirements

The following tolerance are applicable:

- The permissible deviation of the location in plan of the centre line of the sewer from the designated location shall be + 300mm. This location will be treated as the control point for the purpose of locating intersections whether for manholes or inspection chambers. Such manholes or chambers shall be constructed at the meeting points of intersecting pipelines subject only to such deviation as can be tolerated by the junction channels or specials.

- The permissible deviation in location along the centre line for manholes and chambers not situated at control points shall be plus or minus half a pipe length.

- The permissible deviation from the designated level of the invert at each manhole shall be + 50mm but, should the fall between any two successive manholes be less than 90% of that specified, the said permissible deviation shall be reduced to a value such that the fall is at least 90% of that specified.

- Subject to the permitted manufacturing tolerances applicable to the pipes being laid,

xiii. the line of the pipe invert shall at no place between control points at successive manholes:
    - deviate from a straight line between the said control points by more than 5% of the nominal diameter of the pipe; or
    - be lower than at any other place closer to the lower manhole;

xiv. there shall be no steps at the junctions between successive pipes, except where pipes of different diameters are jointed together.

- Materials for pipelines shall be tested in accordance with the relevant requirements of the standards applicable to such materials.

- After bedding and backfilling operations have been completed an air test will be undertaken. All traps shall be filled with water and the outlets of ventilating pipes shall be plugged. Air shall be pumped into such underground sewers under a gauge pressure of not

less than 0,35 kPa. Sewers shall be deemed to be acceptable if the pressure after 3 min is not less than a gauge pressure of 0,25 kPa.

### 18.4.3 Sewers for buildings

*Applicable standard: SANS* 2001-Construction Works Part DP7: Sewers for Buildings

*Specification data:*

- Type of pipe and fittings: Unplasticized poly vinyl chloride (PVC-U)
- Nominal diameter: 110mm
- Pipe class: Class 34 Heavy duty pipe to SANS 791
- Gradient: Varies, refer to design drawings

### 18.4.4 Surface boxes, manhole covers, gulley gratings, frames

Applicable to vehicular and pedestrian areas only (does not apply to gullies and manholes in buildings).

- Type: Varies, refer to design drawings
- Material: Varies, refer to design drawings

**concrete covers**

e) Size: DN1000 refer to design drawings
f) Class: Heavy duty, D400 Type
g) Gulley gratings: Laid loose

### 18.4.5 Grease interceptors

g) Material: Polypropylene
h) Type, capacity and size: Endura MGT200 or similar approved

### 18.4.6 Pit latrines

Not Applicable

### 18.4.7 Conservancy tanks, septic tanks and french drains

e) Type: Septic tank (refer to design drawings)
f) Construction material: Masonry
g) Tank capacity: 24m$^3$
h) French drain length 40m

## 18.5 Water supply

### 18.5.1 Earthworks (SANS 2001-DP1)

*Applicable standard:* SANS 2001-Construction Works Part DP1: Earthworks for buried pipelines and prefabricated culverts

### 18.5.2 Below ground medium pressure pipelines (SANS 2001-DP2)

*Applicable standard: SANS* 2001-Construction Works Part DP2: Medium pressure pipelines

*Specification data:*

#### Materials

b) Pipes and pipe fittings shall be of the types and sizes specified in the scope of work and, unless otherwise specified in the specification data (see annex A), they and their couplings shall be capable of withstanding the applicable test pressure.

c) Pipes shall be handled and stored in accordance with the manufacturer's instructions.

d) Unless otherwise specified in the scope of work, pipes, fittings and specials shall either be handled with care, or be the subject of an Agrement certificate.

e) Screw-ended pipes shall comply with the relevant requirements of SANS 1109-1. Male ends shall be taper-screwed and female ends shall have parallel threads.

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

g) Pipeline materials shall be so transported, stored, and handled that pipes are not overstressed at any time and fittings are not damaged in any way. All thin-walled, flexible, and soft-coated pipes shall be handled with particular care and shall be so stored that they are not subject to concentrated pressure from stones or other objects.

h) Pipe repair clamps shall, where relevant, comply with the requirements of SANS 1808-45 and shall have a pressure rating not less than that of the pipes which are repaired.

#### Steel pipes, fittings and specials

ix. Steel pipes and fittings of nominal bore up to 150 mm shall comply with the requirements of SANS 62-1 for a medium duty pipe. Such pipes shall be supplied in a galvanized condition and with plastic caps.

x. Screwed pieces and fittings shall be medium class fittings that comply with the requirements of SANS 62-2, and shall be galvanized inside and outside.

xi. A certificate stating that each consignment complies with the requirements of SANS 62-1 or SANS 62-2 shall be provided where specified in the specification data

xii. Fabricated flanged steel pipes shall comply with the requirements of SANS 1476 and those specified in the scope of work.

xiii. Ductile iron pipes, fittings, accessories and their joints shall comply with the requirements of SANS 50545, SANS 50598 or SANS 1835, as specified in the specification data, and shall have the attributes as specified in the scope of work.

xiv. Reinforced concrete cylindrical pipes shall comply with the requirements of SANS 676 and shall have the attributes specified in the scope of work.

xv. Prestressed concrete pipes shall comply with the requirements of SANS 975 and shall have the attributes specified in the scope of work.

xvi. Metal couplings of all types and the means used for distributing coupling stresses to the concrete shall ensure that the pipes withstand all stresses caused by the tightening of the bolts without any sign of cracking, or other damage, to the concrete.

xvii. Unreinforced PE pipes shall comply with the requirements of SANS 4427-1 , SANS 4427-2,
xviii. SANS 4427-3 or SANS 4427-5, and shall have the attributes specified in the scope of work. Unless otherwise specified in the scope of work, any of the following shall be used to joint pipes together:

xv. mechanical joint compression fittings that comply with the requirements of SANS 14236;
xvi. suitable push-fit fittings recommended by the pipe manufacturer;
xvii. heated-tool socket weld or electrofusion fittings that comply with the requirements of SANS 4427 -3;
xviii. butt fusion;
xix. ductile iron fittings that comply with the requirements of SANS 52842; or
xx. mechanical jointing systems that comply with the requirements of SANS 4427-3.

xix. PE pipes may be supplied and stored in coils, provided that the diameter of the coil is the greater of 24 times the pipe diameter and 600 mm.

xx. Fittings shall comply with the requirements of SANS 1283 or SANS 52842.

xxi. Metallic compression-type pipe couplings shall comply with the requirements of SANS 1808-2 and shall have the attributes as specified in the scope of work.

xxii. Flexible joints for plain-ended steel pipes shall be of the slip-on type with a centre register that complies with the relevant requirements of EN 10311 , and shall be able to withstand, without any sign of failure, hydrostatic test pressures of twice the working pressures specified for the pipes for which they are required.

xxiii. Coupling flanges shall be capable of withstanding, without any sign of damage, all stresses caused by the proper tightening of bolts.

xxiv. Rubber rings shall comply with the relevant requirements of SANS 4633 and shall have a hardness of (66 to 75) I RHO (international rubber hardness degree).

xxv. Each flanged pipe and fitting shall be supplied complete with one set of flange bolts, nuts and washers, and one joint insertion piece made of material suitable for the maximum test pressure. The drilling of steel and cast iron (CI) flanges shall comply with the requirements of SANS 1123 or EN 1092-1, as applicable, appropriate to the class of pipe, except that:

xxi. in the case of flanges for hydrant and air valve matching tees, the drilling shall match the drilling of the valves supplied; and

xxii. in the case of CI flanges, where M27 and M33 bolts are specified in EN 1 092-1 , M24 and M30 bolts, respectively shall be used as specified in SANS 1123.

xxvi. Loose flanges for welding onto steel pipes on site shall be manufactured from the same steel as is specified for the pipes and shall be in accordance with SANS 1123. Bolt holes shall not be reamed to oversize dimensions in order to make a fit.

xxvii. Bolts and nuts shall comply with the relevant requirements of SANS 1700-7-1 or SANS 1700-7-3 or SANS 1700-14-2 or SANS 1700-14-3. The lengths of the bolts shall be such that, after the nuts have been tightened, the ends of the bolts are flush with the ends of the nut, or project beyond the nuts by not more than two threads.

### Valves

e) Valves shall be of the types and sizes specified in the scope of work.

f) Diaphragm valves shall comply with the requirements of SANS 1808-13 and shall have the attributes as specified in the scope of work.

g) PVC-U gate valves shall comply with the requirements of SANS 1808-18 and shall have the attributes as specified in the scope of work.

h) Float valves (equilibrium type) shall comply with the requirements of SANS 1808-32 and shall have the attributes specified in the scope of work.

i) Automatic control valves shall comply with the requirements of SANS 1808-31 and shall have the attributes as specified in the scope of work.

j) Cast steel gate valves shall comply with the requirements of SANS 191 and shall have the attributes as specified in the scope of work.

k) Cast iron gate valves shall comply with the requirements of the relevant part of SANS 664 and shall have the attributes as specified in the scope of work.

### Inline strainers

i) In line strainers shall comply with the requirements of SANS 1808-58 and shall have the parameters as specified in the scope of work.

### Mechanical backflow-prevention devices

g) Mechanical backflow-prevention devices shall comply with the requirements of SANS 1808-15 and shall have the parameters as specified in the scope of work.

### Fire hydrants

c) Underground and above-ground fire hydrants shall comply with the requirements of SANS 1128-1 and shall have the parameters as specified in the scope of work.

### Manholes, surface boxes, anchor blocks and concrete casing

b) Masonry units shall, unless otherwise specified in the scope of work, have the following attributes:

xxiii. burnt clay units: FBS (face brick standard) or NFP (non-facing plastered) with a nominal compressive strength of 14 MPa, or FBS without frogs and perforations, in accordance with the requirements of SANS 227;

xxiv. concrete units: solid units with a nominal compressive strength of 14 MPa, in accordance with the requirements of SANS 1215.

c) Mortar shall be a class 11 mortar in accordance with the requirements of SANS 2001-CM 1.

d) Plaster shall be an external plaster in accordance with the requirements of SANS 2001-EM1.

e) Suitable prefabricated cylinders may be of spun concrete, fibre cement, glass-reinforced polyester, PVC or high-density polyethylene, except where particular materials are required in terms of the scope of work. Precast concrete cylinders shall comply with the applicable requirements of SANS 1294.

f) Sectional spun concrete cylinders shall comply with the requirements of SANS 677 for SC type pipes. Jointing between cylinders shall be of the interlocking self-centring type suitable for sealing.

g) Concrete shall be grade 20 or higher and shall comply with the requirements of SANS 2001-CC1 or SANS 2001-CC2, as applicable.

h) Step irons shall be of malleable cast iron that complies with the applicable requirements of EN 13101, and shall be of length suitable for fixing in brick, in-situ concrete, or precast concrete, as applicable.

i) cast iron covers and frames for manholes shall comply with the requirements of SANS 558 for type 28 in the case of manholes in roads and other areas subject to road traffic loads, and type 4 in the case of manholes in areas not subject to such loads.

j) Covers and frames for manholes shall be supplied in matching sets. The cover and frame of each set shall bear a serial number (applied with oil paint) to enable the sets to be identified.

k) When installed, the covers and frames shall still comply with the requirements of SANS 558 for freedom from warp and evenness of seating.

### Surface boxes

o) Surface boxes shall, unless otherwise specified in the scope of work, be

xxv. cast iron boxes that comply with the requirements of SANS 558 for type 3A in the case of surface boxes for gate and scour valves, and type 5 in the case of surface boxes for hydrants and air valves;

xxvi. polymer concrete boxes that comply with the relevant requirements of SANS 1882; or

xxvii. made from any suitable materials that comply with the applicable requirements and conform to the relevant shapes and internal dimensions given in SANS 558.

p) All cast iron surface boxes shall be hot-dipped in a bituminous compound before dispatch from the manufacturer's works.

q) Pipes and fittings shall be supplied with the protective coatings specified in the scope of work,

r) Additional corrosion protection measures that are applied on site shall be as specified in the scope of work.

s) Where specified in the scope of work, external protection against electrolytic corrosion, consisting of a plastic wrapping that complies with the requirements of SANS 1117 and that has the specific attributes specified in the specification data, shall be applied.

t) All flanges, valves, flexible couplings and other items not protected from corrosion shall, unless otherwise specified in the scope of work, be thoroughly cleaned with wire brushing and painted with a suitable epoxy primer, followed by one or more coats of a suitable high-build epoxy material to give a total dry film thickness of at least 250 microns. Each coat shall have a different colour from its predecessor and shall be applied not less than 6 h and not more than 24 h after its predecessor. Care shall be taken to ensure that the previous coat has dried sufficiently to prevent solvent entrapment.

u) Joints, bolts, nuts, and washers shall be hot-dip bitumen coated, if not otherwise specified in the scope of work.

v) Steel or ductile iron fittings and joints that are to be subjected to corrosive soil conditions should be treated with a compatible primer. packed with a suitable bitumen-based or tar-based mastic, and wrapped with plastic tape.

**General construction**

f) Pipes shall be handled and placed using equipment and techniques that ensure that no pipe shell is overstressed during any operation covered by this part of SANS 2001 . Care shall be taken, when handling pipes, not to damage the surface of the pipes, especially the pipe ends.

g) Buried pipelines shall be laid and bedded in trenches in accordance with the requirements of SANS 2001-DP1 .

h) Pipe supports, including holderbats, clips and brackets, except at points of positive anchorage, shall not grip the pipe and shall allow back-and-forth movements caused by temperature to take place freely without causing abrasion of the pipe.

i) Pipes that are the subject of an Agrement certificate shall be installed in accordance with the provisions of that certificate.

j) Pipelines shall be laid and bedded to even grades, to the levels and alignments shown in the construction drawings, and with side allowances conforming to the applicable values specified in SANS 2001-DP1 . For ease of inspection and testing, pipes shall be laid with the manufacturer's class and quality identification marks visible from the top of the trench, unless, in the case of large pipes, the position of lifting eyes renders this impracticable.

k) The control of laying and bedding shall be by means of boning rods and sight rails or a suitable laser device. Sight rails shall be painted black and white, and shall be fixed securely and accurately.

l) Each pipe and fitting shall be cleaned and examined for damage and defects immediately before laying.

m) No damaged or defective pipe or fitting shall be laid.

n) Precautions shall be taken to prevent the entry of foreign matter and water into pipelines. At the close of each day's work, or when work is suspended for a significant period, the open ends of

uncompleted pipelines shall be plugged, capped, or otherwise closed until laying is recommenced.

o) Until completed pipelines have passed the required acceptance tests and the trenches have been backfilled, the open trenches shall be kept free of standing water.

p) Unless otherwise shown in the construction drawings or required in terms of the scope of work, the depths of excavation of trenches for medium pressure pipelines shall not exceed 1,5 m, or the outside diameter of the pipe plus the specified cover.

q) Pipes shall be laid to even grades with at least the cover specified in the scope of work. The cover may be varied gradually by deflection at pipe joints, but the deflection shall not exceed the deflections recommended by the manufacturer of the joints.

r) The minimum clearance between the outside of a pipeline that is being laid and the outside of a pipeline that it crosses shall be 150 mm.

s) A pipeline feeding a fire hydrant shall be laid at such a level that the top of the threaded outlet to the hydrant is not more than 400 mm below the level at which the top of the hydrant cover shall be set.

t) Unless otherwise specified in the specification data, pipes shall not be hot-bent to achieve a change of direction.

### Jointing methods and operations

c) In the jointing of steel pipes with flanges, care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Insertion pieces that have accurately cut holes for bolts shall be placed to form a continuous one-piece ring between the flanges. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing on the insertion. Care shall be taken to avoid damage to the internal surfaces of the pipes during assembly of the pipeline.

d) Wherever loose flanges are welded onto pipelines, the pipe linings shall be restored to the thickness specified and the new linings shall be soundly jointed to the existing linings.

e) The welding of polypropylene homopolymer, polypropylene block copolymer, polypropylene random copolymer, polyvinylidene fluoride and high-density polyethylene using the heated-tool butt welding and heated-tool socket welding processes shall be undertaken in accordance with the requirements of SANS 1 0268-1 using equipment that complies with the requirements of SANS 1671-1.

f) The welding of PE and PP pipes by means of electrofusion shall be in accordance with the requirements of SANS 1 0268-2 using equipment that complies with the requirements of SANS 1671-2.

g) The acceptability of the weld shall be assessed in accordance with the assessment table contained in SANS 10268-10.

h) Butt-fusion welding and electrofusion of PP or PE pipes shall be carried out by suitably trained and skilled operators using equipment that complies with the requirements of SANS 1671-1 or SANS 1671-2. Electrofusion control units and butt-fusion welding machines shall be used strictly in accordance with the supplier's instructions and the requirements of SANS 10268-1.

**Thermofusion of PP and PE pipes**

d) Before use, metal heating plates shall be cleaned of all traces of PE or PP remaining from previous operations to avoid inclusion of oxidized PE or PP in the weld.

e) The pipe ends of all pipes joined by means of an electrofusion fitting shall be prepared before jointing by having any surface oxide scraped off and being thoroughly cleaned with a suitable cleaner.

f) The two components that are to be jointed in the butt-welding process shall not be under tension or lateral stress during the welding operation.

g) Welders shall, where specified in the specification data, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate.

**Compression fittings**

b) The end of the pipe shall be inserted into the fitting past the rubber sealing ring. The nut that compresses the sealing ring shall then be hand-tightened and thereafter turned with a suitable spanner a further one and a quarter turns to compress the grip ring onto the pipe. Care shall be taken:

c) not to over-tighten the elastic ring which is in contact with the PVC pipe, as the tightness of the joint might be impaired under pressure; and

d) to ensure that if one end of a pipe is already jointed to another pipe, such pipe does not turn during the screwing process and stress the existing fittings.

**Screwed joints on PE pipes**

iii. Screw threads may, unless otherwise specified in the specification data, be cut on PE 63, PE 40 and PE 32 pipes, provided that a clean sharp suitable die is used.

iv. The die shall be washed in petrol and wiped clean and dry to ensure that no oil is applied to the pipe during the cutting of the thread.

v. The end of the pipe shall be cut off square before the die is run on, and a mandrel shall be inserted in the end of the pipe to support it against the die. The thread shall be cut in one pass without end-pressure on the die. The length threaded shall be such that all the threads will enter the joint. No threads shall be left exposed.

vi. Metal sockets or injection-moulded plastics sockets (or elbows, tees, crosses, reducers, etc.) may be used to complete the joint after wrapping the thread with PTFE (polytetrafluoroethylene) tape and hand-tightening. Care shall be taken when screwing the joint not to overstress the screw thread by applying excessive torque to the socket or to the pipe. Only strap wrenches which grip the pipe with a strap fabric shall be used to finally tighten the joint, if necessary.

**Rubber ring-type integral pipe and sockets**

i) The groove which houses any rubber ring, where such ring is supplied separately, shall be thoroughly cleaned before the insertion of the rubber ring into such groove.

j) The spigot end shall be square to the axis of the pipeline and suitably chamfered. Both the spigot and the rubber ring shall be lubricated with a suitable lubricant recommended by the pipe manufacturer before insertion into the socket. As soon as the spigot and sealing ring have been lubricated, the pipe shall be introduced into the socket, after it has been correctly aligned, so as to prevent any risk of contamination by sand or particles of grit.

k) The spigot shall be inserted into the socket up to the reference {depth-of-entry) mark made by the manufacturer, or a mark measured by the installer to ensure the correct penetration of the pipe into the sealing component of the joint, and to guarantee sealing under pressure.

### Service connections in water mains

Service connections jointed into an existing water main shall be in accordance with the requirements of SANS 2001-DP6.

### Setting of valves, specials and fittings

j) Gate valves shall be set upright and butterfly valves shall be set with the main shafts horizontal. All valves, specials, and fittings shall be correctly set, supported, and placed in position as the work proceeds, and shall be properly jointed to their respective pipes.

k) In urban, industrial, and similar areas, valves, specials, and fittings shall be located in the positions shown in the drawings and not merely to suit standard lengths of pipe. In open country areas, however, they may be located to suit pipe lengths.

l) Above-ground fire hydrants shall, unless otherwise specified in the scope of work, be in accordance with the details given in figure 3 of SANS 2001-DP2.

m) Where required in terms of the scope of work, pipes shall be encased in concrete in accordance with the requirements of SANS 2001-DP1 . No part of the concrete casing shall be closer than 150 mm to any flexible joint of a concrete-encased pipeline.

### Anchor or thrust blocks and pedestals

b) At tees, bends, terminal valves, end caps, and where specified in the scope of work, anchor or thrust blocks shall be constructed to the dimensions specified in the construction drawings.

c) Anchor or thrust blocks and pedestals shall be constructed of grade 15 concrete unless otherwise specified in the scope of work.

d) The concrete shall be well punned around the pipe and, if in trenches, against the undisturbed faces and bottom of the trench. Backfilling shall not be placed behind or under thrust faces. Excess excavation shall be replaced with concrete, as used for the anchor or thrust blocks. Care shall be taken to leave the joints accessible.

### Valve and hydrant chambers

e) On reticulation pipelines of nominal diameter 200 mm or less, each valve shall be housed in a chamber as detailed in figures 4 to 7, as relevant, unless otherwise specified in the scope of work. On pipelines of nominal diameter up to and including 275 mm, chambers shall be constructed around all gate and scour valves, hydrants, and air valves.

f) After all items have complied with the test requirements of clause 5, excavations shall be backfilled to the level of the top of the pipeline in accordance with the requirements of SANS 2001-DP1 .From this level masonry or precast units, as detailed in figures 1, 2 or 3, unless otherwise shown in the construction drawings, shall be constructed to a height such that the top of each valve or hydrant surface box is at the level of the sidewalk or street, or at a height of 50 mm above ground level in unsurfaced areas.

g) The upper dimensions of each structure shall be such as to fit the base of the surface box. The surface box shall be grouted to the top of the structure and the excavation then backfilled around the structure and the surface box. The backfill shall be well compacted to the level of the top of the box, which shall be held firmly in position by the fill.

### Disinfection of potable water pipelines

On completion of laying and testing, each potable water pipeline shall be disinfected as follows:

b) The pipeline shall be flushed out with clean water until all sediment and other foreign matter have been removed.

c) b) The pipeline shall then be filled with water containing 0,15 g/L of calcium hypochlorite. The solution shall be allowed to flow slowly into the pipeline until it fills the whole pipeline and shall be left there for at least 24 hours.

d) The pipeline shall then be repeatedly flushed with clean water until a sample of the washwater drawn from the pipeline complies with the requirements for potable water of the local authority or of the authority supplying such water to the area.

### Compliance with the requirements

### Tolerances

a) No deviation shall be permitted from the minimum cover specified or shown in the drawings

b) For the purposes of this subclause, valves set on the centre lines of pipelines and designated changes in gradient shall be regarded as control points and shall be located with a permissible vertical deviation of± 1 00 mm on the centre line. The same deviation shall be permissible laterally except where the pipeline is to be laid at a designated distance from a fence line, kerb line, or boundary, in which case the permissible deviation shall be ± 20 mm.

c) Scour valves shall be located at the lowest points in pipelines, and air valves shall be located at the highest points, subject to a permissible longitudinal deviation that does not exceed 4m.

d) The permissible deviation in alignment between control points (see 5.1.2.1) from a straight line joining the control points, when measured on the top centre of the pipeline, shall be 100 mm or 20 % of the nominal diameter of the pipe, whichever is the larger, and the permissible deviation per pipe length shall be 20 mm.

e) The permissible deviation from the designated level at any point on the invert of the pipeline shall be ± 50 mm or± 10 % of the nominal diameter of the pipe, whichever is the larger.

f) Manholes, valve chambers, and the like, shall be constructed centrally on the control points and, with the exception of tolerances that affect access to bolts, nuts, etc., with a permissible deviation of± 50 mm on all clearance dimensions. The clearance dimension between the outside of each nut and bolt-head and the inside face of the wall of a structure or any other fitting shall be at least the specified value.

### Construction tests

a) In the case of steel pipelines butt-welded in the field, test joints immediately after being made.

b) Before carrying out the hydraulic test ensure that all valves, tees, and bends are properly secured and shored to prevent movement of pipes and fittings and, should any such movement occur, re-position, repair and secure the pipes and fittings.

c) All pipeline elements are to be test in accordance to the requirements of item 5.3 of SANS 2001-DP2.

b) Type of pipe and associated fittings: HDPE
c) Nominal pipe size: 25mm

### 18.5.3 Below ground water installation for buildings (SANS 2001-DP6)

*Applicable standard: SANS* 2001-Construction Works Part DP6: Below-ground water installations

*Note 1:*
It is noted that potable water supply to the proposed Ntshongwe police station is yet to be confirmed due to supply challenges from the municipal watermains. It was decided that the proposed development would be supplied via borehole located within the site boundary. The location of the borehole, inlet pipeline and fittings to the elevated tank will only be confirmed after geohydrological investigations at the discretion of the Client.

Specification data:

e) Type of pipe and associated fittings: Refer to design drawing
f) Nominal pipe size: Refer to design drawing
g) Meter type and size: Helix 4000 type (Refer to design drawing)

### 18.5.4 Above ground water installation

c) Pipe material: Copper
d) Nominal pipe size: Refer to design drawing
e) Fixing of pipes <20 mm: Refer to design drawing

### 18.5.5 Water storage tanks

*Applicable Particular Specification: Ntshongwe SAPS Police Station - Particular Specifications for Sectional Steel Tanks – S13A*

ii. Tank type: Pressed steel sections bolted & sealed together
iii. Material: Steel
iv. Capacity or size: 64m$^3$
Stand for external tanks: 15m high stand (included in specialist design)

## 18.6 Electric geysers and solar water heaters

## Refer Mechanical engineering specification.

### 18.6.1 Electric geysers

- geyser type: see drawings and schedule of quantities
- nominal capacity: see drawings and schedule of quantities
- design: standard / Heat pump attached.

open outlet and cistern type ≤15 / 25 / 50 / 75 / 100 / 125 / 150 / 175 / 200 / 250 L; closed type 15 / 25 / 50 / 75 / 100 / 125 / 150 / 175 / 200 / 250 / 300 / 400 / 600 L

### 18.6.2 Solar water heaters

- N/A

## 18.8 Fire equipment

## Refer mechanical / fire engineering specification.

**fire hose reels**

- height from floor to spindle if not 2 100 mm: see drawings and schedule of quantities
- enclose reel in security box with clear acrylic cover and suitable closer: required

**portable fire extinguishers**

- portable non-refillable general purpose extinguishers (SANS 1322): see drawings and schedule of quantities
- water, foam or dry powder rechargeable extinguishers (SANS 1910): see drawings and schedule of quantities
- $CO_2$ type extinguisher (SANS 1567): see drawings and schedule of quantities
- BCF type extinguisher (SANS 1151) capacity: see drawings and schedule of quantities
- Enclose extinguisher in security box with clear acrylic cover and suitable closer: required

## 18.9 Sanitary plumbing

### 18.9.1 Sanitary appliances

**appliances**

- appliance type: see drawings
- material: see drawings
- stainless steel grade: 304 ; finish: satin
- anti-theft waste plug: required
- flow restrictors: not required

**baths**

- N/A

**basins**

- type, shape: see drawings

**wash troughs**

- type: see drawings

**water closets**

- type: see drawings

**flushing cisterns**

- type: see drawings
- flush capacity: regular flush (6 or 9 L)
- flush valve flushing operation: single flush

**urinals**

- urinal type: see drawings

**bidets**

- N/A

**sinks**

- sink type: see drawings
- bowl position: see drawings

**shower enclosures**

- shower enclosure type: domestic to SANS 549
- drained floor type: tiled
- glazed wall/door/roof construction: framed
- safety glass: toughened safety glass
- door type: pivoting
- metal finish: powder coating, type 4

### 18.9.2 Taps, valves, showerheads

- tap, valve type: see drawings
- showerhead type: see drawings
- material: chromium plated brass / stainless steel
- flush valve type: WCLP / urinal

### 18.9.3 Traps

- type: see drawings
- material: rubber / chromium plated brass
- depth of seal: 40 / 75 mm.

### 18.9.4 Miscellaneous

**Paper holders / Soap holders / towel rails**

- holder type: see drawings
- material: stainless steel

**shelves**

- material: N/A

**cabinets**

- type: N/A

# 19 Electrical works

## 19.1 Electrical Installation

### 19.1.1 Part 1 – General

| Relevant standards: |
| --- |
| SANS 10114 Interior lighting. |
| SANS 10389 Exterior lighting. |
| SANS 10142 The wiring of premises. |
| SANS 10222 Electrical security installations. |
| SANS 10313: The protection of structures against lightning. |
| SANS 61024 Lightning protection of structures. |

#### 19.1.1.1 Tests

After completion of the works and before practical completion is achieved, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installations will be inspected, and the Contractor shall make good, to the satisfaction of the Principle Agent/Electrical Engineer or the employer, any defects which may arise.

The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installations at completion.

#### 19.1.1.2 Maintenance of Installations

With effect from the date of the Practical completion Certificate the Contractor shall at his own expense undertake the regular servicing of the installation during the maintenance period and shall make all adjustments necessary for the correct operation thereof.

If during the said period the installations is not in working order for any reason for which the Contractor is responsible, or if the installations develop defects, he shall immediately upon being notified thereof take steps to remedy the defects and make any necessary adjustments.

Should such stoppages however be so frequent as to become troublesome, or should the installations otherwise prove unsatisfactory during the said period the Contractor shall, if called upon by the Principle Agent/Electrical Engineer or the Employer, at his own expense replace the whole of the installations or such parts thereof as the Principal Agent/Electrical Engineer or the Employer may deem necessary with apparatus specified by the Principal Agent/Electrical Engineer or the Employer.

#### 19.1.1.3 Regulations

The installation shall be erected and tested in accordance with the Acts and Regulations as indicated in the scope of works.

#### 19.1.1.4 Notices and Fees

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.

On production of the official account, only the net amount of the fee charged by the Supply Authority for connection of the installation to the supply mains, will be refunded to the Contractor by the Employer.

#### 19.1.1.5 Schedule of Fittings

In all instances where schedule of light, socket outlet and power points are attached to or included on the drawings, these schedules are to be regarded as forming part of the specification.

#### 19.1.1.6 Quality of Materials

Only materials of first class quality shall be used and all materials shall be subject to the approval of the Employer. Departmental specifications for various materials to be used on this Contract are attached to and form part of this specification.

Wherever applicable the material is to comply with the relevant South African Bureau of Standards, specifications, or to IEC Specifications, where no SANS Specifications exist.

Materials wherever possible, must be of South African manufacture.

#### 19.1.1.7 Conduit and Accessories

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 Bureau of Standards.

- Screwed metallic conduit and accessories: SANS 61386-1 and 21.

- Plain-end metallic conduit and accessories: SANS 61386-1 and 21.
- Non-metallic conduit and accessories: SANS 61386-1 and 21.

All conduit fittings except couplings, shall be of the inspection type. Where cast metal conduit accessories are used, these shall be of malleable iron. Zinc base fittings will not be allowed.

Bushes used for metallic conduit shall be brass and shall be provided in addition to locknuts at all points where the conduit terminates at switchboards, switch-boxes, draw-boxes, etc.

Draw-boxes are to be provided in accordance with the “Wiring Code” and wherever necessary to facilitate easy wiring.

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.

Only one manufactured type of conduit and conduit accessories will be permitted throughout the installation.

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.

All metallic conduit 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.

Under no circumstances will conduit having a wall thickness of less than 1,6mm be allowed in screed laid on top of concrete slabs.

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 inspectorate staff, be completely removed and rectified and any wiring already drawn into such damaged conduits must be completely renewed at the Contractor’s expense.

Conduit and conduit accessories used for flame-proof or explosion proof installations and for the suspension of luminaires as well as all load bearing conduit shall in all instances be of the metallic screwed type.

All conduit and accessories used in areas within 50 km of the coast shall be galvanised to SANS 32 and SANS 121.

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 regarding the supply authority's requirements.

#### 19.1.1.8 Conduit in Roof Spaces

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5m by means of saddles screwed to the roof timbers.

Nail or crampets will not be allowed.

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 450 mm. The Contractor shall supply and install all additional supporting timbers in the roof space as required.

Under flat roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceilings be insulated with glass wool or other insulating material, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit runs from distribution boards shall, where possible terminate in fabricated sheet steel draw-boxes installed directly above or in close proximity to the boards.

#### 19.1.1.9 Surface Mounted Conduit

Wherever possible, the conduit installation is to be concealed in the building work; however, where unavoidable or otherwise specified under Part 2 of the specification, conduit installed on the surface must be plumbed or levelled and only straight lengths shall be used.

The use of inspection bends is to be avoided and instead the conduit shall be set uniformly and inspection coupling used where necessary.

No threads will be permitted to show when the conduit installation is complete, except where running couplings have been employed.

Running couplings are only to be used where unavoidable and shall be fitted with a sliced couplings as a lock nut.

Conduit is to be run on approved spaced saddles rigidly secured to the walls.

Alternatively, fittings, tees, boxes, couplings etc., are to be cut into the surface to allow the conduit to fit flush against the surface. Conduit is to be bedded into any wall irregularities to avoid gaps between the surface and the conduit.

Crossing of conduits is to be avoided, however, should it be necessary purpose-made metal boxes are to be provided at the junction. The finish of the boxes and positioning shall be in keeping with the general layout.

Where several conduits are installed side by side, they shall be evenly spaced and grouped under one purpose-made saddle.

Distribution boards, draw-boxes, industrial switches and socket outlets etc., shall be neatly recessed into the surface to avoid double sets.

In situations where there are no ceilings the conduits are to be run along the wall plates and the beams.

Painting of surface conduit shall match the colour of the adjacent wall finishes.

Only approved plugging materials such as aluminium inserts, fibre plugs, plastic plugs, etc., and round-head screws shall be used for fixing saddles, switches, socket outlets, etc., to walls, wood plugs and the plugging in joints in brick walls are not acceptable.

### 19.1.1.10 Conduit in Concrete Slabs

In order not to delay building operations the Contractor must ensure that all conduits and other electrical equipment which are to be cast in the concrete columns and slabs are installed in good time.

The Contractor shall have a representative in attendance at all times when the casting of concrete takes place.

Draw-boxes, expansion joint boxes and round conduit boxes are to be provided where necessary. Sharp bends of any nature will not be allowed in concrete slabs.

Draw and/or inspection boxes shall be grouped under one common cover plate, and must preferable be installed in passages or male toilets.

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast. The conduit shall be supported and secured at regular intervals and installed as close as possible to the neutral axis of concrete slabs and/or beams.

Before any concrete slabs are cast, all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

### 19.1.1.11 Flexible Connections for connecting up of Stoves, Machines, Etc.

Flexible tubing connections shall be of galvanised steel construction, and in damp situations of the plastic sheathed galvanised steel type. Other types may only be used subject to the prior approval of the Department's site electrical representative.

Connectors for coupling onto the flexible tubing shall be of the gland or screw-in types, manufactured of either brass or cadmium or zinc plated mild steel, and the connectors after having been fixed onto the tubing, shall be durable and mechanically sound.

Aluminium and zinc alloy connectors will not be acceptable.

### 19.1.1.12 Wiring

See SANS 10198 The selection, handling and installation of electric power cables of rating not exceeding 33 kV.

Except where otherwise specified in Part 2 of this specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduits to be clear of moisture and debris before wiring is commenced.

Unless otherwise specified in Part 2 of this specification or indicated on the service drawings, the wiring of the installation shall be carried out in accordance with the "Wiring Code". Further to the requirements concerning the installation of earth conductors to certain light points as set out in the "Wiring Code", it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductors must be provided and drawn into the conduit with the main conductors to all points, including all luminaires and switches throughout the installation.

Wiring for lighting circuits is to be carried out with 1,5mm² conductors and a 1,5mm²-earth conductor. For socket outlet circuits the wiring shall comprise 4mm² conductors and a 2,5mm²-earth conductor. In certain instances, as will be directed in Part 2 of this specification, the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduit in all other instances, such as feeders to distribution boards, power points etc., shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be determined in accordance with the "Wiring Code".

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 600/1000 V grade cable to SANS 1507.

Where cable ends connect onto switches, luminaires etc., the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

### 19.1.1.13 Switches and Socket Outlets

All switches and switch-socket outlet combination units shall conform to the Department Quality Specifications, which form part of this specification.

No other than 16 A 3 pin sockets are to be used, unless other special purpose types are distinctly specified or shown on the drawings.

All light switches shall be installed at 1,4m above finished floor level and all socket outlets as directed in the Schedule of Fittings which forms part of this specification or alternatively the height of socket outlets may be indicated on the drawings.

### 19.1.1.14 Switchgear

Switchgear, which includes circuit breakers, iron-clad switches, interlocked switch-socket outlet units, contactors, time switches, etc., is to be in accordance with the Departmental Quality Specifications which form part of this specification and shall be equal and similar in quality to such brands as may be specified.

For uniform appearance of switchboards, only one approved make of each of the different classes of switchgear mentioned in the Quality Specifications shall be used throughout the installations.

### 19.1.1.15 Switchboards

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Employer before installation.

In all instances where provision is to be made on boards for the supply authority's main switch and/or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

Any construction or standard type aboard proposed, as an alternative to that specified must have the prior approval of the Employer.

All busbars, wiring, terminals, etc., are to be adequately insulated and all wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give a flush front panel. Cable and boxes and other ancillary equipment must be provided where required.

Clearly engraved labels are to be mounted on or below every switch. The working of the labels in English, is to be according to the lay-out drawings or as directed by the Electrical Engineer and must be confirmed on site. Flush mounted boards to be installed with the top of the board 2,0m above the finished floor level.

### 19.1.1.16 Workmanship and Staff

Except in the case of electrical installations supplied by a single-phase electricity supply at the point of supply, an accredited person shall exercise general control over all electrical installation work being carried out.

The workmanship shall be of the highest grade and to the satisfaction of the Employer.

All inferior work shall, on indication by the Employer's inspecting officers, immediately be removed and rectified by and at the expense of the Contractor.

### 19.1.1.17 Verification and Certification of Electrical Installation (Certificate of Compliance and Test Report)

On completion of the service, a certificate of compliance must be issued to the Principal Agent/Electrical Engineer or Employer in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) in the format as set out in SANS 10142-1 & 2.

### 19.1.1.18 Earthing of Installation

**Main earthing**

The type of main earthing must be as required by the supply authority if other than the Employer, and in any event as directed by the Principal Agent/Electrical Engineer, who may require additional earthing to meet test standards.

Where required an earth mat shall be provided, the minimum size, unless otherwise specified, being 1,0m x 1,0m and consisting of 4mm diameter hard-drawn bare copper wires at 250mm centres, brazed at all intersections.

Alternatively, or additionally earth rods or trench earths may be required as specified or directed by the Electrical Engineer.

Installations shall be effectively earthed in accordance with the "Wiring Code" and to the requirements of the supply authority. All earth conductors shall be stranded copper with or without green PVC installation.

Connection from the main earth bar on the main board must be made to the cold water main, the incoming service earth conductor, if any and the earth mat or other local electrode by means of 12mm x 1,60 mm solid copper strapping or 16 mm² stranded (not solid) bare copper wire or such conductor as the Department's representative may direct.

Main earth copper strapping where installed below 3m from ground level, must be run in 20 mm diameter conduit securely fixed to the walls.

All other hot and cold-water pipes shall be connected with 12mm x 0,8mm perforated for solid copper strapping (not conductors) to the nearest switchboard. The strapping shall be fixed to the pipework with brass nuts and bolts and against walls with brass screws at 150-mm centres. In all cases where metal water pipes, down pipes, flues, etc., are positioned within 1,6m of switchboards an earth connection consisting of copper strapping shall be installed between the pipework and the board. In vertical building ducts accommodating both metal water pipes and electrical cables, all the pipes shall be earthed at each distribution board.

**Roofs, gutters and down pipes**

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 and each switchboard. The roof and gutters shall be connected at 15m intervals to this conductor by means of 12mm X 0,8mm 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.

**Sub-distribution boards**

A separate earth connection shall be supplied between the earth busbar in each sub-distribution board and the earth busbar in the Main Switchboard. These connections shall consist of a 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 where specified or approved.

**Sub-circuits**

The earth conductors of fall sub-circuits shall be connected to the earth busbar in the supply board in accordance with SANS 10142.

**Ring Mains**

Common earth conductors may be used where various circuits are installed in the same wire way in accordance with SANS 10142. In such instances the sizes of earth conductors shall be equivalent to that of the largest current carrying conductor installed in the wire way, alternatively the size of the conductor shall be as directed by the Engineer. Earth conductors for individual circuits branching from the ring main shall by connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

**Non-metallic Conduit**

Where non-metallic conduit is specified or allowed, the installation shall comply with the Department's standard quality specification for "conduit and conduit accessories".

Standard copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including metal 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.

**Flexible Conduit**

An earth conductor shall be installed in all non-metal flexible conduit. This earth conductor shall not be installed externally 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.

**Connection**

Under no circumstances shall any 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 end shall be tinned and lugged.

### 19.1.1.19 Mounting and Positioning of Luminaires

The Contractor is to note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the building contractor is necessary to ensure that as far as possible the luminaires are symmetrically positioned with regard to the ceiling pattern.

The layout of the luminaires as indicated on the drawings must be adhered to as far as possible and must be confirmed with the Department's representative.

Fluorescent luminaires installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be ¾ of the length of the luminaires apart.

Fluorescent luminaires to be mounted on board ceilings shall be secured by means of two 40mm x No. 10 round head screws and washers. The luminaires shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed ¾ of the length of the fitting apart.

Earth conductors must be drawn in with the circuit wiring and connected to the earthing terminal of all fluorescent luminaires as well as other luminaires exposed to the weather in accordance with the "Wiring Code".

Incandescent luminaires are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings the luminaires shall be secured to the brandering or joists by means of two 40mm x No. 8 round head screws.

## 19.1.2 Part 2 – Installation Details

### 19.1.2.1 Cable Sleeve Pipes

Where cables cross under roadways, other services and where cables enter buildings, the cables shall be installed in earthenware or high-density polyethylene pipes.

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.

### 19.1.2.2 Notices

The Contractor shall issue all notices and make the necessary arrangements with Supply Authorities, the Postmaster-General, and S.A. Transport Services, Provincial or National Road Authorities and other authorities as may be required with respect to the installation.

### 19.1.2.3 Electrical Equipment

All equipment and fittings supplied must be in accordance with the attached quality specification (Part 3 of this document), suitable for the relevant supply voltage, and frequency and must be approved by the Employers Electrical Engineer.

### 19.1.2.4 Drawings

The drawings generally show the scope and extent of the proposed work and shall not be held as showing every minute detail of the work to be executed.

The position of power points, switches and light points that may be influenced by built-in furniture must be established on site, prior to these items being built in.

### 19.1.2.5 Balancing of Load

The Contractor is required to balance the load as equally as possible over the multiphase supply.

### 19.1.2.6 Service Conditions

All plant shall be designed for the climatic conditions appertaining to the service.

### 19.1.2.7 Switches and Socket Outlets

The installation of switches and socket outlets must conform to clause 13 of Part 1 of this specification.

### 19.1.2.8 Light Fittings and Lamps

The installation and mounting of luminaires must conform to clause 19 of Part 1 of this specification.

All fittings to be supplied by the Contractor shall have the approval of the Employer.

The light fittings must be of the type specified in the Schedule of Light Fittings.

### 19.1.2.9 Earthing and Bonding

The Contractor will be responsible for all earthing and bonding of the building and installation. The earthing and bonding is to be carried out strictly as described in clause 18 of Part 1 of this specification and to the satisfaction of the Employer/s Electrical Engineer.

### 19.1.2.10 Maintenance of Electrical

All interruptions of the electrical supply that may be necessary for the execution of the work, will be subject to prior arrangement between the Contractor and the Client and the Employer's Electrical Engineer.

### 19.1.2.11 Extent of Work

The work covered by this contract comprises the complete electrical installation, in working order, as shown on the drawings and as per this specification, including the supply and installation of all fittings and also the installation of such equipment supplied by the Employer.

### 19.1.2.12 Supply and Connection

ESKOM Supply and Connection

The supply will be an ESKOM 150kVA Supply taken at 400/230 Volt 50Hz.

The Contractor must arrange in good time with ESKOM for the installation of the 150kVA transformer and low-tension meter point and submit the account to the Employer's Regional Office for payment.

The Contractor will be responsible for the supply and installation of the supply cable from the meter box to the main low-tension Main LV distribution board (MDB). The size and length of the cable is listed in the Schedule of Cables and measured in the Bills of Quantities.

Standby Plant

The 80kVA standby plant complete with automatic changeover control panel (Distribution Board – X) be supplied, installed and commissioned by others.

The Contractor will only be responsible for the supply and installation of the cable connections between the Main Distribution Board and the Charge- over Control Panel (Distribution Board - X).

The supply cables are listed in the Schedule of Cables and measured in the Bills of Quantities.

Solar PV System

The 2 x 40kVA Solar Inverters complete with integrated charge controllers and MPPT's, shall be supplied, installed and commissioned by others.

The Contractor will only be responsible for the supply and installation of the cable connections between the Main Distribution Board and the 2 x 40kVA Solar Inverters.

The supply cables are listed in the Schedule of Cables and measured in the Bills of Quantities.

### 19.1.2.13 Conduit and Wiring

*Conduit and conduit accessories shall be black enameled/galvanized screwed conduit or black enameled/galvanized plain end conduit in accordance with SANS 61386.*

All conduits, regardless of the system employed, shall be installed strictly as described in the applicable paragraphs of clauses 4 to 8 of Part 1 of the specification. Wiring of the installation shall be carried out as directed in clause 9 part 1 of this specification.

Where plain end conduit is offered 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.

#### 19.1.2.13.1 Telephone Installation

The Contractor shall allow for the complete installation of all conduits, outlet boxes, the communication service provider Distribution boards, sleeve pipes, etc., required for the telephone system as shown on the drawings.

The sizes of all telephone conduits are indicated on the drawings and must be installed in the floor slab. Galvanized steel draw-wires shall be installed in all conduits.

End boxes must consist of a 50mm x 100 mm x 100mm outlet box fitted with suitable blank cover plates, flush mounted 0,4m above floor level.

The communication service provider Distribution Board must consist of a 150mm x 600mm x 600mm metal box and hinged door with a 20mm thick wooden backboard. The board must be flush mounted, 1,37m above the floor.

#### 19.1.2.13.2 Intercom Installation

The supply and installation of the intercom system is not included in this Contract.

The Contractor shall allow for the complete supply and installation of all conduits and outlet boxes required for the intercom installation as shown on the drawings.

The size of all conduits, boxes and mounting heights of the end boxes are indicated on the drawings. Galvanized steel draw-wires shall be installed in all conduits and the boxes fitted with suitable blank cover plates.

#### 19.1.2.13.3 Power Trunking

The Contractor shall be responsible for the supply and installation of all power trunking complete with corner pieces, end pieces, junction pieces, supply conduits, cover plates and power outlets as specified and indicated on the drawings.

The power trunking must comply with SANS 61084. The Contractor must ensure that the power trunking is installed to satisfaction of the Employer's Electrical Engineer before commencing with the wiring of the power trunking.

The Power Trunking shall be mounted at floor level, and in each room a vertical Power Trunking shall be installed to connect the power circuits from the Distribution Boards to the Horizontal Power Trucking. The wiring shall be housed in conduits or in Wiring channels routed in the ceiling void.

### 19.1.2.14 Power Points

Allow for the installation of power points and equipment as listed in the schedule, indicated on the drawings and described below:

14.1 ELECTRIC STOVE POINTS

Electric Stove Points are required in the Staff Units kitchens. The contractor shall supply and install 60A DP Flush mounted Stove Isolators with an indicator light mounted at 1400mm AFFL. A round box outlet shall be installed at 600mm AFFL for the wiring connections from the isolator to the Stove that shall be supplied by others. The contractor shall allow to connect the Stove to the Electric Stove Point.

14.2 CEILING FAN POINTS

Ceiling Fan outlet points shall be supplied and installed in the ceiling void of Staff Units and shall be controlled via Fan controllers flush mounted in the wall at 1400mm AFFL. The contractor shall allow to connect the ceiling fans supplied by others, from the Fan controllers.

14.3 EXTRACTOR FAN POINTS

Extractor Fan outlets shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The extractor fan outlets shall be installed in the ceiling void and shall be controlled by occupancy sensors. The contractor shall allow to connect the extractor fans supplied by others, from the power outlets.

14.4 FRESH AIR FAN POINTS

Fresh Air Fan outlets shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The fresh air fan outlets shall be installed in the ceiling void. The contractor shall allow to connect the fresh air fans supplied by others, from the power outlets.

14.5 AIR CONDITIONER POINTS

Air Conditioner Isolator outlets shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The Air conditioner isolator outlets shall be flush mounted in the walls at 2100mm AFFL.. The contractor shall allow to connect the Air conditioners supplied by others, from the isolator outlets.

14.6 HYDRO BOIL POINTS

Hydro boil Isolator outlets shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The Hydro boil isolator outlets shall be flush mounted in the walls at 1400mm AFFL.. The contractor shall allow to connect the Hydro boils supplied by others, from the isolator outlets.

14.7 GEYSER POINTS

Geyser Isolator outlets shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The Geyser isolator outlets shall be Surface mounted in the ceiling voids. The contractor shall allow to connect the Geysers supplied by others, from the isolator outlets.

14.8 WELDING SOCKET OUTLET POINT

Welding socket outlet shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The Welding Socket outlet shall be Surface mounted on the wall at 1200mm AFFL.

14.9 ANCILLARY EQUIPMENT OUTLET POINT

Ancillary equipment outlet points shall be supplied and installed as shown on the drawings and detailed in the schedule of power points. The ancillary equipment outlet shall be flush mounted on the wall at 2100mm AFFL. Ancillary equipment shall be installed by others and shall include Fire Detection Panels and Access Control equipment.

## 19.1.2.15 Cables

The Contractor shall supply and completely install all distribution cables as indicated on the drawings and listed in the Schedule of Cables.

The storage, transportation, handling and laying of the cables shall be according to first class practice, and the contractor shall have adequate and suitable equipment and labour to ensure that no damage is done to cables during such operations.

The cable-trenches shall be excavated to a depth of 0,9m deep below ground level and shall be 450mm wide for one to three cables, and the width shall be increased where more than three cables are laid together so that the cables may be placed at least two cable diameters apart throughout the run. The bottom of the trench shall be level and clean and the bottom and sites free from rocks or stones liable to cause damage to the cable.

The Contractor must take all necessary precautions to prevent the trenching work being in any way a hazard to the personnel and public and to safeguard all structures, roads, sewage works or other property on the site from any risk of subsidence and damage.

In the trenches the cables shall be laid on a 75mm thick bed of earth and be covered with a 150-mm layer of earth before the trench is filled in.

All joints in underground cables and terminations shall be made either by means of compound filled boxes according to the best established practice by competent cable jointers using first class materials or by means of approved epoxy-resin pressure type jointing kits. Epoxy-resign joints must be made entirely in accordance with the manufacturer's instructions and with materials stipulated in such instructions. Low tension PVCA cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off, the ends are to be sealed without delay.

The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused and must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

Backfilling (after bedding) of the trenches is to be carried out with a proper grading of the material to ensure settling without voids, and the material is to be tamped down after the addition of every 150mm. The surface is to be made good as required.

On each completed section of the laid and jointed cable, the insulation resistance shall be tested to approval with an approved "Megger" type instrument of not less that 500 V for low tension cables.

Earth continuity conductors are to be run with all underground cables constituting part of a low tension distribution system. Such continuity conductors are to be stranded bare copper of a cross-sectional area equal to at least half that of one live conductor of the cable, but shall not be less than 4mm² or more than 70mm². A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

### 19.1.2.15.1 Laying, Jointing and making off of Electrical cables

[The requirements specified hereafter, are aimed essentially at high tension cable but are also valid for low tension cable, where applicable.]

1. The use of the term “Inspector”, includes the engineer or inspector of the Department or an empowered person of the concerned supervising consulting engineer’s firm.

2. No cable is to be laid before the cable trench is approved and the soil qualification of the excavation is agreed upon by the Contractor and inspector.

3. After the cable has been laid and before the cable trench is back-filled the inspector must ensure that the cable is properly bedded and that there is no undesirable material included in the bedding layer.

4. All cable jointing and the making off of the cables must only be carried out by qualified experienced cable jointers. Helpers of the jointers may not saw, strip, cut, solder, etc. The cable and other work undertaken by them must be carried out under the strict and constant supervision of the jointer.

5. Before the Contractor allows the jointer to commence with the jointing work or making off of the cable (making off is recognized as half a joint) he must take care and ensure:

5.1 That he has adequate and suitable material available to complete the joint properly and efficiently. Special attention must be given to ensure the cable ferrules and cable lugs are of tinned copper and of sufficient size. The length of the jointing lugs must be at least six times the diameter of the conductor,

5.2 That the joint pit is dry and that all loose stones and material are removed,

5.3 That the walls and banks of the joint pit are reasonable firm and free from loose material which can fall into the pit,

5.4 That the necessary coffer-dams or retaining walls are made to stop the flow of water into the joint pit,

5.5 That the joint pit is provided with suitable groundsheets so that the jointing work is carried out in clean conditions,

5.6 That the necessary tents or sails are installed over the joint pit to effectively avert unexpected rainfall and that sufficient light or lighting is provided,

5.7 That the necessary means are available to efficiently seal the jointing or cable end when an unexpected storm or cloudburst occurs, regardless of how far the work has progressed,

5.8 That the cables and other materials are dry, undamaged and in all respects are suitable for the joint work or making off,

5.9 That the heating of cable oil, cable compound, plumbers metal and solder is arranged that they are at the correct temperature when required so that the cable is not unnecessary exposed to the atmosphere and consequently the ingress of moisture (care must be taken of overheating)

Flow temperatures of cable oil and compound must be determined with suitable thermometers. Cable oil and compound must not be heated to exceed the temperatures given on the containers and precaution must be taken to ensure that the tin is not overheated in one position. The whole mass must be evenly and proportionally heated.

(Temperatures of solder and plumbers metal may be tested with brown paper (testing time: 3 seconds). The paper must colour slightly - not black or burnt).

6. Before the paper-insulated cables are joined, they must be tested for the presence of moisture by the cable jointers test. This consists of the insertion of a piece of unhandled insulated impregnated paper tape in warm cable oil heated to a temperature of 130 ± 5°C.

Froth on the surface of the oil is an indication that moisture is present in the impregnated insulation and the amount of the froth gives an indication of the moisture present.

7. If the cable contains moisture or is found to be otherwise unsuitable for jointing or making of the inspector is to be notified immediately and he will issue the necessary instruction to cope with the situation.

8. The joint or making off of paper insulated cables must not be commenced during rainy weather.

9. Once a joint is in progress the jointer must proceed with the joint until it is complete and before he leaves the site.

10. The jointer must ensure that the material and his tools are dry at all times, reasonably clean and absolutely free from soil.

11. Relating to the jointing of the cable the following requirements apply:

11.1 All jointing must be carried out in accordance with recognized and tried techniques and comply strictly with the instructions given by the supplier of the jointing kit.

11.2 The cables must be twisted by hand so that the cores can be joined according to the core numbers. If necessary the cable is to be exposed for a short distance to accomplish this. Under no circumstances may the cores in a joint be crossed so as to enable cores to be joined according to the core numbers. If it is not possible to twist the cables so that the preceding requirements can be met, then cores are to be joined in the normal way without any consideration of the core numbers.

11.3 Normally the cables will have profile conductors. The conductors shall be pinched with gas pliers to form a circular section, bound with binding wire so that they do not spread, and then tinned before jointing.

11.4 Jointing ferrules, the length of which are at least 6 times the diameter of the conductors, must be slid over the conductor ends to be joined and pinched tightly.

Then they are soldered by means of the ladle process whilst being pinched further closed.

Use resin only as a flux. The slot opening in the ferrule must be completely filled, including all depressions.

Remove all superfluous metal with a cloth dipped in tallow. Work during the soldering process must be from top to bottom. Rub the ferrule smooth and clean with aluminium oxide tape after it has cooled down to ensure that there are not any sharp points or edges.

NB: The spaces between the conductor strands must be completely filled by soldering process and must be carried out quick enough to prevent the paper insulation from burning or drying out unnecessarily.

11.5 After the ferrules have been rubbed smooth and clean, they and the exposed cores must be treated with hot cable oil (110°C) to remove all dust and moisture. These parts are to be thoroughly basted with the oil.

11.6 The jointer must take care that his hands are dry and clean before the joint is insulated. Also the insulating tape which is to be used must first be immersed in warm cable oil (110°C) for a sufficient period to ensure that no moisture is present.

11.7 After the individual cores have been installed they must be well basted with hot cable oil and again after the applicable separator and/or belt insulation tape is applied before the lead joint sleeve is placed in position.

11.8 The lead joint sleeve must be thoroughly cleaned and prepared before it is placed on the cable and must be kept clean during the whole jointing process. Seal the filling apertures of the sleeve with tape until the sleeve is ready for compound filling.

11.9 The plumbing joints employed to solder the joint sleeve to the cable sheath, must be cooled off with tallow and the joint sleeve is to be filled with compound while it is still warm. Top up continuously until the joint is completely filled to compensate for the compound shrinkage.

11.10 The outer joint box must be clean and free from corrosion. After it has been placed in position it must be slightly heated before being filled with compound. Top up until completely full.

12. As far as cable end boxes are concerned the requirements as set out above are valid where applicable.

## 19.1.2.16. Distribution Boards

In addition to clause 14 and clause 15 of Part 1 of this specification the following shall also be applicable to switchboards required for this service.

The Contractor shall supply and install the distribution boards as indicated on the drawings and listed in the distribution Board Schedule. All distribution boards shall comply with the quality specification in Part 3 of this specification and be approved by the Employer's Electrical Engineer.

The following types of distribution boards are required for the service:

| | |
|---|---|
| MAIN LV BOARD – MDB | Floor Mounted distribution board with Non-essential, Essential and Power Factor correction sections. |
| DB1 / DB1E | Flush wall mounted distribution board with a recessed tray, with Non-essential and Essential sections with doors. |
| DB2 / DB2E | Flush wall mounted distribution board with a recessed tray, with Non-essential and Essential sections with doors. |
| DB3 | Flush wall mounted distribution board with a recessed tray, with Non-essential section with door. |
| KIOSK PL | Floor mounted weatherproof IP66 kiosk mounted on a concrete plinth with doors. |
| KIOSK K1 | Floor mounted weatherproof IP66 kiosk mounted on a concrete plinth with doors. |
| KIOSK K2 | Floor mounted weatherproof IP66 kiosk mounted on a concrete plinth with doors. |
| STAFF UNIT DB'S | Flush wall mounted distribution board with a recessed tray, with Non-essential section with door. |

### 19.1.2.17. Solar Photo Voltaic System

A complete 38,5kWp Hybrid Solar PV system, including 70 x 550W PV roof mounted Panels,

2 x 40kVA 3 Phase 50Hz 400V Inverters and 8 x 10kWh Li-Ion Batteries shall be supplied and installed by specialist sub-contractors.

The contractor shall allow to supply and install the cables from the Main LV Board to the 2 x 40kVA Inverters.

### 19.1.2.18. 80kVA Diesel Standby Generator

A complete 80kVA 3 Phase 400V 50Hz diesel Standby generator set, installed in a weatherproof and acoustic soundproof container, mounted on a concrete plinth, shall be supplied and installed by specialist sub-contractors.

The contractor shall allow to supply and install the cables from the Main LV Board Non-essential section to the Automatic Mains Failure change over DB-X in the Generator Container, and back to the Main LV Board Essential section.

### 19.1.2.19. Schedule of Light Fittings

The Departmental Quality Specification for the relevant luminaires must be included in Part 3 of the specification.

The light fittings and accessories are to be according to the quality specifications in Part 3 and shall be approved by the Employer.

Type A1: 30W LED recessed panel light 600x600mm, 220-240AC,50/60Hz, PF 0.9, 3387-3651 lm, neutral white 4000K luminaire with SANS approved mark.

Type A1E: 30W LED recessed panel light 600x600mm, 220-240AC,50/60Hz, PF 0.9, 3387-3651 lm, neutral white 4000K luminaire with emergency battery backup and SANS approved mark.

Type A2: 30W LED surface mounted panel light 600x600mm, 220-240AC,50/60Hz, PF 0.9, 3387-3651 lm, neutral white 4000K luminaire with SANS approved mark.

Type A2E: 30W LED surface mounted panel light 600x600mm, 220-240AC,50/60Hz, PF 0.9, 3387-3651 lm, neutral white 4000K luminaire with emergency battery backup and SANS approved mark.

Type B1: 16W LED surface mounted prismatic bulkhead, 220-240AC, 50/60Hz, PF 0.9, 2190 lm, IP65 neutral white 4000K luminaire with SANS approved mark.

Type B2: 9W LED recessed round downlight with aluminium reflector and acrylic diffused with night light, 220-240AC, 50/60Hz, PF 0.9, 1250 lm, IP20, neutral white 4000K luminaire.

Type B2E: 9W LED recessed round downlight with aluminium reflector and acrylic diffused with night light, 220-240AC, 50/60Hz, PF 0.9, 1250 lm, IP20, neutral white 4000K luminaire with emergency battery backup with SANS approved mark.

Type B3: 26W LED surface mounted Vandal resistant linear 600mm, with polycarbonate diffused without night light, 198-277AC, 50Hz, PF 0.95, 3715 lm, IP66, neutral white 4000K luminaire with SANS approved mark.

Type F1: 52W LED surface mounted Vandal resistant linear 600mm, with polycarbonate diffused without night light, 198-277AC, 50Hz, PF 0.95, 7349 lm, IP66, neutral white 4000K luminaire with SANS approved mark.

Type F1E: 52W LED surface mounted Vandal resistant linear 600mm, with polycarbonate diffused without night light, 198-277AC, 50Hz, PF 0.95, 7349

lm, IP66, neutral white 4000K luminaire with emergency battery backup with SANS approved mark.

### 19.1.2.20. Schedule of Power Points

| BOARD | POWER POINT | TYPE | SIZE OF CABLES, CONDUIT AND WIRING | LOAD WATTS |
|---|---|---|---|---|
| DB-1 | PP1 | Air conditioner CCU2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 5700 |
| DB-1 | PP2 | Air conditioner CCU3 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 4500 |
| DB-1 | PP3 | Air conditioner CCU1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 5000 |
| DB-1 | PP4 | Air conditioner CCU1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 5000 |
| DB-1 | PP5 | Air conditioner MW2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 7000 |
| DB-1 | PP6 | Air conditioner MW2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 7000 |
| DB-1 | PP7 | Extractor Fan EAF2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| DB-1 | PP8 | Air conditioner MW1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 4500 |
| DB-1 | PP9 | Extractor Fan EAF2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| DB-1 | PP10 | Air conditioner CCU2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 5700 |
| DB-1 | PP11 | Extractor Fan EAF2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| DB-1 | PP12 | Hydro boil | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 2000 |
| **DB-1** | PP13 | Dehumidifier | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 1000 |
| **DB-1** | PP14 | Air conditioner CCU2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 5700 |
| **DB-1** | PP15 | Air conditioner CCU4 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 5000 |
| **DB-1** | PP16 | Extractor Fan EAF2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-1** | PP17 | Hydro boil | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 2000 |
| **DB-1E** | PP18 | Fire Detection Panel | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 2000 |
| **DB-1E** | PP19 | Turnstile | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 2000 |
| **DB-2E** | PP1 | Air conditioner MW2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 7000 |
| **DB-2E** | PP2 | Air conditioner MW2 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 7000 |

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|---|---|---|---|---|
| **DB-2** | PP3 | Extractor Fan EAF5 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-2E** | PP4 | Welding Socket | 25mm dia. conduit with 4 x 4mm² conductors and 2,5mm² earth wire | 11000 |
| **DB-2** | PP5 | Geyser | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 3000 |
| **DB-3** | PP1 | Extractor Fan EAF5 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-3** | PP2 | Geyser | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 3000 |
| **DB-1-K1** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-1-K1** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-1-K1** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-1-K1** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-1-K1** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-2-K1** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-2-K1** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-2-K1** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-2-K1** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-2-K1** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-3-K1** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-3-K1** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-3-K1** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-3-K1** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-3-K1** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-4-K1** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-4-K1** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-4-K1** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-4-K1** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-4-K1** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |

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|---|---|---|---|---|
| **DB-5-K1** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-5-K1** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-5-K1** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-5-K1** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-5-K1** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-1-K2** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-1-K2** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-1-K2** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-1-K2** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-1-K2** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-2-K2** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-2-K2** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-2-K2** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-2-K2** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-2-K2** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-3-K2** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-3-K2** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-3-K2** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-3-K2** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-3-K2** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-4-K2** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-4-K2** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-4-K2** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-4-K2** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-4-K2** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |

| | | | | |
|---|---|---|---|---|
| **DB-5-K2** | PP1 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-5-K2** | PP2 | Extractor Fan EAF1 | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 450 |
| **DB-5-K2** | PP3 | Stove | 25mm dia. conduit with 2 x10mm² conductors and 6mm² earth wire | 5000 |
| **DB-5-K2** | PP4 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |
| **DB-5-K2** | PP5 | Ceiling Fan | 25mm dia. conduit with 2 x 4mm² conductors and 2,5mm² earth wire | 80 |

### 19.1.2.21. Schedule of Cables, Conduit and Wiring

Supply, install and connect the following cable, conduit and wiring:

| **FROM** | **TO** | **SIZE AND TYPE** | **LOAD (kVA)** |
|---|---|---|---|
| Meter box Normal Power | MDB | 95mm² 4-core Cu PVC/SWA ECC/PVC cable | 150 |
| MDB Normal Power | Power Factor | 95mm² 4-core Cu PVC/SWA ECC/PVC cable | 150(kVAr) |
| MDB Normal Power | DB-1 | 50mm² 4-core Cu PVC/SWA ECC/PVC cable | 100 |
| MDB Normal Power | DB-2 | 10mm² 3-core Cu PVC/SWA ECC/PVC cable | 6 |
| MDB Normal Power | DB-3 | 6mm² 3-core Cu PVC/SWA ECC/PVC cable | 7 |
| MDB Normal Power | Kiosk K1 | 25mm² 4-core Cu PVC/SWA ECC/PVC cable | 60 |
| MDB Normal Power | Kiosk K2 | 25mm² 4-core Cu PVC/SWA ECC/PVC cable | 57 |
| MDB Normal Power | DB-X | 50mm² 4-core Cu PVC/SWA ECC/PVC cable | 80 |
| DB-X Standby Power | MDB | 50mm² 4-core Cu PVC/SWA ECC/PVC cable | - |
| MDB Standby Power | DB-1E | 16mm² 4-core Cu PVC/SWA ECC/PVC cable | 13 |
| MDB Standby Power | DB-2E | 16mm² 4-core Cu PVC/SWA ECC/PVC cable | 26 |
| MDB Standby Power | DB-PL | 10mm² 3-core Cu PVC/SWA ECC/PVC cable | 1,2 |
| MDB | 2 x 40kVA | 50mm² 4-core Cu PVC/SWA ECC/PVC cable | - |

| | | | |
|---|---|---|---|
| Standby Power | Inverters | | |
| MDB Standby Power | DB-E1 | 4mm² 3-core Cu PVC/SWA ECC/PVC cable | 2.4 |
| MDB Standby Power | DB-E2 | 4mm² 3-core Cu PVC/SWA ECC/PVC cable | 3,8 |
| MDB Standby Power | DB-E3 | 16mm² 4-core Cu PVC/SWA ECC/PVC cable | 40 |
| MDB Standby Power | Borehole Pump | 6mm² 3-core Cu PVC/SWA ECC/PVC cable | 3 |
| MDB Standby Power | Gate Motor | 4mm² 3-core Cu PVC/SWA ECC/PVC cable | 1,5 |
| Kiosk K1 Normal Power | Heat Pump | 4mm² 3-core Cu PVC/SWA ECC/PVC cable | 3,5 |
| Kiosk K1 Normal Power | DB-1-K1 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K1 Normal Power | DB-2-K1 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K1 Normal Power | DB-3-K1 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K1 Normal Power | DB-4-K1 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K1 Normal Power | DB-5-K1 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K2 Normal Power | Heat Pump | 4mm² 3-core Cu PVC/SWA ECC/PVC cable | 3,5 |
| Kiosk K2 Normal Power | DB-1-K2 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K2 Normal Power | DB-2-K2 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K2 Normal Power | DB-3-K2 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K2 Normal Power | DB-4-K2 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| Kiosk K2 Normal Power | DB-5-K2 | 16mm² 3-core Cu PVC/SWA ECC/PVC cable | 10 |
| DB-PL Standby Power | L1 | 6mm² 3-core Cu PVC/SWA ECC/PVC cable | 0,5 |
| DB-PL Standby Power | L2 | 6mm² 3-core Cu PVC/SWA ECC/PVC cable | 0,5 |
| DB-PL Standby | L3 | 6mm² 3-core Cu PVC/SWA ECC/PVC cable | 0,1 |

| | | | |
|---|---|---|---|
| Power | | | |

### 19.1.2.21. Schedule of Distribution Boards

The front panels of normal supply, standby power and no-break supply sections shall be painted in distinctive colours as follows:

Normal supply : Light Orange, colour B26 of SANS 1091.
Standby power: Signal Red, colour A11 of SANS 1091.
No-break supply: Dark Violet, colour F06 or Olive Green, Colour H05 of SANS 1091.

Indicated is the probable fault level rating (kA) of the busbars. Refer to the Summary of Switchgear and Circuits for the minimum fault level rating of specified equipment.

| **BOARD** | **TYPE** | **PANEL** | **FAULT LEVEL** | **LOAD kVA** |
|---|---|---|---|---|
| MDB | Floor standing, without door | Normal power | 10 | 150 |
| | | Standby power | 6 | 80 |
| | | Power Factor | 10 | (150kVAr) |
| DB-1 | Flush, with door | Normal power | 6 | 100 |
| DB-2 | Flush, with door | Normal power | 6 | 6 |
| DB-3 | Flush, with door | Normal power | 6 | 7 |
| Kiosk-K1 | Floor mounted, with doors | Normal power | 6 | 60 |
| Kiosk-K2 | Floor mounted, with doors | Normal power | 6 | 57 |
| DB-1E | Flush, with door | Standby Power | 6 | 13 |
| DB-2E | Flush, with door | Standby Power | 6 | 26 |
| DB-PL | Floor mounted, with doors | Standby Power | 6 | 1,2 |
| DB-1-K1 | Flush, with door | Normal power | 6 | 10 |
| DB-2-K1 | Flush, with door | Normal power | 6 | 10 |
| DB-3-K1 | Flush, with door | Normal power | 6 | 10 |
| DB-4-K1 | Flush, with door | Normal power | 6 | 10 |
| DB-5-K1 | Flush, with door | Normal power | 6 | 10 |
| DB-1-K2 | Flush, with door | Normal power | 6 | 10 |
| DB-2-K2 | Flush, with door | Normal power | 6 | 10 |
| DB-3-K2 | Flush, with door | Normal power | 6 | 10 |
| DB-4-K2 | Flush, with door | Normal power | 6 | 10 |
| DB-5-K2 | Flush, with door | Normal power | 6 | 10 |

### 19.1.2.22. Summary of Switchgear and Circuits

The indicated fault current rating (kA) is the minimum value that the switchgear must comply with for connecting to the busbars of the respective panels-distribution boards.

**MAIN LV BOARD : MDB**

PANEL - 1 : NORMAL POWER

| | | |
|---|---|---|
| Main switch | : | 250A three pole 10kA Isolator |
| Power Factor Correction | : | 250A three pole 10kA circuit breaker |
| DB-1 | : | 150A three pole 10kA circuit breaker |
| DB-2 | : | 32A two pole 10kA circuit breaker |
| DB-3 | : | 40A two pole 10kA circuit breaker |
| Local Feeder Panel - 3 | : | 40A two pole 10kA circuit breaker |
| Kiosk K1 | : | 80A three pole 10kA circuit breaker |
| Kiosk K2 | : | 80A three pole 10kA circuit breaker |
| 80kVA Standby plant | : | 120A three pole 10kA circuit breaker |
| Surge Arrestors | : | 10kA three pole + Neutral |

PANEL - 2 : NORMAL POWER

| | | |
|---|---|---|
| Local Main switch | : | 250A three pole 10kA Isolator |
| Power Factor Correction | : | 150kVAr Power Factor Correction Unit |

PANEL- 3 : NORMAL POWER

| | | |
|---|---|---|
| Local main switch | : | 60A two pole isolator |
| Socket Circuits P1 to P2 | : | 1 x 63A one pole 6kA circuit breakers supplying,<br>1 x 63A two pole 30mA single-phase earth leakage relays,<br>and 2 x 20A Single pole 6kA circuit breakers |

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| P1 | 1-4 | Duo SSO | 2 | 1000 | 2000 | Flush wall mounted, 0,4m above floor |
| | 5 | Single SSO in Weatherproof enclosure | 1 | 500 | 500 | Surface wall mounted, 1,2m above floor |
| P2 | 1-6 | Duo SSO | 3 | 1000 | 3000 | Flush wall mounted, 0,4m above floor |

PANEL - 4 : STANDBY POWER

| | | |
|---|---|---|
| Local main switch | : | 150A three pole 10kA Isolator |
| 2 x 40kVA Inverters | : | 120A three pole 10kA circuit breaker |
| DB-E3 | : | 63A three pole 10kA circuit breaker |
| DB-1E | : | 40A three pole 10kA circuit breaker |
| DB-2E | : | 40A three pole 10kA circuit breaker |
| DB-E2 | : | 32A two pole 10kA circuit breaker |
| DB-PL | : | 20A two pole 10kA circuit breaker |
| DB-E1 | : | 20A two pole 10kA circuit breaker |
| Borehole Pump | : | 20A two pole 10kA circuit breaker |
| Gate Motor | : | 20A two pole 10kA circuit breaker |

Lighting circuits L1 to L4 : 4 x 10A one pole 6kA circuit breakers
**PEC Circuit :** 1 x 6A one pole 6kA circuit breaker feeding PEC Controlling 1 x two pole contactor with 230V coil
Surge Arrestors : 10kA three pole + Neutral

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1-5 | Type B1 | 5 | 16 | 80 | Wall mounted 2,8m above floor level |
| L2 | 1-4 | Type F1, F1E | 4 | 52 | 208 | Ceiling mounted, additional live to emergency battery backup fittings |
| L3 | 1-2 | Type B1 | 2 | 16 | 32 | Wall mounted 2,8m above floor level |
| L4 | 1-3 | Type B1 | 3 | 16 | 48 | Wall mounted 2,8m above floor level |
| | 4 | Type F1 | 1 | 52 | 52 | Ceiling mounted |

**DISTRIBUTION BOARD : DB1 / DB1E**

PANEL - DB1 : NORMAL POWER
Main switch : 150A three pole 10kA Isolator
Socket Circuits P1 to P20 : 5 x 63A one pole 6kA circuit breakers supplying, 5 x 63A two pole 30mA single-phase earth leakage relays, and 20 x 20A one pole 6kA circuit breakers
A/C Circuits PP1, PP3 to PP6, PP10, PP14 to PP15 : 8 x 32A one pole 6kA circuit breakers
A/C Circuits PP2 & PP8 : 2 x 20A one pole 6kA circuit breakers
Hydro boil circuits PP12 & PP17 : 2 x 20A one pole 6kA circuit breakers
Extractor Fan Circuits PP7 PP9, PP11 & PP16 : 4 x 10A one pole 6kA circuit breakers
Surge Arrestors : 10kA three pole + Neutral

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| P1 | 1-3 | Single SSO on P/S | 3 | 500 | 1500 | Mounted on Power Skirting at floor level |
| P2 | 1-3 | Single SSO on P/S | 3 | 500 | 1500 | Mounted on Power Skirting at floor level |
| P3 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 0,4m above floor |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3-4 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 0,4m above floor |
| P4 | 1-3 | Single SSO on P/S | 3 | 500 | 1500 | Mounted on Power Skirting at floor level |
| | 4 | Single SSO | 1 | 500 | 500 | Flush wall mounted, 0,4m above floor |
| P5 | 1-2 | Single SSO on P/S | 2 | 500 | 1000 | Mounted on Power Skirting at floor level |
| P6 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 0,4m above floor |
| | 3-4 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 0,4m above floor |
| P7 | 1-2 | Single SSO on P/S | 2 | 500 | 1000 | Mounted on Power Skirting at floor level |
| P8 | 1-3 | Single SSO on P/S | 3 | 500 | 1500 | Mounted on Power Skirting at floor level |
| P9 | 1-3 | Single SSO | 3 | 500 | 1500 | Flush wall mounted, 0,4m above floor |
| P10 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 0,4m above floor |
| | 3-4 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 0,4m above floor |
| P11 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 0,4m above floor |
| | 3-4 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 0,4m above floor |
| P12 | 1-2 | Single SSO on P/S | 2 | 500 | 1000 | Mounted on Power Skirting at floor level |
| P13 | 1-4 | Single SSO on P/S | 4 | 500 | 2000 | Mounted on Power Skirting at floor level |
| P14 | | | | | | |
| P15 | 1-6 | Duo SSO | 3 | 1000 | 3000 | Flush wall mounted, 0,4m above floor |
| | 7 | Single SSO | 1 | 500 | 500 | Flush wall mounted, 0,4m above floor |
| P16 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 0,4m above floor |
| | 3-4 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 0,4m above floor |
| P17 | 1-4 | Single SSO on P/S | 4 | 500 | 2000 | Mounted on Power Skirting at floor level |
| P18 | 1-2 | Single SSO on P/S | 2 | 500 | 1000 | Mounted on Power Skirting at floor level |
| P19 | 1-6 | Duo SSO | 3 | 1000 | 3000 | Flush wall mounted, 0,4m above floor |
| P20 | 1-6 | Duo SSO | 3 | 1000 | 3000 | Flush wall mounted, 0,4m above floor |
| | 7 | Single SSO | 1 | 500 | 500 | Flush wall mounted, 0,4m above floor |

PANEL – DB1E : STANDBY POWER

Local main switch : 63A three pole 6kA Isolator

Lighting circuits L1 to L9 : 9 x 10A one pole 6kA circuit breakers

**PEC Circuit :** 1 x 6A one pole 6kA circuit breaker feeding PEC Controlling 1 x two pole contactor with 230V coil

Socket Circuits PE1 to PE10 : 3 x 63A one pole 6kA circuit breakers supplying, 10 x 20A one pole 6kA circuit breakers

Surge Arrestors : 10kA three pole + Neutral

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1-7 | Type B1 | 7 | 16 | 112 | Wall mounted 2,8m above floor level. PEC controlled circuit |
| L2 | 1-10 | Type A1, A1E | 10 | 30 | 300 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| | 11-14 | Type A2 | 4 | 30 | 120 | Surface ceiling mounted |
| L3 | 1-4 | Type A1, A1E | 4 | 30 | 120 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. Occupancy sensor-controlled circuit |
| | 5-18 | Type B2, B2E | 13 | 9 | 117 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. Occupancy sensor-controlled circuit |
| | 19-22 | Type F1, F1E | 5 | 52 | 260 | Ceiling mounted, additional live to emergency battery backup fittings |
| L4 | 1-2 | Type A2 | 2 | 30 | 60 | Surface ceiling mounted |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3-6 | Type B2, B2E | 4 | 9 | 36 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. Occupancy sensor-controlled circuit |
| | 7-8 | Type B3 | 3 | 26 | 78 | Ceiling mounted |
| | 9 | Type F1 | 1 | 52 | 52 | Ceiling mounted |
| L5 | 1-10 | Type B2, B2E | 10 | 9 | 90 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. Occupancy sensor-controlled circuit |
| | 11-12 | Type F1E | 2 | 52 | 104 | Ceiling mounted, additional live to emergency battery backup fittings |
| L6 | 1-4 | Type A1, A1E | 4 | 30 | 120 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| | 5-15 | Type B2, B2E | 11 | 9 | 99 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| | 16-17 | Type A2 | 2 | 30 | 60 | Surface ceiling mounted |
| L7 | 1-4 | Type A1, A1E | 4 | 30 | 120 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| L8 | 1-7 | Type B1 | 7 | 16 | 112 | Wall mounted 2,8m above floor level. PEC controlled circuit |

| | | | | | | |
|---|---|---|---|---|---|---|
| L9 | 1-5 | Type A1, A1E | 5 | 30 | 150 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| | 6 | Type B2 | 1 | 9 | 9 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| PE1 | 1-3 | Dedicated Single SSO on P/S | 3 | 250 | 750 | Mounted on Power Skirting at floor level |
| PE2 | 1-3 | Dedicated Single SSO on P/S | 3 | 250 | 750 | Mounted on Power Skirting at floor level |
| PE3 | 1-3 | Dedicated Single SSO on P/S | 3 | 250 | 750 | Mounted on Power Skirting at floor level |
| PE4 | 1-2 | Dedicated Single SSO on P/S | 2 | 250 | 500 | Mounted on Power Skirting at floor level |
| PE5 | 1-3 | Dedicated Single SSO on P/S | 3 | 250 | 750 | Mounted on Power Skirting at floor level |
| PE6 | 1-2 | Dedicated Single SSO on P/S | 2 | 250 | 500 | Mounted on Power Skirting at floor level |
| PE7 | 1-4 | Dedicated Single SSO on P/S | 4 | 250 | 1000 | Mounted on Power Skirting at floor level |
| PE8 | 1-4 | Dedicated Single SSO on P/S | 4 | 250 | 1000 | Mounted on Power Skirting at floor level |
| PE9 | 1-2 | Dedicated Single SSO on P/S | 2 | 250 | 500 | Mounted on Power Skirting at floor level |
| PE10 | 1-2 | Dedicated Single SSO on P/S | 2 | 250 | 500 | Mounted on Power Skirting at floor level |

**DISTRIBUTION BOARD : DB2 / DB2E**

PANEL – DB2 : NORMAL POWER

Main switch : 63A two pole 6kA Isolator

Socket Circuits P1 to P2 : 1 x 63A one pole 6kA circuit breaker supplying,

1 x 63A two pole 30mA single-phase earth leakage relay,
and 2 x 20A one pole 6kA circuit breakers

Geyser Circuit PP5 : 1 x 20A two pole 6kA circuit breaker
Extractor Fan Circuits PP3 : 1 x 10A one pole 6kA circuit breaker
Surge Arrestors : 10kA one pole + Neutral

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| P1 | 1-3 | Single SSO on P/S | 3 | 500 | 1500 | Mounted on Power Skirting at floor level |
| P2 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 0,4m above floor |

PANEL – DB2E : STANDBY POWER
Local main switch : 63A three pole 6kA Isolator
Lighting circuit L1 : 1 x 10A single pole 6kA circuit breaker
Socket Circuits PE1 : 1 x 20A Single pole 6kA circuit breaker
A/C Circuits PP1 & PP2 : 2 x 32A one pole 6kA circuit breakers
Welding Socket PP4 : 1 x 32A three pole 6kA circuit breaker
Surge Arrestors : 10kA three pole + Neutral

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1-3 | Type A1, A1E | 3 | 30 | 90 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top |
| | 4-7 | Type B2, B2E | 13 | 9 | 117 | Recessed ceiling mounted, additional live to emergency battery backup fittings. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. Occupancy sensor-controlled circuit |
| | 8 | Type F1 | 1 | 52 | 52 | Ceiling mounted |
| PE1 | 1-3 | Dedicated Single SSO on P/S | 3 | 250 | 750 | Mounted on Power Skirting at floor level |

**DISTRIBUTION BOARD : DB3**

PANEL – DB3 : NORMAL POWER

| | | |
|---|---|---|
| Main switch | : | 30A two pole 6kA Isolator |
| Lighting circuits L1 to L3 | : | 3 x 10A one pole 6kA circuit breakers |
| **PEC Circuit** | **:** | 1 x 6A one pole 6kA circuit breaker feeding PEC Controlling 1 x two pole contactor with 230V coil |
| Socket Circuits P1 to P2 | : | 1 x 63A one pole 6kA circuit breaker supplying, 1 x 63A two pole 30mA single-phase earth leakage relay, and 2 x 20A one pole 6kA circuit breakers |
| Geyser Circuit PP2 | : | 1 x 20A two pole 6kA circuit breaker |
| Extractor Fan Circuit PP1 | : | 1 x 10A one pole 6kA circuit breaker |
| Surge Arrestors | : | 10kA one pole + Neutral |

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1-5 | Type B1 | 5 | 16 | 80 | Wall mounted 2,8m above floor level. PEC controlled circuit |
| L2 | 1-4 | Type F1 | 4 | 52 | 208 | Ceiling mounted. PEC controlled circuit |
| L3 | 1-4 | Type B2 | 4 | 9 | 36 | Recessed ceiling mounted. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. Occupancy sensor-controlled circuit |
| P1 | 1-2 | Single SSO | 2 | 500 | 1000 | Flush wall mounted, 1,2m above floor |
| | 3-4 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 1,2m above floor |
| P2 | 1-2 | Single SSO in Weatherproof enclosure | 2 | 500 | 1000 | Surface wall mounted, 1,2m above floor |

**KIOSK : DBPL**

PANEL – DBPL : STANDBY POWER

| | | |
|---|---|---|
| Main switch | : | 30A two pole 6kA Isolator |
| Lighting circuits L1 to L3 | : | 3 x 10A one pole 6kA circuit breakers |
| **PEC Circuit** | **:** | 1 x 6A one pole 6kA circuit breaker feeding PEC Controlling 1 x three pole contactor with 230V coil |
| Surge Arrestors | : | 10kA one pole + Neutral |

| CIRCUIT | FITTING | TYPE OF | QTY | LOAD | LOAD | MOUNTING |
|---|---|---|---|---|---|---|

| NO. | NO. | FITTING | | EACH (W) | TOTAL (W) | |
|---|---|---|---|---|---|---|
| L1 | 1-15 | Type G2 | 15 | 38 | 570 | Mounted on 4m Fibreglass pole. PEC controlled circuit |
| L2 | 1-17 | Type G | 17 | 31 | 527 | Mounted on 4m Fibreglass pole. PEC controlled circuit |
| L3 | 1-3 | Type G | 3 | 31 | 93 | Mounted on 4m Fibreglass pole. PEC controlled circuit |
| | 4 | Type G1 | 1 | 22 | 22 | Mounted on 4m Fibreglass pole. PEC controlled circuit |

**KIOSK : K1**

PANEL – K1 : NORMAL POWER

| | | |
|---|---|---|
| Main switch | : | 80A three pole 6kA Isolator |
| Lighting circuits L1 to L2 | : | 2 x 10A one pole 6kA circuit breakers |
| **PEC Circuit** | **:** | 1 x 6A one pole 6kA circuit breaker feeding PEC Controlling 1 x two pole contactor with 230V coil |
| Socket Circuits P1 to P2 | : | 1 x 63A one pole 6kA circuit breaker supplying, 1 x 63A two pole 30mA single-phase earth leakage relay, and 1 x 20A one pole 6kA circuit breaker |
| Heat Pump | : | 1 x 32A two pole 6KA circuit breaker |
| Feed to DB-1-K1 to DB-5-K1 | : | 5 x 45A one pole 6kA circuit breakers |
| Surge Arrestors | : | 10kA three pole + Neutral |

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1-2 | Type B1 | 2 | 16 | 32 | Wall mounted 2,8m above floor level. PEC controlled circuit |
| | 3-7 | Type F1, F1E | 5 | 52 | 260 | Ceiling mounted, additional live to emergency battery backup fittings. PEC controlled circuit |
| L2 | 1-9 | Type F1, F1E | 5 | 52 | 260 | Ceiling mounted, additional live to emergency battery backup fittings. PEC controlled circuit |
| P1 | 1-3 | Duo SSO in Weatherproof | 3 | 1000 | 3000 | Surface wall mounted, 1,2m above floor |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | enclosure | | | | |

**KIOSK : K2**

PANEL – K2 : NORMAL POWER

| | | |
|---|---|---|
| Main switch | : | 80A three pole 6kA Isolator |
| Lighting circuits L1 | : | 1 x 10A one pole 6kA circuit breakers |
| **PEC Circuit** | **:** | 1 x 6A one pole 6kA circuit breaker feeding PEC Controlling 1 x two pole contactor with 230V coil |
| Heat Pump | : | 1 x 32A two pole 6KA circuit breaker |
| Feed to DB-1-K2 to DB-5-K2 | : | 5 x 45A one pole 6kA circuit breakers |
| Surge Arrestors | : | 10kA three pole + Neutral |

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1-2 | Type B1 | 2 | 16 | 32 | Wall mounted 2,8m above floor level. PEC controlled circuit |
| | 3-7 | Type F1, F1E | 5 | 52 | 260 | Ceiling mounted, additional live to emergency battery backup fittings. PEC controlled circuit |
| L2 | 1-9 | Type F1, F1E | 5 | 52 | 260 | Ceiling mounted, additional live to emergency battery backup fittings. PEC controlled circuit |
| P1 | 1-3 | Duo SSO in Weatherproof enclosure | 3 | 1000 | 3000 | Surface wall mounted, 1,2m above floor |

**DISTRIBUTION BOARDS : DB-1-K1 to DB-5-K1 and DB-1-K2 to DB-5-k2 (x 10)**

PANEL – DB : NORMAL POWER

| | | |
|---|---|---|
| Main switch | : | 60A two pole 6kA Isolator |
| Lighting circuits L1 | : | 1 x 10A one pole 6kA circuit breaker |
| Socket Circuits P1 to P3 | : | 1 x 63A one pole 6kA circuit breaker supplying,<br>1 x 63A two pole 30mA single-phase earth leakage relay,<br>and 3 x 20A one pole 6kA circuit breakers |
| Stove Circuit PP3 | : | 1 x 32A one pole 6kA circuit breaker |
| Ceiling Fan cct PP4 to PP5 | : | 2 x 10A one pole 6kA circuit breakers |
| Extractor Fan cct PP1 to PP2: | | 2 x 10A one pole 6kA circuit breakers |
| Surge Arrestors | : | 10kA one pole + Neutral |

| CIRCUIT NO. | FITTING NO. | TYPE OF FITTING | QTY | LOAD EACH (W) | LOAD TOTAL (W) | MOUNTING |
|---|---|---|---|---|---|---|
| L1 | 1 | Type B1 | 1 | 16 | 16 | Surface ceiling mounted. Occupancy sensor-controlled circuit |
| | 2-6 | Type B2 | 5 | 9 | 45 | Recessed ceiling mounted. 5A 3 pin SSO mounted adjacent to luminaire, complete with captyre and 5A plug top. |
| P1 | 1 | Single SSO | 1 | 500 | 500 | Flush wall mounted, 1,2m above floor |
| | 2 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 0,4m above floor |
| P2 | 1 | Single SSO | 1 | 500 | 500 | Flush wall mounted, 0,4m above floor |
| | 2 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 1,2m above floor |
| P3 | 1 | Single SSO | 1 | 500 | 500 | Flush wall mounted, 1,2m above floor |
| | 2 | Duo SSO | 1 | 1000 | 1000 | Flush wall mounted, 1,2m above floor |

### 19.1.3 Part 3 – Quality Specification for Materials and Equipment of Electrical Installations

LED LIGHTS

All Light fittings installed for this project is to be of the LED type, unless otherwise stated.

The following international standard specifications and South-African Bureau of Standards shall apply to the LED luminaire specification:

| | |
|---|---|
| SANS 475 | Luminaires for interior lighting, street lighting and floodlighting – Performance and requirements |
| SANS 10114-1 | Interior lighting part 1: Artificial lighting of interiors |
| SANS 10114-2 | Interior lighting part 2: Emergency lighting |
| SANS 60598-1 | Luminaires part 1: General requirements and tests |
| SANS 60598-2.1 | Luminaires part 2: Particular requirements section 1 – Fixed general purpose luminaires. |
| SANS 60598-2.2 | Luminaires part 2: Particular requirements section 2 – Recessed luminaires. |
| SANS 60598-2.3 | Luminaires part 2: Particular requirements section 3 – Luminaires for road and street lighting. |
| SANS 60598-2.5 | Luminaires part 2: Particular requirements section 5 – Flood lighting. |
| SANS 61347-1 to 13 | Lamp control gear |
| SANS 62031 | LED modules for general lighting – Safety specifications |
| SANS 62384 | DC or AC supplied electronic control gear for LED modules – Performance requirements. |
| SANS 62560 | Self-ballasted LED lamps for general lighting services with supply voltages > 50V – Safety specification. |
| SANS 62612 | Self-ballasted LED lamps for general lighting services with supply voltages > 50V – Performance requirements |
| EN 55015 | Limits and methods of measurement of radio disturbance of electrical lighting or equipment. |
| EN 61000-3.2 | Electromagnetic compatibility (EMC) limits for harmonic current emissions. |
| EN 61000-3.3 | Electromagnetic compatibility (EMC) limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems. |
| EN 61547 | Equipment for general lighting purposes: EMC immunity requirements. |
| IEC-EN 62471 | Photo biological safety of lamps and lamp systems for LEDs |
| IES LM-79-08 | Approved method: Electrical and photometric measurement of solid-state lighting products. |
| IES LM-80 | Approved method: Measuring lumen maintenance of LED light sources. |

General requirements:

The luminaire shall be suitable for operation with mid-power LEDs. Note that no LED tubes are allowed to be used.

The luminaire shall be suitable for operation on a 230V single phase 50Hz mains supply.

Power factor capacitors shall be supplied to correct the power factor to at least 0.95 of higher.

The luminaire shall be marked with identification labels stating the brand name and model and shall bear the SANS approval mark.

The driver shall comply with IEC 61347-1 and IEC 61347-2B as applicable and shall be suitable for operation on 230V +-10%, 50Hz single phase system and it must be insured that harmonics filter is provided as per SANS 61000-3-2. The drivers and LED circuitry shall be protected against lighting and power surges. Suitable surge arrestors with a 10kA rating shall be provided for indoor installations and 20kA for outdoor installations.

Colour rendering (Ra) shall be not less than 80 and lumen depreciation of not more than 30% L70 at 50 000 hours @ Tq 25°C. Colour temperature of the LED lamp shall be 4000K, unless otherwise stated.

Thermal requirements:

The luminaire must be able to withstand an ambient temperature of 35°C. Storage temperature of this luminaire should be able to handle -40°C < T < 60°C.

To this end internal electrical and mechanical components shall not be allowed to exceed their maximum temperature ratings of 75°C. Test reports from an independent authorised testing facility proving this requirement shall be made available on request.

Noise requirements:

The noise level emitted from the luminaire shall be kept as low as possible. Drivers/electronic components shall therefore fully comply with the latest edition of SANS 55015.

### 19.1.4 Part 4 – Electrical Work Material Schedule

The Contractor shall complete the following schedules and submit them to the Electrical Engineer within 21 days of the date of the acceptance of the tender.

The schedules will be scrutinised by the Electrical Engineer and should any material offered not comply with the requirements contained in the specification, the Contractor will be required to supply material in accordance with the contract at no additional cost.

**NB:** **Only one manufacturer's name to be inserted for each item.**

| Item | Material | Make or trade name | Country of origin |
|---|---|---|---|
| 1. | Distribution boards | | |
| 2. | Circuit breakers 1P, 2P, 3P | | |
| 3. | On load isolators without trips | | |
| 4. | Contactors 1P, 2P, 3P | | |
| 5. | Earth leakage relays 1 & 3 phase | | |
| 6. | H.R.C. fuse switches | | |
| 7. | Kilowatt hour meter | | |
| 8. | Current transformers | | |
| 9. | Voltmeter | | |
| 10. | Maximum demand ammeter | | |
| 11. | Daylight sensitive switch | | |
| 12. | Conduit | | |
| 13. | Conduit boxes | | |
| 14. | Power skirting | | |
| 15. | Surface switches | | |
| 16. | Watertight switches | | |
| 17. | 16A flush socket outlets | | |
| 18. | 16A surface socket outlets | | |
| 19. | 16A watertight socket outlets | | |
| 20. | 16A watertight socket outlets | | |
| 21. | LED luminaires | | |
| | Type A1 | | |
| | Type A1E | | |
| | Type A2 | | |
| | Type A2E | | |
| | Type B1 | | |
| | Type B2 | | |
| | Type B2E | | |
| | Type F1 | | |
| | Type F1E | | |
| 22. | Pole top fittings: | | |
| | Type G | | |
| **Item** | **Material** | **Make or trade name** | **Country of origin** |
| | Type G1 | | |

| | | | |
|---|---|---|---|
| | Type G2 | | |
| 23. | PVC/SWA ECC/PVC cable | | |
| 24. | Cable trays | | |
| 25. | Wiring Channel | | |

### 19.1.5 Part 5 – Particulars of Electrical Contractor

DPW -22(EC) Particulars of electrical contractor is recorded in main tender document.

### 19.1.6 Part 6 – Drawings

The following drawings form part of this Specification documentation:

**Single Line Diagram Drawings**

| | | |
|---|---|---|
| NCE 23003-SLD-01 | Single Line Diagram – Main LV Panel & Change Over Panel Block C - Power Management (A1) | |
| NCE 23003-SLD-02 | Single Line Diagram – Typical Unit DB (x10) & Perimeter Lighting DB Block D1 & D2 and Site (A3) | |
| NCE 23003-SLD-03 | Single Line Diagram – DB 1/DB 1E | Block A – Passage (A2) |
| NCE 23003-SLD-04 | Single Line Diagram – DB 2/DB 2E | Block A – Server Room (A2) |
| NCE 23003-SLD-05 | Single Line Diagram – DB 3 | Block B – Cleaner Room (A2) |
| NCE 23003-SLD-06 | Single Line Diagram – Kiosk K1 | Block D1 (A2) |
| NCE 23003-SLD-07 | Single Line Diagram – Kiosk K2 | Block D2 (A2) |

**Layout Drawings**

| | |
|---|---|
| NCE 23003-EE-01 | Community Centre & Barracks Ground Floor - Sleeve Layout (A0) |
| NCE 23003-EE-02 | Site Conceptual Plan – Perimeter Lighting Layout (A0) |
| NCE 23003-EE-03 | Community Centre & Barracks Ground Floor - Power Layout (A0) |
| NCE 23003-EE-04 | Community Centre & Barracks Ground Floor – HVAC Power Layout Layout (A0) |
| NCE 23003-EE-05 | Community Centre & Barracks Ground Floor - Lighting Layout (A0) |
| NCE 23003-EE-06 | Community Centre & Barracks Ground Floor – Wireways & Trunking Layout (A0) |
| NCE 23003-EE-07 | Community Centre & Barracks Ground Floor – Earthing & Lightning Protection Layout (A0) |
| NCE 23003-EE-08 | Community Centre & Barracks Ground Floor – CCTV & Wireways Layout (A0) |

| | |
|---|---|
| NCE 23003-EE-09 | Community Centre & Barracks Ground Floor – Access Control & Wireways Layout (A0) |
| NCE 23003-EE-10 | Roof Plan - Solar PV Panel Layout (A0) |

## 19.2 Outdoor Standby Generator Installation

### 19.2.1 Part 1 – General

#### 19.2.1.1 Intent of Specification

The specification is intended to cover the complete installation and commissioning of the generator plant. The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

For the purposes of this document the following applies:

- Generator Contractor shall be referred to as the Generator Contractor or simply Contractor.
- The masculine includes the feminine.
- The singular includes the plural.

#### 19.2.1.2 Standards and Codes

All standards referenced shall be the latest editions.

| | |
|---|---|
| SANS 10142-1 | the wiring of premises: Low Voltage Installations |
| SANS 8528 | Reciprocating internal combustion engine driven alternating current generating sets. |
| SANS 60034 | Rotating electrical Machines |
| SANS IEC 60947 | Low Voltage Switchgear |
| OHSACT | Occupational Health and Safety Act. |

Department of Public Works Quality Specification Parts A, B and C.

Local municipality by-laws for generator installations. (To be obtained from local municipality)

#### 19.2.1.3 Compliance with Regulations

The installation shall be erected and tested in accordance with the following Acts and regulations:

- The Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended,
- The Local Government Ordinance 1939 (Ordinance 17 of 1939) as amended and the municipal by-laws and any special requirements of the local supply authority,
- The Fire Brigade services Act 1987 (Act 99 of 1987) as amended,
- The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as emended,
- The Electricity Act 1984 (Act 41 of 1984) as amended.
- The environmental Act and regulations

#### 19.2.1.4 Scope of Work

Included in this Outdoor Generator Specification

Supply, delivery, installation and commissioning of the complete outdoor emergency generator inside an IP65 canopy/container set on a concrete plinth as specified in this document.

The successful tenderer shall supply, deliver and install a complete single enclosed diesel driven standby generator set in a position that will be determined on site. The machine shall be totally enclosed in a 3CR12 stainless steel housing powder coated or within 50km from the coast with grade 316 steel housing powder coated. The exhaust shall be manufactured from stainless steel.

The housing is to be provided on galvanized 3CR12 stainless steel skids so that the generator set can be transported to site and placed in position on a concrete plinth, casted by the successful tenderer. The skids must be of sufficient height to allow for the passage of storm water under the set.

#### 19.2.1.5 Co-ordinating

The Contractor shall familiarise himself with the requirements of the other professional disciplines and shall examine the plans and specifications covering each of these sections.

The generator space, noise and vibration requirements shall be carefully checked with other professional disciplines to ensure that the equipment can be installed in the proper sequence in the space allotted.

#### 19.2.1.6 Tests Certificates and Inspections

The following tests are to be carried out:

- At the supplier's premises, before the generating set will be delivered to site Representatives of the Department must be present during the test to satisfy themselves that the generating set complies with the specification and delivers the specified output. The test must be carried out in accordance with SANS 8528. The Representative/Agent must be timeously advised of the date for the test.
- After completion of the works and before practical completion is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installation will be inspected, and the contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.
- The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installation at completion.
- Test reports of both tests as specified under (a) and (b) are to be submitted to the Representative/Agent.

The total costs for these tests shall be included in the tendered amount.

In the event of the plant, equipment or installation not passing the test, the Representative/Agent shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer and/or the Representative/Agent attending the test.

#### 19.2.1.7 Operating and Maintenance Manuals

The Contractor shall be responsible for the compilation of a complete set of Operating and Maintenance manuals.

This shall be done in accordance with Section 4 – Operating and Maintenance manuals.

All information shall be recorded and reproduced in electronic format as well as supplying the Representative/Agent with three sets of hard copies.

Approval of the final Operating and Maintenance Manuals shall be a prerequisite for issuing of a Certificate of Practical Completion of the installation.

#### 19.2.1.8 Guarantee

After works completion of the installation have been achieved, there will follow a 12-month free maintenance period.

During this period the generator contractor shall maintain the generator installation as per the requirements of the Occupational Health and Safety Act. This maintenance shall include systematic examinations, adjustments and lubrication of all generator equipment. Electrical and mechanical parts shall be repaired or replaced whenever it is required to maintain optimum performance without additional cost to the Department, unless the condition was caused by misuse or vandalism of the generator equipment or natural hazards/force majeure.

The work under this section shall be performed by competent, qualified accredited personnel under the supervision and in the direct employment of the Generator Contractor and shall not be transferred to any non-affiliated agent. Contract maintenance and repair work shall be done during normal working hours and shall further provide emergency call-back service twenty-four (24) hours a day, seven (7) days a week.

During the guarantee/maintenance period the Department will invite tenders for the comprehensive maintenance of the generator, which will commence after the final completion has taken place, i.e. after the twelfth month guarantee period is over and all defects are corrected.

#### 19.2.1.9 Materials and Workmanship

- The work throughout shall be executed to the highest standards and to the entire satisfaction of the Representative/Agent who shall interpret the meaning of the Contract Document and shall have the authority to reject any work and materials, which, in his judgement, are not in full accordance therewith. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Representative/Agent.
- All work shall be executed in a first-class manner by qualified accredited tradesman.
- The Contractor shall be fully responsible for his work and shall replace any of the work which may be damaged, lost or stolen. The Contractor shall protect the building and its contents against damage by him, his employees or sub-contractors and shall make good any damage thereto.
- The Contractor shall indemnify the Employer of all liability for damages arising from injuries or disabilities to persons or damage to property occasioned by any act or omission of the Contractor or any of his sub-contractors, including any and all expenses, legal or otherwise,

which may be incurred by the Employer or Representative/Agent in the defence of any claim, action or suit.

- The Contractor shall warrant that the materials and workmanship shall be of the highest grade, that the equipment shall be installed in a practical and first-class manner in accordance with the best practices and ready and complete for full operation. It is specifically intended that all material or labour which is usually provided as part of such equipment as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether or not shown or described in the Contract Document.
- The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation and commissioning work. The Contractor shall also be prepared to promptly furnish any information relating to his own work as may be necessary for the proper installation work and shall co-operate with and co-ordinate the work of others as may be applicable.
- The Contractor shall inspect and verify that the existing power feeder system is compatible with the equipment offered and any changes or upgrading of the electrical supply shall be brought to the attention of the Representative/Agent.
- Material and equipment damaged in transit shall be replaced with undamaged material without additional cost to the Department.
- All components and their respective adjustment, which do not form part of the equipment installation work but influence the optimum and safe operation of the equipment shall be considered to form part of and shall be included in the Contractor's scope of works.
- All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.
- The Contractor shall make sure that all safety regulations and measures and environmental regulations are applied and enforced during the installation and guarantee period to ensure the safety of the public and the User Client.

#### 19.2.1.10 Brochures

Detailed brochures of all equipment offered shall be presented together with the tender documents.

## 19.2.2 Part 2 – Equipment Requirements

### 19.2.2.1 Engine

19.2.2.1.1 General

The engine must comply with the requirements laid down in SANS 8528 and must be of the atomized injection, compression ignition type, running at a speed not exceeding 1500 r.p.m. The engine must be amply rated for the required electrical output of the set, when running under the site conditions. The starting period for either manual or automatic switching-on until the taking over by the generating set, in one step of a load equal to the specified site electrical output, shall not exceed 15 seconds. This must be guaranteed by the Tenderer.

Turbo-charged engines will only be accepted if the Tenderer submits a written guarantee that the engine can deliver full load within the specified starting period.

Curves furnished by the engine makers, showing the output of the engine offered against the speed, for both intermittent and continuous operation as well a fuel consumption curves when the engine is used for electric generation, must be submitted with the Tender.

19.2.2.1.2 Rating

The set shall be capable of delivering the specified output continuously under the site Conditions, without overheating. The engine shall be capable of delivering an output of 110% of the specified output for one hour in any period of 12 hours consecutive running in accordance with SANS 8528.

19.2.2.1.3 De-Rating

The engine must be de-rated for the site conditions as set out in the Technical Specification, Section 3 of this document.

The de-rating of the engine for site conditions shall be strictly in accordance with SANS 8528 as amended to date. Any other methods of de-rating must have the approval of the Department and must be motivated in detail. Such de-rating must be guaranteed in writing and proved by the successful Tenderer at the site test.

19.2.2.1.4 Starting and Stopping

The engine shall be fitted with an electric starter motor and be easily started from cold, without the use of any special ignition devices under summer as well as winter conditions.

Tenderers must state what arrangements are provided to ensure easy starting in cold weather. Full details of this equipment must be submitted. In the case of water-cooled engines, any electrical heaters shall be thermostatically controlled. The

electrical circuit for such heaters shall be taken from the control panel and must be protected by a suitable circuit breaker.

19.2.2.1.5 Starter Battery

The set must be supplied a fully charged lead-acid type or maintenance free type battery, complete with necessary electrolyte. The battery must have sufficient capacity to provide the starting torque stipulated by the engine manufacturer. The battery capacity shall not be less than 120 Ah and shall be capable of providing three consecutive start attempts from cold and thereafter a fourth attempt under manual control of not less than 20 seconds duration each. The battery must be of the heavy duty “low maintenance” type, house in a suitable battery box.

19.2.2.1.6 Cooling

The engine may be either of the air- or water-cooled type. In the case of water-cooling, a built-on heavy duty, tropical type pressurised radiator must be fitted. Only stand-by sets that are water cooled shall have electric heaters.

For either method of cooling, protection must be provided against running at excessive temperatures. The operation of this protective device must give a visual and audible indication on the switchboard. Water-cooled engines shall in addition be fitted with a low water cut-out switch, installed in the radiator, to switch the set off in the event of a loss of coolant. The protection shall operate in the same way as the other cut-outs (e.g. low oil pressure). All air ducts for the cooling of the engine are to be allowed for. The air shall be supplied from the cooling fan cowling/radiator face to air outlet louvers in the enclosure.

19.2.2.1.7 Lubrication

Lubrication of the main bearings and other important moving parts shall be by forced feed system. An automatic low oil pressure cut-out must be fitted, operating the stop solenoid on the engine and giving a visible and audible indication on the switchboard.

19.2.2.1.8 Fuel Pump

The fuel injection equipment is suitable for operation with the commercial brands of diesel fuel normally available in South Africa.

19.2.2.1.9 Fuel Tank

The fuel tank shall be an integral part of the base frame of the generator set. The tank shall have sufficient capacity for standby sets to run the engine on full load for a period of 24 hours.

The diesel fuel storage system / tank which will be provided with the standby generator installation must be fitted with a fuel filtration and water separation system (filter & separator) which is entirely separate from the fuel supply line and line filter to the engine. This filtration and water separation system must be dedicated to

purifying the content of the storage system / tank by way of the cleaning processes which are applied while circulating the fuel through the filter & separator unit.

The filtration system must be able to handle diesel fuel of “high” and of “low” sulphur content for an indefinite period. The suction line of the system must be connected to the lowest part of the storage system / tank. The return line must be connected in the top section of the storage system / tank in such a position and in such a way that the flow of fuel within the storage system / tank between the fuel return point and the fuel suction point will induce scouring of the bottom of the system / tank to effectively capture sediment and water in the to be filtered fuel.

The filtration unit must filter the diesel fuel, removing suspended particles of effective diameters down to 5 microns. In addition, it must separate all water from the fuel and the fuel storage system and automatically dispose of / dump such water into an open, removable receptacle for disposal at the installation or in a suitable position outside the building. Separation of the fuel and water must be sufficiently effective that the discharged water will meet the standard required for it to be disposed of into a municipal drain and sewer system.

The filter and water separator unit must draw its power from the DC batteries used to power the relevant generator set. The circulating pump shall be provided with a controller programmed to switch the pump through not more than three complete on and off cycles of equal time (i.e. 50% on; 50% off), per hour, with a deviation of not more than 10 % ±. The pump must be capable of a duty cycle of not less than 60% running time. The flow rate through the circulating pump must be between 1 L/min and 1.25 L /min.

The filter cartridge of the filter and water separator unit must be replaceable, and, in normal operational conditions, not require replacement within periods shorter than three months. The replacement units must be readily available.

The filtration & separator system may be mounted against the wall of the plant room or on the inside of a container, which may house the installation as may be specified elsewhere in this document.

The tank shall be fitted with a suitable filter, a full height gauge glass, “low fuel level” alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.

An electrically operated pump with sufficient length of oil-resistant hose to reach 2m beyond the door of the canopy/container, shall be supplied, for each set for filling the fuel tank/s from 200 litre drums.

The interconnection fuel piping shall consist of copper tubes and the connection to vibrating components shall be in flexible tubing with armoured covering.

The contractor shall allow for the supply and installation of a fuel shut off fusible link in the container. The fusible link shall shut off the fuel at a temperature of 130 degrees in an event of a fire in the self-contain enclosure. The fusible link shall be mounted above the engine and coupled to the shut off valve by means of a 2mm stainless steel cable. The cable shall be installed to the shut off valve without any

possibility of kinking the cable which may cause malfunctioning of the protection device.

19.2.2.1.10 Governor

The speed of the engine shall be controlled by a governor in accordance with ECM of SANS 8528 if not otherwise specified in the Detailed Specification.

The permanent speed variation between no load and full load shall not exceed 4.5% of the nominal engine speed and the temporary speed variation shall not exceed 10%. External facilities must be provided on the engine, to adjust the nominal speed setting by ± 5% at all loads between zero and rated load.

19.2.2.1.11 Flywheel

A suitable flywheel must be fitted, so that lights fed from the set will be free from any visible flicker.

The cyclic irregularity of the set must be within the limit laid down in SANS 8528.

19.2.2.1.12 Exhaust Silencer

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of the residential type must be provided and shall be capable of providing 20 to 30 decibels of suppression.

The exhaust system shall consist of 3CR12 steel for inland areas (greater than 50km from the coast) or Grade 304 stainless steel in coastal areas.

The exhaust pipe shall be installed in such a way that the expulsed exhaust fumes will not cause discomfort to the public. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust piping and silencer shall be lagged and then cladded in stainless steel sheet to reduce the heat and noise transmission in the generator enclosure and shall be protected against the ingress of driving rain at 45° to the horizontal. The exhaust pipe must extend 0,5m above the canopy.

19.2.2.1.13 Accessories

The engine must be supplied complete with all accessories, air and oil filters, 3 instruction manuals, spare parts lists, the first fill of all lubricating oils, fuel, etc.

19.2.2.1.14 Exhaust emissions

The exhaust emissions shall comply with US Tier III/EU stage III standards.

### 19.2.2.2 Alternator

19.2.2.2.1 General

The alternator shall be of the self-excited brushless type, with enclosed ventilated drip-proof housing and must be capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in SANS 60034-1 for rotor and stator windings.

The alternator shall be capable of delivering an output of 110% of the specified output, for one hour in any period of 12 hours consecutive running.

Both windings must be fully impregnated for tropical climate and must have an oil resisting finishing varnish.

19.2.2.2.2 Regulation

The alternator must preferably be self-regulated without the utilisation of solid-state elements. The inherent voltage regulation must not exceed plus or minus 5% of the nominal voltage specified, at all loads with the power factor between unity and 0,9 lagging and within the driving speed variations of 4,5% between no-load and full load.

19.2.2.2.3 Performance

The excitation system shall be designed to promote rapid voltage recovery following the sudden application of the load. The voltage shall recover to within 5% of the steady state within 300 milli-seconds following the application of full load and the transient voltage dip shall not exceed 18%.

19.2.2.2.4 Coupling

The engine and alternator must be directly coupled by means of a high-quality flexible coupling, ISO 9001:2000 approved and must be designed and manufactured to this quality system.

### 19.2.2.3 Switchboard

19.2.2.3.1 General

A switchboard must be supplied and installed to incorporate the equipment for the control and protection of the generating set and battery charging.

The switchboard must conform the specification as set out in the following paragraphs.

19.2.2.3.2 Construction

The switchboard shall be enclosed in the steel enclosure.

All equipment, connections and terminals shall be easily accessible from the front. The front panels may be either hinged or removable and fixed with studs and chromium-plated cap nuts. Self-tapping screws shall not be used in the construction of the board.

All pushbuttons, pilot lights, control switches, instrument and control fuses, shall be mounted on hinged panels with the control wires in flexible looms.

The steelwork of the boards must be thoroughly de-rusted, primed with zinc chromate and finished with two coats of signal red quality enamel, or a baked powder epoxy coating.

Suitably rated terminals must be provided for all main circuits and the control and protection circuits. Where cable lugs are used, these shall be crimped onto the cable strands. Screw terminals shall be of the type to prevent spreading of cable strands. All terminals shall be clearly marked.

For the control wiring, each wire shall be fitted with a cable or wire marker of approved type, and numbering of these markers must be shown on the wiring diagram on the switchboard. Control wiring shall be run in PVC trunking. The trunking shall be properly fixed to the switchboard steelwork. Adhesives shall not be acceptable for the fixing of trunking or looms.

The modular generator set controller and protection equipment shall be mounted on a separate easily replaceable panel.

All equipment on the switchboard, such as contactors, isolators, busbars, etc., shall have ample current carrying capacity to handle at least 110% of the alternator full load current.

Access to the cubicle will be such that all components can be conveniently reached for testing and maintenance purposes.

The necessary bushes and a screen over the terminals will be provided where the power feeds enter and leave the cubicle.

The cubicle will be so constructed that the ac and dc components are screened from one another.

19.2.2.3.3 Protection and Alarm Devices

All switchboards shall be equipped with protection and alarm devices as described below.

A circuit breaker and an adjustable current limiting protection relay must be installed for protection of the alternator. The protection relay shall be of the type with inverse

time characteristics. The relay shall cause contactor to isolate the alternator and stop the engine.

Protection must be provided for overload, high engine temperature, low lubricating oil pressure, over speed, start-failure, and low water level.

Reset push buttons are required on the modular generator set controller and a visible signal are required, and the engine must stop when any of the protective devices operate. In the case of manual operation of standby sets, it shall not be possible to restart the engine.

The indication on the modular generator set controller must be in ENGLISH.

"OVERLOAD"
"TEMPERATURE HIGH"
"OIL PRESSURE LOW"
"OVERSPEED"
"START FAILURE"
"LOW WATER LEVEL"

In addition, an audible and visible flashing signal shall be provided, when:

- The fuel level in the service tank is low. The indication on the modular generator set controller shall be "FUEL LOW".
- The battery charger failed. The indication on the modular generator set controller shall be “CHARGER FAIL”

A low-low level sensor must be provided. At this level the engine must stop to prevent air entering the fuel system.

This is also applicable to the engine driven generator/alternator.

All alarm conditions must operate an alarm hooter. A pushbutton must be installed in the hooter circuit to stop the audible signal, but the fault indicating light on the control panel must remain lit until the fault has been rectified.

An on/off switch is not acceptable. After the hooter has been stopped, it must be re-set automatically, ready for a further alarm.

The hooter must be of the continuous duty and low consumption type. Both hooter and protection circuits must operate from the battery.

Potential free contacts from the alarm relay must be brought down to terminals for remote indication of alarm conditions.

A test pushbutton must be provided to test all indicators lamps.

19.2.2.3.4 Modular Generator Set controller

The modular generator set controller shall be an electronic unit to match those of the other modular generator set controllers and of a high quality i.e. Levato, Deep Sea Electronics, Circom. It must be provided with IO and communication facilities.

The modular generator set controller will be supplied with all its functions and shall be mounted on a separate easily replaceable panel with plug in termination blocks for easy installation and replacement.

The modular generator set controller interface will be implemented with relays, contactors etc.

The modular generator set controller will have a mimic display of the alternator/mains/ change over contactors configuration with LED's showing the status of the mains, alternator and change over contractors.

Configuration software shall be supplied with the system. The software will be capable of the following:

- Fault management (event log)
- Configuration management (software upgrades and function changes)
- Account management (energy management)
- Performance management (generator set point changes)
- Security management (passwords)

The modular generator set controller will have a standard RS 232/485 or Ethernet interface suitable for TCP I/P transport medium. All communication including configuration management will be done through this port. Equipment connected at each end of the RS 232 or Ethernet cable shall be adequately protected against transient over-voltages, lightning effects (particularly if the set and remote alarms are in separate buildings), switching surges, power system surges or mains and alternator borne noise/interference.

The controller will incorporate the following functions:

- Mains sensing
- Alternator output-voltage sensing
- Alternator over- frequency sensing
- Control of processor unit (self-diagnostics)
- Alarm/ Status indications
- Control selector and operation
- Phase rotation monitor

A 4- position control selector on the controller will be provided to facilitate the following modes of operation:

- OFF: Diesel/ alternator generator set switched off
- MANUAL: Mains bypassed: Diesel/ alternator will not take load
- AUTO: Diesel /alternator takes load on mains failure
- TEST: Diesel /alternator takes load on mains failure
- A standby failure alarm (SF) will be given on the controller and to the output alarms when "Not in Auto" is selected.

The modular generator set controller must monitor the following

When the voltage of the incoming mains varies by more than a pre-program value (default +- 10%) from the normal voltage on any phase, the controller will signal that the incoming mains will be disconnected, and the engine-starting sequence initiated.

When the frequency of the incoming mains varies by more than pre- program value (default +-5%) from the normal frequency, the controller will signal that the incoming mains will be disconnected, and the engine-starting sequence initiated.

Upon restoration of the incoming mains to the pre-program value (default +-10%) of the normal voltage on all phases, the monitor will signal that the load will be disconnected from the alternator and reconnected to the incoming mains.

If the alternator has been disconnected from the load and the incoming mains within the voltage limits of +- 10% on all phases, the controller will signal that the load will be reconnected to the incoming mains.

Should the incoming mains fail or not in the specified limits while the engine is running under control of the cooling-off timer, the control for the cooling –off timer in the controller will be cancelled and the load connected to the alternator.

When the output voltage of the alternator varies by more than the pre-program value (default value +- 10 %) on ANY phase, the controller will signal that the load will be disconnected from the alternator and the engine stopped.

A software over and under-frequency monitor will be provided in the controller if the frequency exceeds or drop below pre-programmed values. It will meet the requirements of class G2 governing. The monitor will not be influenced by harmonics.

Note: Software monitors will include adjustable overshoot and undershoot timers to be fully compatible with Class G2 governing.

All timers will be implemented in software.

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 1 s to 10 s required

The timer default value will be generator set to 3 s

The signal generated by the mains voltage monitor will start the timer. If the duration of the signal is less than the generator setting on the timer, the signal is suppressed to that the switching and starting sequence is initiated. However, if the duration of the signal is more than the generator setting on the timer, the signal will be transmitted to initiate the switching and starting sequence.

Incoming supply restoration 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 1 s to 10 s required.

The timer default value will be generator set to 3 s.

The signal generated by the mains voltage monitor will start the timer. If the duration of the signal is less than 150 sec, the signal is suppressed, and the timer is regenerator set. However, if the duration of the signal is more than 150 sec, the signal will be transmitted to initiate the switching sequence.

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. This will be software generator settable in the controller with a minimum of 5 seconds and maximum of 20 seconds.

On receipt of the switching signal, the alternator supply will be disconnected from the load and timer started. After 5 sec, the incoming supply will be reconnected to the load.

Engine cooling-off timer

After the load has been transferred to the incoming supply the engine will run without load for a period to cool off and then stop.

A timer, software adjustable in the controller from 5 to 10 min is required.

Repeat- start control

A repeat- start control is required in the controller software adjustable so that in the event of the engine falling to start on the first start attempt, the starter motor will be released and repeat the start attempt.

The repeat-start attempt will be repeated 3 times.

The duration of each start attempt will be 6 sec with a period of 15 sec between successive start attempts.

Should the engine fail to start after the third start attempt, the controller will transmit a signal for alarm purposes.

In addition to the requirement for the switchboard instruments listed elsewhere in this document metering will also form part of the modular generator set controller and must be accessible on the software.

The modular generator set controller shall display the following alarm/status indications:

- High engine temperature.
- Low Oil pressure
- High/low alternator output voltage
- Over and under speed (frequency)
- Low water level
- Emergency stop activated
- Mains fail
- Battery chargers fail
- Dummy load in operation (When provided)
- Unit not in Auto
- Engine running
- Low fuel alarm
- Engine start failure

Conditions one to six above will stop the engine.

The Contractor shall provide a remote alarm mimic panel and the associated control wiring for the set. The panel shall be installed in the duty/security room at the entrance to the building approximately 70m from the generator set position.

The mimic panels must fit into furniture and blend with the design. Before manufacture, the Contractor shall submit and obtain the approval, from the Engineer, for the mimic panel.

The remote alarm must have potential free relay contacts which shall indicate the following on each set:

- Mains on/off
- Alternator running
- Common fault alarm
- Buzzer which can only be reset at the generator panel
- Fuel low

The cable between the remote alarms is to be a signal cable with a screen and this option must be able to operate from a 12 / 24 V dc supply so that it can be powered from the generator set batteries.

A facility to originate a fault message should a warning or shutdown fault occur.

A facility to allow the mode of the control system to be changed to any of the four modes to allow the set to be run from a remote location.

A facility to originate a call to the control cellular and to transfer a fault message should a warning or shutdown fault occur. The alarm conditions above from the controller will be extended to four relays with a make and break contact and terminal strip to allow for remote monitoring of the following alarms:

- Mains fail
- Standby run
- Standby fail
- Low Fuel

A remote start facility must be supplied, software controllable in the controller.

All events relating to the status of the generator set shall be logged with date and time in a non-volatile memory (which can retain information for a period of 6 months in the absence of power to the controller) and the user shall be able to contain a hard copy on site.

The modular generator set controller system must be able to operate with a minimum DC supply voltage of 4 volts (without making use of either an internal or an external auxiliary battery) to allow cranking and starting under conditions of low battery capacity. Control cables between the set and the control panel shall be fitted with sockets for ease of undoing in the event the modular generator set controller has to be removed.

19.2.2.3.5 Manual Starting

Each switchboard shall be equipped with two pushbuttons marked “START” and “STOP” for manual starting and stopping of the set.

19.2.2.3.6 Battery Charging Equipment

Each switchboard shall be equipped with battery charging equipment.

The charger shall operate automatically in accordance with the state of the battery and shall generally consist of an air-cooled transformer, a full wave solid state rectifier, and the necessary automatic control equipment of the constant voltage system.

The charger must be fed from the mains. An engine driven alternator must be provided for charging the battery while the set is operational. Failure of this alternator must also activate the battery charger failure circuit.

The starter battery voltage will be software monitored by the modular generator set controller. The voltage will be digitally displayed.

19.2.2.3.7 Switchboard Instruments

Each generating set shall have a switchboard equipped as follows:

- One flush square dial voltmeter, reading the alternator voltage, scaled as follows:

- 0-300V for single phase generators.
- 0-500V for three phase generators. In this case a six position and off selector switch must be installed for reading all phase and phase to neutral voltages.

- A flush square dial combination maximum demand and instantaneous ampere meter for each phase, with resettable pointer suitably scaled 20% higher than the alternator rating. A red arc stripe above scale markings from 0-20A and a red radial line through the scale at full-load current, shall be provided. This instrument shall be supplied complete with the necessary current transformer.
- One flush square dial vibrating type frequency meter, indicating the alternator frequency.
- A six-digit running hour meter with digital counter, reading the number of hours the plant has been operating. The smallest figure on this meter must read 1/10 hour.
- Fuses or m.c.b.’s for the potential voltage circuits of the meters.
- One flush square dial ampere meter suitably scaled for the battery charging current.
- One flush square dial voltmeter with a spring loaded pushbutton or switch for the battery voltage.

19.2.2.3.8 Marking

All labels, markings or instructions on the switchgear shall be in English.

19.2.2.3.9 Earthing

An earth bar must be fitted in the switchboard, to which all non-current carrying metal parts shall be bonded.

The neutral point of the alternator must be solidly connected this bar by means of a removable link labelled “EARTH”. Suitable terminals must be provided on the earth bar for connection of up to three earth conductors, which will be supplied and installed by others.

19.2.2.3.10 Operation Selector Switch

A four-position selector switch must be provided on the switchboard marked “AUTO”, “MANUAL”, “and TEST” and “OFF”.

With the selector on “AUTO”, the set shall automatically start and stop, according to the mains supply being available or not.

With the selector on “TEST”, it shall only be possible to start and stop the set with the pushbuttons, but the running set shall not be switched to the load.

With the selector on “MANUAL”, the set must take the load when started with the pushbutton, but it must not be possible to switch the set on to the mains, or the mains onto the running set.

With the selector on “OFF”, the set shall be completely disconnected from the automatic controls, for cleaning and maintenance of the engine.

19.2.2.3.11 Automatic Change-over System

A fully automatic change-over system must be provided to isolate the mains supply and connect the standby set to the outgoing feeder in case of a mains failure and reverse this procedure on return of the mains.

The contactors for this system must be electrically and mechanically interlocked.

19.2.2.3.12 By-pass Switch and Main Isolator

The switchboard shall be equipped with an on-load isolator to isolate the mains and a manually operated on-load 4 pole 4 position by-pass switch, which shall switch the connected loads as follows:

NORMAL: will allow for the normal connection i.e. connects the incoming mains to the

Automatic control gear or directly to the outgoing feeder.

In the GEN BY-PASS position the switch will disconnect the automatic changeover control gear and will connect the municipal mains directly the essential supply

busbar which will allow for the maintenance of either or both the generator and the automatic changeover equipment.

MAINS BY-PASS switching position would allow the generator to be connected directly to the essential supply busbar. This is when there is a problem with the automatic changeover equipment and there is no municipal power available.

The final position is an OFF position which will remove all power downstream of this switch.

It is required that this by-pass switch and mains isolator be mounted away from the automatic control gear, in a separate compartment, either on the side or in the lower portion of the switchboard cubicle, and that the switches are operated from the front of the compartment.

Contractor to note: The by-pass and mains isolator switch shall also break the main neutral.

19.2.2.3.13 Start Delay

Starting shall be automatic in event of a mains failure. A 0-15 second adjustable start delay timer shall be provided to prevent start-up on power trips or very short interruptions.

19.2.2.3.14 Stop Delay

A stop delay with timer is required for the set, to keep the set on load for an adjustable period of one to sixty seconds after the return of the mains supply, before changing back to the supply. An additional timer shall keep the set running for a further adjustable cooling period of 5 to 10 minutes at no-load before stopping.

### 19.2.2.4 Installation

Except for the supply of the incoming mains cable and outgoing feeder cables, the tenderer must include for the complete installation and wiring of the plant in running order, including the connection of the incoming cable and outgoing feeder cables.

The connecting of the cable and control cabling to the generator and the control terminals in the LV board remains the responsibility of the tenderer.

### 19.2.2.5 Warning Notices

Notices, in English, must be installed on the outside of the steel enclosure.

The successful tenderer must consult the Occupational Health and Safety Act 83 of 1993 and get approval of the wording from the Department's representative, prior to ordering the notices.

The notice shall be made of a non-corrodible and non-deteriorating material, preferable plastic, and must read as follows:

DANGER: This engine will start without notice. Turn selector switch on control board to "OFF" before working on the plant.

An engraved label shall be installed next to the fuel cap that indicates the following:

Base Tank Capacity

Bulk Tank Capacity (if provided)

Full load litres per hour consumption

#### 19.2.2.6 Construction

The engine and alternator of the set shall be built together on a common frame, which must be mounted on a skid base on anti-vibration mountings. The set must be placed inside an IP65 canopy/container. A drip tray must be fitted under the engine. The tray must be large enough to catch a drip from any part of the engine.

The frame must be of the 'DUPLEX' type.

#### 19.2.2.7 Operation

The set is required to supply the lighting and power requirements in the case of a mains power failure.

The set shall be fully automatic i.e. it shall start when any one phase of the main supply fails or get switched and shall shut down when the normal supply is re-established. In addition, it shall be possible to manually start and stop the set by means of pushbuttons on the switchboard.

The automatic control shall make provision for three consecutive starting attempts. Thereafter the set must be switched off, and the start failure relay on the switchboard must give a visible and audible indication of the fault.

To prevent the alternator being electrically connected to the mains supply when the mains supply is on and vice versa, a safe and fail proof system of suitably interlocked contactors shall be supplied and fitted to the changeover switchboard.

## 19.2.3 Part 3 - Technical Specification

### 19.2.3.1 General

Supply, deliver, install, commission, test and maintain an emergency generating set the Ntshongwe Police Station found in the Umkhanyakude District Municipality in Kwazulu-Nalal Province.

This installation must comply fully with all the sections and drawings of this document. This technical specification is supplementary to the Equipment Requirements, Part 2, and must be read together where they are at variance the Technical Specification shall apply.

Supply, delivery, installation and commissioning of the complete outdoor emergency generator set inside an IP65 canopy/container on a concrete plinth as specified in this document and indicated on the drawings.

The surface of the concrete plinth shall be 50mm higher than the existing ground level. The thickness and strength of the plinth shall be designed by the consulting engineer and are detailed on the drawings.

A tap to be provided to drain all the water that accumulates inside the bund wall. Final position of the tap will be determined on site. It is the engineer's responsibility to ensure plinth design complies with generator dimensions and weights. The bund wall shall contain 110% of the fuel, oil and water capacity of the generator. The bund wall shall not constrain the canopy doors from opening completely.

The contractor shall install an earthing system in the concrete plinth. The contractor shall install two (2) earth studs 1.8 meters long on opposite corners of the concrete plinth into the ground. The earth studs shall be connected by means of a 70mm2 bare copper earth wire to the main earth bar in the control panel. The earth conductor shall be connected to the earth bar, canopy, bass, skid and earth bar by means of suitably crimping lugs and brass bolts.

### 19.2.3.2 Site Information and Conditions

19.2.3.2.1 Location

The site is at Nyshongwe Police Station in the Umkhanyakude District Municipality, in Kwazulu- Natal province.

19.2.3.2.2 Site Conditions

The following site conditions will be applicable, and equipment shall be suitably rated to develop their assigned rating and duty at these conditions.

**d)** Height above sea level : .189 Meter
**e)** Maximum ambient temperature : 33,5°C
**f)** Maximum ambient humidity at lowest temperature : 100 %

### 19.2.3.3 Output and Voltage

After the de-rating factors for the engine and generator due to site conditions have been taken into account, the set must have a site output and voltage as follows: -

| | | |
|---|---|---|
| No load voltage | : | 400/230 Volt |
| Prime Power Rating | : | 80kVA |
| Standby Power Rating | : | 88kVA |
| Power at 0.9 power factor | : | 79,2 kW |
| Frequency | : | 50Hz |
| Fault Level | : | 6kA |

The generating set is required to feed the following electrical load:

| | **Load KW** | **Power factor** |
|---|---|---|
| LED lighting | 5,5 | 0,9 |
| Heaters & plugs | 15 | 1 |
| Air conditioners | 12,5 | 0.9 |
| Fire Pumps | 30 | 0.8 |

### 19.2.3.4 Switchboard/Control Panel Unit

All switch- and control gear shall be rated for a fault current level of 6kA.

The switchboard/control panel unit shall be enclosed in the IP65 canopy/container.

### 19.2.3.5 Cables

The contractor will be responsible for all electrical cable connections associated with the complete generating set installation.

The following cables will be supplied, installed and terminated at the Switchboard by others. Adequate provision shall be made for the termination of these cables at the Switchboard:

**d)** DB X fed from Main LV Board (Non-Essential) with a **50 mm² PVC/SWA ECC/PVC** Cable
**e)** Main LV Board (Essential) fed from DB X with a **50 mm² PVC/SWA ECC/PVC** Cable

### 19.2.3.6 Engine

A sump drainpipe must be fitted with a shut-off valve placed in a convenient position outside the base frame to facilitate drainage.

Recommended oil types must be indicated on the engine, or base frames, by means of suitable labels.

All engine instruments shall have clear markings on the faceplates, indicating the normal operating zone(s), maximum and minimum allowable values/limits and danger zone(s).

The flywheel shall be covered by approved hoods.

### 19.2.3.7 Alternator

The Alternator shall be of the low harmonic type.

### 19.2.3.8 Load Acceptance

The generator set shall be capable of accepting 75% of the specified site electrical output 10 seconds after the starter motor is energised and the remaining 25%, 5 seconds thereafter, i.e. 100% load acceptance shall not exceed 15 seconds.

### 19.2.3.9 Enclosure

The standby set is a free standing unit and shall be mounted in an enclosure as detailed below:-

19.2.3.9.1 General

The enclosure, shall be completely vermin-proof, powder coated and shall be constructed of 3CR12 stainless steel or within 50km from the coast with grade 316 steel housing of a minimum thickness of ±1.5 mm.

The enclosure shall allow easy access to the engine, alternator, radiator filler cap and control cubicle for maintenance purposes.

The door shall be flush with the rest of the canopy and of the side opening type. A minimum of four doors are required i.e. two on either side.

The door hinges and locking bars shall be of a heavy-duty type and be manufactured of 3CR12 stainless steel or within 50km from the coast with grade 316 steel and shall be fitted with a grease nipple.

The doors and panels shall be suitably braced and stiffened to ensure rigidity and to prevent bending and warping.

Suitable door restraints shall be fitted to all the doors, enclosure including the control panel to prevent wind damage. The restraint shall consist of a steel rod in a steel groove or slide with a spring-loaded catch, which is to be manually reset to close the door.

No flexible restraints will be accepted.

The diesel fuel level indicator and alternator rating plate shall be clearly visible with the doors open.

Unless specified the silencers shall be mounted within the enclosure.

Perforated sheeting shall be fitted over all the insulating material inside the canopy of all soundproof sets.

Rubber seals on doors shall be equal to or similar to rubber pinch weld, wind lace.

19.2.3.9.2 Design

The enclosure shall be designed to be weather-proof and soundproofing as specified. Rivets or self-tapping screws will under no circumstances be allowed for fixing the various sections of the enclosure. Only cadmium coated nuts and bolts are acceptable.

19.2.3.9.3 Roof

The roof of the enclosure shall be constructed for proper drainage of water as per the drawing.

19.2.3.9.4 Lamp fitting

A lamp fitting and it's associated on/off door switch shall be provided inside the enclosure for illumination of the control panel. The power for the lamp shall be obtained from the starter battery.

19.2.3.9.5 Soundproofing

The soundproofing on canopy engine sets shall be such that the maximum noise level generated by the set under any load condition shall not exceed 65 dB measured in any direction at a distance of 5m from the centre of the set with the doors closed.

The supply and discharge air paths will require separate attenuators on soundproof sets.

19.2.3.9.6 Padlock and keys

The contractor shall supply padlocks and keys for all the doors of the enclosure. The padlock shall be off the "Viro A82 keyed alike with stainless steel shackles" type.

Suitable brass metal plates shall be installed behind each lock for the protection of the enclosure against scratching or damaging, where the locks are hanging.

### 19.2.3.10 Alarms

The successful tenderer must pay particular attention to the requirements of the alarms as described in the Equipment Requirements, Section 2.

One alarm hooter and red light shall be supplied and installed on the outside of the generator container in a position as indicated by the Department's Representative.

The hooter shall consist of an electronic unit similar and equal to a "Klaxon" - type SY2/725 hooter with a continuously rated output and 110 dB at a distance of 2 metres and shall be IP55 weatherproof rated.

The warning light shall consist of a 40W flashing red light, which shall be mounted on a galvanised steel frame together with the hooter.

The hooter and light shall be switched on or off simultaneously after initiation or cancellation of an alarm condition. The supply and installation of the wiring between the control board and the alarm unit forms part of this contract.

The successful tenderer must ensure that the hooter control circuit resets automatically after cancellation due to a low fuel condition or battery charger failure, but the visible fault indication must remain, i.e. should the operator continue to run the set, the hooter must sound, should any other condition develop.

A remote alarm panel shall be supplied and installed by the contractor in the control room. This shall be of surface mounting, enamelled sheet metal (colour to approval), minimum depth construction, and shall incorporate a flashing red pilot alarm light, adjustable electronic sounder, and a silence push button. The silence button shall not switch off the pilot light - this shall only be switched off when the alarm is reset at the Generator Panel.

A 2,5mm² x 4-core PVC SWA PVC cable will be supplied, installed and terminated by others between the Generator Panel and the Charge Office. The Contractor shall connect this cable at both ends and shall supply and install all switch gear relays, etc. to ensure satisfactory operation of the Remote Alarm Panel.

### 19.2.3.11 Remote Control Generator Switch

A Remote-Control Generator "ON/OFF/AUTO" switch will be supplied and installed by others in the control room, and a 2,5mm² x 4-core PVC SWA PVC cable will be supplied and installed by others between the control room and the Generator Panel.

The contractor shall connect this cable at both ends, and shall supply and install all switch gear, relays, etc. to ensure satisfactory operation of the remote-control switch.

### 19.2.3.12 Fuel Drip Tray

A drip tray approximately 100mm deep shall be mounted below the generator and must be large enough to collect any fuel that drips from the generator fuel accessories. The drip

tray shall be manufactured from black mild steel. The thickness of the drip tray sheet steel shall not be less than 2mm.

#### 19.2.3.13 Completion Time

The Generator Set is required to be commissioned in conjunction with the building contract.

#### 19.2.3.14 Inform

The successful tenderer shall inform the Engineer when the set is ready for installation.

#### 19.2.3.15 Fuel Supply Tank

The fuel tank shall be an integral part of the base frame of the generator set. The tank shall have sufficient capacity to run the engine on full load for a period of 24 hours. The base tank shall be an open channel self-bund walled type that shall be of sufficient capacity to contain a spillage equivalent to 110% in volume of the base tank. The containment tank shall be manufactured from black mild steel with a thickness of not less than 2mm.

A float level alarm connected to the generator controller shall be incorporated into the bund area located such that the alarm will be activated when 50% of the volume of the bund area has been reached in the event of any diesel fuel leakage.

## 19.2.4 Part 4 – Schedules of Technical Information

**(TO BE FULLY COMPLETED BY TENDERER)**

### 19.2.4.1 Engine

| NO | ITEM | REMARKS |
|---|---|---|
| **j)** | Manufacturer's Name | |
| **k)** | Country of Origin | |
| **l)** | Manufacturer's model No. and year of manufacture | |
| **m)** | Continuous sea level rating after allowing for ancillary equipment :<br><br>a) In b.h.p.<br>b) In kW | |
| **n)** | Percentage de-rating for site conditions, in accordance with SANS 8528<br><br>a) For altitude<br>b) For temperature<br>c) For humidity<br>d) Total de-rating | |
| **o)** | Net output on site in kW | |
| **p)** | Nominal speed in r.p.m. | |
| **q)** | Number of cylinders | |
| **r)** | Strokes per working cycle | |
| **s)** | Stroke in mm | |
| **t)** | Cylinder bore in mm | |
| **u)** | Swept volume in $cm^3$ | |
| **v)** | Mean piston speed in m/min | |
| **w)** | Compression ratio | |
| **x)** | Cyclic irregularity | |
| **y)** | Fuel consumption of the complete generating set on site in l/h of alternator output at :<br><br>a) Full load<br>b) ¾ load<br>c) ½ load<br><br>NOTE : | |

| NO | ITEM | REMARKS |
|---|---|---|
| | A tolerance of 5% shall be allowed above the stated value of fuel consumption. | |
| **z)** | Make of fuel injection system. | |
| **aa)** | Capacity of fuel tank in litres | |
| **bb)** | Is gauge glass fitted to tank? | |
| **cc)** | Is electric pump for filling the fuel tank included? | |
| **dd)** | Method of starting | |
| **ee)** | Voltage of starting system | |
| **ff)** | Method of cooling | |
| **gg)** | Type of radiator if water-cooled | |
| **hh)** | Type of heater for warming cylinder heads | |
| **ii)** | Capacity of heater in kW | |
| **jj)** | Method of protection against high temperature | |
| **kk)** | Method of protection against low oil pressure | |
| **ll)** | Type of governor | |
| **mm)** | Speed variation in %<br><br>a. Temporary<br>b. Permanent | |
| **nn)** | Minimum time required for as assumption of full load in seconds | |
| **oo)** | Recommended interval in running hours for :<br><br>a. Lubricating oil change<br>b. Oil filter element change<br>c. Decarbonising | |
| **pp)** | Type of base | |
| **qq)** | Can plant be placed on solid concrete floor? | |
| **rr)** | Are all accessories and ducts included? | |
| **ss)** | Is engine naturally aspirated? | |
| **tt)** | Are performance curves attached? | |
| **uu)** | Diameter of exhaust pipe | |
| **vv)** | Noise level in plant room in dBA | N/A |
| **ww)** | Noise level at tail of exhaust pipe in dBA | |
| **xx)** | BMEP (4 stroke) at continuous rating (kPa) | |
| **yy)** | % Load acceptance to SANS 8528, with 10% transient speed drop | |

### 19.2.4.2 Alternator

| NO | ITEM | REMARKS |
|---|---|---|
| **e)** | Maker's name and model no. | |
| **f)** | Country of Origin and year of manufacture | |
| **g)** | Type of enclosure | |
| **h)** | Nominal speed in r.p.m. | |
| **i)** | Number of bearings | |
| **j)** | Terminal voltage | |
| **k)** | Sea level rating kVA at 0,9 power factor | |
| **l)** | De-rating for site conditions | |
| **m)** | Input required in kW | |
| **n)** | Method of excitation | |
| **o)** | Efficiency at 0,9 power factor and :<br><br>a) Full load<br>b) ¾ load<br>c) ½ load | |
| **p)** | Maximum permanent voltage variation in % | |
| **q)** | Transient voltage dip on full load | |
| **r)** | Voltage recovery on full load application in milli-seconds | |
| **s)** | Is alternator brushless? | |
| **t)** | Class of insulation of windings | |
| **u)** | Is alternator tropicalised? | |
| **v)** | Symmetrical short circuit current at terminals n Ampere | |
| **w)** | Type of Coupling | |

#### 19.2.4.3 Switchboard

| NO | ITEM | REMARKS |
|---|---|---|
| **v)** | Maker's Name | |
| **w)** | Country of Origin | |
| **x)** | Is board floor mounted? | |
| **y)** | Finish of board | |
| **z)** | Make of volt, amp, and frequency meters | |
| **aa)** | Dial size of meters in mm | |
| **bb)** | Scale range of voltmeter | |
| **cc)** | Scale range of ammeters | |
| **dd)** | Ration of current transformers | |
| **ee)** | Make of hour meter | |
| **ff)** | Range of cyclometer counter | |
| **gg)** | Smallest unit shown on counter (Item 11) | |
| **hh)** | Make of circuit breaker | |
| **ii)** | Type of circuit breaker | |
| **jj)** | Rating of circuit breaker in Amp and fault level in kA | |
| **kk)** | Setting range of overload trips | |
| **ll)** | Setting range of instantaneous trips | |
| **mm)** | Make of change-over equipment | |
| **nn)** | Make of voltage relay | |
| **oo)** | Is control and protection equipment mounted on a small removable panel? | |
| **pp)** | Type of control equipment | |
| **qq)** | Make of mains isolator | |
| **rr)** | Type of indicators for protective devices | |
| **ss)** | Make of rectifier | |
| **tt)** | Type of rectifier | |
| **uu)** | Is battery charging | |
| **vv)** | Are volt- and ammeters provided for charging circuit? | |
| **ww)** | Is the alarm hooter of the continuous duty type? | |
| **xx)** | Rating in Amps of :<br><br>a. Change-over equipment<br>b. Mains on load isolator | |

| NO | ITEM | REMARKS |
|---|---|---|
| | c. By-pass switch<br>d. Circuit breaker to outgoing feed | |
| **yy)** | Is manufacture of switchboard/control panel to be sub-let? | |
| **zz)** | If yes, state name and address of specialist manufacturer | |

### 19.2.4.4 Battery

| NO | ITEM | REMARKS |
|---|---|---|
| **m)** | Maker's Name | |
| **n)** | Country of Origin | |
| **o)** | Type of battery | |
| **p)** | Voltage of battery | |
| **q)** | Number of cells | |
| **r)** | Capacity in cold crank amp | |

### 19.2.4.5 Dimensions

| NO | ITEM | REMARKS |
|---|---|---|
| **q)** | Overall dimensions of set in mm | |
| **r)** | Overall mass | |
| **s)** | Is the canopy/container adequate for the installation of the set, switch board and fuel tank | |

### 19.2.4.6 Deviation from the Specification as an Alternative (State Briefly)

| NO | DESCRIPTION |
|---|---|
| | |
| | |
| | |
| | |
| | |

### 19.2.4.7 Spare Parts and Maintenance Facilities

| NO | ITEM | REMARKS |
|---|---|---|
| 1 | Approximate value of spares carried in stock for this particular diesel engine and alternator | |
| 2 | Where are these spares held in stock | |
| 3 | What facilities exist for the servicing of the equipment offered | |
| 4 | Where are these facilities available | |

## 19.3 Solar Photo Voltaic Installation

### 19.3.1 Introduction

The backup system with solar charging herein specified is to be installed at the Ntshongwe Police Station in the Umkhanyakude district in Kwazulu-Natal.

The system shall generally comprise of inverter-chargers, lithium-ion batteries, charge-controllers, solar modules, isolating and protection equipment, associated cabling, monitoring systems and a load control system. The system shall operate on a priority basis as detailed under the design criteria

The tenderer must sign and return the compliance document. Failure to do so will automatically lead to disqualification of the tenderer and his/her tender will not be considered regardless of tendered value.

### 19.3.2. Scope of work

The contract comprises of the design, installation, testing, commissioning and hand-over of the complete system. This includes the items below and details further mentioned:

l) Inverter-chargers
m) Lithium-ion batteries
n) Solar inverters with optimizers
o) Charge-controllers
p) Solar modules complete with mounting structure
q) DC cabling complete with protection for parallel arrays
r) DC isolation complete with surge protection
s) AC input isolation c/w surge protection
t) AC output isolation c/w residual current protection and surge protection
u) AC cabling
v) Feeder circuit breaker in DB
w) Manual by-pass switch
x) Electrical earthing and bonding to closest earth point
y) Inverter-charger monitoring system
z) Power usage monitoring system
aa) Load control system
bb) Interface with generator controller
cc) Labelling
dd) Drawings (for approval prior to construction) must include
a. Solar panel layout
b. DC cabling
c. System wiring
d. AC tie-in
ee) Equipment list that includes all equipment
ff) Design (signed by ECSA registered Pr Eng or Pr Tech Eng)
gg) Delivery, off-loading and installation
hh) Site acceptance testing and commissioning
ii) Hand-over to and training of client

jj) Quality, compliance and operating and maintenance documents
kk) Health and safety

### 19.3.3. Site specific supply

The supply to which the system is to be connected is 3-phase, 4-wire, 400/230 V with a frequency of 50 Hz.

### 19.3.4. Inverter-chargers

Single phase inverter-charger's must be connected in parallel and connected to create a three-phase network and must comply to the following:

| | | |
|---|---|---|
| Individual inverter size | : | 32kW / 40kVA |
| Number of units | : | 2 (three phase configuration, two in parallel) |
| System size | : | 64kW / 80kVA |
| Inverter inputs | : | Two independent with integrated auto transfer |
| Inverter outputs | : | Two outputs, one permanent and one switched |
| Parallel operation | : | Possibly up to 6 units per phase |
| Power control | : | Yes |
| Power assist | : | Yes |
| Remote monitoring | : | Yes |
| Remote control | : | Yes |
| Remote configuration | : | Yes (with configurable access levels) |
| Integrated transfer switch | : | Yes, rated at 100A |
| AC Input voltage range | : | 187V to 265V |
| AC Input frequency | : | 45Hz to 65Hz |
| DC Input voltage range | : | 38V to 66V |
| AC Output voltage | : | 230V, +/- 2% |
| AC Output frequency | : | 50Hz, +/- 0.1% |
| DC Charge current | : | 200A |
| Programmable output relays | : | 3 |
| Battery connection | : | 4 x M8 bolts |
| AC connection | : | M6 bolts |
| Safety standard | : | EN-IEC 60335-1, EN-IEC 60335-2-29, EN-IEC 62109-1 |
| Crest factor | : | 3:1 |
| Lifetime free online monitoring | : | Yes |
| Efficiency | : | 96 % |
| IP rating | : | 21 |
| Anti-islanding | : | Yes, NRS and SANS compliant |

### 19.3.5. Lithium iron phosphate battery

Only lithium iron phosphate batteries will be considered. As charging and discharging voltages and currents are critical to batteries these must be considered in the selection of the battery. The battery back-up time shall be sized to meeting design criteria.

The battery shall comply to the following:

| | | |
|---|---|---|
| Number of batteries | : | 8 |
| kWh rating | : | 10kWh |
| Usable kWh | : | 8kWh |
| Current capacity (Ah) | : | 200Ah per battery |
| Nominal voltage | : | 52V (to suit 48V inverters) |
| Minimum voltage | : | 47V |
| Maximum voltage | : | 56V |
| Charge / Discharge current | : | 100A per battery |
| Cooing fan | : | No |
| Enclosure | : | 3mm aluminium, powder coated white |
| External interface | : | AC DB (various signals), 2 x RJ45 (CAN Bus) |
| Protection | : | Circuit breaker with shunt |
| Remote tripping over CAN Bus | : | Yes |
| Manual reset | : | Yes |
| Cell under- & over volt protection | : | Yes |
| Built-in temperature protection | : | Yes |
| Minimum SOC control | : | Yes |
| Human machine interface | : | Yes, with 0-100% state of charge indication |
| Wi-Fi remote monitoring | : | Yes |
| Warranty | : | 10 years / 4000 cycles |
| Service life | : | >16 years at 70% DoD |
| Mounting | : | cabinet mounting |

### 19.3.6. Solar inverters and optimizers

The solar inverters complete with optimizers shall be installed on the load side of the inverter-chargers and shall comply with the following:

| | | |
|---|---|---|
| Individual inverter size | : | 32kW |
| Number of inverters | : | 2 |
| Total inverter capacity | : | 64kW |
| Configurable power factor | : | Yes |
| Maximum continuous output current | : | 40A per inverter |
| T4 DC input pairs | : | 3 |
| Built-in module level monitoring | : | Yes |
| Transformer less topology | : | Yes |
| Adjustable grid code selection | : | Yes, in field |

| | | |
|---|---|---|
| Lifetime free online monitoring | : | Yes |
| Max DC input power | : | 37250kW |
| Max DC input voltage | : | 900 V |
| Nominal DC input voltage | : | 750V |
| Reverse polarity protection | : | Yes |
| Ground fault isolation detection | : | Yes |
| AC connection type | : | Three phase 4-wire + protective earth |
| Grid voltage | : | 400 V |
| Rated frequency | : | 50/60 Hz |
| AC connection type | : | 2.5mm2 – 10mm2 |
| Anti-islanding protection | : | Yes |
| Efficiency | : | 98.3 % |
| Night consumption | : | < 4 W |
| Wireless remote monitoring | : | Yes |
| User interface | : | Yes, screen |
| Ambient temperature range | : | -20 to +60 degrees Celsius |
| IP rating | : | 65 |
| Cooling | : | Forced air with fan, field replaceable |
| Isolation | : | Transformer-less |
| Photovoltaic array isolation control | : | as per IEC 62109 |
| Safety standard | : | IEC 62109-1 & 2 |

| | | |
|---|---|---|
| Optimizer configuration | : | Dual |
| Optimizer rating | : | 950W |
| Number of optimizers | : | 134 |
| Efficiency | : | 99.5% |
| Maximum DC input voltage | : | 125V |
| Operating DC voltage range | : | 12.5 to 105V |
| Overvoltage category | : | II |
| Safety output voltage per optimizer | : | 1Vdc |
| Safety standard | : | IEC 62109-1 & 2 |
| Fire safety standard | : | VDE-AR-E 2100-712:2013-05 |
| Relative humidity | : | 0-100 % |
| Type | : | To match inverter model and specification |

### 19.3.7. Charger-controllers

Charge-controllers will be installed for solar charging of the battery. It is imperative that the design consider the maximum charge current of the battery, charging current of charge controllers, cable ratings and fuse ratings. The total solar module capacity connected to the charge controllers shall be adequately designed considering DC losses.

The following items shall form part of the charge controller design:

f) Maximum DC input voltage (PV input)
g) Maximum input current per termination point (T4 connector rating)
h) PV fuse protection per parallel array at charge controller (no field fuses)
i) DC input shall have DC isolator (PV rated)
j) DC input shall have Type 2 40kA PV rated surge protection
k) DC output fuse protection
l) DC output isolation

Charge-controllers shall also comply to the following:

| | | |
|---|---|---|
| Number of charge controllers | : | 2 |
| Maximum open circuit voltage | : | 250V |
| Charge current | : | 100A |
| Battery voltage | : | 48V |
| Built-in MPPT | : | Yes (PWM chargers not permitted) |
| Cooling fan | : | No |
| Protection | : | Over-temp, PV reverse polarity & current |
| Remote monitoring | : | Yes |
| Remote control | : | Yes |
| Programmable relay | : | 1 |
| Safety standard | : | EN-IEC 62109-1 |
| Efficiency | : | 99% |
| Consumption | : | 20mA |
| Charge algorithm | : | multi-stage adaptive |
| IP rating | : | 22 |

### 19.3.8. Solar modules and installation

Solar modules must be the poly-crystalline type and comply with the following:

| | | |
|---|---|---|
| Number of solar modules | : | 70 |
| Solar module rating | : | 550W |
| Maximum system voltage | : | 750 V |
| Operating voltage (Vmp) | : | 39.1V |
| Operating current (Imp) | : | 10.49A |
| Efficiency | : | 18.6% minimum |
| Fire performance | : | Class C as per IEC 61730 |
| Tier rating | : | 1 |
| Application class | : | C |
| Power tolerance | : | +/- 10 W |
| Cell arrangement | : | 144 |
| Front cover | : | 3.2 mm tempered glass |
| Frame | : | Anodized aluminium alloy, crossbar enhanced |
| Junction box | : | IP68, 3 bypass diodes |
| Cable | : | 6 $mm^2$ |

| | | |
|---|---|---|
| Connector | : | T4 series |
| Temperature Co-efficient | : | -0.36 % ($P_{max}$), -0.28 % ($V_{OC}$) and 0.05 % ($I_{SC}$) |
| Operating temperature | : | -40 to +85 degrees Celsius |

The solar modules shall be installed on a suitable mounting system. The mounting system shall be certified and have appropriate installation instructions. Weather conditions must be considered when the mounting system is designed to match the installation site's weather conditions.

Solar modules must be installed in neatly arranged rows with consideration for cleaning, servicing and maintenance. For this reason, access paths must be included in the design. A maximum linear string must have an access path every 50m. The design must be submitted for approval to the engineer prior to ordering and installation of any equipment.

Where appropriate, permanent safety lines or anchors for temporary safety line must be included in the design and the tender offer.

The Employer shall provide the successful tenderer with confirmation that the roof is capable of carrying the weight of the intended solar PV installation. Tenderers shall provide the weight of all equipment in their data sheets as part of the tender submission.

The Employer shall be responsible for the installation of water points for cleaning purposed.

Permanent or temporary access **post** hand-over (via mobile ladders, permanent cat ladders or access equipment) shall the Employer's responsibility.

## 19.3.9. DC cabling and installation

DC cabling and installation shall comply with the following:

| | | |
|---|---|---|
| DC cable standard | : | IEC 62930 |
| Installation standard | : | IEC 60364-4 |
| DC voltage rating | : | 1000 V |
| Cable size | : | 6 $mm^2$ |
| Connectors | : | T4 |
| Junction boxes | : | IP65, UV and weather proof |
| Cable installation: on roof | : | Below solar modules allowed |
| Cable installation: solar modules to DC isolators | : | Galvanized conduit |
| Cable installation | : | Earth- and short-circuit proof |
| Cable installation | : | UV and weatherproof |
| Parallel strings | : | Fused on positive and negative poles with PV rated DC fuses |
| Field array enclosures | : | Must include surge protection and fuse protection of strings |
| Earthing | : | Galvanized conduits to be bonded with earth strapping |
| Earthing | : | All solar modules to have individual earth wires to structure |
| Earthing | : | Mounting structure to be earthed with minimum 16 $mm^2$ wire |

All connections and extensions to be done with T4 connectors. No joining or extending of solar cable to be done with terminals or strip connectors.

### 19.3.10. Solar inverter and charge controller DC isolation and surge protection

DC isolation shall be provided. The DC isolation enclosure(s) shall be double insulated and mounted on an external wall of the building to provide easy isolation for emergency services. Alternatively, a remote emergency stop shall be installed that isolates the DC supply from the solar modules. A fail-safe design for this type of installation shall be used.

The enclosure shall be weatherproof and include individual surge protection per incoming string. The DC isolators and surge protection shall be PV rated. Clearly visible labelling shall be installed for emergency personnel.

### 19.3.11. Inverter-charger AC input isolation

Each inverter-charger's AC input shall be fitted with an AC isolator. The AC isolator shall be fitted with a circuit breaker with isolation behaviour. The AC isolator shall be 25% larger than the maximum current of the inverter-charger

Included in the AC input isolator enclosures will be Type 2 40kA surge arrestors complete with fuse protection to surge protection arrestors manufacturer's requirements

Also included in the AC input isolator enclosures will be by-pass switches that allow for easy by-pass of the inverter-charger system for maintenance or failures

### 19.3.12. Inverter-charger and solar inverter AC output isolation

Each inverter-charger 's AC output shall be fitted with an AC isolator. The AC isolator shall be fitted with a circuit breaker with isolation behaviour. The AC isolator shall be 25% larger than the maximum output current of the inverter

Included in the AC output isolator enclosures will be Type 2 40kA surge arrestors complete with fuse protection to surge protection arrestors manufacturer's requirements

The by-pass unit fitted in the AC input isolator enclosure will be wired to this enclosure for by-pass requirements

As most inverter-chargers are transformer-less and not galvanically isolated, the output AC isolator shall be fitted with Type B residual current protection. The AC isolator shall be IP65 rated and mounted within 1.5 m of the inverter(s).

### 19.3.13. AC cabling

All AC cabling shall be neatly installed on a suitable cable support system. Saddles shall not be permitted to support AC cabling. AC cabling shall be PVC/SWA/PVC four core cabling

with external insulated earth. The cabling sizing shall consider fault level, voltage drop at full load as well as the current carrying capacity after deratings

The cable support system shall be galvanized. All joints and bends shall be done with suitable equipment as supplied by the cable support system suppliers. No custom-made joints and bends will be permitted. Bonding of the cable support system is considered to be an integral part of the installation.

Suitable glands shall be used for all cables entering and exiting electrical equipment and enclosures. Should BW glands be used they will be fitted with suitable rubber shrouds.

### 19.3.14. Inverter-charger circuit breaker in distribution board

The installation of the inverter infeed circuit breaker is part of this contract

The circuit breaker shall be clearly labelled, have isolation behaviour and be correctly rated for voltage, current and fault level at the point of installation. Cascading shall not be permitted

The circuit breaker shall be installed by an experienced electrical panel builder that must issue a routine test report. The panel builder shall be liable for the alteration to the DB and take full responsibility and liability for the work done. Busbar or cabling used shall be matched to the current rating of the circuit breaker.

### 19.3.15. Design and system criteria

The system design must comply with the following criteria:

f) 2 x 32kW (40kVA) three phase inverters in parallel
g) kWh meter fed back to solar inverter for monitoring platform
h) 20% oversizing of solar modules on solar inverters and charge controllers
i) DC cable sizing to avoid DC ripple
j) DC busbars to suite battery and inverter-charger supplier's requirements
k) DC fuses between charge controllers and battery
l) DC fuses between inverter-charger and battery
m) Surge protection as indicated in this document and drawings
n) Back up time: 6 hours at full load (64kW)
o) The system shall be programmed to meet output demand and the balance of the capacity of the system shall be fed back into the local electrical network up to the full rating of the system. This will be applicable from 09:00 to 15:00
p) The control and load control (see below) systems shall use the following priorities
    i. Grid tied solar first priority of power source
    ii. Charge controller solar modules power over battery charging to meet demand
    iii. If the grid tied solar and charge controller power can't meet demand utilize battery power until battery reaches 20% SOC (state of charge)
    iv. Once the battery reaches 20% SOC the utility power shall be used to meet demand. If the demand is above the utility limit of 80kVA the generator shall be started until the demand is below 80kVA or / if conditions a. and b. above can provide enough power to meet demand
    v. The generator shall automatically start upon power failures or if the demand is above the

hybrid system capacity (80kVA / 64kW)

q) Battery re-charge time: 10 hours @ 100A per battery from 20:00 to 06:00
r) AC cabling sizing to consider deratings, voltage drop and short-circuit rating
s) Generator control and programming for low battery level and power assist (configurable)
t) Generator supplier liaison

### 19.3.16. Inverter-charger monitoring system

The backup system shall have a monitoring system. The monitoring system will monitor the inverter-chargers, charge controllers and lithium iron phosphate battery. The monitoring system will be connected to a local area network or local Wi-Fi network and must be accessible via the internet and a dedicated smart phone application

The monitoring system shall monitor and include the following as minimum:

f) Remote control and configuration of system
g) Inverter-charger values i.e. voltage, current, power and load
h) Inverter-charger statuses i.e. healthy input and output, alarms and protections
i) Charge controller values i.e. voltage, current and power
j) Charge controller statuses i.e. alarms and protections
k) Battery information i.e. DoD, SOC, temperatures, cell voltages and charging status
l) kWh from and to grid

### 19.3.17. Power usage monitoring system

As part of the solar installation contract a permanent power usage monitoring system shall be installed. The information shall be locally stored in the data concentrator and shall be accessible via the built-in webserver.

The power usage monitoring system shall include the following:

j) Installation of kWh meters in the main distribution boards on the following circuits:
    i. Incomers: Transformer, Generator and Solar PV
    ii. HVAC feeder(s)
    iii. Feeds to sub distribution board(s)
k) Installation of a data concentrator with built-in webserver (see specification below)
l) Communication cabling between kWh meters and data concentrator
m) Setup, commissioning and hand-over
n) Training of the Employer on access to and use of the monitoring system

The kWh meters for the power usage monitoring system shall measure the following:

o) Voltage, current, power factor
p) Active power (kW) – 4 quadrant metering
q) Apparent power (kVA)
r) Reactive power (kVAr)

The kWh meters shall comply with the following:

| | | |
|---|---|---|
| Values | : | Voltage, current, kW, kVA, kVAr and PF |
| Meter type | : | Active, reactive, apparent (signed, four quadrant) |
| Accuracy class | : | Class 1 to IEC 62053-21 and IEC 61557-12 |
| Rated voltage | : | 100 to 277 Vac and 173 to 480 Vac |
| Network frequency | : | 50 Hz and 60 Hz |
| Technology type | : | Electronic |
| Display type | : | LCD |
| Sampling rate | : | 32 samples / cycles |
| Tariff input | : | Tariff (4) |
| Communication protocol | : | Modbus RTU |
| Local signalling Green | : | Power ON, Yellow: Modbus comms active |
| Digital inputs | : | 1 |
| Digital outputs | : | 1 |
| Over voltage category | : | III |
| Pollution degree | : | 2 |

The data concentrator shall comply with the following:

| | | |
|---|---|---|
| Component type | ; | Energy server |
| Power supply | : | 24V dc |
| Power consumption | : | 26 W for 24V dc and 15 W for PoE |
| Communication | : | RS485 to meters and Ethernet for network |
| Digital inputs | : | 6 |
| Analog inputs | : | 2 |
| Analog input types | : | PT100, 0-10 V & 4-20 mA |
| Memory capacity | : | 128 MB RAM, 256 MB Flash and 4G SDRAM |
| Number of sub devices | : | 32 serial devices (Modbus RS485) |
| Data storage duration | : | 2 years |
| Built-in webserver | : | Yes |
| Real time data | : | Yes |
| Historical data | : | Bar graph and trending formats |
| Built-in data publisher | : | Yes |
| LED indication | : | Power supply, status, communication & IO’s |
| 3G Modem | : | Yes |

The following items shall be trended:

m) Voltages and currents – all meters
n) Imported kW, kVA, kVAr – all meters
o) Power factor – all meters
p) Imported kWh – Incomers (Transformer, generator and solar PV)
q) Exported kWh – Incomer (Transformer)

A monthly report, containing the trended information above, shall be automatically emailed from the data concentrator to email addresses that shall be provided by the client

## 19.3.18. Load control system

A load control system will be installed as part of this contract. The load control system shall switch circuit breakers ON and OFF based on total facility load by measuring the current. The system will consist of a programmable logic controller (PLC), human machine interface (HMI) and other associated equipment. The associated equipment shall include the required power supply, relays, lights, push buttons, selector switches, wiring and terminals.

The power supply for the PLC and HMI shall be taken from the output isolator of the inverter-charger to guarantee continuous power supply to the system.

The load control system shall be installed in a dedicated enclosure.

All the cabling to and from the load control system to the inverter charger, generator and main DB shall be installed by the electrical contractor.

The following items shall be covered by the load control system:

f) At an adjustable high current limit, selected circuit breakers shall be switched OFF
g) At an adjustable low current limit, selected circuit breakers shall be switched ON
h) All switching shall be time delay based
i) Selectable circuit breakers, current limits and time delays shall be adjustable via a dedicated settings screen on the HMI
j) Current values shall be determined by current transformers fitted on transformer incomer, generator incomer, inverter-charger output and solar incomer. The current values shall be converted with transducers from the current transformer 5A output to 4-20mA. The 4-20mA signals shall be wired into analogue inputs on the PLC. Each incomer shall have a current transformer per phase. The highest current of each incomer shall be used to determine when to switch by the PLC
k) All inputs onto the PLC shall be fused
l) All output on the PLC shall be wired to relays that will switch the required equipment
m) In addition to the above circuit breaker switching the load control system shall switch change-over switches to control current flow from the transformer and generator supply during power failures or as needed to meet the total building demand
n) The load control system shall be linked, via a multiport network switch, with Modbus TCP/IP to a transformer incomer power meter, generator controller and the inverter-charger system
o) The following values shall be displayed on the HMI:
    i. Transformer voltages: phase-to-phase and phase-to-neutral
    ii. Transformer load: total kVA, total kW and ampere per phase
    iii. Generator voltages: phase-to-phase and phase-to-neutral
    iv. Generator load: total kVA, total kW and ampere per phase
    v. Generator fuel level
    vi. Inverter-charger system input and output voltages and currents per phase
    vii. Battery percentage
    viii. Solar inverters' kW production
    ix. Charge controller's kW production
    x. All switched circuit breakers' statuses
p) The HMI shall be a 12"touch screen with full colour display and communicate over TCP/IP to the PLC
q) The PLC shall be a reputable brand well supported in the market

### 19.3.19. Site Acceptance Test (SAT)

The contractor will have a dedicated test sheet for testing the system that must be completed during the SAT. This test sheet shall include voltage measurements (AC and DC), current measurements (AC and DC) and frequency. The readings must be recorded and signed off by a trade-tested electrician

The SAT shall include a full battery test that include discharge and re-charge cycles as well as a full test of the load control system

Prior to the SAT all labelling will be fitted indicating the function and isolation points

### 19.3.20. Drawings

Within one week of the receipt of order the successful tenderer shall submit the following drawings / information for approval prior to placing orders on suppliers / delivery to site:

o) Inverter-charger details
p) Battery details
q) Solar inverter with optimizers
r) Charge controller details
s) Solar panel details
t) Solar panel layout
u) Mounting system details
v) DC cabling details
w) DC isolator with surge protection details
x) AC input and output isolator details
y) AC tie-in
z) Manual by-pass switch
aa) AC and DC wiring schematic
bb) Equipment lists
cc) Design details showing voltage and power calculations
dd) Design confirmation using dedicated solar design software
ee) Power usage monitoring system
ff) Load control system
gg) Recommended spare parts

### 19.3.21. Operating and maintenance manuals

The contractor shall supply three complete, comprehensive sets of operating and maintenance manuals containing all design and drawing information as listed above.

The above manuals are to be handed to the Employer’s authorised representative on completion of the site acceptance test

## 49.3.22. Warranty

| | | |
|---|---|---|
| General workmanship | : | 12 months |
| Electrical equipment and material (AC and DC) | : | 12 months |
| Solar modules | : | 25 year product |
| | | 10 year performance |
| Inverter-chargers and charge-controllers | : | 10 years |
| Lithium iron phosphate battery | : | 10 years / 4000 cycles |

The tenderer shall provide the warranties above on the system for the indicated periods, starting from the date of hand-over. During the warranty periods, the tenderer shall repair any defective material, equipment or workmanship (excepting proven, wilful or accidental damage, or reasonable wear and tear). These shall be made good with all possible speed at the tenderer's expense and to the satisfaction of the Employer.

When called upon by the Employer, the tenderer shall make good on site and shall bear all expense incidental thereto, including making good of work by others, arising from the removal or reinstallation of equipment. All work arising from the implementation of the guarantee of equipment shall be carried out at times which will not result in any undue inconvenience to users of the equipment or occupants of premises.

If any defects are not remedied within a reasonable time, the Employer may proceed to do the work at the tenderer's risk and expense, but without prejudice to any other rights which the Employer may have against the tenderer.

The Employer reserves the right to demand replacement or making good by the tenderer at his own expense of any part of the tender which is shown to have any latent defects or not to have complied with the specification, notwithstanding that such work has been taken over or that the guarantee period has expired.

Should any specified materials or equipment in the tenderer's opinion be of inferior quality, or be unsuitably employed, rated or loaded, the tenderer shall prior to the submission of his tender advise the Employer accordingly. His failure to do so shall mean that he guarantees the work including all materials or equipment as specified.

## 19.3.23. RETURNABLE HYDRID SOLAR PV SYSTEM DATA SHEET

# SCHEDULE OF INFORMATION / COMPLIANCE DOCUMENT (RETURNABLE DOCUMENT)

The tenderer must sign and return the compliance document. Failure to do so will automatically lead to disqualification of the tenderer and his/her tender will not be considered regardless of tendered value.

** Tenderer to indicate Yes or No to confirm compliance to specification **

| Description | Yes / No | Make & model & size |
|---|---|---|
| Inverter-chargers | | |
| Lithium iron phosphate batteries | | |
| Solar inverters with optimizers | | |
| Charge controllers | | |
| Solar modules | | |
| Mounting system | | |
| DC cabling and installation | | |
| DC isolation with surge protection | | |
| AC input isolation with surge protection | | |
| AC output isolation with surge protection | | |
| AC output isolation with Type B RCD | | |
| AC cabling and installation | | |
| Feeder circuit breaker in DB | | |
| By-pass switch included | | |
| Electrical earthing and bonding allowed for | | |
| Inverter-charger monitoring system | | |
| Power usage monitoring system | | |
| Load control system with PLC & HMI | | |
| Generator control and programming for low battery etc | | |
| Generator supplier integration and liaison | | |
| Labelling | | |
| Drawings, equipment lists & design requirements | | |
| ECSA accredited (Pr Eng / Pr Tech Eng) sign off | | |

| | | |
|---|---|---|
| Health & Safety file allowed for | | |
| Site acceptance testing allow for | | |
| Customer hand-over and training allow for | | |
| Anti-islanding NRS and SANS approved | | |
| Guarantee | | |

_____ _____

Date Tenderer authorised signature

_____ _____

Name and Surname Position

# 20 Mechanical works

## 20.1 Installation

- routing and/or concealment of cables, ducts, trays, pipes etc. : see mechanical drawings.

## 20.3 Location and access

- catwalks, cat ladders, access panels: see structural and architectural drawings / metalwork schedule.

# 21 External works

## 21.1 Paving (refer to SANS 1200 MJ Segmental paving.)

### 21.1.1 Materials

**units**

a. Paving unit type: Precast concrete blocks

**precast concrete segmental paving blocks**

a. Type: S-C (rectangular)
b. Class: 25
c. Nominal thickness: 80mm
d. Top edges: Chamfered
e. Colour: Refer to Architects specifications

**sand for bedding and jointing of flexible paving**

a. Sand shall be used for jointing to fill gaps between pavers.

### 21.1.2 Preparation

**subgrade**

b. Subgrade levels and falls: Refer to design drawing

**weed killer**

a. Treat area to be paved with suitable weed killer Required

**levels, falls, pattern**

a. Levels and falls: Refer to design drawing
b. Pattern: Refer to Architects specifications

**accuracy**

## 21.2 Concrete culverts, kerbs, channels

a. Type: Varies, refer to design drawings

### Materials

a. Kerb type: Mountable
b. Edging type: Refer to design drawings
c. Channel type: Varies, refer to design drawings

### 21.2.2 Laying

a. Movement joints: Filled with joint sealant and soft board.

## 21.3 Concrete retaining blocks

**blocks**

- shape, size and colour: …

**preparation**

- depth, level and type of foundation: see drawings

Foundations: also on sloping or gravel foundation. *Drawings* should show this. Compacted earth foundation is usually sufficient for structures not higher than 1,2m. Higher walls should be thicker, inclined towards the retained earth, anchored with a geogrid mesh, or by modifying the properties of the backfill. Consult the supplier of the blocks and/or Competent Person. Ensure building regulations are complied with.

- width of foundation: see drawings

Show width of foundation if of concrete.

- drain pipes, aggregate drain, geofabric drain behind retaining wall: required / not required

**placing**

- stacking pattern: see drawings
- geofabric reinforcement: required / not required.

SANS 207 gives recommendations for the application of reinforcement techniques to soils and other fills.

## 21.4 Gabions

*Applicable standard*: SANS 1200 Standardized specification for civil engineering construction Section DK: Gabions and pitching

**materials**

h) Type: Hexagonal woven steel wire mesh gabions and mattresses
i) Cage dimension: 2m x 2m x 0.3m
j) Mesh wire to be PVC-coated: Not required

## 21.5 Fencing

- type:
  Hot Dipped Galvanised Steel (Class A) high density Anti Climbing and Anti Cut pressed Metal panel fencing with Anthracite Grey Colour formed of 4mm Diameter Horizontal and Vertical High Tensile Line Wires with Aperture size 76.2 x 12.7mm and reinforcing V- Section Ribs, bolted with vandal resistant bolts and clamping plates to and including taper locking posts with sealed end caps and 30 x 3mm x 250mm long angle section base anchors with posts bedded in and including 400 x 400 x 600mm deep cement concrete pads.
- Fencing to include:
  250 x 750mm Reinforced concrete 15MPa sill beam between fence posts set level and secured to fence panels with anti theft double bar riveted to mesh and bedded in concrete sill all in strict accordance with the manufacturers instructions including excavations, backfilling, concrete, reinforcing etc. Exposed faces of sill beam to be form,ed with class 2 timber shutters, exposed corner edges chamfered and finished to top surface with brush finish.
- Product specification. Wireforce Wirewall code 358, or equal approved, mesh fencing. Comprising mesh in 75x12.5 apertures, 4mm vertical wires and 4mm horizontals. Base material in 220g/sqm Aluzinc coating with finishing in 400 micron coloured thermoplastic finish. Colour (provisionally) Black.
  - Panels of height 2400mm, 3000mm width with 4 V- profiles per panel.
  - Fence posts in same finish coat, of 3600mm length set in concrete pad footings
  - Fence panels topped with secure razor wire Flat-wrap on gms straining wires. All installed in strict accordance with manufacturer's specifications.

### 21.5.1 Line wire and chain-link mesh fencing

- N/A

### 21.5.2 Weld mesh fencing

- Material: Refer general fencing specification above

High tensile steel (>950 MPa); very high tensile steel (>1 250 MPa).

### 21.5.3 Barbed tape fencing

- type: B (flatwrap)
- material: zinc-coated steel strip
- zinc coating grade: heavy

### 21.5.4 Palisade fencing

- N/A

### 21.5.5 Electric fencing

- N/A

### 21.5.6 Gate automation

- theft-resistant cages with padlock: required

### 21.5.7 Private swimming pool fencing

- N/A

## 21.6 Precast concrete plank walling

- N/A

## 21.7 Swimming pools

- N/A

## 21.8 Timber decking

- N/A

## 21.9 Landscaping

### 21.9.9 Garden furniture

- garden furniture type: N/A

### 21.9.10 River pebbles

- N/A

# PROPOSED NEW NTSHONGWE POLICE STATION
# KWAZULU-NATAL PROVINCE

# AUTOMATIC FIRE DETECTION AND ALARM SYSTEM

# TECHNICAL SPECIFICATIONS


**PART 1 :** **PARTICULAR TECHNICAL SPECIFICATION (Page FD-2)**

**PART 2:** **STANDARD TECHNICAL SPECIFICATIONS (Page FD-26)**



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**Contact person:** Mr M Khoosal
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***Prepared for :***

South African Police Service

Back to Basics
Towards a Safer Tomorrow

**SEPTEMBER 2024**

# NEW AUTOMATIC FIRE DETECTION, ALARM AND EVACUATION INSTALLATION

# AT NTSHONGWE POLICE STATION

## PART 1: PARTICULAR TECHNICAL SPECIFICATIONS

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**JULY 2024**

# PART ONE : PARTICULAR TECHNICAL SPECIFICATION

## C O N T E N T S

Page

*1.1.0 GENERAL ..... FD-4*
*1.1.2 Tender Drawings ..... FD-4*
*1.1.3 Works Programme ..... FD-4*
*1.1.4 Maintenance And Guarantee ..... FD-4*
*1.1.5 Shop Drawings ..... FD-4*
*1.1.6 Tender Price Details ..... FD-5*
*1.1.1 Standard Technical Specification ..... FD-5*
*1.1.7 Make and Model of Equipment Offered ..... FD-5*
*1.1.8 Price Variance/Price Adjustment ..... FD-5*
*1.1.9 Progress Payments ..... FD-5*
*1.1.10 Ordering Of Materials ..... FD-5*
*1.1.11 As-Built Drawings ..... FD-6*
*1.1.12 Maintenance And Operating Manuals ..... FD-6*
*1.1.13 Power Supply For Site Works ..... FD-7*
*1.1.14 Contracts Management ..... FD-7*
*1.2.0 SITE DESCRIPTION, SCOPE of CONTRACT, etc ..... FD-8*
*2.0 SCOPE OF WORKS ..... FD-8*
*3.0 CONTRACTOR RESPONSIBILITY ..... FD-8*
*4.0 FIRE ALARM CONTROL PANEL ..... FD-9*
*6.0 AUTOMATIC DETECTORS ..... FD-10*
*7.0 ADDRESSABLE MANUAL FIRE ALARM BOXES (CALL POINTS) ..... FD-11*
*8.0 AUDIBLE AND VISUAL NOTIFICATION APPLIANCES ..... FD-13*
*9.0 LINE ISOLATOR ..... FD-15*
*10.0 WIRIING AND CABLING ..... FD-15*
*11.0 ACCEPTANCE TEST (HANDOVER) ..... FD-17*

# NEW AUTOMATIC FIRE DETECTION, ALARM AND EVACUATION INSTALLATION AT NEW NTSHONGWE POLICE STATION

## PARTICULAR SPECIFICATIONS

1.1.0 **General**

1.1.1 Standard Technical Specification

This part of the specification takes precedence over Part 2 (Standard Technical specification) in respect of any discrepancies in the description of equipment or materials.

1.1.2 Tender Drawings

The following drawings form part of this specification and must be read in conjunction with it:

M693/FD/01 (Rev.0) Automatic Fire Detection and Alarm Installation Layout

1.1.3 Works Programme

Unless otherwise stated, in the tender documentation, the successful Tenderer, shall within 1 week of appointment, provide the Engineer with a comprehensive programme of works to tie in with that of the main contract programme. The programme must be comprehensive and indicate lead time for equipment, production of shop drawings, first and second fix items, and commissioning. Adequate time must be allocated for commissioning of the systems.

The contract completion period shall be as per the main contract.

1.1.4 Maintenance and Guarantee

All plant and equipment supplied under this contract shall be guaranteed for a period of twelve (12) calendar months from the date of practical or first handover of the installation, whichever occurs first.

1.1.5 Shop Drawings

The successful Tenderer will be required to issue for the Engineer's acceptance three copies of all shop drawings, including floor plan and control board circuit diagram within three weeks of the tender being awarded to him or as and when requested by the Engineer.

These drawings shall be adjusted and re-submitted should they be red-lined by the Engineer.

The acceptance of shop drawings by the Engineer shall in no way relieve the air conditioning Contractor of his responsibilities, such as accurate dimensioning of builder's works, providing correct size and strength of supporting structures, location of plants, fittings and access panels for adequate access for servicing and maintenance, and adherence to all applicable regulations, generally accepted good practice, and the technical specification and drawings.

The Contractor must draw to the Engineer's attention, in good time, if any part of the design he believes to be not correct or in compliance with the applicable rules and regulations or standards.

Drawings shall be produced using a reputable drawing package, and compatible with AutoCad.

1.1.6 Tender Price Details

The tenderer shall be required to complete the tender price schedule at the time of tender. Failure to do so may result in the tenderer being disqualified. Alteration to the bill of quantities, in anyway whatsoever, shall render the tender invalid.

1.1.7 Make and Model of Equipment offered

Where alternate make of equipment to that indicated in this specification is offered, then this shall be equal, and subject to acceptance by the Engineer, prior to submission of the tenders. Acceptance of the alternative shall not relieve the tenderer from his/her obligation to ensure compliance with the specification, compatibility with other components forming part of the system, and that the equipment will fit in the space available without compromising function and access. The Engineer reserves the right to reject the alternate, for any reason whatsoever, and call for the make and model specified to be provided at no additional cost.

1.1.8 Price Variance/Price adjustment

As indicted in the contract data and/or the Note to Tenderers.

In situations where the equipment supplier offer terms of payment and conditions of contract which are at variance with this contract, then these shall be for the Contractor's account.

1.1.9 Progress Payments

The Contractor shall submit his claim timeously to allow for the Engineer at least 7 working days to process and submit his payment certificate to the University.

1.1.10 Ordering of Materials and Equipment

Within 2 weeks of acceptance of the successful Tenderer, the Contractor shall submit, for the Engineer's approval, a list of make and model numbers of all equipment and materials to be utilised in this contract. An approval by the Engineer shall not absolve the Contractor from complying with the specification unless the Contractor has specifically applied for deviation from the specification for the item in question.

The equipment and materials referred to above shall include but not be limited to;

- Alarm and mimic panels
- detectors
- sirens
- loud speakers
- microphones

- audible alarm devices

The Contractor shall be responsible to ensure that the contract programme is adhered to and that no delays are caused by late deliveries of equipment and materials.

Other activities which must precede placing of orders must be taken into account when the Contractor schedules his activities.

1.1.11 As-Built Drawings

The Contractor shall provide a complete set of as-built drawings one electronic copy on a compact disk in AutoCad Format, with each operating and maintenance manual.

The provision of complete and approved as-built drawings shall be a prerequisite to first delivery.

Any changes to the designed location of notification appliances and detection devices shall be approved prior to installation. Additionally, the as-builts shall show how the cable and conduit has been routed and the location of all terminal and junction boxes. The as-builts shall account for all field changes that were made during the installation.

The Contractor shall develop a matrix of operations for each detection device (point), grouped for each building, which shows the device address, location, and function.

The Contractor shall show the equipment and addresses associated with each device, as listed in this specification, on a separate layer and provide copies of only this layer shown on the floor plans as part of the set of as-built drawings.

Upon completion of the installation of the system and a minimum of one (1) week prior to the Acceptance Test, the Contractor shall deliver two (2) complete sets of reproducible, full-size, appropriately scaled, as-built drawings to the Engineer.

1.1.12 Maintenance and Operating Manuals and Maintenance Plan

Three (3) copies of maintenance and operating manuals, each with CD with a scanned PDF copy of the entire manual is required for this installation. The manuals must include the following items;

(a) List of contents.
(b) Training notes.
(c) Client's, Consultant's and Sub Contractor's details including name, contact person telephone and fax numbers, etc.
(d) Full description of installation and operating features.
(e) Description of automatic control system, accompanied by control schematics.
(f) Step-by-step instructions for testing of the system.
(g) Step-by-step functional description of the system.
(h) Step-by-step operator instructions.
(i) Abbreviated operating instructions for mounting at fire alarm control units and mimic panel.
(j) Program Software Backup: on compact disk, complete with data files.
(k) Software operating and upgrade manuals.

(l) Device address list.
(m) Printout of software application and graphic screens.

(n) Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 or applicable codes
(o) Requirements and recommendations related to results of maintenance.
(p) Manufacturer's user training manuals.
(q) Manufacturer's required maintenance related to system warranty requirements.
(r) List of all equipment with reference numbers, model numbers, Serial Numbers, and suppliers names and contact details.
(s) Names and addresses of firms from whom spare parts can be obtained if different from the above.
(t) Spare parts lists.
(u) Full maintenance and servicing schedules (as recommended by equipment suppliers and including schedules attached to this document)
(v) Full set of as-built installation drawings. wiring diagrams, etc.,
(w) CD with copy in PDF format of entire document and drawings.

Each manual must be bound in a hard covered ring file or similar, with the project title and type of installation printed permanently on the face and spine of the manual.

A draft copy of the manual must be submitted to the engineer during commissioning stage for his approval and shall include all items stated above except for the commissioning data.

Once commissioning has been completed a draft copy of the commissioning data must be submitted to the engineer for his approval. The accepted commissioning data must then be bound with the rest of the manual for final submission.

The Engineer reserves the right, at any time, to request a resubmission of draft copies by the Sub Contractor for the Engineers approval.

**The provision of complete and approved set of Operating and Maintenance Manuals shall be a prerequisite to first delivery or beneficial handover.**

1.1.13 Power and Water Supply for site Works

Existing power and water supply shall be made available free of charge to the contrcator for site works. Power requirements for welding and cutting purposes shall be provided by the contractor.

1.1.14 Contracts Management

1.1.14.1 Upon appointment, the Contractor shall allocate to this project, a suitably qualified Contracts Engineer and a site foreman, each with at least 7 years experience, who shall at all times be in full control of, and be able to report expediently to the Engineer and the Client’s project manager on all aspects of the Contract. The site foreman representing the fire installation, will be required to be full time on site, and as and when the Engineer and/or the Client deems it necessary.

1.1.14.2 Should the Engineer indicate that the Contractor has not satisfactorily complied with the above and has failed to remedy the situation within 14 days of written instruction to do so, the contract may be cancelled or payments withheld.

1,2.0 **Site Description and conditions**

1.2.1 Site Description

1.2.1.1 The site for this contract is located in Ward 19, Umkhanyakude District Municipality, Kwazulu-Natal.

1.2.2 Site Conditions

Site conditions are as follows:

(a) Altitude: 100m above sea level
(b) Electrical Supply 400 Volts (+/-10%), 3 phase, 50 Hz, 4 wire
(c) Design summer outdoor air condition: 35.0$^{o}$C db/75%RH

Fault levels for Switchboards: 5kA

All equipment selected must be capable to operate safely at a voltage supply of 220V or 400V with +/-10% fluctuation.

1.2.3 **Abnormal and/or unusual conditions**

The tenderer shall make note of the following conditions, and shall make adequate allowance in his/her rates for such conditions;

i) The building will be occupied and operational throughout the contract period.

1.2.4 QUALIFICATIONS

All works shall be carried out by SAQCC certified designers, installers, cablers, Commissioners and servicemen, or equivalent and approved by the Engineer.

**2.0 SCOPE OF WORK**

The scope of work includes the installation of a new fire alarm and detection system complete with a local fire alarm control panel (FAP), as indicated on the drawings and identified in this specification.

The scope of work also includes training of SAPS personnel on the operation of the system, required maintenance tasks and frequencies, and the locations of all equipment necessary to maintain and operate the fire alarm system.

3.0 CONTRACTOR RESPONSIBILITIES

The installation and wiring of all devices in accordance with the latest published revision of the manufacturer's installation instructions to achieve the system operation and function as specified herein.

Metal raceway, conductors, fittings, and all other accessories required to provide a complete and operable fire alarm system.

The development of installation shop drawings for each fire alarm system installation in accordance with the applicable codes, cited in this specification.

The Contractor shall submit the working drawings for review and approval by

ENGINEER.

Providing all required documentation, as specified in this specification

Coordinating the Acceptance Test of the networked fire alarm systems with the building operators, Engineer, and other parties identified by the Engineer.

Prerequisites to the acceptance Test are:

1. Provide documentation of all system startup, and pre-requisite tests, and record of completion.

2. Provide a test plan that outlines the sequence of testing, who will test, and how the Acceptance Test results will be documented at the time of the testing. Failure to provide this for review will result in postponement of the Acceptance Test

The Systems shall be tested in accordance with the latest published edition of the equipment manufacturers' testing procedures and guidelines.

4.0 FIRE ALARM CONTROL PANEL

The panel shall be ZIton ZP3 series or equal and approved by the Engineer prior to tender closing. The panels shall be supplied and located as indicated on the drawings and as summarized below;

| REFERENCE | LOCATION | AREA SERVED |
|---|---|---|
| **FIRE ALARM PANEL:** | | |
| FAP1 | Station Commanders office in Main Administration block | Block A - Main administration Block, Staff accommodation, Service areas |

FUNCTIONAL DESCRIPTION OF THE SYSTEM

The following sections are a functional description of each fire alarm system in each building unless otherwise noted.

The new FAP shall include new control/communications equipment which is UL Listed or FM approved to operate with the submitted manual fire alarm boxes, heat detectors and smoke detectors, alert building occupants using audible and visible notification appliances, supervise each system for conditions which would impair proper system operation, annunciate such abnormal conditions, and where applicable, control related equipment as indicated on contract documents such as air handling units and smoke control.

Alarm Condition

The system operation shall be such that the alarm operation of any alarm initiating device shall not prevent the subsequent alarm operation of any other initiating device due to wiring or power limitations.

The system alarm operation subsequent to the alarm activation of any manual fire alarm box, any system-type automatic detection device (smoke detector or

heat detector), or sprinkler waterflow switch shall automatically perform the functions contained in this section and operate as follows:

All wiring extending from the FAP shall be supervised for opens, shorts, and grounds. Systems containing unsupervised wiring of any type shall not be acceptable.

The occurrence of any fault shall activate the system trouble circuitry, but shall not interfere with the proper operation of any circuit that does not have a fault condition.

Incoming 220 VAC line power shall be supervised so that any power failure shall be audibly and visually indicated at the control unit.

Batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control unit and at the security Center.

Interconnected Fire Safety Systems, where applicable (releasing panels) shall be monitored for alarm and trouble conditions. The supervisory signal shall activate any time the monitored system indicates an off-normal condition.

System Reset

A “SYSTEM RESET” button shall be used to return the system to its normal state after an alarm condition has been remedied. Printed messages shall provide operator assurance of the sequential steps (i.e.: “IN PROGRESS”, “RESET COMPLETED”) as they occur, should all alarm conditions be cleared.

Should an alarm condition continue to exist, the system shall remain in an ab-normal state. System control relays shall not reset. The control unit “ALARM” LED shall remain on. These points shall not require acknowledgment if they were previously acknowledged.

## 6.0 AUTOMATIC DETECTORS – GENERAL

All automatic smoke detectors shall be of the addressable, analog photoelectric type and shall be interchangeably mounted into a common twist-lock base.

The control unit shall recognize changes of detector type in each location and provide proper indication that reprogramming for the affected address is required.

Detector bases shall have Brady, or similar approved equal, adhesive markers attached to them indicating the address of the detector. Markers shall be installed, by
the Contractor, on the inside of the base and lettering shall be a minimum of 12 point.

## 6.1 ADDRESSABLE PHOTOELECTRIC SMOKE DETECTORS

Photoelectric smoke detectors shall have a general alarm setting in all common spaces of 3.0% - 4.0% per foot obscuration.

The detectors shall provide a combination alarm/power LED. The LED shall flash under normal conditions, indicating that the detector is operational and in regular

communication with the control unit. The LED shall be placed into steady illumination under an alarm condition. An output connection shall also be provided in the base to connect an external remote alarm LED.

6.2 DETECTOR BASES

Automatic detectors shall utilize a common, plug-in, twist-lock, tamper-resistant type base that accommodates photoelectric and thermal detectors. Detectors shall be interchangeable to simplify field conversion.

Removal of the detector from the base shall cause a trouble indication at the FAP. Removal of the detector shall not disrupt the alarm circuit wiring or prevent the receipt of alarms from other devices operating in the circuit.

Insertion of an incorrect detector type into the base shall cause a "Wrong Device" trouble condition at the FACU until the proper type of detector is installed, or the system is re-programmed. The system program shall recognize the insertion of a wrong device and shall automatically default to the setpoint values corresponding to the inserted device, and shall monitor alarm and trouble conditions according to the default parameters.

Provide bases constructed of white, high impact polycarbonate designed for mounting on a standard 3-1/2 inch or 4-inch octagonal or 4-inch square outlet box. Provide screw terminal connections for No. 12 AWG wire.

7.0 ADDRESSABLE MANUAL FIRE ALARM BOXES

Manual fire alarm boxes (manual call points) shall be of the non-coded, double-action type, surface or semi-flush mounted, neat in appearance, with integral contact monitor module to provide addressable operation.

Faceplates shall be red with raised white identification lettering and bear the legend “FIRE – BREAK GLASS”.

Stations shall mechanically latch after operation, with a key operated reset feature, keyed the same as FAP.

Every manual fire alarm box shall have an engraved nameplate permanently installed on its face or Brady, or equal approved equal, adhesive markers attached to them indicating the address of the station. The Contractor shall install markers on the outside of the manual fire alarm box and lettering shall be a minimum of 12 point.

The manual call point shall have an LED which shall immediately confirm its actuation.

It must be able to test the Call point without destroying the glass or removing the cover. It shall be possible to reset the alarm call point with a special tool only.

The manual Call Points shall consist of a base and insert, and shall be able to accept a transparent snap cover. Removal of a call point shall not cause disconnection of the wiring, and shall not interfere with the remaining devices on the line.

The breaking of the glass must initiate an alarm. The glass shall be of the type that when broken, does not produce sharp edges which could cause injury.

**ADDRESSABLE MONITOR MODULES**

Furnish and install addressable monitor modules to supervise and monitor the status
of each non-addressable device, such as conventional spot-type heat detectors, sprinkler waterflow alarm switch and valve supervisory switch contacts, special hazard fire suppression alarm contacts and fire pump supervision contacts.

Each addressable monitor module shall be able to support any number of normally open (N/O) devices. Wiring to the devices(s) being monitored shall be Class A supervised (Style D). Module status (normal, alarm, supervisory, trouble) shall be transmitted to the FACU.

The addressable monitor modules shall provide address-setting means.

Each addressable monitor module shall be provided with a switch to provide a means of disconnecting the initiating circuit to allow work to be performed on the initiating circuit without causing an alarm.

An LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control unit.

**ADDRESSABLE CONTROL RELAY OUTPUT MODULES**

Where specified and applicable, provide addressable control relay output modules to permit hardwired control capability from the signaling line circuit. Relay contacts shall be DPDT, rated 2 amperes at 24 VDC.

Furnish and install addressable control relay output modules for the functions as specified in this specification.

Each relay shall operate according to the control program resident in the FAP. Relays shall be supervised for trouble conditions (open, short, device missing/failed) at the FAP.

Relay output modules shall include a mounting plate for installation in a junction box.

The relay output module shall provide address-setting means and shall also store an internal identifying code that the control unit shall use to identify the type of device.

An LED shall be provided which shall flash under normal conditions, indicating that the Relay Output Module is operational and is in regular communication with the control unit.

Provide transient suppressors for inductive loads.

## 8.0 AUDIBLE AND VISIBLE NOTIFICATION APPLIANCES

**General**

All notification appliances shall be rated at 24 VDC and shall be powered by supervised notification appliance circuits originating from the FAP or remote power extenders listed for this purpose.

Notification appliances installed in the men and women rooms shall be weather proof.

**Visible (strobe) notification appliances**

All strobes shall conform to the requirements of NFPA 72, UFAS and the ADA and shall be listed to UL 1971, Standard for Signaling Devices for the Hearing Impaired.

All visible notification appliance circuits shall be synchronized and have a rated light output as indicated on design drawings.

A strobe notification appliance shall be installed on the outside of every entry door to a space that is protected by a HALON suppression system. The body of the notification appliance shall have the words HALON on it.

**LOUD HORNS**

When shown on the drawings, provide a fire alarm system printer Listed and labeled
as an integral part of the fire alarm system. The system printer shall be UL listed to Standard 864 under UL category UOXX System Control Unit Accessories and supervised by the FACU.

The system printer shall record all alarm, supervisory, and trouble events. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.

he system printer shall be arranged to have the ability to provide hard copy records of system events, addressable analog sensor reports (sensitivity reports, etc.), Walk test system testing reports and History files.

Printer Ribbons: The Contractor shall furnish 2 spare printer ribbons.

The fire alarm system printer shall be installed in the vicinity of the FACU. If adequate table space is not provided by SRP for the printer, the Contractor shall furnish
and install an adequately sized table.

The manufacturer's technical representative shall also be required to instruct designated building and management personnel in the general operation of the system and to give the designated personnel an overview of the system functions when the system is in normal, supervisory mode, alarm mode, and trouble mode, as specified in this specification.

**Automatic Detectors**

In general, automatic detectors shall be mounted on the structural ceiling or finished ceiling and not on the bottom or side of any type of construction or structure, which extends down from the ceiling.

Automatic detectors shall be located near points where air currents normally intersect. Detectors shall not be located in the direct path of the draft from an HVAC air supply grille, a door, window, or hallway. Detectors shall be installed a minimum of three (3) feet from an HVAC air supply diffuser, in accordance with NFPA 72.

All automatic detectors shall be installed as indicated on the plans, within five (5) feet of the location shown on the drawings to accommodate construction, and readily visible from the floor.. The mounting location of every device shall be approved by the Engineer

**Addressable Photoelectric Smoke Detectors**

Addressable analog photoelectric smoke detectors shall be installed as shown on the drawings. These common area detectors shall be spaced at thirty (30) foot centers, and in accordance with NFPA 72 and the manufacturer's installation instructions. Smoke detectors shall only be installed in those environments suitable for proper smoke detector operation.

**Addressable Manual Fire Alarm Boxes**

Unless otherwise directed, manual fire alarm boxes shall be installed at every exit. Install in accordance with NFPA 72 and as shown on the drawings.

Manual fire alarm boxes shall be installed within five feet (5') of each exit that they serve and mounted no higher than forty eight inches (48") above the finished floor. All boxes shall have a protective cover installed over them in the vehicle repair bays, shops, and warehouse areas.

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**Addressable Monitor Modules**

Addressable monitor modules shall include a mounting plate for installation in a junction box or shall be mounted in a locked cabinet or approved box, as shown on the manufacturers recommended specifications.

**Audible and Visible Notification Appliances**

The notification appliances shall be installed in accordance with the recommended audibility levels and the required illumination levels as described in NFPA 72. The minimum acceptable decibel level is 15 dBA over background noise. The maximum acceptable decibel level is 110 dBA.

All notification appliances shall be installed in environmental conditions in accordance with their Listing and manufacturer's specifications and installation instructions.

**Notification Appliance Circuits**

Notification appliance circuits shall not be installed in the same raceway with

signaling line circuits unless approved in writing by the networked fire alarm systems supplier.

Notification appliance circuits and control equipment shall be arranged and installed so that loss of any one (1) notification appliance circuit shall not cause the loss of any other notification appliance circuit in the systems.

**Labeling and Marking**

All of the hardware covered in this Specification shall l have Brady adhesive markers, or SRP approved equal, attached to them indicating the address of the hardware. Markers shall be installed, by the Contractor, on the inside of the base and lettering shall be a minimum of 12 point

## 9.0 LINE ISOLATORS

Line isolators shall be installed at intervals on the addressable detector line. In the event of a line short circuit, the isolatros on each side of the short must open, and isolate the faulty section of the wiring thus enabling the remainder of the system to function normally.

## 10.0 WIRING AND CABLING

All cabling between detectors, manual call points and fair alarm panels and mimic panel shall be fire rated. The rating shall be either 30minutes of 120 minutes as indicated in the bill of quantities.

All field wiring and cabling shall be run in PVC conduit or trunking. Sprague tubing shall be used within 1m of devices to facilitate removal of devices of moving of movable substrates such a ceiling tiles.

The entire wiring and raceway system for the networked fire alarm systems shall be
in full accordance with NFPA 70, or applicable Electrical Codes.

The Contractor shall furnish and install low voltage surge arrestors on all SLCs, NACs, transmitter, and auxiliary control circuits for all circuits that leave the building
shell. Units shall be UL 497B compliant with a 30 volt clamping level and have a response time of 5 nanoseconds. The Contractor shall install such devices in strict accordance with manufacturer's recommendations. Acceptable manufacturer: Edco, Inc., Ocala, Fl, model numbers P264, PC-642030XLC.

The Contractor shall provide all metal raceway, wiring, outlet boxes, junction boxes, cabinets, labels and similar devices necessary for the complete installation of the fire alarm systems. All wiring shall be of the type as specified herein and recommended by the manufacturer and shall be installed in metal raceway throughout.

Terminal cabinets with side hinged, lockable red covers, supplied by Space Age Electronics, Marlboro, MA, or approved equal shall be provided at all junction points.

All conductor splices shall be made on screw-type terminal blocks – wire nuts, butt, crimp or screw type connectors shall not be used. All terminals within a terminal

cabinet shall be properly and permanently labeled. All junction box covers shall be painted red.

Raceways containing conductors identified as "Fire Alarm System" conductors shall not contain any other conductors, and no alternating current carrrying conductors shall be allowed in the same raceway with the DC fire alarm detection and signaling conductors.

The conductors for the notification appliance circuits shall not be installed in the same raceway as the conductors for signaling line circuits unless written certification from the manufacturer is supplied to the Engineer indicating that the inclusion of these circuits in the same raceway is acceptable and that no additional consideration is needed for these circuits.

All existing wiring shall be removed and discarded.

All wiring shall tested free from grounds and short circuit faults. The testing results shall be recorded, signed by the Contractor and forwarded to the Engineer. No connections to the FAP shall be made until the system wiring has been tested and verified to the Engineer.

All conductors installed in ducts, plenum, air handling spaces and the under floor of computer rooms shall comply with the applicable sections of NEC Section 300.22.

Exposed raceways shall be run parallel and perpendicular to the walls and ceilings.

Wherever practical, exposed raceways shall be run on the ceiling as close as possible to a wall or as high as possible on a wall. Where exposed raceways shall cross under a structural beam or rib, they shall be run down on one side of the beam or rib, across its bottom, and up to the ceiling on the other side of the beam or rib. No
spanning from beam to beam or rib to rib shall be permitted. The use of a raceway body on one side of a beam or rib shall be permitted provided it shall be readily accessible. Where metal raceway is installed exposed, it shall be painted to match the walls and/or ceilings on which it is installed, as instructed by the Engineer. The method and location of all exposed raceways shall be approved by the Engineer prior to start of any installation work.

The power employed to operate the fire alarm systems shall have a high degree of reliability and capacity for the intended service. Connections to this power service shall be made on a dedicated branch circuit(s). The circuit shall be mechanically protected.

Circuit disconnecting means shall have a red marking, shall be accessible to authorized personnel, and shall be identified as “FIRE ALARM CIRCUIT CONTROL.” The location of the circuit disconnecting means shall be permanently identified on a nameplate installed on the inside of the FACU.

All wiring within the control unit shall be neatly served in the panel gutters and be secured by means of Thomas & Betts "Ty-Raps" or by other approved means.

All conductors and EMT shall be installed in a neat and workmanlike manner. Vertically and horizontally positioned EMT and or conductors shall be supported in accordance with good tradesman practices and including but not limited to the NEC Sections 376 and 378.

Where penetrations of floor slabs, fire-resistance rated walls and/or smoke barrier walls are made, the wiring shall be sleeved in metal raceway and the penetrations shall be fire-stopped with approved or UL Listed through-penetration firestop assembly material acceptable to Engineer.

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## 11.0 ACCEPTANCE TEST

Upon completion of the installation of each system and a minimum of two (2) weeks prior to the Acceptance Test, the Contractor shall deliver two (2) complete sets of the Test Plan, which shall describe how the system shall be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be employed. All tests shall be conducted in the presence of SRP and other parties identified by SRP and shall not be conducted until the “Test Plan” is approved.

**PART 2 : STANDARD TECHNICAL SPECIFICATIONS**

# STANDARD TECHNICAL SPECIFICATION FOR AN AUTOMATIC FIRE ALARM AND EVACUATION INSTALLATION

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Back to Basics
Towards a Safer Tomorrow

# STANDARD SPECIFICATION - FIRE ALARM AND EVACUATION INSTALLATION

1 INTRODUCTION FD-S4

1.1 SCOPE FD-S4
1.2 DEFINITIONS FD-S4
1.3 STANDARDS AND REGULATIONS FD-S5
1.4 DESIGN FD-S6
1.5 MATERIALS FD-S6

2 SYSTEM REQUIREMENTS FD-S6

2.1 REMOTE INDICATOR LIGHTS FD-S4

2.2 SOFTWARE FD-S4

2.3 SCADA SOFTWARE FD-S4

2.4 FIRE ZONES FD-S4

2.5 SPARE CAPACITY FD-S4

3 EQUIPMENT REQUIREMENTS FD-S4

3.1 QUALITY OF EQUIPMENT FD-S4

3.2 FIRE ALARM PANELS (CONTROL PANELS) FD-S4

3.3 CONVENTIONAL FIRE ALARM PANELS (CONTROL PANELS) FD-S4

3.4 ANALOGUE ADDRESSABLE FIRE ALARM PANELS (CONTROL PANELS) FD-S47

3.5 POWER SUPPLY FD-S4

3.6 DETECTORS AND DETECTOR BASES IN GENERAL FD-S4

3.7 CONVENTIONAL DETECTORS AND DETECTOR BASES FD-S4

3.8 ANALOGUE ADDRESSABLE DETECTORS AND BASES FD-S4

3.9 MANUAL CALL POINTS (BREAK GLASS UNITS) FD-S4

3.10 AUDIBLE ALARMS (SOUNDERS) FD-S4

3.11 FIRE BRIGADE SIGNALLING FACILITIES FD-S4

3.12 FLAME DETECTORS FD-S4

4 INSTALLATION METHODS AND MATERIAL FD-S4

4.1 DEVICES FD-S4

4.2 CIRCUIT WIRING FD-S4

4.3 ARMOURED CABLES FD-S4

4.4 CONDUIT AND CONDUIT ACCESSORIES FD-S4

4.5 WIRING TRUNKING FD-S4

4.6 CABLE RACKS AND LADDERS FD-S4

4.7 LIGHTNING AND SURGE PROTECTION FD-S4

5 COMMISSIONING OF SYSTEMS FD-S4

5.1 COMMISSIONING AND HANDING OVER TESTS FD-S4

6 DOCUMENTATION, DRAWINGS AND MAINTENANCE FD-S4

6.1 BLOCK PLAN FD-S4

6.2 TRAINING PROGRAM FD-S4

6.3 OPERATING INSTRUCTIONS FD-S4

6.4 OPERATING MANUALS FD-S4

6.5 MAINTENANCE MANUALS FD-S4

6.6 MAINTENANCE FD-S4

ADDENDUM “A” FD-S4

A1. APPLICABLE STANDARDS (NOT A COMPLETE LIST) FD-S4

A2. SCADA SOFTWARE (REFER TO CLAUSE 2.3) FD-S4

# STANDARD TECHNICAL SPECIFICATION FOR AN AUTOMATIC FIRE ALARM AND EVACUATION INSTALLATION

## A. INTRODUCTION

This Standard Technical Specification forms part of, and shall be read with, the Conditions of Contract, Supplementary Specification, schedules, drawings and other parts that form part of the tender/contract documents.

1.1 SCOPE

1.1.1 This Standard Technical Specification covers the general technical requirements for automatic fire detection systems and installations. The following aspects are covered: - System requirements -Equipment requirements -Installation methods and materials - Commissioning and handing over -Documentation and drawings

1..1.2 The Supplementary Specification, drawings and schedules will take precedence over this Standard Technical Specification.

1.1.3 The Supplementary Specification, drawings and schedules shall be referred to for the specific requirements for the system.

1.2 DEFINITIONS See also the definitions in EN 54-1 and BS 839-1. Analogue Addressable System In an analogue addressable system the control equipment receives analogue signals from the sensing devices in the system and knows with which sensing device it is communicating by reading the address of each sensing device.

Analogue The term analogue refers to an electronic signal which can represent a large number (e.g. 256) of values. This signal can be in the form of a current level, pulses, frequency or any combination of these.

Addressable Device

A device is addressable if the control equipment can communicate with the device, or select such a device by sending an address to it.

Approved

Approved shall mean accepted by the Department for a specific installation. The Department does not keep a list of approved equipment, and equipment accepted for a specific installation does not necessarily imply approval or acceptance for another installation.
Access Levels

The levels of access applicable to the control panel. (These definitions modify those of BS 5838-4 in that level 4 is added and level 1 allows the silence function).

| | |
|---|---|
| Level 1 : No password or key : | Access by members of the general public. In addition the “silence” function shall be accessible or operational. |

| | |
|---|---|
| Level 2 : Password or key : | Access by the person responsible for the system and trained on the system, and for system maintenance. |
| Level 3 : Password or key : | Access by persons trained to reconfigure the system. |
| Level 4 : Password or key : | (a) Access by persons authorised by the system owner to allocate passwords to levels 2 and 3. |
| | (b) Access by persons trained and authorised by the manufacturer to repair, or to alter the firmware, thereby changing its basic mode of operation. |

Conventional System

A system is conventional if the control equipment determines the status of the zone wiring as follows:

Fault : low or no current
Normal : current within limits
Fire : high current
Short circuit : abnormally high current

Control Equipment. Unit or Panel

The control equipment receives information from the field devices and displays information as described in BS 5839-4 or EN 54-2.

The following references have the same meaning:

-Control equipment
-Control unit
-Control panel
-Fire panel
-Fire alarm panel

Detector

That part of an automatic fire detection system which constantly, or at frequent intervals, monitors suitable phenomena, such as smoke, fire, heat, etc.

Detectors are also field devices.

1.3 STANDARDS AND REGULATIONS See Addendum “A” for a list of the applicable standards. In all cases the most recent amendments, of the standards, shall apply.

1.3.1 The completed system and its components shall be in accordance with the following regulations:

- The wiring of premises (SABS 0142)
- Occupational Health and Safety Act (Act 85, 1993)
- Local municipal by-laws and regulations
- -Local fire regulations -Regulations of Telkom
- -Regulations of the local electrical and gas supply authorities

- -National Building Regulations Act No 103 of 1977 (SABS 0400)

1.3.2 The design of an automatic fire detection system, the equipment supplied for the system, and the installation of such equipment shall be in accordance with the Standards listed below. The equipment and components shall be deemed to have been tested and approved by a reputable and recognised international test laboratory to prove compliance with at least one or more of these Standards. Copies of test certificates shall be provided by tenderers with their tenders:

EN 54 : Components of automatic fire detection systems

BS 5445 : Components of automatic fire detection systems

BS 5839 : Fire detection and alarm systems for buildings

1.3.3 Material for which an SABS specification exists, shall be in accordance with such a specification, and shall bear the SABS mark.

1.3.4 All equipment used shall originate from suppliers which have been certified in accordance with SABS ISO 9001 (ISO 9001) or SABS ISO 9002 (ISO 9002) for quality assurance. Copies of certificates of approval shall be provided by the tenderers with their tenders.

1.3.5 Equipment designed to BS 5446, Fire systems for residential premises, or similar other standards, are not acceptable.

1.4 DESIGN

1.4.1 Any uncertainty which may exist in regard to the specification requirements shall be submitted to the Department in writing. .

1.4.2 The requirements and design standards of the specification shall be adhered to unless otherwise approved by the Department or it's authorised representative in writing.

1.4.3 Small items of equipment forming part of a system are not covered by this specification. However, the Department still requires that the total system shall comply with the highest standard of the design and fire protection practice.

1.5 MATERIALS

1.5.1 All materials used on the contract shall be new and of the very best of their respective types and kind.

1.5.2 No equipment or parts older than 2 years, at the commencement of the contract, shall be installed in this system.

1.5.3 All equipment and parts used in a particular system shall originate from one supplier as far as practicable.

**SYSTEM REQUIREMENTS**

2.1 REMOTE INDICATOR LIGHTS

2.1.1 Detectors mounted in hidden areas, or areas which may be kept locked for specific reasons, shall

each be provided with a permanently marked remote indicator LED light mounted in a conspicuous position on the wall outside the area and close to the point of entry into such areas. The method and equipment used to mount the remote LED shall be acceptable to the Department.

2.2 SOFTWARE

2.2.1 The requirements stipulated hereunder in connection with the availability and the usage of software for computer based equipment (not fire control panels) which is to be supplied to the Department in terms of the contract, shall be adhered to:

a. Computer based systems shall not become unserviceable due to the loss of,or damage to software.
b. It shall be possible to reinstate software after maintenance or after possible damage to the software. Full back-ups must therefore be available on site.

2.2.2 Software shall be loaded when so required, even if the time at which the software is to be loaded,
does not suit the supplier of the software.

2.2.3 The Department shall also be able to reload software on systems without the assistance of the supplier or contractor.

2.2.4 The Department will only be interested in reloading of software into a system for which the software was originally written, and not in the copying of software from one system to another.

2.2.5 Back-ups of software shall be supplied to the Department for future use.

2.2.6 The Department will use the original contractor or supplier of the system to reload software, whenever possible or practicable.

2.3 SCADA SOFTWARE

Software to be used for monitoring and reporting, or SCADA (Supervisory Control and Data Acquisition) application, shall comply with the following requirements:

2.3.1 The software shall be able to run on an MS-DOS based PC computer.

2.3.2 Software packages shall be approved by the Department for the installation.

2.3.3 The software shall not be system specific, i.e. it shall be compatible with a number of control panels on the market.

2.3.4 The software shall be available from a supplier other than the manufacturer of the equipment.

2.3.5 Upgrading of the software shall be possible at a later stage without changing the system configuration.

2.3.6 See Addendum “A” for some acceptable software.

2.4 FIRE ZONES

Devices shall be grouped into zones as follows, unless the zones are indicated on the drawings
and/or Supplementary Specification:

2.4.1 A zone shall not have more than 20 field devices.

1. 2.4.2 Each building shall have separate zones.

2. 2.4.3 The roof space shall be on a separate zone or zones.

3. 2.4.4 The floor area of a single zone shall not exceed 2000 m²

4. 2.4.5 Every floor of a building larger than 300 $m^2$ shall be on a separate zone.

5. 2.4.6 Every area enclosed by fire walls shall be on a separate zone.

6. 2.4.7 In analogue addressable system, each zone shall be enclosed by 2 line isolators.

7. 2.5 SPARE CAPACITY

2.5.1 20% spare capacity shall be allowed in the design of the control panels, loops, zones, etc.

2.5.2 The control panel shall have facilities to accommodate a further two detector circuits, additional to the required number of zones, without having to replace or add additional cabinets (extensions) to the control panel, unless specified otherwise.

## C. EQUIPMENT REQUIREMENTS

3.1 QUALITY OF EQUIPMENT

Only equipment complying with the following shall be used:

3.1.1 The equipment required under any contract shall be of the latest manufactured equipment of its kind on the market.

3.1.2 The equipment shall preferably be manufactured in the RSA, and equivalent or replacement equipment shall also be available in the RSA.

3.1.3 Replacement units shall be available for the equipment and the complete maintenance of equipment shall be undertaken in the RSA.

3.1.4 Equipment shall have been installed in the RSA in a similar installation as the one specified in the Supplementary Specification and shall have operated reliably and satisfactorily for at least 1 year.

3.1.5 Equipment shall exist of completely enclosed units and the units shall be vermin-proof.

3.1.6 All items of equipment shall be fitted with nameplates containing information, such as serial numbers, model numbers, type numbers, manufacturer's name, etc. This information, together with the description of each and every piece of equipment, shall be listed in the Maintenance Manual.

3.1.7 All components and PC boards shall also be marked with type numbers and descriptions and this information shall be contained in the Maintenance Manual.

3.1.8 No equipment without detailed specifications and/or testing results will be allowed.

3.1.9 All components of the system offered and installed, shall be available for a period of at least 15 years from the onset of the contract. A certificate of guarantee to this effect shall be submitted by the supplier of such components.

3.2 FIRE ALARM PANELS (CONTROL PANELS)

3.2.1 Control panels shall conform to BS 5839 part 4 or EN 54-2. See clause 1.3.2.

3.2.2 A control panel shall be able to function as a stand-alone unit, together with its own power supplies, and shall not be dependent on external control equipment, such as computers, for functioning.

3.2.3 Provision in the form of suitable terminals, connectors, or ports, shall be made on the control panel for the connection of peripheral equipment, such as computers, printers and interface equipment, to enable the accumulation of data generated by detectors and the control panel, to be used for future reference, or for the relaying thereof to remote monitor or control equipment.

3.2.4 Control panels shall be constructed for minimum power usage in both battery and mains power supply modes.

3.2.5 The control panel shall be of the wall mounted type, and shall also be suitable for mounting flush in a console, if so required in the Supplementary Specification.

3.2.6 Battery charging equipment mounted in the control panel, or elsewhere, shall be mounted in such a way that 230 Volt terminals and wiring and other mains voltage equipment are shielded against accidental contact. All shields shall be marked "230 VOLT".

3.2.7 No 230 Volt terminals shall be placed directly next to other terminals containing wiring at other voltages.

3.2.8 Reset of the control panel shall only be possible at access level 2.

3.2.9 Terminals shall be clearly grouped and marked with a label strip for identification, so as to simplify installation and connection of wires on site by installation personnel. All outgoing and incoming terminals, and all other equipment in the control panel, shall be suitably labelled to simplify maintenance and installation, and all panel mounted equipment shall likewise be labelled.

Outgoing and incoming power and field wiring shall be individually, and correspondingly, numbered at each point of termination.

3.2.10 The control panel shall have knock-outs in the bottom plate thereof to terminate conduiting for all power cabling, and knock-outs in the top plate thereof to terminate conduiting for signal and other electronic cabling/wiring. Holes drilled on site for this purpose will not be acceptable.

3.2.11 All identification labels, as well as wire terminal numbers, shall be clearly shown on all wiring diagrams in the Maintenance Manual.

3.2.12 It shall be possible to silence the audible alarms without influencing the visual alarms or alarm transmissions to the Fire Brigade. This shall be possible at access level 1.

3.3 CONVENTIONAL FIRE ALARM PANELS (CONTROL PANELS)

3.3.1 Conventional Control panels shall be conformed to BS 5839-4 or EN 54-2. See clause 1.3.2.

3.3.2 The control panel shall be suitable to operate in conjunction with conventional detector heads or detector bases.

3.3.2 The control panel shall further have the facilities to execute the following functions:

a. Transmission of a general fire alarm to the Fire Brigade. Transmitting equipment shall

however not be supplied with the control panel unless specifically specified in the Supplementary Specification.

b. Switching off of air conditioning equipment in case of a general fire alarm.

c. Closing of dampers over ventilation openings in case of a general fire alarm.

d.The connection of an external repeater panel for remote indication of fire and fault alarms.

e. A maintenance mode or ”one man test facility” for routine testing shall be possible where the control panel resets a fault or alarm condition a short time after the event. This will allow easy testing of the field devices. The control panel shall give a warning when it is in this mode.

3.4 ANALOGUE ADDRESSABLE FIRE ALARM PANELS (CONTROL PANELS)

3.4.1 Analogue Addressable Control panels shall conform to BS 5839-4 or EN 54-2. See clause 1.3.2.

3.4.2 Type of System

a. An analogue addressable system consists of a control panel connected to analogue addressable field devices.

The control panel continuously monitors a number of parameters of the field devices, makes decisions and takes actions based on the information received.

b. Sensing devices shall not switch into an alarm state. All decisions shall be taken by the control panel only.

c. To enable the system to be tailored to suit the protected building and to permit future changes, the alarm management shall be configurable from the control panel via a keypad. This configuration shall be maintained under power failure conditions in non-volatile memory.

d. The front panel of the control panel shall comprise a keyboard, alpha numeric display, text and indicator LEDs, etc. The occurrence and location of an event shall be displayed on the screen.

e. Outputs for communicating with devices such as remote text display units, graphic display units, computers, printers and intelligent mimic panels shall be provided where necessary.

f. Control panels shall incorporate facilities for operating as stand-alone units, or as part of a network with full communication capability.

g. Control panels shall be supplied complete with printout facilities. Only connections (a printer port and 24 Vdc power connector) for a portable printer shall be required, unless otherwise specified.

h. The control panel shall further have the facilities to execute the following functions:

- Transmission of a general fire alarm to the Fire Brigade. Transmitting equipment shall not be supplied with the control panel unless specifically specified in the Supplementary Specification.

- Monitored switching off of air conditioning equipment in case of a general fire alarm. -Monitored closing of dampers over ventilation openings, switching on of stairwell pressure fans, etc. in case of a general fire alarm.

- Monitored alarm outputs, e.g. sirens.
- Monitored outputs and inputs for gas control panels.

i. Consecutive alarms shall be stored by the control panel in chronological order and shall have the ability to determine the priority order of alarms by means of repetitive receipt of data from detectors.

j. The transmission of all data shall be via a two-wire system, which shall carry both the supply voltage and the data.

k. The type of wire or cable used shall be suitable for the speed of data transmission so that signals can be carried over without losses or corrupted data. Wiring shall meet the requirements of the detection system manufacturer, which requirements shall be published in a formal wiring specification.

3.4.3 Ring (loop) Wiring

a. Wiring shall to be arranged in a return loop (ring), in such a manner that, in the event of an open circuit or a short occurring on the line, the control panel communicates with the detectors from both sides of the loop.

b. The arrangement shall be such that during an open or short circuit no more than 20 detectors shall be deactivated. To enable this, line isolators shall be provided on the line on each side of each zone.

Master Control Panel

a. The purpose of a master control panel will be to communicate with more than one satellite fire control panel, to simplify the central monitoring and control of the other satellite panels.

b. A master control panel will be required when two or more control panels are to be linked. This master control panel shall conform to all the requirements of the other control panels and shall be of the same manufacture as the other control panels.

c. The master control panel shall have its own battery back-up system.

d. All communication to computers, the Fire Brigade, etc. shall be handled by the master control panel.

e. All communication between satellite and central panels, as well as between satellite panels, shall utilise a protocol which verifies the receipt and accuracy of each message sent. Receipt of all messages shall be acknowledged by the receiving panel, and messages shall be retransmitted by the sending panel in the event of failure to receive such an acknowledgement. An industry standard method, such as a CRC check sum technique, or similar, shall be used to verify the accuracy of each message received.

Messages received incorrectly shall be retransmitted by the sending panel. Retransmission shall continue until the receiving panel acknowledges receipt of a correctly received message. If, after a number of transmission attempts, the transmitting panel still does not receive an acknowledgement from the receiving panel, it shall register a fault signal.

3.4.5 Remote Display/Mimic Panels

a. Remote display/mimic panels, or fireman's panels, shall communicate with the control

panel. No “hard wiring” to these panels will be allowed.

b. Remote panels shall function completely independently of the- control panels, and shall not affect the functioning of the control panels.

3.4.6 Programmability

a. The control panel shall be fully programmable through the keypad on the front of the panel, and through an RS 232 port by using a separate computer.

b. It shall be possible to make back-ups of the programmed data onto separate magnetic media by means of an external computer linked to an RS 232 port on the control panel.

3.4.7 Communications

a. Communications with other equipment, such as computers, shall be achieved through RS 232 ports using a fully documented public domain protocol. The protocol documentation shall also be included in the Maintenance Manual so that it will be possible for another party to communicate with the control panel without the approval of the control panel manufacturer.

b. All communications with other equipment shall be bi-directional, and at least the functions and displays available on the front of the control panel shall be possible through the communications port. Programming of the control panel by means of other equipment is not required (except as described earlier).

3.4.8 Local Printer

a. A printer shall be available as an option.

The printer shall provide a hard copy of the following:

- Alarms
- Faults
- Maintenance data
- Control panel operations
- Outputs Operated
- Configuration report
- Status report

b. The printer shall print out the following information for each alarm or signal:

- Type of Alarm or Fault
- Device Type
- Device Number
- Zone Number
- User message
- Day
- Date
- Time

c. It shall be possible to set the printer to print out alarms, faults, control panel operations, and

outputs operated, either individually or- in any combination.

3.4.9 Device Addresses

a. Each sensing device shall be numbered individually and uniquely to correspond with its address on the control panel.

b. If a detector head is moved from its base to another base, the address of such a detector shall remain at its original location indicated on the control panel.

c. The address of each device shall be manually set to the desired value.

3.4.10 Display

a. The control panel shall be equipped with an alphanumeric display capable of displaying at least 80 characters.

b. A message of at least 40 characters long per device shall be programmable and displayable on the display.

c. The display of the following reports/information shall be possible:

-Device information
-List of devices isolated
-List of devices that need maintenance
-List of the most resent events
-I/O mapping
-Device messages

With reference to 3.4.9(0), the following will also be acceptable to the Department:
*"If a detector head. is moved from. its base to another base, and this result, in the address being moved to another zone, then an alarm shall be generated in the control panel. This alarm can only be cancelled by replacing the head in its original zone*.

3.4.11 Device Status

Addressable devices shall be polled by the control panel and the equipment condition and analogue status shall be read and stored in the control panel.

The varying status of each device shall be assessed by software algorithms and the control panel shall indicate the following conditions:

a. <u>Analogue Detectors</u>

Detector removed
Incorrect type of Detector
Detector failed
Detector contaminated
Pre-alarm
Fire Alarm
Detector healthy

b. . <u>Interface to contacts</u>

Fire Alarm
Interface removed
Interface faulty

Contact wiring open circuit
Contact wiring short circuit
Contacts normal

3.5 POWER SUPPLY

3.5.1 Power supplies shall conform to BS 5839-4 or EN 54-4. See clause 1.3.2.

3.5.2 The Power pack of the control panel shall be able to accept an incoming 230 Volt single phase supply and shall be equipped with transformers, rectifiers, inverters, condensers and integrated circuits for the supply of stabilised power to the control panel equipment and detector circuits.

3.5.3 The power supply unit shall be equipped with over voltage protection and spike arresters to prevent damage to the equipment by lightning or other spikes, or damage due to over voltages.

3.5.4 The battery charger shall be able to deliver the full charging current to discharged batteries, and

thereafter the charger shall automatically vary the charging current to the batteries as may be

required by battery voltage conditions.

3.5.5 Batteries shall not be subjected to overcharging.

3.5.6 The battery charger shall be protected against reverse polarity and short circuits on the DC

supply side.

3.5.7 The power pack of the control panel shall regulate the supply voltage to detectors so that detectors or bases are operated in their nominal supply voltage range.

3.5.8 Upon loss of mains power, the power supply unit shall automatically revert to battery power, where after the system shall remain fully operational for a period of 24 hours and shall be able to operate the total alarm load for a further period of 1 hour. The unit shall automatically revert back to mains power upon mains power restoration and manual resetting of the unit shall not be necessary.

3.5.9 The power supply shall be equipped with the following indications on the front of the unit:

a. "Mains On" : green LED

b. "Charger Fault" : amber LED

3.5.9 Batteries shall be mounted in a separate ventilated padlockable cubicle. Batteries shall be mounted in such a way that contamination of other equipment by batteries cannot take place. Batteries shall be in a special plastic container to contain any possible spillage.

3.5.10 Any supply fault, charging fault or low battery voltage shall be transmitted to the control panel so that an alarm can be generated.

3.5.12 No fuses or switches shall be accessible on the front of the power supply unit without opening the door.

3.5.13 Batteries shall be of the sealed lead acid type and the sizes of the batteries to be used shall be indicated on a label in the battery cubicle.

3.5.14 Batteries shall be charged to 85% of their capacity within 24 hours.

3.6 DETECTORS AND DETECTOR BASES IN GENERAL

3.6.1 lionization smoke detectors, optical smoke detectors and heat detectors are covered under this heading.

3.6.2 The detector base shall be such that the detector head is held firmly in the base by means of an insert and twist (bayonet) action.

3.6.3 Reverse polarity or faulty circuit wiring shall not cause damage to the detector head or base.

3.6.4 The detector base shall be suitable for surface mounting on a ceiling and shall fit on a 65 mm ? standard C-type electrical outlet box with fixing holes at 50 mm centres. Fixing lugs or holes in the base shall be substantial and shall withstand repeated insertion and removal of the head without damage.

3.6.5 The base shall be provided with wire terminals suitable for wire sizes up to 1,5 mm².

3.6.6 The wiring terminals of the unit shall be able to accept wiring lugs and shall be of the screw and clamp plate type to hold a lug firmly pressed against it's contact surface. Spring loaded push-in contacts will not be acceptable.

3.6.7 Terminals for circuit wiring shall be clearly marked.

3.6.8 The base shall be suitable for the connection of a remote indicator LED.

3.6.9 The detector or base shall be fitted with a local indicating LED, which shall flash/illuminate under an alarm condition.

3.7 CONVENTIONAL DETECTORS AND DETECTOR BASES

3.7.1 Conventional detectors and bases shall conform to BS 5445 or EN 54 or BS 5839. See clause 1.3.2.

3.7.2 It shall be possible to reset detectors from an alarm condition to normal by disconnecting the supply voltage to the unit.

3.7.3 Upon removal of a detector head, the control panel shall indicate that a head has been removed and also the zone where the head has been removed.

3.7.4 The base at end of circuit, in the case of radial circuits, shall be suitable to accept a termination resistor/circuit.

3.8 ANALOGUE ADDRESSABLE DETECTORS AND BASES

3.8.1 Analogue addressable detectors and bases shall conform to BS 5445 or EN 54 or BS 5839. See clause 1.3.2.

3.8.2 The removal of a detector from the base shall not affect the operation of other detectors on the line.

3.8.3 The control panel shall indicate when a detector head has been removed and also the address where it has been removed. Likewise it shall indicate when a wrong type of head is inserted in a base, as well as its address.

3.8.4 The detector shall be suitable to operate on a two-wire system carrying both power and signals for the operation of each and every detector in the system.

3.8.5 The detector shall be able to receive, and decode signals transmitted to it by the control panel. Upon receipt of a signal directed at its particular address, the detector shall transmit data back to the control panel for processing and storage thereof by the control panel. Such data transmitted shall represent the analogue values present in the electronic circuits of the detector head/base combination at that point of time.

3.8.6 The detector, when "addressed" by the control panel, shall transmit data to enable the control panel to deduce the following basic information:

a. The type of head generating the data (i.e. ionisation, optical, heat, etc.)

b. The address of the detector

c. The reference limits of calibration of the detector

d. The % visible or invisible combustion particles per meter present in the detector chambers at that point in time, or the temperature measured at the detector.

3.9 MANUAL CALL POINTS (BREAK GLASS UNITS)

3.9.1 Manual call point units shall be in accordance with BS 5839-2, except that it shall be resettable i.e. the front face of the unit shall not be a frangible element.

3.9.2 The unit shall be finished in RED.

3.9.3 The unit shall be large enough to cover a 65 mm conduit draw box when the unit is surface mounted.

3.9.4 Flush mounted units shall be provided with a special flush mounting box, which can accept electrical conduit terminations.

3.9.5 Surface mounted units shall be deep enough to terminate 20 mm diameter conduits into the unit, and shall be mounted solidly on the wall by means of their back plates.

3.9.6 Addressable manual call point units shall be fitted with an address card, which will enable communication with the control panel.

3.9.7 The wiring terminals of the unit shall be able to accept wiring lugs, and shall be of the screw and clamp plate type to hold a lug firmly pressed against it's contact surface. Spring loaded push-in contacts will not be acceptable.

3.10 AUDIBLE ALARMS (SOUNDERS)

3.10.1 Sounders shall conform to BS 5839 part 1 and part 4.

3.10.2 The sounders shall operate off a 24 volt DC supply. Electronic sounders will be preferable.

3.10.3 The sound level for sounders and audible alarms shall be as follows:

- Audible indications (e.g. in the control panel) • 65 dB(A) at 1 m

- Evacuation sounders - at least 103 dB(A) at 1 m

- Outdoor sirens - 112 dB(A) at 1 m

3.10.4 The frequency, or major frequency in a two tone alarm, shall lie in the range of 500 to 1000 Hz.

3.11 FIRE BRIGADE SIGNALLING FACILITIES

3.11.1 The transmitting equipment, when required for the transmission of a general fire alarm to the local Fire Brigade, shall form an integral part of the fire control panel.

3.11.2 The transmitting equipment shall be fully compatible with the receiving equipment already installed at the Fire Brigade. Any facilities necessary to accomplish this compatibility shall be included in the transmitting equipment.

3.11.3 The output to the Fire Brigade shall be a monitored output.

3.11.4 The transmitting equipment shall not be supplied, unless specifically specified in the Supplementary Specification.

3.11.5 Even if the transmitting equipment is not specified in the Supplementary Specification, a appropriate port, or ports, shall be provided on the control panel for connecting any future transmitting equipment.

3.12 FLAME DETECTORS

All flame detectors designed to detect hydrocarbon fires shall comply with at least the following requirements, in addition to the specified standards:

3.12.1 Flaming fires shall be detected by the flame detector by detecting infra-red and/or ultraviolet radiation emitted from the flames.

3.12.2 Detectors that monitor only ultraviolet radiation will not be acceptable.

3.12.3 At least two different radiation frequencies shall be detected and analysed by the flame detector in order to increase the reliability of the detector in the presence of the following:

-Artificial light sources
-Sunlight
-Hot vibrating bodies
-Arc welding
-Lightning

3.12.4 Flame detectors shall be fitted with automatic self-test circuits which will simulate a fire condition by generating artificial radiation through the lenses. Dirty lenses shall, therefore, also generate a fault.

3.12.4 The flame detector shall be able to detect a 0,1 $m^2$ petrol fire at a distance of 14 m.
3.12.5 Detection integration time shall be adjustable up to 30 seconds.
3.12.6 The detector shall have at least a 50% sensitivity at a horizontal angle of 45° from the centre line.

**INSTALLATION METHODS AND MATERIAL**

4.1 DEVICES

4.1.1 The base of a detector shall always be mounted in the area which it protects so that the indicator LED can be seen from the doorway which normally provides access to the room. The indicator LED shall face towards the main entrance or lobby or side of main approach in the passage. See also clause 2.1.1.

4.1.2 Bases shall be provided with dust caps to protect the base against dust and dirt whilst construction work is in progress. This is only applicable to bases that contain electronic components.

4.1.3 Surface mounted units shall be solidly fixed to the wall by means of their back plates.

4.1.4 Manual call point units shall be mounted at 1,4m above finished floor level, unless otherwise specified in the Supplementary Specification.

4.2 CIRCUIT WIRING

4.2.1 The following methods are acceptable for the wiring of detector circuits:

a. Steel conduit and conduit accessories cast into, or built into, the building structure and wired with insulated conductors of a type which complies with the requirements of this specification.

b. Steel conduit and conduit accessories, surface mounted in building structures and wired with insulated conductors of a type approved by the Department.

4.2.2 Wires and cables may also be installed in wiring trunking and armoured cable may also be installed on cable racks, all as specified further herein.

4.2.3 Cables with stranded wires shall be terminated by the crimping on of lugs. No stranded wires without lugs will be accepted.

4.2.4 T-Junctions shall be made only in approved draw boxes at detector outlets.

4.2.5 Separate wiring installations for detector circuits, evacuation communication wiring, audible alarms, electrical lock wiring, card reader wiring, AC and DC power circuits, remote control circuits and monitor wiring, video cables, computer cables, etc., shall all be done in separate conduit- or trunking installations. Detector wiring shall not be installed together with any other wires in wire ways.

4.2.6 Detector wiring may share the same draw boxes or expansion joint boxes with other fire fighting system wiring or security system wiring, but the boxes shall be subdivided by means of steel plates.

4.2.7 All electrical work and wiring associated with "FIRE DETECTION SYSTEMS", shall be carried out in compliance with the requirements of the "STANDARD SPECIFICATION FOR ELECTRICAL
EQUIPMENT AND INSTALLATIONS FOR MECHANICAL SERVICES" of the Department.

4.2.8 No wiring shall be installed vertically for more than 1,5 m. Cables installed over vertical distances of more than 1,5 m, shall be properly supported at intervals of less than 1,5 m.

4.3 ARMOURED CABLES

4.3.1 Armoured cables shall be used in sleeves, in cable tunnels and on cable racks or trays.

4.3.2 Armoured cables shall have twisted pairs and/or screens if so required in the wiring specification of the manufacturer of the equipment.

4.4 CONDUIT AND CONDUIT ACCESSORIES

4.4.1 The Contractor for the fire detection system shall be responsible for the supply and installation of all conduits, conduit accessories, wiring trunking and cable trays, as may be necessary or required for the system, unless specified otherwise in the Supplementary Specification.

4.4.2 conduit and conduit accessories shall be cast in, or built into, the building structure in new

buildings. No surface mounting will be acceptable in new buildings or structures.

4.4.3 Surface mounted conduit and conduit accessory work will be allowed only in existing buildings.

4.4.4 Steel conduit and conduit accessories surface mounted on building structures, steelwork and woodwork, shall be done neatly and in straight lines and shall be saddled at 1 m centres with spacer saddles.

4.4.5 M4 machine screws shall be used for fixing of spacer saddles onto steelwork. Suitable holes shall
be drilled and tapped in the steelwork for this purpose.

4.4.6 Steel conduit and conduit accessories, surface mounted in roof spaces of buildings or structures with pitch roofs, shall follow the roof structural elements.

4.4.7 The quality of materials and the methods of installation of steel conduit and conduit accessories shall be carried out in compliance with the requirements of the "STANDARD SPECIFICATION FOR ELECTRICAL EQUIPMENT AND INSTALLATIONS FOR MECHANICAL SERVICES" of the
Department and SABS 0142.

4.4.8 Conduit installations shall be done in such a way that detector circuit wiring can be done without interruption and without T-joints.

4.4.9 Round draw boxes for detectors shall be mounted hard against the ceiling in the case of false ceilings or ceilings of pitch roof buildings and detector bases shall be mounted against boxes so that no open wiring occurs anywhere in a conduit and wiring system.

4.4.10 No sprague tubing or PVC conduits shall be used in detector circuit wiring systems. Only flexible conduit which is not of the spiral type may be used in special applications.

4.5 WIRING TRUNKING

4.5.1 The quality of materials and the methods of installation of wiring trunking shall be carried out in compliance with the requirements of the "STANDARD SPECIFICATION FOR ELECTRICAL EQUIPMENT AND INSTALLATIONS FOR MECHANICAL SERVICES" of the Department.

4.5.2 Trunking shall be fitted throughout with covers.

4.5.3 PVC wiring trunking may be used only to house detector circuit wiring, but then only as specified in the section "CIRCUIT WIRING" in the Specification and only with the type of cable as specified.

4.5.4 No wiring trunking may be used in microfilm vaults and in high risk areas such as fuel. oil. tyre. paint, wood. paper, cardboard box storage areas, record rooms, and vaults.

4.6 CABLE RACKS AND LADDERS

4.6.1 The quality of materials and the methods of installation of cable racks and ladders shall be carried out in compliance with the requirements of the "STANDARD SPECIFICATION FOR ELECTRICAL EQUIPMENT AND INSTALLATIONS FOR MECHANICAL SERVICES" of the Department.

4.6.2 No cable racks and ladders may be used in microfilm vaults and in high risk areas such as fuel. oil. tvre. paint, wood. paper, cardboard box storage areas, record rooms, and vaults.

4.6.3 Armoured cable may be mounted on cable racks and ladders.

4.6.4 The type of wire or cable used shall be suitable for the speed of data transmission, so that signals can be carried over without losses or corrupted data.

4.7 LIGHTNING AND SURGE PROTECTION

4.7.1 All wiring going out from and coming into any building shall be fitted with suitable surge absorbers, which have been approved by the manufacturer of the equipment. This includes 230 V supplies, telephone lines and detector lines.

4.7.2 Special attention shall be given to the proper connecting and earthing of the system.

**COMMISSIONING OF SYSTEMS**

5.1 COMMISSIONING AND HANDING OVER TESTS

5.1.1 The testing of the system shall be done in the presence and to the satisfaction of an authorised representative of the Department.

5.1.2 Tests shall include simulation of fire conditions in each zone to prove the efficiency of all aspects of the system to the satisfaction of the Department.

5.1.3 All equipment, material, etc., which may be necessary for these tests shall be supplied by the Contractor, including a suitable smoke generator.

5.1.4 The Contractor shall do his own complete commissioning tests before the actual first take-over tests are done. This is to satisfy himself that everything is working and is in accordance with the specification.

**DOCUMENTATION, DRAWINGS AND MAINTENANCE**

6.1 BLOCK PLAN

6.1.1 An approved block plan, indicating the zones and appropriate zone reference numbers, shall be installed at all control panels and repeater panels.

6.1.2 The block plan shall be discussed with the Fire Prevention Officer of the Department before manufacturing takes place.

6.1.3 The block plan shall have a professional appearance. Text shall be in English and at least one other official language to be decided in conjunction with the Department and the User Department. A freehand drawing or badly finished plan will not be acceptable.

6.1.4 The block plan shall clearly indicate the position of the zone in which a fire has started, when read together with the displays and indications on the control panel.

6.1.5 Non-fading material shall be used for the artwork. The block plan shall be mounted in a frame behind glass, or shall be covered with a transparent stick-on material, to protect the artwork.

6.1.6 The block plan shall be mounted in an approved position at the control panel.

6.1.7 For an addressable system, the addresses of all field devices shall be shown on the block plan.

6.1.8 The exact requirements of the panel and block plan will be specified in the Supplementary Specification.

6.2 TRAINING PROGRAM

6.2.1 Tenderers shall allow in their tender prices for a training course, to train on site at least four (4) persons, as nominated by the User Department from his own operating personnel. The training shall be adequate for the installation, to ensure that operating staff fully understand the system. During this period, the personnel shall be made fully conversant with the operation of, and daily maintenance required for, each item of equipment of the system. The training,

especially on computer equipment and control panels, shall be of such a standard that will enable the User Department to carry out his own in-house training of other personnel.

6.2.2 The training course shall start only after first take-over inspection of the system.

6.2.3 The training course shall be carried out in the language medium as chosen by the User Department.

6.2.4 The Operating Manual of the contract shall include a full description of the contents of the training course, referred to in clause 6.2.1. above.

6.3 OPERATING INSTRUCTIONS

6.3.1 Instruction cards, indicating clearly the procedure to be followed in the event of a "FIRE" alarm, shall be supplied and framed under Perspex in approved teak or non-ferrous material frames. The instruction cards shall be in English and at least one other official language to be decided in conjunction with the Department and the User Department. The frame shall be neatly mounted on the walls alongside the control panel and external indicator panels respectively, where they can be clearly read.

6.3.2 In the case of the control panel, the instruction card shall also state clearly the procedure to be followed in the event of a "FAULT" alarm.

6.4 OPERATING MANUALS

6.4.1 Three complete sets of the Operating Manuals, in English, shall be provided to be used by the User's personnel who will operate the system. The Operating Manuals shall be in the form of plastic display binders, and shall contain the following:

a. Complete operating instructions.
b. Action to be taken during "FAULT" and "FIRE" conditions.
c. Names, telephone and facsimile numbers, and addresses of contact personnel.
d. Operating procedures, as contemplated in clause 6.3 hereof.

6.4.2 The Operating Manuals shall contain no technical information. This shall be included in the Maintenance Manuals.

6.4.3 A concept copy of the Operating Manual(s) shall be submitted to the Department's consultant, at least two (2) weeks prior to the anticipated first hand-over of the installation, for scrutiny and possible amendment.

6.4.4 <u>First delivery of an installation will not be taken unless acceptable manuals are submitted prior to the first hand-over inspections.</u>

6.5 MAINTENANCE MANUALS

6.5.1 Three complete sets of the Maintenance Manuals, in English only, shall be provided. The manuals shall contain the following:

a. A complete set of "as built" drawings of the contract, in a form acceptable to the Department. No drawings shall be smaller than A4 size. Large drawings shall be reduced to A3 or A4 size for inclusion in the manuals, provided they remain legible.
b. A complete set of "machine shop" drawings of the contract, showing dimensions, finishes, general arrangements of panels, consoles, computer assemblies, etc.
c. A complete set of wiring diagram drawings of all equipment, showing component identification, types and values.
d. block diagram drawing for each piece of equipment containing more than one PC board, showing the interconnections of boards, complete with connector and plug numbers, and PC board identification markings.
e. A complete list of all equipment containing the following information:

i. Name of the equipment (or description thereof).
ii. Serial number of equipment.
iii. Type number of equipment.
iv. Manufacturer of equipment.
v. Equivalent replacement model of equipment (where applicable).
vi. Names, addresses, telephone and facsimile numbers of firms supplying equipment.

.

f. A complete and comprehensive description of the operation of the system and of each individual piece of equipment.

g. A complete and comprehensive description of the maintenance of the system and of each individual piece of equipment in respect of daily, weekly, monthly or annual maintenance.

h. Advanced technical information of the system may also be bound into the Maintenance Manuals as additional information. Any literature not in the English language, shall have the English translation attached.

6.5.2 A concept copy of the Maintenance Manual(s) shall be submitted to the Department's consultant, at least two (2) weeks prior to the anticipated first hand-over of the installatipn for scrutinizing and possible amending.

6.5.3 First delivery of the installation will not be taken, unless acceptable manuals are submitted prior to the first hand-over inspections.

6.6 MAINTENANCE

6.6.1 Maintenance and Guarantee

a. The tenderer for this contract shall allow in his tender price for the maintenance of the complete installation for a period of twelve (12) months, starting from the date of the first take-over of the contract by the Department.

b. It is a specific requirement of this contract that the Contractor shall allow for monthly inspection visits during the 12 month maintenance period, and that he shall submit full reports for each monthly visit. The reports shall contain the status of the system as well as the faults which occurred on the system during the previous month.

c. A log book shall be supplied by the Contractor. The log book shall be kept on site in charge of the responsible person appointed by the User Department for this purpose. The Contractor shall complete the log book,showing all maintenance done by him, as well as repairs of faults which may have occurred.

d. The log book shall also contain the following information:

-Date -Type of fault reported and by whom -Date of fault report -Work done -Name and signature of person carrying out the work -Name and signature of the person in charge of the site.

e. The log book shall be filled in in TRIPLICATE. One copy shall accompany the monthly report to the Regional Representative of the Department, one copy shall be for the Contractor's own use, whilst the third copy shall remain in the logbook as a record.

f. The Contractor shall also allow for a complete maintenance service of the system after every six (6) months, i.e. two such services in the twelve (12) month guarantee period. The logbook shall also be filled in and reports submitted for these services to the Regional Representative of the Department.

g. The reports shall be submitted to the Department within seven (7) days of the service.

Serious faults shall immediately be reported to the Regional Representative and the Consulting Engineer by telephone.

h. No maintenance or repair work shall be done on site without the knowledge, and approval, of the responsible person in charge on the site.

6.6.2 Maintenance Program

a. The Contractor shall draw up a complete maintenance program document for the system, which shall enable the User Department to maintain the system on a daily basis. This program must be inserted into both the Operating Manuals and Maintenance Manuals.

b. This document shall be in English and at least one other official language to be decided in conjunction with the Department and User Department, and shall indicate clearly the steps to be taken to prevent failure of the system.

c. The normal maintenance, which is, for example, necessary for the maintenance of batteries in the system, shall be clearly indicated in the documentation in a separate section.

## ADDENDUM 'A'

## TO THE STANDARD TECHNICAL SPECIFICATION

## FOR AN AUTOMATIC FIRE ALARM INSTALLATION

This addendum contains a list of applicable standards and other information that may change. The most recent amendments and publication is applicable. Contractor to ensure that the latest versions are used.

A1. APPLICABLE STANDARDS (NOT A COMPLETE LIST) EN 54 -COMPONENTS OF

AUTOMATIC FIRE DETECTION SYSTEMS.

or
BS 5445
Part 1 Introduction
Part 2 Control and indicating equipment (draft)
Part 4 Power supplies (draft)
Part 5 Heat sensitive detectors - point detectors containing a static element.
Part 6 Heat sensitive detectors - point detectors, rate of rise only.
Part 7 Specification for point type smoke detectors using scattered light, transmitted light or ionization.
Part 8 Specification for high temperature heat detectors.
Part 9 Methods of test of sensitivity to fire.
BS5839 -FIRE DETECTION AND ALARM SYSTEMS FOR BUILDINGS
Part 1 Code of practice for system design, installation and servicing;
Part 2 Specification for manual call points.
Part 3 Specification for automatic release mechanisms for certain fire protection equipment.
Part 4 Specification for control and indicating equipment.
Part 5 Specification for optical beam Smoke detectors
SABS 0400 : 1990 THE APPLICATION OF THE NATIONAL BUILDING REGULATIONS.
SABS ISO 9000 to 4 QUALITY MANAGEMENT AND QUALITY ASSURANCE STANDARDS
SABS ISO 9000 Guidelines for selection and use
SABS ISO 9001 Model for quality assurance in design/development, production, installation and servicing SABS ISO 9002 Model for quality assurance in production and installation.
SABS ISO 9003 Model for quality assurance in final inspection and test.
SABS ISO 9004 Guidelines

A2. SCADA SOFTWARE (REFER TO CLAUSE 2.3)

Monitoring software shall be similar and equivalent to the following. Other software shall be submitted for approval.

.a. Turbo link
.b. Ziton (ZG 100)
.c. Genesis
.d. DMacs

# PROPOSED NEW NTSHONGWE POLICE STATION

# KWAZULU-NATAL PROVINCE

# SLIDING GATE MOTORS AND TURNSTILE INSTALLATION

# TECHNICAL SPECIFICATIONS


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***Prepared for :***

South African Police Service

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**JULY 2024**

# PROPOSED NEW NTSHONGWE POLICE STATION KWAZULU-NATAL PROVINCE

## SLIDING GATE MOTORS AND TURNSTILE INSTALLATION

### TECHNICAL SPECIFICATION

1.0 SLIDING GATE MOTORS

1.1 The vehicle entrance at the boundary fence as well as the residential parking entrance shall each be provided with a single sliding gate as per drawing. These gates shall be provided with motors to drive them open and close and shall be equal and approved to Centurion make.

1.2 Refer to attached drawing M693/GM/01 for general layout.

1.3 Each motor shall be provided as follows;

1.3.1 Automated commercial grade motor drives suitable for up to 1000kg gate weight.

1.3.2 The motor battery shall be 24 Volt DC type.

1.3.3 Rack and pinion type drive .

1.3.4 Lockable anti-theft steel cages.

1.3.5 On-board receiver shall be Code-hopping multichannel type with selective add and delete.

1.3.6 Minimum number of remote code storage capacity: 50

1.3.7 The gate motors shall also be operated via hardwired open/close button station at the reception offices and provided with a minimum of three wireless infrared remotes.

1.3.8 Free-exit pressure loops to automatically open the gates for vehicles existing the premises.

1.3.9 Safety infrared safety beams to prevent closure of gate when obstruction is encountered.

1.3.10 1 year maintenance and guarantee

2.0 TURNSTILE

2.1 A single full height turnstile shall be provided at the pedestrian entrance along the fence line as shown on the attached drawing.

2.2 The installation shall be suitable for outdoor installation with 304 grade stainless steel finish.

2.3 The turnstile shall be provided with the following features:

2.3.1 The turnstile shall be factory-set such that on power failure it shall fail-secure (auto-lock) in entry direction and fail-safe (auto-unlock) in exit direction. The turnstile shall also be unlockable via a mechanical key override.

2.3.2 Suspended rotor technology.

2.3.3 Self-centering rotation system.

2.3.4 Bi-directional operation.

2.3.5 rotor returns to starting position after every rotation.

2.3.6 Shock absorbing rubber coupling system.

2.3.7 Rotor diameter: 1200mm.

2.3.8 Rotor Arms : 50mm diameter tube arms spaced 120mm apart.

2.3.9 3-arm configuration.

2.3.10 Provided with self-centering rotation system such that the rotor will return to starting position after every rotation.

2.3.11 The must not lock in mid rotation upon power failure.

2.3.12 Maintenance free.

2.3.13 Programmable logic controls.

2.3.14 Access control function ready.

2.3.15 Mounting brackets for Biometric / fingerprint reader.

2.3.16 The turnstile shall be powered via the police stations essential supply and operate on 220Volt supply.

2.3.17 1 year guarantee on electrical and electronic components and 10 year guarantee on all mechanical components, including ratchet disk and locking pawls.

2.3.18 1 year serviced and maintenance from date of practical handover.

2.3.19 Allow for coordination with access control contractor for integration.

2.3.20 Allow for coordination with electrician for power supply specification and location.

2.3.21 Allow for coordination with pedestrian gate contractor and architect.

2.3.22 Allow for testing of installation and training of user personnel.

# PROPOSED NEW NTSHONGWE POLICE STATION
# KWAZULU-NATAL PROVINCE

## AIR CONDITIONING AND VENTILATION INSTALLATION

## TECHNICAL SPECIFICATIONS

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*Prepared for :*

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Back to Basics
Towards a Safer Tomorrow

**JULY 2024**

## TECHNICAL SPECIFICATION

# C O N T E N T S

PAGE

*1.1.0 GENERAL ..... AC-5*
*1.1.1 Standard Technical Specification ..... AC-5*
*1.1.2 Tender Drawings ..... AC-5*
*1.1.3 Works Programme ..... AC-5*
*1.1.4 Maintenance And Guarantee ..... AC-5*
*1.1.5 Shop Drawings ..... AC-5*
*1.1.6 Tender Price Details ..... AC-6*
*1.1.7 Make and Model of Equipment Offered ..... AC-6*
*1.1.8 Price Variance/Price Adjustment ..... AC-6*
*1.1.9 Progress Payments ..... AC-6*
*1.1.10 Ordering Of Materials ..... AC-6*
*1.1.11 As-Built Drawings ..... AC-7*
*1.1.12 Maintenance And Operating Manuals ..... AC-7*
*1.1.13 Power Supply For Site Works ..... AC-8*
*1.1.14 Contracts Management ..... AC-8*
*1.2.0 SITE DESCRIPTION, SCOPE of CONTRACT, etc ..... AC-8*
*1.3.0 DUCTWORK ..... AC-10*
*1.4.0 AIR CONDITIONING EQUIPMENT – DX SPLIT ..... AC-11*
*1.5.0 REFRIGERANT PIPING AND FITTINGS ..... AC-12*
*1.6.0 DRAIN PIPING ..... AC-12*
*1.7.0 DUCTED DX-SPLIT AIR CONDITIONING SYSTEM (AHU1/CND1) ..... AC-12*
*1.8.0 ELECTRICAL SWITCHBOARDS AND CONTROLS ..... AC-13*
*1.9.0 SOUND LEVELS ..... AC-18*
*1.10.0 TESTING AND COMMISSIONING ..... AC-19*
*1.11.0 PLANT LABELLING ..... AC-19*
*1.12.0 PAINTING ..... AC-19*
*1.13.0 EQUIPMENT GUARANTEE ..... AC-19*
*1.14.0 CORROSION PROTECTION ..... AC-19*
*1.15.0 INSPECTIONS AND HANDOVER ..... AC-19*
*1.16.0 SERVICE AND MAINTENANCE ..... AC-19*
*1.17.0 TRAINING OF STAFF ..... AC-20*
*1.18.0 METHOD OF DUCT MEASUREMENT ..... AC-20*

# PROPOSED NEW NTSHONGWE POLICE STATION KWAZULU-NATAL PROVINCE

## AIR CONDITIONING AND VENTILATION INSTALLATION

### TECHNICAL SPECIFICATION

1.1.0 **General**

1.1.1 Project Details

The project entails construction of a new police station at Ntshongwe in Kwazulu-Natal Province. The site is located in the Umkhanyakude District Municipality.

This technical specification is for the supply, installation, commissioning and maintenance of the air conditioning and ventilation installation.

1.1.2 Tender Drawings

The following drawings form part of this specification and must be read in conjunction with it:

M693/AC/01 (REV.0): AIR CONDITIONING AND VENTILATION: LAYOUT

1.1.3 Works Programme

Unless otherwise stated, in the tender documentation, the successful Tenderer, shall within 1 week of appointment, provide the Client with a comprehensive programme of works to tie in with the contract completion date. The programme must be comprehensive and indicate lead time for equipment, production of shop drawings, first and second fix items, and commissioning.

**The Tenderer shall make allowance in the programme for working in the area which is set in a rural area far from nearest urban area.**

Adequate time must be allocated for commissioning of the systems.

The contract completion period shall be as indicated in the contract data.

1.1.4 Maintenance and Guarantee

All plant and equipment supplied under this contract shall be guaranteed for a period of twelve (12) calendar months from the date of practical or first handover of the installation, whichever occurs first.

**Where extended warranty is provided by the suppliers beyond the first 12-month period shall be ceded to the client.**

1.1.5 Shop Drawings

The successful Tenderer will be required to issue for the Engineer's acceptance three copies of all shop drawings, including control board circuit diagram within three weeks of the tender being awarded to him or as and when requested by the Engineer.

These drawings shall be adjusted and re-submitted should they be red-lined by the Engineer.

The acceptance of shop drawings by the Engineer shall in no way relieve the air conditioning Contractor of his responsibilities, such as accurate dimensioning of builder's works, providing correct size and strength of supporting structures, location of plants, fittings and access panels for adequate access for servicing and maintenance, and adherence to all applicable regulations, generally accepted good practice, and the technical specification and drawings.

The Sub Contractor must draw to the Engineer's attention, in good time, if any part of the design he believes to be not correct.

Drawings shall be produced using a reputable drawing package, and compatible with AutoCad.

1.1.6 Tender Price Details

The tenderer shall be required to complete the tender price schedule at the time of tender. Failure to do so may result in the tenderer being disqualified. Alteration to the bill of quantities, in anyway whatsoever, shall render the tender invalid.

1.1.7 Make and Model of Equipment offered

Where alternate make of equipment to that indicated in this specification is offered, then this shall be equal, and subject to acceptance by the Engineer, prior to submission of the tenders. Acceptance of the alternative shall not relieve the tenderer from his/her obligation to ensure compliance with the specification, compatibility with other components forming part of the system, and that the equipment will fit in the space available without compromising function and access. The Engineer reserves the right to reject the alternate, for any reason whatsoever, and call for the make and model specified to be provided at no additional cost.

1.1.8 Price Variance/Price adjustment

As indicted in the contract data and/or the Note to Tenderers.

In situations where the equipment supplier offer terms of payment and conditions of contract which are at variance with this contract, then these shall be for the Contractor's account.

1.1.9 Progress Payments

The Contractor shall submit his/her claim timeously to allow for the Engineer at least 7 working days to process and submit to the University.

1.1.10 Ordering of Materials and Equipment

Within 2 weeks of site handover the Contractor shall submit, for the Engineer's approval, a list of make and model numbers of all equipment and materials to be utilised in this contract. An approval by the Engineer shall not absolve the Contractor from complying with the specification unless the Contractor has specifically applied for deviation from the specification for the item in question.

The equipment and materials referred to above shall include but not be limited to;

- DX air conditioning units
- Fans
- controllers

The Contractor shall be responsible to ensure that the contract programme is adhered to and that no delays are caused by late deliveries of equipment and materials.

Other activities which must precede placing of orders must be taken into account when the Contractor schedules his activities.

1.1.11 As-Built Drawings

The Contractor shall provide project system design drawings/diagrams and detail equipment installation and operation manuals of all air conditioning units and intelligent controller.

The provision of complete set of approved as-built information shall be a prerequisite to first delivery.

1.1.12 Maintenance and Operating Manuals and Maintenance Plan

Four (4) copies of maintenance and operating manuals, each with a flash drive with a scanned PDF copy of the entire manual and DWG format as-built drawings is required for this installation. The manuals must include the following items;

(a) List of contents.
(b) Training notes.
(c) Client's, Consultant's and Sub Contractor's details including name, contact person telephone and fax numbers, etc.
(d) Full description of installation and operating features.
(e) Description of automatic control system, accompanied by control schematics, screen grab of setup graphics displays and schedule Input and output points.
(f) Step-by-step instructions for starting/stopping each item of equipment.
(g) List of all equipment with reference numbers, model numbers, Serial Numbers, and suppliers names and contact details.
(h) Names and addresses of firms from where spare parts can be obtained if different from the above.
(i) Spare parts lists.
(j) Commissioning data (water flow quantities, temperatures, thermostat, pressurestat and timer settings, motor voltages, amperages, meg-ohm readings, trend logging, system pressures, etc.,
(k) Manufacturers data, brochures, etc.
(l) Full maintenance and servicing schedules (as recommended by equipment suppliers and including schedules attached to this document)
(m) Full set of as-built installation drawings. wiring diagrams, piping schematics, etc.,
(n) Flash memory drive with copy in PDF format of entire document and drawings. Drawings shall be in PDF and DWG Autocad format.

Each manual must be bound in a hard covered ring file or similar, with the project title and type of installation printed permanently on the face and spine of the manual.

A draft copy of the manual must be submitted to the engineer during commissioning stage for his approval and shall include all items stated above except for the commissioning data.

Once commissioning has been completed a draft copy of the commissioning data must be submitted to the engineer for his approval. The accepted commissioning data must then be bound with the rest of the manual for final submission.

The Engineer reserves the right, at any time, to request a resubmission of draft copies by the Contractor for the Engineers approval.

**The provision of complete and approved set of Operating and Maintenance Manuals shall be a prerequisite to first delivery or beneficial handover.**

1.1.13 Power and Water Supply for site Works

Power and Water supply to site works shall be as per the contract agreement. Power requirements for welding and cutting purposes shall be allowed for under this contract.

1.1.14 Contracts Management and Personnel

1.1.14.1 Upon appointment, the Contractor shall allocate to this project, a suitably qualified HVAC Contracts Engineer and a site foreman, each with at least 7 years air conditioning demonstrable experience in similar type and size of installation, who shall at all times be in full control of and be able to report expediently to the Engineer on all aspects of the Contract. The site foreman representing the air conditioning installation, will be required to be full time on site, and as and when the Engineer and/or the main Contractor deems it necessary.

The installation shall at all times be supervised on site by a competent refrigeration mechanic with a valid SAQCC Gas Certificate and certified to handle refrigerant gases.

1.1.14.2 Should the Engineer indicate that the Contractor has not satisfactorily complied with the above and has failed to remedy the situation within 14 days of written instruction to do so, the contract may be deemed to be in Breach of the contract.

## 1,2.0 **Site Description, Scope of Contract, etc**

1.2.1 Site Description

1.2.1.1 The site for this contract is located in Ward 19, Umkhanyakude District Municipality, Kwazulu-Natal.

1.2.2 Site Conditions

Site conditions are as follows:

(a) Altitude: 100m above sea level
(b) Electrical Supply 400 Volts (+/-10%), 3 phase, 50 Hz, 4 wire

(c) Design summer outdoor air condition: 35.0°C db/70%RH

Fault levels for Switchboards:

(a) Air conditioning switchboards – 5kA

All equipment selected must be capable to operate safely at a voltage supply of 220V or 400V with +/-10% fluctuation.

1.2.3 **Abnormal and/or unusual conditions**

The tenderer shall make note of the following conditions, and shall make adequate allowance in his/her rates for such conditions;

Work is being carried out in a remote rural environment.

1.2.4 **Scope of Contract**

1.2.4.1 The proposed new police station shall be provided with air conditioning and ventilation as herein specified.

1.2.4.2 This air conditioning contract incorporates the supply, installation, testing and 12 months guarantee and maintenance of air conditioning and ventilation system.

1.2.4.3 The scope of this contract shall entail the following installation of

- DX split cassette and midwall type air conditioning units in the administration building
- Ducted fresh air fans,
- Ducted and wall mounted extract fan system,
- Ceiling fans with wall mounted controllers in the staff accommodation units.
- Wall mounted fresh air fans,
- Testing and Commissioning,
- Service and maintenance of entire air conditioning and ventilation system for 12 months,

1.2.5 Electrical and Builder's Works

1.2.5.1 Power supply to local isolators/plug points for air conditioning units sand fans shall be provided by main contractor's Electrician. The final making good to equipment from this point shall form part of this contract, and shall include allowance for openings in panel, glands terminals, etc., where applicable.

1.2.5.2 Unless otherwise specifically indicated, builder's works shall be by main contractor.

1.2.6 Site Inspection

1.2.6.1 The site currently is a greenfield site with no building structure. If called for elsewhere, a pre-tender site inspection and briefing meeting will take place. Failing which it will be the tenderer's responsibility to visit the site and take account of all site conditions, and it shall be assumed that the site was visited. Failure to attend compulsory site briefing where called for shall result in the tenderer being disqualified.

## 1.3.0 DUCTWORK

All air conditioning and extract ducting shall be of galvanised sheetmetal to SABS1238 latest amended for low pressure ducting.

Ducting shall be fabricated and installed by an approved specialist.

All rectangular sheetmetal ducting shall have “Mez” or TDC flanged joints with sealing gaskets. Slip and drive joints will only be accepted with prior approval by the Engineer and where spacing does not permit flanged connections.

All round ducting shall have sleeve and beaded joints.

All rectangular ducting shall be internally insulated with 25mm thick Sonic liner.

All round ducting and spigots shall be internally lined with 15mm “Thermoflex” or equal and approved thermal insulation. Insulation shall be glued throughout its surface and shall be in addition provided with fixings such as grip-nail at not less than 300mm apart.

Flexible ducting shall only be used in concealed spaces and only where shown on the drawings, and shall be EUROPAIR insulated type, with 50mm fibreglass, lined internally and externally with aluminium foil face.

Flexible ducting shall be supported at not less than 1400mm intervals. Ducting shall be fixed to spigots by firstly strapping the internal aluminium lining on to the spigot by broad Q-bands, and then the insulation and external lining with ducting tape and an additional Q band strap.

Allowance must be made to paint the inside of ducting black, where visible through grilles, louvers, etc.

Internal surfaces of the ducting shall be kept clean at all times. The duct ends shall be temporarily covered if stored on site. Air handling unit fans shall be run to blow out dust prior to installation of terminals or ceiling tiles.

All ducting shall be pressure tested for air leaks through joints.

## 1.4.0 AIR CONDITIONING EQUIPMENT - DX SPLIT

All air conditioning units shall be of the DX-split heat pump inverter type enless stipulated elsewhere. **The units shall use R32 or 410A as refrigerant.**

Equipment offered must of reputable make, with agency and part availblilty in RSA for at least the past 7 years. The following makes of equipment will be acceptable provided they meet the required specifications, viz., Diakin, Samsung, LG, Dunham Bush.

Equipment offered and listed in the schedules shall be capable of performing the specified duties and complying fully with the specification requirements in all respects. The capacities specified are based on 27 Deg C DB/19 Deg C WB air-on -coil conditions. Should it transpire that such equipment, even when offered by make, model and/or type, is unsuitable or incapable of performing in accordance with the specified requirements in any respect, the contractor shall nevertheless be

responsible for any additional costs incurred in providing the required or suitable equipment.

Tenderers shall hand the rated capacities of all equipment as well as descriptive literature with the tender documents.

All units shall be selected and designed for operating at a minimum ambient temperature of 35.0 deg C

The maximum noise levels within the offices shall not exceed NC 35.

Panels shall be made of sheetmetal, zinc coated, primed and factory finished with silicone polyester paint.

Refrigerant piping shall be insulated and run in PVC trunking.

All support brackets shall be hot-dipped galvanised. Brackets shall be bolted to walls using rawl bolts of a minimum diameter of 8mm.

Split units shall be installed and commissioned by a certified refrigeration mechanic; proof of certification will be required upon appointment.

Drain pipes from all units shall be provided to nearest drain point.

## 1.5.0 REFRIGERANT PIPING AND FITTINGS

Refrigerant piping and fittings shall generally be as described in the standard specifications, and in the drawings. Piping shall refrigerant grade copper.

All split- direct expansion air conditioning equipment shall be provided with built in HP and LP cutout protection, service ports and isolating valves for pumping down of refrigerant.

Piping shall be run in PVC trunking. Trunking shall be installed neatly with standard corner sections and covers, and shall be run square.

Refrigerant piping connections at the evaporator and the condenser shall be insulated with cork based non-drip tape. Exposed lagging shall be painted over with white epoxy paint.

## 1.6.0 DRAIN PIPING

1.6.1 Condensate drain from evaporators and the AHU shall be piped, under this contract, to a drain point.

1.6.2 All condensate drain piping from air conditioning units shall be uPVC and lagged with pre-formed “Armaflex” or equal. Joints shall be glued using bitumen based adhesive and strapped at 600mm intervals with. Adhesive tape will not be acceptable.

## 1.8.0 ELECTRICAL WORKS, SWITCHBOARDS AND CONTROLS

All air conditioning and ventilation switchboards to be manufactured by specialist manufacturers.

All electrical work shall be carried out in accordance with SANS standards, and what is considered as good practice. An electrical compliance certificate will be required.

Infrared imaging shall be conducted for all joints and connections in panels as a prerequisite to practical completion and repeated every 6 months, and for final completion at end of 12-month maintenance and guarantee.

All starting and stopping of equipment shall be sequenced.

Emergency mushroom head type isolators shall be provided at each remote equipment, such as pumps, cooling towers and fans.

### 1.8.1 GENERAL:

The control panels shall be built in accordance with the SABS Wiring Code of Practice SANS 0142, and the SANS Specification for Low Voltage Switchgear and Control Gear Assemblies SANS 60439-1.

Load carrying equipment installed within the control panels must comply with the following specifications:

- Isolators IEC 60947-3
- Contactors IEC 60947-1
- MCBs IEC 60947-2
- Terminals IEC 6097-7-1
- Fuses IEC 60269-1-2
- Thermal Overloads IEC 947-4
- Manual Motor Starters IEC 947-4-1

Notwithstanding the requirements herein, the tenderer shall nevertheless include in his tender for all components and circuitry to ensure that the system operates correctly and safely, is to regulations, and is in accordance with the recommendations of the suppliers of the plants offered.

**b. Cable Connections**

Cable ends shall be finished off in the type of boxes as recommended by the manufacturers.

The steel wire cable protection shall be properly clamped between conical bushes and kept in position with lock nuts. Cable ends shall be properly earthed.

**d. Wiring Channels**

Channels must be current catalogued products of a reputable make and shall be complete with bends, T-pieces, corner-pieces, internal dividing plates, knock-out sections, etc. and all other accessories as may be required for the installation.

Channels shall be galvanised or properly cleaned and painted with a lead primer and finished off with two coats of approved enamel paint with colour to match the existing installation.

Wiring channels shall be provided with snap-on lids or if channels are too wide, lids will be neatly screwed on.

Knock-out holes for conduits will be provided on the sides of wiring channels in positions as shown on the drawings or as may be required.

**g. Fault Level**

The fault level of the distribution and protection system shall be in accordance with the fault level of the general electrical installation in the building but **shall not be less than 5kVA**.

The air conditioning Contractor shall arrange with the Engineer for the witnessing of the testing of the boards at the manufacturer's workshop prior to they being transported to site and the Engineer must be notified in good time as to when the boards will be available for inspection.

A complete and detailed circuit diagram for each board shall be issued, in good time, to the Engineer for his approval prior to manufacturing. The Engineer reserves the right to request a resubmission of the diagrams for his approval.

Final CAD drawn circuit diagrams, drawn to European standards with grid and component references shall be produced and approved by the Engineer. These shall be included in the operating and maintenance manuals. In addition, a copy of the chiller plantroom switchboard circuit diagram shall be mounted on a frame and bolted on the plantroom wall adjacent to the board.

**c. Pilots Lights**

Pilot lights shall be flush mounted on panel doors and shall have coloured glasses which shall be removable from the front of the door for replacement of lamps. Provide one spare lamp for every five pilot lights. The colour of the lenses shall be:

| | | |
|---|---|---|
| RUN | : | Green |
| FAIL | : | Red |
| INDICATION | : | Amber |

**d. Starters, Contactors and Relays**

Contactors shall be sized to take 10% higher load than the actual imposed load.

Contactors shall also be able to withstand the following:

- Over current and fault currents that may occur for the time required for its own tripping device to operate.
- All fault currents up to the back-up fuses or circuit breakers trip.

All contactors shall be provided with at least two auxiliary contactors for interlocking and indication.

Starters, contactors and relays of a similar make and type shall be employed wherever possible to reduce the number of spares to be kept.

**e. Labelling**

All labels shall be of the engraved type with black letters on white/silver background.

**f. Access**

All equipment mounted in the electrical switchboards shall have sufficient space to be easily accessible for removal, repair and maintenance.

**g. Wiring and Terminals**

Copper stranded conductors with Polyvinyl Chloride Insulation shall be used for all small wiring in the switchboard.

Wiring inside the compartments shall be neatly bundled together and fastened with patented PVC bands and shall run in near horizontal or vertical lines wherever possible. Wiring from one compartment to another shall be done in wiring channels with clip on lids.

Wiring shall be connected to terminal blocks and no more than two wires shall be connected to any one terminal. Provide 10% spare terminals for possible future extensions or additions to the board. Identification of small wiring shall be in accordance with BS 158. Wiring connected to panel doors shall be protected by a plastic spiral wrapped around the conductor bundle and sufficient slack of wire shall be provided to allow easy opening of doors without putting any strain on the terminal connections.

Multi-core incoming cables shall be connected to the switchboard wiring by means of terminal blocks. All cables entering the switchboard shall be neatly finished off.

**h. Switchgear**

All switchgear shall comply with the relevant SANS and BS standards such as SANS 152 and 156 and BS 5419.

**I. Isolators**

All isolators shall be load break switches and shall be pad lockable off.

## 1.8.2 ELECTRICAL WIRING

All the wiring between localised motor control centres installed under this subcontract and from isolators provided by the electrician shall form part of this air conditioning subcontract. See enclosed tender drawings for the position of the Motor control centres.

All electric wiring reticulation is to be carried out in strict accordance and in compliance with the South African Bureau of Standards wiring code SANS 0142.

All electric reticulation must either be drawn in steel conduit or laid in a steel trunking/cable racks.

Upon completion of the Works, the Contractor shall issue a Certificate of Compliance for all electrical work undertaken.

**a. Cables**

Wiring shall be multi-strand silicone insulated copper wiring. Wire ways and layouts shall be planned in advance to minimise cable crossings. Wiring shall be installed parallel to one another and shall be properly fixed. Joining of cables will not be acceptable.

Each cable shall be identified with a metal tag bolted to the cable ends and identification numbers will be stamped on the tags.

**b. Local Isolators**

Provide local isolators adjacent to motor driven equipment remote from switchboards.

**c. Cable Racks**

Where cable racks are used the cables shall be laid on factory manufactured cable racks. Cable racks shall be current catalogued products of a reputable make complete with all bends, tee pieces, reductions, take-offs and clamps.

All cable racks shall be galvanised and painted with a lead primer and two coats of approved enamel paint with colour to match the existing installation. Sufficient support brackets shall be provided to prevent sagging of cable racks.

Cables and wires shall not be fitted directly to cable racks. All cable racks shall have earthing continuity.

**e. Conduit**

Conduits shall be galvanised steel and shall bear the SABS mark. The minimum diameter of conduits used shall be 20mm.

Conduits shall be screwed and socketed and bends shall be of the long radius type. PVC conduits are not acceptable.

f. Draw Boxes

Draw boxes shall be installed so that not more that two bends occur between a draw box and the end of the conduit or between two draw boxes.

## 1.8. SOUND LEVELS

All equipment shall be selected such that the following sound levels, are not exceeded within any occupied spaces.

i) All areas unless otherwise indicated : NC35

## 1.10.0 TESTING & COMMISSIONING

1.10.1 Tests shall generally be done in accordance with the Standard Specification.

1.10.2 The contractor shall provide at no additional cost all equipment for testing, and shall offer all assistance to the Engineer for him to conduct his/her inspections and tests.

1.10.3 The contractor shall complete all tests and commissioning and provide all commissioning data to the Engineer prior to calling the Engineer for Inspections. Any delays caused to the contract due to the contractor failing to adequately complete all tests and commissioning and provision of complete commissioning data for the Engineer's inspection and tests shall not form any grounds for granting of extension of time.

## 1.11.0 PLANT LABELLING

1.11.1 Allowance must be made to provide ivorene labels with minimum of 10mm letters on all switchboards, air conditioning units (outdoor and indoor Units). Contents of these labels shall be as instructed by the Engineer during the construction period.

## 1.12.0 PAINTING

1.12.1 Allowance shall be made for painting of concrete bases for plants installed under this contract.

1.12.2 All brackets exposed to the weather shall be galvanized and primed and painted.

## 1.13.0 EQUIPMENT GUARANTEE and WARRANTY

All equipment and workmanship shall be guaranteed for 12 months from practical handover. All extended suppliers' warranty shall be ceded to the Client.

## 1.14.0 EQUIPMENT CORROSION PROTECTION

All metal surfaces, unless otherwise stated shall be hot dipped galvanized to SANS121 (ISO 1461).

## 1.15.0 INSPECTIONS AND HANDOVER

The contractor shall ensure that he carries out his own quality control. Contractor to fully inspect the installation and rectify the works prior to requesting the Engineer to conduct his inspections as per the JBCC contract. Contractor shall provide all assistance required by the Engineer to conduct his inspections at no additional cost, including all test or measuring equipment, ladder, etc.

## 1.16.0 SERVICE AND MAINTENANCE

The entire air conditioning installation shall be serviced and maintained for 12 months following practical handover.

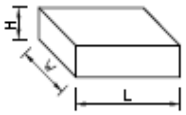
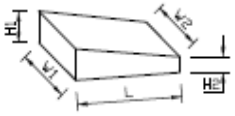
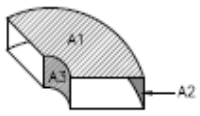
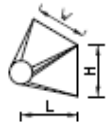
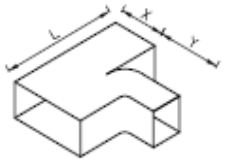
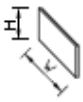
A monthly maintenance inspection schedule shall be completed and signed off by the building manager and submitted to the Engineer. The schedule shall include all plants and verification of correct operations. Abnormal noise, vibrations, high operating temperature, leaks, sweating, rust shall be reported and rectified.

## 1.17.0 TRAINING OF STAFF

Allowance shall be made for training of client representative and building supervisor. Draw up a training chart and attendance register. Conduct training, incorporate but not limited to the following;

- Description of the plant,
- Demonstration of the operation of the central intelligent management controller, how to view and adjust the various user functions,
- Operating procedures,
- Procedures to follow during malfunction,
- Daily checks (maintenance staff),
- How to access the controls and change allowable parameters (maintenance staff)

## 1.18.0 METHOD FOR DUCT MEASUREMENT

| ITEM | SHEETMETAL (m^2) | FITTINGS No. |
|---|---|---|
| STRAIGHT RECTANGULAR DUCT:<br>  | 2(H+W)xL | 0 |
| RECTANGULAR EQUAL AND UNEQUAL TRANSFORMATION:<br>  | 2(H1+W1)xL | 1 |
| RECTANGULAR BEND:<br>  <br>A1–AREA OF TOP OF BEND<br>A2–AREA OF OUTER SURFACE OF BEND<br>A3–AREA OF INNER DIAMETER OF BEND | (2xA1)+A2+A3 | 1 |
| RECTANGULAR–TO–ROUND TRANSFORMATION:<br>  | 2(H+W)xL | 1 |
| TROUSER PIECE:<br>  | 2(X+Y)xL | 1 |
| STOP–END:<br>  | 2(H+W) | 0 |

| | | | |
|---|---|---|---|
| MECHANICAL CONSULTING ENGINEERS:<br>**MAHESH KHOOSAL & ASSOCIATES**<br>*Mechanical Consulting Engineers*<br>PH: 031–5631985<br>FAX: 031–5631930 | DRAWING TITLE :<br>METHODOLOGY FOR DUCT MEASUREMENT | DESIGNED : MK | SCALE : 1:150 |
| | | DRAWN : OA | REV: 2 |
| | | CHECKED : MK | DRAW NO: MKA/AC/01 |
| | | PRINCIPAL : MK | |

# HVAC - DRAWINGS

**South African Police Service**

**Back to Basics**
Towards a Safer Tomorrow

**PROJECT TITLE**

# CONSTRUCTION OF NTSHONGWE POLICE STATION

**PREPARED BY**

**PNHUNGASHE HEALTH AND SAFETY CONSULTING (PTY) LTD**

## DOCUMENT INFORMATION

**Project Name:** **Construction of Ntshongwe Police Station**

**Client:** **South African Police Service**

**Construction Health and Safety Agent:** **Phungashe Health and Safety Consulting (PTY) LTD**

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| **Compiled by:** | **Approved by:** |
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| Phungashe Health and Safety Consulting (PTY) LTD | South African Police Service |
| Name: Ayanda Buthelezi | Name: |
| | |

# *Table of Contents*

**SECTION A: OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION ..... 1**

**1. PREAMBLE ..... 1**

**2. LEGAL FRAMEWORK ..... 1**

**3. ABBREVIATIONS ..... 1**

**4. DEFINITIONS ..... 2**

**5. PROJECT BACKGROUND AND SCOPE ..... 3**

**6. PROJECT TEAM MEMBER ..... 5**

**7. MINIMUM HEALTH AND SAFETY ADMINISTRATIVE REQUIREMENTS ..... 5**

7.1 OCCUPATIONAL HEALTH AND SAFETY PLAN ..... 5
7.2 OCCUPATIONAL HEALTH AND SAFETY FILE ..... 5
7.3 CONSTRUCTION WORK PERMIT ..... 9
7.4 OCCUPATIONAL HEALTH AND SAFETY POLICY ..... 10
7.5 LEGAL APPOINTMENTS ..... 10
7.6 HEALTH AND SAFETY ORGANOGRAM ..... 10
7.7 COMPENSATION FOR OCCUPATIONAL INJURIES AND DISEASED ..... 10
7.8 SUB - CONTRACTORS ..... 11
7.9 HAZARD IDENTIFICATION AND RISK ASSESSMENT ..... 11
7.10 SAFE WORKING PROCEDURES ..... 12
7.11 HEALTH AND SAFETY REPRESENTATIVES ..... 12
7.12 HEALTH AND SAFETY COMMITTEES ..... 12
7.13 MEDICAL FITNESS ..... 13
7.14 HEALTH AND SAFETY TRAINING ..... 14
7.15 MARALIA PREVENTION PROGRAM ..... 15
7.16 DAILY SAFE TASK INSTRUCTIONS ..... 16
7.17 PLANNED TASK OBSERVATIONS ..... 16
7.18 INCIDENTS AND EMERGENCY PLAN ..... 17
7.19 FIRST AID ATTANDANCE ..... 19
7.20 ACCIDENT & INCIDENT REPORTING, INVESTIGATION AND STATISTICS ..... 19
7.21 NON-CONFORMANCE AND ACTION MANAGEMENT ..... 21
7.22 OHS AUDITS, MONITORING AND REPORTING ..... 22
7.23 GENERAL RECORD KEEPING ..... 22

**8. PHYSICAL REQUIRMENTS ..... 23**

8.1 SITE ESTABLISHMENT ..... 23
8.2 DRIVING ON GRAVEL ROAD &TRANSPORTATION OF EMPLOYEES ..... 26
8.3 PERSONAL PROTECTIVE EQUIPMENT ..... 26
8.4 HAZARDS AND POTENTIALLY HAZARDOUS SITUATIONS ..... 35
8.5 EXTREME WEATHER CONDITIONS ..... 35
8.6 SITE CLEARANCE ACTIVITIES ..... 36
8.7 LONE WORK ..... 36
8.8 PLANT AND EQUIPMENT OPERATION ..... 37
8.9 TRAFFIC MANAGEMENT ..... 38

8.10 EXCAVATIONS ..... 38
8.11 EDGE PROTECTION ..... 39
8.12 WORKING AT HEIGHTS ..... 40
8.13 TEMPORARY WORKS ..... 50
8.14 LIFTING AND TACKLING ..... 51
8.15 CONCRETE WORKS ..... 52
8.16 STRUCTURES ..... 53
8.17 CONFINED SPACE ..... 53
8.18 LOCKOUT PROCEDURES ..... 54
8.19 GENERAL MACHINERY ..... 55
8.20 HAND TOOLS ..... 58
8.21 MANUAL HANDLING ..... 58
8.22 VIBRATION ..... 59
8.23 HAZARDOUS CHEMICAL SUBSTANCES ..... 60
8.24 FUEL / FLAMMABLE LIQUID ..... 62
8.25 STACKING OF MATERIALS ..... 64
8.26 FIRE PROTECTION AND PREVENTION ..... 65
8.27 INSTALLATION OF SERVICES ..... 67
8.28 DEMOLISHING ..... 67
8.29 SMOKING ..... 67
8.30 HOUSEKEEPING ..... 68
8.31 WASTE MANAGEMENT ..... 68
8.32 WORKING IN MALARIA ENDEMIC AREA ..... 68
8.33 WELFARE FACILITIES ..... 69
8.34 HEALTH, SAFETY AND HYGIENE MANAGEMENT PROGRAM ..... 69

**9. CLOSE OUT REQUIREMENTS ..... 70**

**10. COST OF COMPLYING WITH THE OHASA AND CR 2014 ..... 70**

**11. CONCLUSION ..... 70**

**SECTION B: BASELINE RISK ASSESSMENT ..... 72**

# SECTION A: OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION

## 1. PREAMBLE

In terms of Construction Regulations 2014 section 5 (1) (b) the Construction Health and Safety Agent on behalf of the Client must prepare an Occupational Health and Safety (OHS) Specification for the proposed construction project. This OHS Specification has been compiled by Phungashe Health and Safety Consulting (PTY) LTD, the Construction Health and Safety Agent for the Construction of Ntshongwe Police Station.

The Health and Safety specification establishes the generic and specific requirements to enable the Client and the eventual appointed Contractor to satisfy the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) its Regulations and related legislation.

This specification sets out the requirements for eliminating and/ or mitigating health and safety risks, injuries, accidents and incidents on site. It addresses legal compliance, hazard identification, risk assessment, risk management and promotion of health and safety culture within the project. The specification also makes provision for the protection of personnel other than the employees.

## 2. LEGAL FRAMEWORK

- Occupational Health and Safety Act no.85 of 1993 and Its Regulations
- Compensation for Occupational Injuries and Disease act no. 130 of 1993
- Regulations For Hazardous Biological Agents, 2022
- National Environmental Management Act No. 107 of 1998
- National Building Regulations, SANS 10400
- By-Laws

## 3. ABBREVIATIONS

- CEO – Chief Executive Officer
- CR – Construction Regulations 2014
- PC – Principal Contractor
- DB – decibels
- DMR – Driven Machinery Regulations
- DSTI - Daily Safe Task Instruction
- EMPr – Environmental Management Program
- ER – Electrical Installations Regulations
- ERW – Environmental Regulations for Workplaces
- FR – Facilities Regulations
- GAR – General Administration Regulations

- GSR – General Safety Regulations
- HCSR – Hazardous Chemical Substances Regulations
- OHS – Occupational Health and Safety
- SABS – South African Bureau of Standards
- SACPCMP - South African Council for Project and Construction Management Professions
- SANS – South African National Standards
- PPE – Personal Protective Equipment
- PTO - Planned Task Observations

## 4. DEFINITIONS

For the purpose of the OHS Specification, the definitions given hereunder must apply. All definitions as listed under the Occupational Health and Safety Act, 1993 and legislation are applicable

“Agent (Pr. CHSA)” means a competent person Registered with the SACPCMP who acts as a representative for a Client in terms of regulation (5)5.

“Client” means South African Police Service

“Competency” means combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely;

“Competent person” means a person who-

(a) Has in respect of the work or task to be performed the required knowledge, training and experience and, where applicable, qualifications specific for that work or task: Provided that where appropriate qualifications and training are registered in terms of the provisions of the National Qualifications Framework Act, 2000 (Act No.67 of 2000),

(b) Is familiar with the Occupational Health and Safety Act No. 85 of 1993 and with the applicable regulations made under the Act;

"Construction Manager (Site Agent)" means a competent person responsible for the management of the physical construction processes and the coordination, administration and management of resources on a construction site;

"Construction Site" means a workplace where construction work is being performed;

"Construction Supervisor" (Site Foreman) means a competent person responsible for supervising construction activities on a construction site;

"Construction Vehicle" means a vehicle used as a means of conveyance for transporting persons or material, or persons and material, on and off the construction site for the purposes of performing construction work;

"Construction work" means any work in connection with –

(a) The construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure; or

(b) the construction, erection, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system; or the moving of earth, clearing of land, the making of excavation, piling, or any similar civil engineering structure or type of work;

"The Principal Contractor" means an employer appointed by the client to perform construction work;

"Contractor" means an employer who performs construction work; in this case the

"Fall Protection Plan" means a documented plan, which includes and provides for-

(a) All risks relating to working from a fall risk position, considering the nature of work undertaken;

(b) The procedures and methods to be applied in order to eliminate the risk of falling; and

(c) A rescue plan and procedures;

"OHS File" means a file, or other record containing the information in writing required by these Regulations;

"OHS Plan" means a site activity or project specific documented plan in accordance with the Client's OHS Specification requirements which is based on the Baseline Risk Assessment;

"OHS Specification" means a site activity or project specific document prepared by the client pertaining to all health and safety requirements related to construction work;

"Medical Certificate of Fitness" means a certificate contemplated in regulation 7(8) of Construction Regulations 2014;

“OHS Officer” – a person deemed competent by SACPCMP under the relevant category of registration.

“The Act” – Occupational Health and Safety Act No.85 of 1993

## 5. PROJECT BACKGROUND AND SCOPE

The project is a new build of Ntshongwe Police Station in Umkhanyakude District under Umhlabuyalingana Local Municipality. Site is located adjacent to KwaZulu Natal Department of Transport public road (P447). The proposed site for construction is a vacant land, covered by indigenous vegetation. The scope of work is a follows:

### 5.1 Service point

Covered veranda

Work area in front of counter

Work area behind counter

Rest rooms members working shifts

Radio room

CSC Commander

Members Level 5

Members Level 6

Strong Room

Kitchen

General stores

Lecture / tea room

Holding cell

Interview room

### 5.2 Public Ablutions

Male

Female

Disabled

### 5.3 Living Quarters

Bedroom

Bathroom

Kitchen

Covered veranda

Patios

### 5.4 General Support Rooms

Cleaners rest room

Emergency generator room

Emergency water storage

Airconditioning

Security measures

### 5.5 Non-Assignable Areas

Non assignable area for circulation, tea kitchens and ablutions

Public ablution

Staff ablution

Staff circulation within residence

### 5.6 Service Room / Spaces

Under cover parking – official light vehicle

Wash bay

Refuse area

Open parking

### 5.7 Additional Rooms

Battery and server room

Water and power management

## 6. PROJECT TEAM MEMBER

| DESINATION | LEAD NAME | ORGANISATION | CONTACT NO. |
|---|---|---|---|
| Construction Health and Safety Agent | Ayanda Buthelezi | Phungashe Health and Safety Consulting (PTY) LTD | 061 416 2618 |
| Project Manager | Dayalan Chetty | Naidu Consulting | 031 265 6007 |
| Structural Engineer | Manivasen Govender | Naidu Consulting | 031 265 6007 |
| Civil Engineer | Ashveer Goorun | Naidu Consulting | 031 265 6007 |
| Quantity Surveyor | Thavandran Naidoo | Rovert Consulting | 031 708 4001 |
| Architect | Somakanthen Govender | Artek 4 Architects | 031 201 0445 |
| Mechanical Engineer | Maheshkumar Khoosal | MKA Mechanical Consulting Engineers | 031 536 8306 |
| Electrical Engineer | Bothata Lenka | Ningi Consulting Engineers | 072 249 3459 |

| | | |
|---|---|---|
| **Safety Agent Professional Registration: Ayanda Buthelezi** | SACPCMP | CHSA/059/2017 |

## 7. MINIMUM HEALTH AND SAFETY ADMINISTRATIVE REQUIREMENTS

### 7.1 OCCUPATIONAL HEALTH AND SAFETY PLAN

The PC/ successful bidder must compile a documented OHS Plan as per CR 7(1) (a) based on the information / requirements contained in this specification and demonstrate to us how he/ she is going to implement health and safety requirements during works. The OHS Plan must be submitted for approval by the Agent prior construction works commencement on site.

### 7.2 OCCUPATIONAL HEALTH AND SAFETY FILE

The PC must, in terms of CR 7(1)(b) compile and keep on site an OHS file that must include all documentation required in terms of this Specification, The Act and its Regulations. The PC must submit the OHS file to Health and Safety Agent for perusal and advise within 14 days of appointment. The following are the minimum standard legal documentation that must form part of the OHS submitted for approval:

| No. | Item | Submit with file for approval | Comments |
|---|---|---|---|
| 1. | Index | Yes | None |
| 2. | Letter of Good Standing | YES | To be kept up to date and Filed in File |
| 3. | Construction Work Permit | No | Application to be submitted to DOL by Agent |
| 4. | Signed and dated SHE Management Plan | Yes | To be Filed in File |
| 5. | Organogram & Legal appointments | Yes | To be placed on the File, kept updated |
| 6. | Signed and dated Health and Safety Policies | Yes | To include communication Register and Filed in File |
| 7. | Site Layout Plan | Yes | To be kept updated and Filed |
| 8. | Pre employment and exit Certificates of medical fitness | No | To be provided prior work commencement and Filed |
| 9. | Signed and dated Emergency Plan | Yes | To be kept updated and Filed |
| 10. | Signed and dated Environmental Management Plan | Yes | To be kept updated and Filed |
| 11. | Signed and dated Personal Hygiene and Infectious Disease Management Plan. | Yes | To be kept updated and Filed. |
| 12. | Signed and dated Fall Prevention Plan | Yes | To be reviewed prior to work being conducted, and Filed |
| 13. | Waste management Plan | Yes | To be reviewed prior to work being conducted, and Filed |
| 14. | Traffic Management Plan | Yes | To be reviewed prior to work being conducted, and Filed |
| 15. | Demolition Plan | No | To be submitted to CHSR and Structural Engineer for approval before activity commences and Filed. |
| 16. | Signed and dated risk assessments | Yes | To be submitted with File for evaluation. To be filed and reviewed prior to work being conducted. |
| 17. | Signed and dated Method Statements/ Safe Work Method Statements for the | Yes | To be submitted with File for evaluation. To be reviewed prior to work being conducted. |

| | | | |
|---|---|---|---|
| | priority risk assessments as per risk assessment | | |
| 18. | Continuous Risk assessments and Method Statements. | No | To be kept on FILE with communication records |
| 19. | Daily Safe Task Instruction (DSTI) | NO | To be signed off at the start of shift with communication record, to be kept in File |
| 20. | Induction Program | No | To be reviewed, kept updated and include communication record register |
| 21. | Toolbox talks | No | To include communication register and Filed |
| 22. | PPE Issue Record | No | To include training in correct use etc and Filed |
| 23. | Checklists and registers | No | To be Filed and reviewed prior work commencement |
| 24. | Sub – Contractor Monthly Audit records | No | To be discussed at SHE Committee meeting, closed out and kept on file |
| 22. | External Audit Reports | No | To be discussed at SHE Com Meetings, Internal Meetings etc and filed. |
| 23. | Audit Close out Reports | No | To be completed on a monthly basis, forwarded to Agent least 7 after receiving Audit and Filed |
| 24. | Sub- Contractor Appointments and scope and list | No | To be kept on File. |
| 25. | Section 37(2) Agreements | No | To be kept on File. |
| 26. | Copy of Construction Regulations | No | To be kept on File. |
| 27. | Construction Manager (CR 8(1)) | Yes | Including CV / Proof of Competency. To be kept in the File. |
| 28. | Assistant Construction Manager (CR 8(2)) | Yes, if applicable | Including CV / Proof of Competency. To be kept in the File. |
| 29. | SHE Officer (CR 8(5)) | Yes | Including CV / Proof of Competency and SACPCMP Registration. To be kept in FILE. |

| | | | |
|---|---|---|---|
| 30. | Construction Supervisor (CR 8(7)) | Yes | Including CV / Proof of Competency. To be kept in File. |
| 31. | Assistant Construction Supervisor (CR 8(8)) | Yes, if applicable. | Including CV / Proof of Competency. To be kept in File. |
| 32. | Risk Assessor (CR 9 (1)) | Yes | Including CV / Proof of Competency. To be kept in File. |
| 33. | Fall Prevention Planner (10 (1)(a)) | Yes | Including CV / Proof of Competency. To be kept in File. |
| 34. | Temporary Works Designer (CR 12(1)) | No | Including CV / Proof of Competency. To be kept in File. |
| 35. | Temporary Works Supervisor (CR 12(2)) | No | Including CV / Proof of Competency. To be kept in File |
| 36. | Excavation Supervisor (CR 13(1)(a)) | No | Including CV / Proof of Competency. To be kept in File |
| 37. | Demolition work Supervisor (14(1)) | No | Including CV / Proof of Competency. To be submitted with Demolition Plan. To be kept in File |
| 38. | Scaffold Supervisor (CR 16(1)) | No | Proof of Competency. To be kept in File |
| 39. | Scaffold Erector (CR 16 (2)) | No | Proof of Competency. To be kept in File |
| 40. | Scaffold Inspector (CR 16(2)) | No | Proof of Competency. To be kept in File |
| 41. | Suspended Platform Supervisor (CR 17(1)) | No | Proof of Competency. To be kept in File |
| 42. | Material Hoist Inspector (CR 19(8)(a)) | No | Proof of Competency. To be kept in File |
| 43. | Bulk Mixing Plant Supervisor (CR 20(1)) | No | Proof of Competency. To be kept in File |
| 44. | Construction vehicle and Mobile Plant Operator (CR 23(1)(d)) | No | Proof of Competency, medical fitness etc. To be kept in File |
| 45. | Crane Supervisor (CR 22(a)) | | Proof of Competency, medical fitness. To be kept in File |

| | | | |
|---|---|---|---|
| 46. | Temporary Electrical Installation Inspector (CR 24(d)) | No | Proof of Competency. To be kept in File |
| 47. | Stacking and storage Inspector (CR 28 (a)) | No | Appointment, to be kept in File |
| 48. | Fire Equipment Inspector (CR 29(h)) | No | Including basic Fire Fighting Training proof of competency |
| 49. | Fire Team Member (CR 29 (i)) | No | Including basic Fire Fighting Training proof of competency |
| 50. | Portable Electrical Equipment Inspector (EMR 9) | No | Appointment to be kept in the File |
| 51. | Accident Incident Investigator ( GAR 9(2)) | Yes | Including CV / Proof of Competency. To be kept in File |
| 52. | First Aider GSR (3(4)) | No | Including at least Level 2 First Aid Competency. To be kept in the File |
| 53. | Welding/Flame cutting equipment Inspector (GSR 9) | No | Appointment to be kept in the FILE |
| 54. | Ladder Inspector (GSR 13 (a)) | No | Appointment to be kept in the FILE. |
| 55. | Hazardous Chemical Substances Supervisor (HCSR 3(3)) | No | Appointment to be kept in the FILE. |
| 56 | Hand Tool Inspector (Sec 8(2)(a)) | No | Appointment to be kept in the FILE. |
| 57. | SHE Representative (Sec 17) | No | Including proof of Competency. To be Filed in FILE |
| 58. | Sub-Contractor (CR 7(1)(c) | No | As per applicable legislative requirements |
| 59. | Electrical Contractor (EIR 6) | No | Including proof of Professional Registration |

## 7.3 CONSTRUCTION WORK PERMIT

The project will require a Construction Work Permit (CWP). The application for the CWP must be conducted by the Agent after approving the PC Health and Safety Plan as per CR 3

requirements. No work will commence, including establishment until CWP is granted by the DOL.

## 7.4 OCCUPATIONAL HEALTH AND SAFETY POLICY

The Contractor must prepare a written policy concerning the protection of the health and safety of employees at work, including the description of his organization and the arrangements for carrying out and reviewing the policy. The OHS policy must be signed by the CEO. A copy of the OHS policy must be prominently displayed on site and also be kept on the OHS file.

## 7.5 LEGAL APPOINTMENTS

The Client shall appoint the PC (successful bidder) for the works as per CR 5 (1) (k). A section 37 (2) agreement shall also be signed between the Client the PC.

The PC must make appointments as per The Act and its Regulations; structured and guided by the scope of works to be performed.

It is acknowledged that the PC may need to allocate more than one appointment to certain staff members. This practice may only take place if health and safety standards will not be negatively affected. If the Agent deem such practice as having a negative effect on health and safety standards; then alternative arrangements will have to be made.

The project will require a full time Construction Health and Safety Officer to implement and manage OHS compliance on site. COMPETENCY OF APPOINTEES

Contractor's competent persons for the various risk management portfolios must fulfil the criteria as stipulated under the definition of Competent Person in accordance with the CR and The Act. All competency certificates must be South African Qualifications Authority (SAQA) accredited. The competency must be subjected to approval by the Agent.

## 7.6 HEALTH AND SAFETY ORGANOGRAM

An organogram outlining the Health and Safety Management as per appointments under the OHS Act and the Regulations must be provided by the PC and be kept in the health and safety file.

The PC must update the site Health and Safety Management Organogram when there are any changes in the Site Management Structure.

## 7.7 COMPENSATION FOR OCCUPATIONAL INJURIES AND DISEASED

The PC must warrant that all employees are fully covered in terms of the Compensation for Occupational Injuries and Diseases Act 1993 (Act No. 130 of 1993) (COID Act) and that such cover must remain in force for the duration of the project.

All bidders must supply proof of such insurance cover to the Client at the time of the bid.

The PC must ensure that all Sub-Contractors appointed by him are fully covered in terms of the COID Act, and that such cover must remain in force for the duration of their contract.

The PC must also provide Public Liability Cover that must adequately make provisions for any losses and / or his employee's acts and / or omissions whilst working on the Client's premises.

## 7.8 SUB - CONTRACTORS

All Sub - Contractors will be responsible for their own OHS on site under supervision of the PC. The PC must appoint the Sub – Contractors as per CR 7 (1) (C) (v) and sign a section 37(2) mandatory agreement with them. The OHS requirements for works must form part of Sub - Contractor's tender documents. Selection criteria for Sub- Contractors must include ability to meet health and safety requirements for the works. Sub – Contractor must demonstrate OHS budget allocations for the works.

The PC must issue Sub-Contractors with the OHS Specification for the works. All Sub – Contractors must open their own OHS Files. The PC must approve Sub – Contractors OHS Plan and agree on the files before they commence on site. The files must be updated monthly as per works progress and will be subjected to monthly Audits by the PC. Audits must be emailed to Sub-Contractors and the Agent must be copied. The PC must monitor all Contractors and ensure closing out of deviations.

The Sub – Contractors must update and provide monthly incidents statistics, pre – employment and exit medicals status to the PC and Agent.

## 7.9 HAZARD IDENTIFICATION AND RISK ASSESSMENT

The PC must allow for and cause a Site-Specific Hazard Identification and Risk Assessment exercise to be performed by a competent Risk Assessor before commencement of construction work based on his scope of works, activities to be executed on site. The Risk Assessment must include the following:

- A list of activities to be performed and hazards identified for tasks;
- Health, and safety effects from exposure to hazards;
- Risk rating and its methodology / matrix;
- Control / mitigation measures to identified hazards;
- Method statements and safe working procedures for the high-risk tasks intended to eliminate, reduce and/or control the risks assessed;
- A monitoring and review procedure of the risk assessment as the risks change.

The PC must provide a baseline risk assessment to Sub-Contractor for the works they shall be conducting before any work commences and thereafter at regular intervals as the risks change and as new risks develop.

The PC must allow for and be responsible for ensuring that all persons who could be negatively affected by construction operations are informed and trained according to the hazards and risks and are conversant with the safe work procedures, control measures and other related rules (for example "tool box talk" strategy to be implemented).

Should the Agent or other Clients Representative identify alternative hazardous activities performed by the PC or its Sub - Contractors on site for which a Risk Assessment was not performed, works will be stopped and the PC or Sub - Contractors will be required to perform such an exercise before continuing such work.

## 7.10 SAFE WORKING PROCEDURES

The Contractor must develop, document and implement safe working procedures (SOP) for all activities involving significant health or safety risk. These procedures must detail the control measures required to effectively manage the health and safety risks associated with the work activities.

SOPs must be consistent with the task-based risk assessment completed for the activity.

Every person engaged in an activity for which a SOP has been developed must receive suitable training on the procedure before commencing the works.

Furthermore, the contractor must develop, document, communicate and implement formal procedures, work instructions and / or programmes for the operation, maintenance, inspection and testing of all plant and equipment (including protective systems and devices) brought onto the project site(s).

## 7.11 HEALTH AND SAFETY REPRESENTATIVES

The PC and Sub - Contractors must allow for and ensure that OHS Representative(s) as per OHS Act section 17 are appointed and trained to carry out their functions as per section 18 of The Act.

The appointments must be in writing and the OHS Representative must carry out regular inspections, keep records and report all findings to the OHS Officer.

## 7.12 HEALTH AND SAFETY COMMITTEES

When there is more than one Health and Safety Representative on site, a Health and Safety Committee must be developed as per the requirements of section 19 of The Act. The person nominated by an employer on the health and safety committee must be designated in writing by Contractor for such a period as may be determined by him. Health and Safety Representatives shall be members of the committee for their entire period of designation. The functions of the health and safety committee must be as per OHS Act section 20. The PC must ensure that project Health and Safety Committee Meetings are held a minimum of once a month or more as deemed necessary by the project requirements. The following must be in place regarding the meetings:

- Minutes must be kept on record and filed in the site health and safety file.
- Meetings must be organized and chaired by the PC's Responsible Person appointed in writing.

## 7.13 MEDICAL FITNESS

The contractor must develop and implement a programme to manage employee fitness for work. All employees working on site for whom the contractor is responsible (i.e., direct employees of the contractor as well as the employees of any appointed sub-contractors) must be subject to this programme.

All employees on site must have valid certificates of medical fitness as per CR 7(1)(g).

The results of an exit medical examination / any certificate of medical examination from a previous employment will not be accepted as a pre-employment medical examination for this project.

The medical examinations described above may only be carried out by an Occupational Medical Practitioner (i.e., a medical doctor who holds a qualification in occupational medicine).

A detailed job (role) description and an exposure profile (noise, dust, heat, working at height, working with machinery, etc.) must be provided for each employee. The medical examinations that an employee undergoes must be based on (i.e., the employee's fitness must be assessed against) the information contained in these documents as well as the baseline risk assessment for the work. This information must be made available to the occupational medical practitioner performing the medical examination.

For each role, the medical criteria for fitness must be documented and these must be based on an evaluation of the physical and medical requirements for the role.

The medical examinations carried out for all drivers and operators must include testing / assessment for medical conditions that could affect the safe operation of vehicles or equipment.

Specific testing / questioning must be carried out to determine if an individual:

- Suffers from epilepsy or any other medical condition deemed to be a risk by the occupational medical practitioner.
- Makes use of chronic medication that could affect performance.
- Is colour-blind; or
- Has poor day or night vision.

The medical examinations carried out for employees that are required to work at height must include testing / questioning to determine if an individual suffers from epilepsy, hypertension (high blood pressure) or any other medical condition deemed to be a risk (with regard to working at height) by the occupational medical practitioner.

Electricians must be tested for colour-blindness.

If an individual is found to be medically "unfit for placement", the doctor will indicate which work activities cannot be performed by the person.

The individual may still be employed on the project if his medical restrictions can be accommodated and provided that no legislation is transgressed.

A process must be established to manage medical restrictions that may be placed on an employee. For every employee with a medical restriction, regular follow up visits with the

occupational medical practitioner must be arranged to ensure that each case is proactively managed.

An employee in a safety critical job must report (to his supervisor) any condition that might impair his ability to safely perform the duties associated with his role. A mechanism must be in place for such reports to be referred to an occupational medical practitioner to determine if the employee is fit to continue with his work.

Proof of all medical examinations (i.e., certificates of fitness signed by an occupational medical practitioner) must be kept on site and these records must be readily available for inspection by the nominated project management representative.

An employee's certificates of fitness must be included in his personal profile.

No employee may commence work on site without proof that he has undergone a pre-employment medical examination.

Employees must be subjected to exit medical evaluation when their contract ends on site.

All occupational medical data and records must be retained for at least 40 years.

## 7.14 HEALTH AND SAFETY TRAINING

### *7.14.1 Induction*

The PC must develop and devise an OHS induction program for the site and highlight specific hazards and risks associated to site. All personnel on site must undergo a site-specific health and safety induction training session before starting work. A record of attendance must be kept in the OHS File. Induction training must also include training on the risks associated with the works to be executed, safe work procedures and emergency procedures.

All visitors to the site must also be subjected to site-specific induction training highlighting items such as site safety and health risks, steps to follow in the event of emergency, restricted areas and on the site health and safety rules upon entering the site.

### *7.14.2 Displaying of Information*

The site must display as a minimum notices and awareness information as per table below:

**Table 2: Warning / Informative signs requirements**

| **Area and/or activity where notice or sign is required** | **Notice or sign required in terms of** |
|---|---|
| Display of notices and signs | GSR 2B and SABS Code 1186 |
| Entry | GSR 2C (2) |
| First-aid | GSR 3(6) |
| Toilets and change rooms | FR 2(5); 4(2)(f) |
| Storage of flammable materials | GSR 4(8)(a)(i) and (ii) (10(e) only applicable to Contractor's yards) |

| | |
|---|---|
| Grinding wheels | DMR 8(1)(7) |
| Machinery | General Machinery Regulation 9 *(Schedule D)* |
| Explosive powered tools | Construction Regulation 21(2)(f) |
| Prohibition on smoking and eating or drinking at the workplaces where high-risk substances are stored or handled | Facilities Regulation 6(b) |
| Non-potable water | Facilities Regulation 7(b) |

In addition to the above requirements; notices, information and instructions must be displayed on site as per risk assessment requirements.

### *7.14.3 Awareness Training*

The PC must ensure that, on site, toolbox talks pertaining to hazards and risks on site take place at least once a week. These talks must deal with risks relevant to the construction work at hand.

### *7.14.4 Competency*

All Competent persons must have the knowledge, experience, training, and qualifications which are specifically applicable to the work they have been appointed to supervise, control, and execute.

The abovementioned competency requirements will be assessed on a regular basis by the Health and Safety Agent by means of Audits.

The PC is responsible for ensuring that competent Sub-Contractors are appointed to carry out construction work.

## 7.15 MARALIA PREVENTION PROGRAM

The site is located in a Malaria high risk area. Malaria is a serious and sometimes fatal disease caused by a parasite that commonly infects a certain type of mosquito which feeds on humans. People get infected by malaria if they get bitten by an infected female Anopheles mosquito.

People who get malaria are typically very sick with high fevers, shaking chills, and flu-like illness.

PC must develop and resource malaria prevention program for the works in collaboration with an accredited body. The program must entail the following:

- Providing malarial prevention training
- Providing permanent employees and visitors with medical advice / administration of antimalaria medication at least two weeks before site visit
- Ensuring spraying every six months of site facilities for mosquito prevention
- Preventing standing water where mosquito can breed
- Ensuring spraying every six months of permanent employees accommodation

- Providing bed nets to permanent employees
- Encouraging visitors to apply mosquito repellents on their skin before coming to site
- Displaying malaria prevention signage and information on site and accommodation permanent employees
- Identification of vulnerable employees
- Measures to be taken in case of suspecting Malaria

## 7.16 DAILY SAFE TASK INSTRUCTIONS

DSTI is a pre-start discussion amongst the members of a work team, led by the appointed supervisor, aimed at anticipating hazards and potential risks associated with the activities planned for the day or shift, and ensuring that the necessary control measures are in place to prevent incidents.

At the start of any work, each appointed supervisor must inspect the work area for which he is responsible and ensure that it is safe. He must then conduct a DSTI with his work team specifically concerning the tasks that they will be performing during the course of the day or shift. The relevant Task-Based Risk Assessment for the activity must be used as the basis for the discussion. The correct work method must be reiterated, and the identified hazards, risks and control measures must be discussed with the team (each team member must be given the opportunity to contribute and participate in the discussion).

Any team member arriving late must first be taken through the information that was discussed (work method, hazards, risks and control measures) before being permitted to start working. If the work method changes after activities have already begun, the DSTI must be revisited and updated with the team, and the changes must be signed off by the relevant Contractor Health and Safety Officer.

Every member of the work team must sign the DSTI attendance register. The attendance records must be kept and maintained in the Contractor's OHS File.

The Contractor's OHS Officer must evaluate the content of the DSTI's daily to ensure that they are task-specific. Furthermore, the OHS Officer must attend at least one DSTI per day prior to the start of work. The OHS Officer may not lead the DSTI discussions, as this is the responsibility of the appointed supervisor.

## 7.17 PLANNED TASK OBSERVATIONS

All Contractor, Management Supervisors must perform PTO to verify that the control measures that have been identified in Safe Work Procedures (and associated Risk Assessments) are being adhered to and are being properly implemented, and to provide guidance where deviations are noted.

Each supervisor must complete at least one PTO per day involving one or more employees in his work team.

When an unsafe act or condition is identified, the supervisor must coach the work team to correct the act or condition in line with the safe work procedure.

Where valid changes to the work method are identified, the supervisor must ensure that the safe work procedure and risk assessment are updated to reflect the current practice.

The Construction Manager and / other Project representatives will carry out PTO's on contractor employees on an ad hoc basis. Should deviations from the contractor's safe work procedures be observed, the work may be stopped until these deviations are rectified.

## 7.18 INCIDENTS AND EMERGENCY PLAN

The contractor must develop, implement, test and maintain an emergency response plan (incorporating emergency procedures and evacuation procedure) that focuses specifically on the Contractor's team and work activities. The plan must be risk-based and must detail the procedures that must be followed when responding to all potential emergency scenarios such as:

- Vehicle's accidents
- Strike actions
- Political / community protests
- Falls from heights
- Collapse of structures
- Animals' attacks (snakes, bees, scorpions)
- Spillages of hazardous chemical substances / flammable liquids
- Fire
- Flash floods

The plan must be adequately resourced to ensure effective implementation. Accountability for the Emergency Response Plan must be clearly defined. An emergency response team responsible for the implementation, management and execution of the emergency response plan must be established. the roles and responsibilities of each team member must be clearly defined in the plan. Each team member must receive appropriate training to ensure that each role is performed competently.

The process for managing incident communication, notification, and reporting must be incorporated into the emergency response plan. The responsible person(s) must be clearly identified, and the protocols for communicating with internal and external stakeholders must be defined.

Emergency evacuation procedures must be developed and included in the emergency response plan.

The emergency response plan must be formally reviewed (and amended if necessary) on at least an annual basis, and following any emergency situation, to ensure that it remains appropriate and effective.

The Contractor must ensure the following:

- A suitable evacuation alarm (siren) is provided. Alarms must be installed in work areas. All persons working in an area where an evacuation alarm is sounded must respond to it immediately.
- Suitable fire-fighting equipment must be provided and maintained, all work stations must be provided with two or more trained in fire-fighting procedures and the use of fire-fighting equipment.
- Suitable first aid equipment and supplies must be providing. First aid station must be established and an adequate number of appropriately trained First Aiders must be in place.
- Emergency assembly points positioned in safe locations away from buildings, plant and equipment must be designated (and conspicuously signposted). In the event of an evacuation, all persons (i.e. personnel and visitors) must assemble and be accounted for at these emergency assembly points.
- All personnel must receive awareness training on the applicable emergency response procedures, and all visitors entering the site must be properly instructed in these procedures.
- The emergency response procedures must be displayed on each notice board.
- A diagram (site plan) indicating evacuation routes, emergency assembly point locations, and the positioning of emergency equipment (fire extinguishers, first aid boxes, etc.) must be prominently displayed in strategic locations; in all offices, on all notice boards, and in other locations on the site as may be required.
- An up-to-date list of emergency telephone numbers must be compiled and maintained. A copy of this list must be posted at each site entrance, in each office, near each telephone, and on every notice board.
- Emergency response drills must be conducted to test the effectiveness of the emergency procedures and equipment, as well as the knowledge and proficiency of the response personnel. A variety of emergency scenarios must be tested including, but not limited to, medical emergencies, fires, rescues, hazardous substance spills and drowning. A drill must be carried out one month after site establishment and six-monthly thereafter.
- Each drill must be monitored and the outcomes (highlights and shortcomings) must be documented. Corrective actions must be identified and implemented to address the shortcomings, and the emergency response plan and associated procedures must be amended as required.

Potential off-site emergency scenarios must be included (e.g., emergency scenarios related to the transport of personnel).

Consideration must be given to neighbours, and to the availability and capability of local emergency services. Details of any arrangements with external emergency response service providers must be included.

## 7.19 FIRST AID ATTANDANCE

The PC must appoint in writing a Level 2 First Aider in terms of Regulation 3 of the General Safety Regulations. The number of first aiders shall be as follows:

- One first aider for up to 50 workers
- one additional for every additional 50 workers (additional first aiders can be level 1)

Metal box first aid kits are recommended for the works.

Location and quantity of first aid kits must be as follows, it should be noted that the requirements are in consideration high risk activities associated with the project:

- one kit, including specific first aid modules, for up to 50 employees
- one additional kit, with specific modules, for every additional 50 employees
- The first aid kits must be easily accessible without obstructions

The contractor must identify the Hospital to be used in case of medical attention. Means transportation to the hospital must be documented.

## 7.20 ACCIDENT & INCIDENT REPORTING, INVESTIGATION AND STATISTICS

Injuries sustained on site are to be categorized into the following categories:

- First aid;
- Near misses;
- Medical attendance (Doctor);
- Disabling; and Fatal injuries

All Sub- Contractors must report medical attendance injuries to the PC no later than the end of the shift and disabling and fatal incidents as soon as they occur.

First aid cases must be recorded in the safety files dressing register.

Medical Attendance accidents must be recorded on the safety file as per annexure 1, the PC's competent person (Incident / Accident Investigator) must investigate these incidents / accidents and forward a copy of the report to the Health and Safety Agent without within seven days.

Disabling and fatal accidents must immediately be reported to the Health and Safety Agent telephonically after they occur. The Health and Safety Agent shall manage these accidents investigations. All incidents as described in Section 24 of the OHS Act must be reported in the prescribed period and manner to the National Department of Labour. Copies of Section 24 reports, including WCL 2 forms must be forwarded to the Health and Safety Agent.

Near misses must be reported, recorded and investigated.

The PC must establish a procedure for the management of all health and safety incidents. This procedure must define the responsibilities, methodologies and processes that must be followed for:

- Reporting an incident;
- Investigating an incident;
- Analysing an incident to determine the root cause;
- Identifying and implementing corrective actions to prevent a recurrence; and
- Communicating information concerning an incident to relevant persons and / or groups.

An incident must be reported to the Construction Supervisor and section Safety Representative immediately after they occur. The Construction Supervisor / Safety Representative must report incidents / accidents to the Safety Officer and Construction manager on the same work day or shift on which it occurs and preliminary details must be recorded.

The Construction Manager must ensure that an investigation is completed for each incident that occurs, and that Construction Supervisor and section Safety Representative participate in each investigation. Incident investigations must be facilitated by competent and experienced Incident Investigator who have been trained in the appropriate methodology.

Investigation process for near misses, medical attendance, disabling and fatal incidents must be completed within 7 days. Investigation on first aid kit cases must be dome monthly and report to be provided.

Each incident must be analysed to determine the root cause, and corrective actions must be identified and prioritised for implementation to eliminate or reduce the risk(s) in order to prevent recurrence of the incident.

For each corrective action, a responsible person must be designated and an appropriate timeframe (target date) for completion of the corrective action must be specified. Progress on implementing corrective actions (i.e., closing incidents) must be monitored and reported on. The implementation of corrective actions must be verified during monthly audits by the Agent but also no later than 30 calendar days after the conclusion of the incident investigation.

As a minimum, each incident report must include:

- The date, time and location of the incident;

- A detailed description of the incident, including photographs;
- The names of any injured persons;
- Injury details (if applicable);
- A summary of the first aid and / or medical treatment provided (if applicable);
- The current status of any injured persons;
- The root causes of the incident; and
- Detailed corrective actions, including responsible persons and target dates for implementation.

Each significant incident must be summarised for its lessons learnt following the investigation. This information must be reviewed by the Contractor's Construction Manager to assure completeness, accuracy and relevance before it is shared with (communicated to) all project personnel.

Record of monthly incidents / accidents statistics must be provided to the Agent during the time of the Audit.

## 7.21 NON-CONFORMANCE AND ACTION MANAGEMENT

The contractor must establish a process for identifying and recording corrective actions arising from:

- Incident investigations;
- Hazard identification and risk assessment;
- Measurement and monitoring;
- Improvement plans and suggestions;
- Managing change;
- Audits and inspections; and
- Safety observations and coaching (safety interactions).

The contractor must establish a procedure for managing actions that addresses:

- Identification, categorisation and prioritisation of actions;
- Formal evaluation and approval of actions (management of change process);
- Assignment of responsibilities, resources and schedules for implementation;
- Implementation of actions;
- Tracking and reporting on implementation status; and
- Monitoring and verifying the effectiveness of the actions.

## 7.22 OHS AUDITS, MONITORING AND REPORTING

The Agent shall during the duration of the contract conduct OHS Audits of the work operations. The audit shall be consisting of a full audit of physical site activities as well as an audit on the administration of health and safety. Copies of the audit reports will be forwarded to the Principal Contractor, Principal Agent, Client and all stakeholders within seven days. Copies of the Audit report must be kept in the site OHS File. The Agent may at any time visit the site for an Audit without prior notification to the contractor.

The benchmark for OHS Compliance is set at 85% to ensure safety. The Contractors overall performance as per Audit checklist assessing physical and administration requirements shall be deemed as acceptable when over 85% benchmark is met. When Contractors fails to achieve the benchmark for two consecutive Audits, that shall be taken as failure to meet compliance and sections with non -compliances will be stopped. All deviations have a critic impact on safety and health on site and shall be closed without delays.

If an Audit identifies high risks with immediate dangers to health and safety, the section / tasks posing the risk or the whole site will be stopped until compliance is met.

The PC must allow for and conduct similar audits on all Sub- Contractors under him/ her, provide reports to the Sub-Contractors within seven days and keep copy of the reports in his on the OHS File.

## 7.23 GENERAL RECORD KEEPING

The PC must keep and maintain Health and Safety records to demonstrate compliance with this Specification, The Act and with the CR on the OHS File which must always be kept in the site office.

The PC must ensure that every Sub-Contractors opens their individual health and safety files, maintains the files and makes them available on request by any duly authorized person.

# 8. PHYSICAL REQUIRMENTS

## 8.1 SITE ESTABLISHMENT

### 8.1.1 Public Safety and Security

*Barricading and Access Control*

- Site parameter must be fenced using gum poles, bonox fence of minimum of 1,8 meters high and be hoarded with 85% shade cloth.
- The Contractor is required to maintain fencing intact.
- Lockable gates must be controlled by competenct security company, day and night.

*Warning / informative signs*

The entrances of the site must have construction safety warning signs which should contain a minimum of the following information:

- Construction site entrances must display the following signs:
    - Name of the PC
    - No unauthorised entry
    - Type of Personal Protective Equipment required for the site as per risk assessment.
    - Speed limit (20 km/h)
    - Visitors to report to the site office
- Informative signs indicating following must be displayed in in the vicinity of locations on site:
    - Assembly points
    - Location of fire extinguishers
    - First aid kits and name of first aider
    - Malaria control signs

### 8.1.2 Site Camp Layout

Layout of the site must be in a manner that will ensure sufficient space for the following:

- Material storage
- Construction vehicle and plant movement
- Construction vehicle and plant parking

The PC must ensure that the following is considered in areas selected for site camp establishment:

- Existing services to be located and addressed according to Engineers Specifications.
- Adequate space to be allocated in consideration to facilities to be provided.
- Access roads, office areas, employees' facilities, parking areas, turning areas and stacking areas to be properly designated.
- Ground surfaces to be stable with safe gradient and free from slipping, tripping and falling hazards.

### *8.1.3 Site Access Management*

Access control, procedures and systems must be developed for the site.

Access must be controlled as follows:

- The access to be strictly controlled and managed.
- A system for identifying site employees must be developed.

*Visitors*

Visitors (including suppliers) must be advised in advance of the mandatory PPE requirements for the site and must arrive with all of this PPE.

Upon arrival, all visitors must report to the Security Office to be signed in.

All visitors must undergo a visitor induction briefing before entering the site.

Whilst on site, visitors must be accompanied at all times by an appropriately senior employee who has been inducted fully. The visitor(s) must be start at the site office and when the visit is over, must be escorted off site.

*Alcohol, Drugs and Other Intoxicating Substances*

The contractor must ensure that all personnel under his authority do not at any time enter the site or perform any work whilst under the influence of alcohol, a drug, or any other intoxicating substance.

Entering the site possessing drugs, alcoholic beverages or any other intoxicating substance on the site is strictly prohibited.

A drugs and alcohol testing program must be implemented. Persons entering the site must be randomly tested. Any person who tests positive for alcohol or drug consumption will be subject to disciplinary action and shall be permanently removed from the site.

Any person has the opportunity to rather report that he/she is under the influence before accessing the project site – in these cases the employee may only be send home for the day

by the responsible project manager representative but will then be tested for the following five days (each day) on his return to the project site. If it is found that the same person is frequently reporting that he/she is under the influence before even accessing the project site. It shall be the responsibility of the nominated project management representative to take disciplinary action and remove such a person's form the project site.

Should the actions and / or demeanour of an employee suggest possible narcosis or drunkenness, the employee must be removed from the site. This may be done without testing. A full disciplinary procedure must be followed by the Contractor concerned and a copy of the disciplinary action must be forwarded to the PC for his records.

Any person on the construction site who is on prescription drugs must inform the safety officer or the safety representative accordingly

All personnel involved in an incident / accident must immediately be subjected to an alcohol test and a drug test as part of the investigation.

*Firearms, Ammunition and Offensive Weapons*

Firearms, ammunition, and offensive weapons of any kind are strictly prohibited. No person may enter /shall not be permitted to enter the site carrying any such item.

### *8.1.4 Facilities*

The site facilities must comply with Facilities Regulations, 2004 under the Act.

### *8.1.5 Electrical Connections*

All electrical connections on site must be done by a registered electrical contractor and a COC must be provided upon completion of the installation.

Temporary electrical installations must be inspected weekly by a competent person and records must be kept on the health and safety file.

### *8.1.6 Lighting*

The PC must ensure that lighting on site is in accordance with illumination values per specific area / works as per Environmental Regulations, 1987 under the Act.

### *8.1.7 Ventilation*

Ventilation in the workplace must comply with Environmental Regulations, 1987 under the Act.

The PC shall ensure that every workplace in his undertaking is ventilated either by natural or mechanical means in such a way that:

- The air breathed by employees does not endanger their safety
- The prescribed exposure limits for airborne substances as per legislation not exceeded

- The concentration therein of any explosive or flammable gas, vapour or dust does not exceed the lower explosive limit of that gas, vapour or dust.

Where there is a danger of unsafe air in the breathing zone of an employee, the employer shall provide every such employee with, and ensure that he correctly uses, respiratory protective equipment of a type that reduces the exposure of the employee to a safe level and the employer shall, further, inform him of the dangers of and the precautionary measures against excessive exposure.

Risk assessment on ventilation must be done for all areas.

## 8.2 DRIVING ON GRAVEL ROAD &TRANSPORTATION OF EMPLOYEES

Caution must be taken when transitioning from paved to gravel road and the gravel roads can result in skidding and slipping due to reduced ground traction on the road. The following measures must be taken when driving on gravel road:

- Adherence to speed limit and further reduction to safe driving speed depending on the car used.
- Ensuring safe following distance
- Drivers to be extra vigilant for animals.
- Cars to be road worthy, tyres to be in good condition and have uptodate service history.

The PC and Sub –Contractors shall meet the following requirements for transportation of employees:

- Transport employees on a road worthy vehicle that also complies with CR 23 requirements and transportation to obey road rules.
- Vehicle to have sits and sit belts.
- Vehicles transporting employees to be not overloaded.
- The PC shall not allow employees to be transported in a goods vehicle unless the portion of the vehicle in which the employees are being conveyed is enclosed to a height of: –
    - at least 350 mm above the surface on which employees are seated; or

## 8.3 PERSONAL PROTECTIVE EQUIPMENT

SABS standards concerning PPE must be complied with at all times.

As a minimum, the following PPE must be issued to all employees and be worn by all persons at all times whilst on a project site:

- Ankle covering safety boots with steel toe protection
- Overalls with reflective taping (long trousers and long-sleeved shirts with collars and cuffs). Each employee to be issued with a minimum of two sets annually.
- Reflector vests to be worn over overalls. Each employee to be issued with a minimum of two reflective vests.

- Helmets
- Additional PPE requirements must be determined through hazard identification and risk assessment which includes the following PPE must be provided and must be worn as required (e.g., when in a certain area, when performing a certain task, or when working with a certain substance);
- Steel toed gum boots for employees working in water / muddy environments
- Sun hats
- Dust masks
- Ear protection
- Face /eye protection
- Leather / rubber gloves
- SANS 50381-5 leg protection for tree fellers
- Safety harnesses for employees working in an elevated position (1.5m or higher) where the potential exists that such employees may fall

The contractor must ensure that correct PPE must always be worn:

- In accordance with site requirements designated areas on the onsite;
- In zoned areas e.g., noise zones
- As required by a Safe Work Procedure, a risk assessment, or a Material Safety Data Sheet (MSDS).

Each Contractor must provide each of his employees with all required PPE (at no cost to the employee). PPE policy must be developed for the site.

Any employee who does not have all of the PPE that is required for him to perform his duties safely will not be permitted to work.

Each employee must care for his PPE, maintain it in good condition, and inspect it on a daily basis.

If an item of PPE has worn out, has become damaged, or is found to be defective in any way, it must be replaced by the contractor.

PPE must be stored in accordance with the manufacturer's requirements and / or recommendations.

Each employee must receive training in the use, maintenance and limitations of the PPE that is provided to him, and must be made aware of why the PPE is necessary as well as the consequences of not wearing it as instructed (i.e., the potential for injury and / or disciplinary action). Training records must be retained.

Any person who refuses to wear PPE as required must be removed from the site.

Symbolic signs indicating mandatory PPE requirements must be prominently displayed at the entrances of site and at the entrances to sections and / or designated areas on the premises where additional PPE is required. These signs must comply with the applicable national standard (if one exists).

Each contractor must appoint an employee to:

- Control the issuing and replacement of PPE;
- Keep an up-to-date register as proof that items of PPE have been issued to individuals (an employee must sign for the items that he receives);
- Ensure that there is an adequate supply of all required PPE (i.e. maintain PPE stock levels on site); and
- Carry out regular inspections to ensure that PPE is being used correctly, is being maintained in a good, serviceable and hygienic state, and is not being shared between employees.

Personal protective equipment should be last resort in control exposure to hazards. PPE should provide protection to the health and safety of employees as follows:

*Head Protection*

A safety helmet (or hard hat) worn correctly will help protect the head in the event of:

- An employee being struck on the head by a falling or flying object;
- An employee striking his head against a fixed or protruding object; or
- Accidental head contact being made with an electrical hazard.

A safety helmet must be worn at all times on a project site, with the following exceptions:

- Vehicle and equipment operators inside enclosed cabs;
- In offices and in office or administration buildings; and
- At designated lunch and break areas (provided that no work is in progress in the immediate break area).

A safety helmet must be worn in accordance with the manufacturer's requirements.

A safety helmet must be worn directly on the head. The wearing of a cap or other headgear beneath a safety helmet is prohibited unless the items have been specifically designed to be used in combination (i.e., the arrangement is approved by the safety helmet manufacturer).

The suspension system inside a safety helmet (that acts as a shock absorber) may not be removed.

Safety helmets may only be cleaned using a detergent and water. No solvents may be used.

*Eye Protection*

If an employee is carrying out, assisting with, or working adjacent to any activity where sparks or projectile particles are being generated, where chemical mists or fumes are being generated, where liquids may splash or spray, where harmful electromagnetic radiation (heat or light) is being generated, or where there is a risk of wind-blown particles entering the eyes, then suitable protective eyewear must be worn at all times (i.e. safety glasses, safety goggles, a face shield, a welding helmet, or a combination of these).

Such activities include:

- Working with rotating equipment (e.g., grinders, drills, mills, lathes, and saws);
- Welding and cutting;
- Chipping, chiselling or caulking;
- Using explosive powered tools;
- Abrasive blasting;
- Sanding; and
- Working with chemical substances (e.g., drilling fluids, acids, solvents, paints, pesticides, etc).

  For certain activities, special eye protection is required (e.g., a heat-resistant face shield is required when working near molten metal).

Double eye protection is required for activities such as:

- Grinding, cutting, chipping, chasing and reaming (employees must wear both a full-face shield and safety glasses or goggles); and
- Arc welding (welders must wear both safety glasses and a welding helmet).

Screens must be erected to protect passers-by, where practical.

in certain areas may not be suitable because of increased risk to the eye due to dust or heat.

*Hearing Protection*

Employees should not be exposed to noise levels exceeding 85db.

“Low noise” tools and machinery must be used wherever possible to reduce noise levels.

Where noise cannot be reduced to an acceptable level through engineering and work practice controls, measures must be put in place to minimise the exposure of employees to the noise (i.e., administrative controls and personal hearing protection).

Areas / activities producing noise levels exceed 85dB, or areas where impulse noise exceeds 140dB, must be designated as noise zones. These noise zones must be clearly demarcated

and mapped, signs must be posted, and all employees must be made aware of the requirements for working in such an area.

Suitable hearing protection must be worn in all designated noise zones and when carrying out (or working in the vicinity of) any activity where the noise level exceeds 85dB or impulse noise exceeding 140 db.

Where hearing protection is required, a hearing conservation programme (applicable to all personnel and visitors) must be implemented. The programme must include training in the correct use and proper storage of hearing protection devices as well as replacement requirements. Training must be provided when hearing protection is first issued to an employee and refresher training must be carried out at least annually thereafter. Training records must be retained.

Hearing protection devices must be made available to employees. The hearing protection devices must have adequate noise reduction ratings (i.e., must be able to attenuate the noise level to below 85dB.

Personal hearing protection must be issued on an individual basis and must not be shared.

In addition to personally issued hearing protection, suitable disposable hearing protection must be made available at the entrances to all noise zones.

All hearing protection devices (except for disposable hearing protection) must be properly inspected and cleaned on a regular basis.

*Respiratory Protection*

Suitable Respiratory Protection Devices (RPDs) must be worn in all designated respirator zones and when carrying out (or working in the vicinity of) any activity where the risk assessment has identified the need for respiratory protection.

RPD's must be selected based on:

- The type(s) of airborne contaminants that are present (gases, vapours, and particulates and aerosols including dusts, fumes, sprays, mists, and smoke);
- The potential particulate size distribution;
- Substance toxicity; and
- The likely concentrations.

Compatibility with the work tasks and other PPE, comfort (as it affects wear-time), and the ability to communicate adequately, must also be considered.

The risk assessment and method statement for the work to be performed, the information contained in the relevant Material Safety Data Sheets (MSDSs), and the results of any air monitoring associated with the substances to be worked with or activities to be carried out, must be used to ensure that the most suitable RPD is selected.

Only RPDs certified to a recognised standard and approved by the nominated project management representative may be used.

Where respiratory protection is required, a respiratory protection programme (applicable to all personnel and visitors) must be implemented.

The respiratory protection programme must include:

- Periodic inspection of RPDs, including before each use;
- Periodic evaluation (by competent persons) of cleaning, sanitising, maintenance and storage practices;
- Performance of positive pressure and negative pressure fit checks by RPD wearers before each use to ensure that the respirator is functioning properly; and
- Training at first issue of an RPD and regular refresher training thereafter in accordance with regulatory requirements or at least once every two years (the training must cover fit testing, use, cleaning, maintenance, filter cartridge replacement, and storage). Training records must be retained.

RPDs must be used, maintained, and stored in compliance with the manufacturer's requirements as well as the respiratory protection programme.

Suitable facilities must be provided for the cleaning and sanitary storage of RPD's.

*Hand and Arm Protection*

Gloves must be worn when handling or working with equipment, materials or substances with the potential to cause injury or illness.

Suitable gloves must be selected based on the task to be performed and the specific hazard against which the employee requires protection, such as:

- Sharp edges;
- Sharp points and splinters;
- Abrasive surfaces;
- Hazardous chemical substances (toxic, corrosive, sensitising, etc.);
- Extreme temperatures; and
- Viruses, bacteria and parasites

*Foot Protection*

Ankle covering steel toed boots must be worn at all times whilst on a project site.

Safety boots must provide the following protection:

- Steel toe cap to protect against crushing (impact and compression forces);
- Leather uppers that provide resistance against water penetration and water absorption or and also protects ankles from snakes' bites;
- Slip resistant soles;

And where a risk assessment identifies the need:

- Puncture resistant soles (i.e., steel midsoles) for protection against sharp objects;
- Chemical resistant soles for protection against spilt chemical substances (such as solvents, hydrocarbons, acids, and alkalis);
- Heat resistant soles for protection against hot surfaces or molten metal; or
- Electrical shock resistant soles for protection (insulation) against live electrical conductors.
- Gumboots with steel toe caps must be worn when working in water or very wet conditions

*Body Protection*

Suitable body protection must be provided as required to protect employees against specific hazards. A range of work activities require body protection in one form or another, including but not limited to:

- Hot work (e.g., welding, burning, cutting and grinding);
- Working with hazardous chemical substances (e.g., acids, solvents, pesticides, etc.); and
- A wide variety of protective garments are available, such as, leather aprons, leather spats, chemical resistant aprons, chemical resistant (or hazmat) suits, and disposable coveralls. Suitable items must be selected to provide protection against the specific hazard(s) to which an employee is exposed. Hazards must be carefully identified and characterised to ensure that the correct protection is used.

Body protection must be sized properly to prevent tearing, the parting of seams, tripping, or restriction of movement.

*Sun Protection*

The contractor must ensure that all personnel are protected in sunlight through the use of lose long sleeve shirts, long trousers and sun hats. Shade structures must also be made available to all employees.

*Electrical Protective Equipment*

To reduce the risk of electric shock, electrical insulating equipment appropriate for the voltage that may be encountered must be worn when working on energised electrical installations and when working within two metres of exposed energised conductors.

All rubber electrical insulating equipment (including gloves, sleeves, matting, covers, and line hoses) must be inspected for damage prior to and after each use, and immediately following any incident that can reasonably be suspected of having caused damage.

Rubber insulating equipment with any of the following defects and / or damage may not be used:

- A cut, rip, tear, hole, or puncture;
- Ozone cutting or ozone checking (i.e., the cutting action of ozone on rubber under mechanical stress causing a series of interlacing cracks);
- An embedded foreign object;
- Chemical deterioration (texture changes) such as swelling, softening, hardening, or becoming sticky or inelastic; or
- Any other defect that damages the insulating properties.

Rubber insulating gloves must be electrically tested before first issue and every 12 months thereafter as a minimum. Insulating gloves must also be given an air test along with the daily inspection. Essentially, this involves filling a glove with air and checking for any holes or leakage.

Insulating equipment must be stored in such a location and in such a manner so as to protect it from light, temperature extremes, excessive humidity, ozone, and other damaging substances and conditions.

*Jewellery*

Necklaces, dangling earrings, and bracelets may not be worn on a project site.

No jewellery or other conductive apparel (such as a key chain or watch) may be worn when carrying out energised electrical work.

*Task-Specific PPE*

In addition to the standard PPE required for a project site (including a safety helmet, safety glasses, safety boots, and high visibility protective clothing), the following task-specific PPE must be used as a minimum by any person carrying out or assisting with such a task:

- Arc Welding – safety glasses and welding helmet (i.e., double eye protection), respiratory protection against the specific airborne contaminants being generated

(fumes, gases, dusts, etc.), leather welding gloves, leather apron, leather spats, leather yoke (for work above shoulder height), and knee pads for welders in kneeling positions;

- Gas Welding, Cutting or Brazing – gas cutting or welding goggles with shade 4 filter lenses and full-face shield (i.e., double eye protection), respiratory protection against the specific airborne contaminants being generated (fumes, gases, dusts, etc.), leather gloves (long cuff for welding and cutting, short cuff may be used for brazing), leather apron, leather spats, and leather yoke (for work above shoulder height);
- Grinding – safety glasses or goggles and full-face shield (i.e., double eye protection), hearing protection, respiratory protection where dust or fumes may be generated, leather gloves, leather apron, and leather spats;
- Abrasive Blasting – respiratory protection (air-supplied hood), hearing protection, leather gloves, and leather apron;
- Spray Painting – respiratory protection (air-supplied hood for confined spaces), safety goggles (if the respirator design does not provide this protection), hearing protection (where air compressors are used), chemical resistant gloves, and chemical resistant disposable coveralls.

*Visitors PPE*

All visitors to wear safety boots, reflective vests and helmets on site..

Visitors must be informed to come wearing their own PPE.

Visitors must not be allowed to go to site if PPE requirements are not met. Construction manager and OHS Officer to ensure this compliance is met.

Contractor must inform visitors on PPE requirements before they come to site. Visitors must bring their own PPE to site to avoid sharing of PPE.

Contractor is however required to keep a minimum number of 10 helmets for visitors. Means of sanitizing helmets to be in place.

*PPE Policy*

PC and Sub – Contractors must have a PPE policy with must outline the following:

- Training on purpose and use of PPE
- Address procedures to be taken when PPE is lost, stolen, worn out, damaged or defective PPE
- Measures to be taken for employees to come to site without issued PPE
- Procedure for issuing visitors with disinfected PPE

## 8.4 HAZARDS AND POTENTIALLY HAZARDOUS SITUATIONS

The PC must always ensure that works are conducted under safe conditions and environment.

Should a hazardous be identified, works must be stopped, and corrective actions must be applied to ensure safety.

Employees must be encouraged to report condition that seem unsafe to the Safety Representation or Supervisor.

## 8.5 EXTREME WEATHER CONDITIONS

If the weather condition poses a threat to the health & safety of employees; be it extreme heat, cold, lightning, wet and slippery conditions. The following measures must be in place to address adverse weather conditions:

*Heat*

Hot periods or activities where employees have experienced or could experience excessive fatigue, muscle cramp, dehydration, dizziness and other symptoms of heat stress must be identified and described:

A thermal stress risk assessment must be conducted in consultation with workers.

The contractor must implement the following measures for works conducted in hot areas:

- Ensure reduction of metabolic heat rate on employees by automation and mechanization of tasks minimize the need for heavy physical work and the resulting build-up of body heat
- Implement administration preventative measure as follows:
    - Allow sufficient acclimatization period before full workload
    - Shorten exposure time and use frequent rest breaks
    - Provide cool – sheltered rest-areas
    - Provide cool drinking water, drinking water to be kept in a cool area
    - If practical, allow workers to set their own pace of work
    - Define emergency procedures. Assign one person trained in first aid to each work shift. Train workers in recognition of symptoms of heat exposure
- Employees to wear loose clothing that permits sweat evaporation but stops radiant heat. Employees exposed to the sun to wear sun hats.

*Cold*

Cold areas or activities where employees could experience pain or loss of feeling in their hands, severe shivering, excessive fatigue and other symptoms of cold stress must be identified and described.

The contractor must ensure that employees with the following PPE to prevent cold stress:

- Warm clothing for the body.
- Cotton / polyester gloves for cold resistance (such gloves to be worn other gloves required for the task).

*Wet Conditions Due to rainy weather*

Works must not be conducted on site during rainy weather which has resulted in slippery conditions on the roads and onsite which makes it unsafe.

*Thundering Conditions*

Changes in weather conditions must be continuously observed on site. When thundering conditions are eminent, works must be stopped and employees must be addressed to take shelter in their rest areas. Taking shelter under poles or tree is prohibited on site.

*Visibility*

The Construction Manager and the Safety Officer shall ensure that works conducted outside of buildings is not carried out during extreme weather conditions that have resulted in poor visibility. An assessment must be done for tasks during misty/ fogy conditions and works to be suspended in areas that pose risks due to poor visibility until the weather has cleared.

## 8.6 SITE CLEARANCE ACTIVITIES

The site must be cleared of vegetation and be made safe. Method statement for site clearance must be provided.

Safe working procedures to be in place.

The existing 22 kv overhead electrical cable on site must be addressed as per Engineers requirements. A 12-meter servitude must be allowed on both sides of the cable and 12 meter clearance must be complied with vertically for the cable. Signs must be displayed in the vicinity. Goal posts must be positioned if construction plant shall be passing under the cable.

## 8.7 LONE WORK

A lone worker is an employee who performs an activity that is carried out in isolation from other workers without close or direct supervision. Such staff may be exposed to risk because there is no-one to assist them. Lone work is therefore forbidden on site.

## 8.8 PLANT AND EQUIPMENT OPERATION

### *8.8.1 Selection / Suitability*

The construction vehicle and plant selected for the works must be able to be driven without any risks in consideration to site terrains which may contain sharp inclines and declines. Before any plant is selected and used to carry out an activity, it must be checked for its suitability for the task, e.g., accessories available, boom length, reach capability, safe working loads.

Construction plant and vehicle selected must be designed to safely is the under site & environmental conditions without safety risks.

All light duty vehicle to be fitted with buggy whips to ensure visibility to attenuated dump trucks and other construction plants.

All construction vehicle and plant operations to comply with CR 23 requirements.

### *8.8.2 Speed Restrictions and Protections*

The maximum speed limit for construction vehicle and plant on site shall be limited to 20 km/h. Compliance shall always be as per signage displayed per section.

Vehicle movement routes on site must be clearly indicated through signage. Signage to ensure the safe movement of vehicles, as well as to ensure the health and safety of all employees and public around site must be displayed in strategic locations.

Construction vehicle on public roads must comply with requirements of National Roads Traffic Act, 1996.

### *8.8.3 Safe Parking*

Contractor to designate parking areas for all construction plan and vehicle. Such areas must be fenced off and be provided with security (warm body at nigh). All construction plant and equipment should be parked in a safe and designated area when not in use. The following should always be in place:

- The hand parking brake must always be engaged when vehicles are parked.
- Buckets, lifting gear, loads, etc should also be lowered to the ground and keys should be removed from the ignition and stored safely.
- Wheel stoppers must be applied when trucks are parked without operators in them.
- Light duty vehicles parked in sloppy conditions to also apply wheel stoppers.
- No cars or construction vehicles should be left alone with running engines.

## 8.9 TRAFFIC MANAGEMENT

Traffic management plan for the project must be developed, documented and approved by the site Engineer and Agent. The plan must address accommodation of all traffic on site i.e., site vehicles, delivery vehicles, construction plant and visitors' vehicles.

Traffic routes must be clearly defined, all hazards on the routes which included power lines / any form of obstructions must be identified and controlled on the site roads to ensure safety for all intended traffic on site.

Speed to be maintained at 20km inside the site boundary. If the Contractor requires the speed to be at 40km p/h i.e., at work stations, risk assessment and consultation with the Agent and Project Manager to be done.

Contractor shall ensure that the traffic management plan addressed the following:

- Warning signs and speed control signs to be adequately displayed
- Haul roads to be designed to ensure good visibility for plant and construction vehicles
- Haul roads width to meet permissible standards for the plant and vehicles to be operated on it.
- All personnel on site to wear reflective clothing
- All construction vehicle to have warning lights and audio

Traffic management plan for the site must address all areas of the works and must be constantly reviewed with activities to ensure effectiveness.

## 8.10 EXCAVATIONS

Prior conducting any excavation, a detailed risk assessment taking into consideration the depth and the type of soil as per Geotechnical Reports must be conducted. Method statement must be provided for all excavation's dipper than 1.5 meters.

All excavations must be carried out as per CR 13.

All excavation work must comply with the following:

- Excavation work must be carried out under the supervision of a competent person with experience in excavation work who has been appointed in writing
- Before excavation work begins the stability of the ground must be evaluated
- Excavation that are mother than 3 meters deep must be excavated using plant
- The location and nature of any existing services must be established before any excavation is commenced with and any service that may be affected by the excavation must be addressed as per Engineer's specification.

- Whilst excavation work is being performed, the PC must take suitable and sufficient steps to prevent any person from being buried or trapped by a fall or dislodgement of material.
- No person may be required or permitted to work in an excavation with a risk of collapsing that has not been adequately shored or braced.
- Shoring and bracing design must be approved by an Engineer and be constructed to safely support the sides of the excavation and prevent it from collapsing.
- Where uncertainty exists regarding the stability of the soil the opinion of a competent professional engineer or professional technologist must be obtained whose opinion will be decisive. The opinion must be in writing and signed by the engineer or technologist as well as the appointed excavator
- Neighbouring roads that may be affected or endangered by the excavation must be suitably protected; no vehicle / plant or vehicle shall come 1 meter to the edges of excavations.
- Excavated material to also be kept 1 meter from excavation edge.
- Lose material excavated material and stones that could fall from the overhead excavations to be removed and be kept at minimum of 1 meter away from the edges.
- Excavations to be maintained safe and water to be drained away from the face and be mechanically pumped out from inside the excavations continuously.
- Excavations deeper than 1.5 meters must be accessed using a ladder.
- Every excavation, including the shoring and bracing or any other method to prevent collapse, must be inspected by the appointed competent person as follows:
    - Daily before work commences
    - After every blasting operation
    - After an unexpected collapse of the excavation or part thereof
    - After substantial damage to any support
    - After rain
- The results of any inspections must be recorded in a register kept on site
- Every excavation that is dipper than 1.5 meters / any excavation accessible to the public or that is adjacent to a public road or thoroughfare or that threatens the safety of persons, must be adequately barricaded with a net or fenced off to at least 1-meter high.
- Where there are hard surfaces near excavations edges which prevents digging holes for barricading installation, i.e., on roads, the contractor must obtain buckets/ containers that shall be weighted down with concrete and barricading poles can be installed in those buckets / containers to ensure all excavations are barricaded.
- Vicinity of the excavation must display signage indicating of open excavations.
- Traffic management should be in place for any works done near / on roads.

## 8.11 EDGE PROTECTION

All open edges from above 1.5 meters must be guarded with suitable guards that are strong enough to restrain a fully grown human from falls. Open edge protection must be a minimum of 1 m high and be clearly visible.

Vehicles and plant must keep 1 meter away from open edges. Method statements to be provided for works that may require construction vehicles or plant to work in near open edges.

All edges that may be deemed by the Health and Safety Agent pose safety risks must be provided with protection.

## 8.12 WORKING AT HEIGHTS

All applicable legislation concerning work performed from an elevated position must be complied with at all times.

Fall protection measures must be in place as per CR 10 whenever the potential exists for a person to fall from elevated positions.

Contractor to ensure that all structures that contractor stands on has been assessed for stability and does not pose a risk of breaking while standing on it i.e., roof structures.

### *8.12.1 Fall prevention*

*Risk Assessment and Permitting*

Prior to commencing with any work at height, an assessment must be conducted to determine if the work requires the use of fall protection equipment, and if so, which fall protection system is the most appropriate for the work.

The following documentation is required for any work where fall protection is required (i.e., where a risk of falling exists):

- A Risk Assessment for the task to be performed;
- A Fall Protection (and Rescue) Plan;
- A Safe Work Procedure for the task to be performed; and
- As part of the Risk Assessment and planning processes, the following must be considered:
    - Hazards relating to accessing the location at height or below ground;
    - The nature of the work location;
    - The nature of the work activities to be undertaken at height;
    - Environmental and weather conditions;
    - The presence of nearby persons who may be at risk due to falling objects (potentially) or who's activities may be affected by the work being performed at height;
    - The selection of fall protection equipment (considering fall clearances) and / or access equipment;
    - The selection of anchorage points;

- The load ratings of access platforms (scaffolding), work areas, anchorage points, life nines and etc.;
- The condition of supporting structures
- Exposure to heat sources;
- The use of a mobile elevating work platform, man basket, or boatswain's chair; and
- Any other conditions that may affect the safe execution of the task.

*Work platform*

All elevated work platforms and walkways must have complete floors, and edge protection must be in place in the form of toe boards and sturdy guard rails properly secured (i.e., bolted, welded, clamped, etc.) to prevent accidental displacement. Safe means of access and egress must be provided.

Guard rails must be capable of withstanding a force of at least 150 kilograms applied in any direction at any point.

The top rail must be positioned at a height of 1 metre above the working surface, and a mid-rail must be provided.

*Floor openings, holes and edges*

Any opening or hole (temporary or permanent) in a floor, platform or walkway must be protected by sturdy guard rails or a cover to prevent a person from stepping into or falling through the gap. Covers must be strong enough to support the loads that will be imposed on them and must be secured to prevent accidental displacement.

*Fall Protection*

Whenever there is a risk of falling from elevated position or whenever work must be carried out within 1.5 metres of an opening through which (or an edge over which) a person could fall, no work may commence unless:

- Fall protection by physical barrier / fall rescue plan is in place (prepared by a competent person, who is appointed in writing).
- A detailed task-specific risk assessment has been carried out;
- A safe work procedure is in place for the task to be performed;

*Fall Arrest Equipment*

The use of fall restraint or fall arrest systems must be avoided wherever and whenever possible through the installation of physical barriers that protect persons from falling. Only if physical barriers protecting against free falls at heights 1.5 meters or more cannot be installed must fall protection equipment be used.

Fall protection (fall restraint or fall arrest) systems are items of personal protective equipment and, if required, must be purchased, installed and provided to employees.

There must be a system for ensuring that fall protection equipment is:

- Tested and certified for use;
- Inspected by the user before use; and
- Destroyed following a fall or where inspection has shown evidence of excessive wear or mechanical malfunction.

Approved full body harness with two shock absorbing lanyards or two short restraining lanyards and secure anchorage points (and lifeline) must be provided as fall arrest equipment.

When selecting fall arrest equipment, care must be taken to ensure that the potential fall distance is greater than the height of the person plus the length of the lanyard with its shock absorber deployed (taking the height of attachment into account).

Anchorage points must, where practical, be above the head of the person, and must ensure that in the event of a fall the person will neither swing nor touch the ground.

All anchorage points and lifeline systems must be designed and approved by a professional structural engineer.

All persons that are required to work at height must first be trained and certified competent to do so. Furthermore, each person must be in possession of a valid medical certificate of fitness specifically indicating that the person is fit to work at height.

All persons required to use personal fall protection equipment must be trained and certified competent in the correct selection, use, maintenance and inspection of such equipment.

All fall protection equipment must be thoroughly inspected on a monthly basis by competent persons appointed in writing and each item of equipment must be tagged to show when it was last inspected. All inspections must be recorded in a register.

On finding defective or damaged equipment, appropriate action must be taken by the competent person (i.e., the destruction of the equipment to prevent further use).

Persons making use of personal fall protection equipment must do so in strict accordance with the instructions or requirements specified by the manufacturer or supplier of the equipment or system.

Specific pre-use inspection, maintenance and fitting protocols must be established in accordance with the manufacturer's requirements or guidelines and these protocols must be followed by all users of the fall protection equipment.

Competent supervision must be in place at all times for all work carried out at height. Supervisors must be appointed in writing.

Emergency response (rescue) procedures for the rapid retrieval of suspended persons in the event of a fall from height must be prepared and tested.

No person required to use personal fall protection equipment may work in isolation (a minimum of two persons working together is required).

A person may climb or descend a ladder without fall protection provided that he is able to use both hands and legs to do so, faces the ladder, and uses one step at a time. The ladder must be tied off or supported at its base.

Prior to any roof work being performed, or prior to persons accessing a roof, a structural engineer must verify that the roof is of sound construction and that it is capable of supporting

the weight of the persons as well as any equipment that may be required. Should the engineer's findings be to the contrary, alternative methods of performing the work must be found?

*Elevating Work Platforms*

Before hiring or purchasing an elevating work platform (e.g., a scissor lift, man lift, boom lift, cherry picker or similar equipment), the certification of the equipment (with regard to suitability of design and construction) must be verified.

Before using an elevating work platform, it must be verified that the equipment is in good working order and has been serviced regularly. The service record and instruction manual must be kept on site. A system must be in place to ensure that the equipment is maintained and inspected as required by the manufacturer and / or local regulations.

Load bearing capacity must be displayed.

Operators must be formally trained through an accredited training provider and certified competent in the operation of the equipment.

Before using an elevating work platform, the operator must inspect the equipment and a pre-use checklist must be completed.

A mobile elevating work platform must not be driven unless the "basket" has been lowered and secured in a stable position.

An elevating work platform must only be operated on a firm surface with the outriggers extended (where fitted).

An elevating work platform must not be operated on a grade or slope beyond the capability of the machine (every mobile elevating work platform that is used must be fitted with an inclinometer which sounds an audible alarm before the maximum safe incline has been reached).

The area beneath the "basket" and the boom must be barricaded.

A second competent operator of the mobile elevated work platform to be in place on the ground level – to ensure that the elevated work platform could be lowered in case of an emergency.

A spotter must be used at all times when moving a mobile elevating work platform and when the "basket" is in an elevated position.

*Falling Objects*

In the process of planning work activities, the risks associated with falling objects (i.e. materials, tools or equipment) must be assessed and appropriate control measures must be identified, implemented, and monitored taking the following hierarchy of controls into consideration:

- Preventing objects from falling – by using containment sheeting, lanyards to secure tools (to a person or to the structure), ropes or chains to secure equipment (to the structure), lift boxes, cages, etc. and by properly securing loads when lifted by crane or hoist;

- Protecting people from falling objects – by establishing barricaded exclusion zones, installing catch platforms or catch nets, displaying warning signage, and posting safety watchers and / or traffic controllers;
- Personal Protective Equipment (particularly safety helmets and safety boots) – protective equipment is a last line of defence and must be worn.

Where overhead work is being carried out, barricading must be erected around the work area (at the level at which the work is taking place and at every level below including ground level) to prevent persons from entering such an area and potentially being struck by falling objects.

Wherever hazards related to falling objects exist, appropriate warning signage (i.e., "overhead work in progress" and "no unauthorised access") must be prominently displayed.

No items are permitted to lie loose in elevated positions (e.g., nuts and bolts must be securely stored) and good housekeeping standards must be maintained at all times.

No tools, equipment, material, debris, waste, etc. may be dropped from height. Objects must be lowered or chuted to ground level in a safe and controlled manner.

### *8.12.2 Scaffolding*

*Training, Competency and Supervision*

Scaffolding used on site must comply with SANS 10085 standards.

Scaffolding must be designed by a competent person to ensure calculations of safe working loads and maximum permissible heights. Scaffolding designs must be available on site.

Scaffolding may only be erected, maintained, altered or dismantled under the strict personal supervision of a competent Scaffolding Supervisor (or Scaffolding Inspector) who has been appointed in writing.

Scaffolding may only be erected, maintained, altered or dismantled by competent and appointed Scaffolding Erectors. It is the Scaffolding Supervisor's responsibility to ensure that all persons carrying out such work are suitably trained and experienced.

A certificate of competency issued by a SAQA accredited and approved training provider must be produced for each Scaffolding Supervisor and each Scaffolding Erector.

*Erecting and Dismantling of Scaffolding*

Surface which scaffolding shall be erected must be approved by the Scaffolding Supervisor. Where doubt exist, approval from professional engineer must be obtained.

Methodology and safe working procedure to be provided for scaffolding erecting must be provided. Stability of the scaffolding to be maintained at all times, which included during erecting, bracing and dismantling.

Only approved scaffolding components may be used to erect a scaffold. Scaffolding must be erected, modified and used in accordance with the manufacturer's guidelines or recommendations, and in strict compliance with standards and design.

Each person erecting, maintaining, altering or dismantling scaffolding must use fall arrest equipment at all times (i.e., a full body safety harness with two shock absorbing lanyards fitted with scaffold hooks). The work must be planned to enable every Scaffolding Erector to be securely anchored and lifelines at all times.

The area around the base of a scaffold must be barricaded to prevent unauthorised access into the work area. When scaffolding is erected or dismantled on a level, platform, or floor lying above ground level and the potential exists for components to fall to levels below the level on which the scaffolding is positioned, then the area directly below the scaffolding on each of those levels must also be barricaded. Appropriate warning signage (i.e., “overhead work in progress” and “no unauthorised access”) must be prominently displayed.

Methodology for safe lifting scaffolding components must be in place. Hoists, lifts and approved material baskets must be used (where available) to lift scaffolding components to elevated positions.

No scaffolding components, tools, or any other material may be dropped from height or thrown from one level to another. Components, tools and materials must be lowered or lifted in a controlled manner. Use may be made of a chute.

Each tool must be secured to the wrist, harness or structure by means of a lanyard. A tool bag (around the waist or over the shoulder) may be used for carrying tools up and down a scaffold structure. Tools or equipment may not be carried by hand up or down a structure, as both hands must be used for climbing. If necessary, a rope must be used for lifting or lowering tools or equipment.

While a scaffold is being erected or dismantled, no scaffolding components may be stacked on the scaffold structure unless it has been designed for that purpose. Any loading of a scaffold structure must be authorised in writing by a structural engineer.

Scaffolding may not stand on steel grating unless the grating is adequately supported from below. Scaffolding must rather stand on the structure that supports the grating.

Before scaffolding is erected in close proximity to an electrical installation or live conductors, an electrical engineer must inspect the area and determine whether or not the scaffolding must be earthed. Should the scaffolding require earthing, this must be done as soon as possible while the scaffolding is being erected.

Scaffolding may not be erected if it is raining or in strong winds.

Scaffolding must not be:

- Left partially erected or partially dismantled except for normal work stoppages (for example, over weekends) and with approval of the scaffolding supervisor
- Left in an unsafe condition (if scaffolding is unavoidably in an unsafe condition, barricading must be in place to prevent unauthorised access and the required red tags must be prominently displayed on the scaffold structure); or
- Moved or altered while work is in progress.

Mobile scaffolding must be equipped with brakes, which must be engaged at all times when the scaffolding is in use. A scaffold may not be moved if any person is on the structure.

*Safe Scaffolding Access*

Safe and convenient access must be provided to every scaffold platform by means of properly installed ladders or approved stairways, which must remain unobstructed at all times. Climbing up or down a scaffold on the braces or ledgers is forbidden.

All ladders used to access scaffolding must be securely attached to the scaffold structure.

Hook-on and attachable ladders must be specifically designed for use with the type of scaffolding being used.

If a ladder is used to access a scaffold platform at a height greater than 1.5 metres above the ground, then the ladder must be secured internally (i.e., within the scaffold structure) and there must be an opening (closed with a trap-door) in the platform at the top of the ladder.

If the scaffold platform is at a height of less than 1.5 metres above the ground, then the ladder may be attached externally provided the guard rails around the platform are modified to allow access (the opening in the guard rails must be kept closed using a self-closing gate). No person may climb over or through the guard rails to gain access to a platform.

If a vertical ladder used on scaffolding is more than 5 metres in length it must be equipped with a ladder cage extending from a point 2 metres from the base of the ladder to a height of 1 metre above the platform (or the uppermost platform) that the ladder is providing access to.

Circular ladder cages must have an internal diameter of no more than 700mm. Square ladder cages must have internal dimensions of no more than 700mm by 700mm.

The requirement for a ladder cage may be waived if platforms are provided at height intervals not exceeding 4 metres, with the vertical ladder secured on the inside of the scaffolding framework and an opening (closed with a trap-door) in each platform.

Vertical ladders must be braced at three metre intervals (as a minimum) to prevent undue movement.

All vertical ladders providing access to a platform must be left in place for as long as the scaffold remains in place and must be inspected as part of the scaffold structure.

Any deviation from the requirements stipulated above must be subjected to a risk assessment and the Construction Supervisor must authorise the deviation in writing.

*Scaffolding Platforms*

Safe working platforms must be provided.

Every work platform must be complete (i.e., from ledger to ledger in order to prevent personnel, materials, tools, etc. from falling through the platform.

Every work platform must be constructed from manufactured steel scaffold boards of equal thickness. Timber boards are not permitted under any circumstances.

Each steel scaffold board must be securely hooked (fastened) onto the ledgers or transoms that support it.

On all sides except the one facing the structure, every scaffold platform must be provided with:

- Sturdy guard rails positioned 500mm above the platform floor (the mid rail) and 1100mm above the platform floor (the top rail); and
- Steel toe boards that are at least 150mm high and securely attached such that no gap exists between the toe boards and the platform floor.

Scaffold platforms must be as close to the structure as is practicable (but not closer than 75mm)

Scaffold platforms must, at all times, be kept free of waste, protruding objects, and any other obstructions. Platforms must be cleaned, if necessary, to ensure that they are maintained in a non-slip state.

*Inspection of Scaffolding*

Scaffolding to be inspected after erecting for safety, a green tag (displaying the words, "Scaffold Safe for Use") or a red tag (displaying the words, "Danger: Do Not Use Scaffold") must be prominently displayed on each scaffold at all times. The tag must be positioned close to the base of the ladder or staircase provided for safe access.

As a minimum, a green tag must display the Scaffolding Supervisor's name, load bearing capacity, the date that the scaffold was erected, and the date that the scaffold was last inspected.

Hand over certificate to be issued by Scaffolding supervisor to Construction supervisor per scaffolding before use.

Only an appointed Scaffolding Supervisor may attach, change, update the information on, or remove these tags.

Scaffolding must thereafter be inspected weekly, after inclement weather and after altering and records must be kept on the file.

A record of each inspection (date and time of inspection, location of scaffolding, findings, etc.) must be captured in a register. The register(s) must be maintained by the Scaffolding Supervisor(s) carrying out the inspections.

*Using Scaffolding*

The Contractor must inspect the erected structure prior to acceptance and must ensure, as far as is reasonably possible, that the scaffold is safe and fit for purpose before allowing his team to make use of the scaffold.

In particular, the user must ensure that:

- The scaffold and the platforms have been constructed to meet the loading requirements of the work that is to be carried out (the Scaffolding Supervisor must be consulted in this regard);
- The Scaffolding Supervisor has checked that adequate ties and braces are in place;
- The work platforms are in the correct positions and are complete with toe boards and guard rails;
- Safe and convenient access has been provided (ladders and / or stairways); and

- A green ("Scaffold Safe for Use") tag has been attached to the scaffold by the Scaffolding Supervisor.

Use of an incomplete or unsafe scaffold is prohibited.

Unsteady or non-rigid scaffolds must not be used and inadequacies must be reported to, and rectified by, the responsible Scaffolding Supervisor.

The user of a scaffold must ensure that every person in his team is aware that no alterations to the scaffold may be made by the team during the course of their work, and that if any alterations are required, they must be made by competent Scaffolding Erectors under the supervision of an appointed Scaffolding Supervisor.

A scaffold may not be used:

- If a red tag is displayed indicating that the scaffold is not safe to use; or
- During inclement weather, defined as wind speeds greater than 40km/h, thunderstorms, or heavy rain (in excess of 40mm/h).

With due consideration of possible educational limitations, the contractor must ensure that all persons understand what green and red tags mean.

The area around the base of a scaffold must be appropriately barricaded to prevent unauthorised access into the work area. Appropriate warning signage (i.e., "overhead work in progress" and "no unauthorised access") must be prominently displayed.

Loose tools and / or materials on scaffold platforms must be secured using lanyards, wire or fibre rope, or must be placed in secured containers.

Where appropriate, "catch nets" deemed may be installed as an additional safety measure to prevent materials or tools from falling to the ground.

The storage or placement of materials on scaffolding platforms must be kept to a minimum. Debris as well as tools and materials that are no longer required must be removed from all working platforms at least once per day.

Scaffolding platforms must be cleaned regularly.

A heavy load may not be placed on a scaffolding platform unless the scaffold has been designed and constructed specifically for that purpose. Any loading of a scaffold structure must be authorised in writing by a structural engineer.

Scaffolds may not be used as hoisting towers or to support piping or equipment.

Each person working from scaffolding must wear fall protection (i.e., a full body safety harness with two shock absorbing lanyards fitted with scaffold hooks) and must be securely anchored at all times.

All work must be carried out from properly constructed work platforms. Standing on railings or braces in order to perform work is forbidden.

Where work on an electrical system is to be undertaken from a scaffold, an electrical engineer (employed by Project or the client) must determine whether or not the scaffolding structure requires bonding and earthing. The scaffolding may not be used until this has been determined, and if required, until the structure has been bonded and earthed.

*Storage of Scaffolding Components*

All scaffolding components must be stored in a demarcated storage area in such a manner that they are not exposed to environmental extremes and will not cause injury to persons. Suitable barricading / demarcation must be erected to prevent unauthorised entry to scaffolding storage area.

Each scaffolding stack must be stable and components must be neatly placed to ensure that no ends protrude into any pathway. The various components must be stacked separately.

Any storage area for scaffolding components must be positioned such that it will not interfere with any onsite activity (including the operation of any plant or equipment), block any access way, or obstruct access to any plant or equipment. Before establishing a storage area, the location must be agreed with the nominated project management representative.

### 8.12.3 Ladders

All ladders used on site must be of sound construction and adequate strength. Ladders must comply with GDR 13A requirements.

The use of makeshift ladders is forbidden.

All ladders must be numbered, listed in a register, and inspected by a competent person on a monthly basis (the results of each inspection must be recorded in the register).

Before using a ladder, the user must inspect it for damage.

Ladders with missing, broken, cracked or loose rungs, split stiles, missing or broken spreaders (stepladders) or any other form of damage or defect may not be used.

A damaged ladder must be removed from service (and tagged, “out of service”) without delay and must then either be repaired (if possible) or destroyed to prevent further use.

Safe working procedures for use of ladders must be communicated to personnel.

Ladders may only be used as a means of access and egress. The use of ladders as working platforms is prohibited, except for inspection and carrying out minor tasks (i.e., light work and short duration).

All portable ladders must be fitted with non-skid safety feet (or some other means to prevent the base of the ladder from slipping) and the feet must always be placed (stand) on a firm level surface.

The use of bricks, stones, wood or any other material to level the stiles of a ladder is prohibited.

Ladders may not be placed on movable bases such as boxes, tables, etc.

The base or foot of a ladder must always be secured to prevent it from slipping. The ladder must be held by an assistant if the base cannot be secured in any other way (e.g., tied off).

A straight ladder must extend at least one metre above its support (or above the working platform that it is providing access to). The top of the ladder must be tied off (or otherwise secured to its support) to prevent accidental movement.

A straight ladder must be placed at a safe angle, i.e., tilted at a ratio of approximately 4:1, meaning that the base of the ladder must be one metre away from the wall (or other vertical surface) for every four metres of height to the point of support.

A stepladder may never be used as a straight ladder. A stepladder must be opened fully and the spreaders must be locked securely.

When using an extension ladder, at least four rungs must always overlap at the centre of the ladder.

Ladders may not be joined together unless they have been specifically designed and manufactured for that purpose.

A ladder may not be placed against a window, glass or any other material which is unlikely to withstand the force exerted on it by the top of the ladder.

Materials and / or equipment may not be placed in close proximity to the base or landing of any ladder.

When ascending or descending a ladder, a person must always face the ladder and use both hands.

Nothing may be carried up or down a ladder if it prevents the person from holding on to the ladder with both hands. Tools must always be properly secured. This can be achieved by attaching them to the wrist using lanyards or placing them in a tool belt around the waist. Tools and materials may also be carried in a bag over the shoulder or hoisted to the landing using a tool bag and rope.

Only one person at a time may use (i.e., be positioned on) a ladder.

No person may stand or step above the third rung from the top of a straight ladder or above the second highest step of a stepladder.

Overreaching from a ladder is prohibited. If the target is not within comfortable reach, the person must climb down and reposition the ladder.

No person may run up or down a ladder, or jump from the lower rungs or steps to the ground.

All ladders must be properly maintained and cared for.

Ladders must be stored under cover and should be hung in a horizontal position from several brackets.

No ladder may be left lying on the ground or be left exposed to the weather. A ladder left lying on the ground presents a tripping hazard and it may be damaged by vehicles running over it.

No ladder may be left in such a position where it may fall over, be accidentally knocked over, or be blown over by the wind.

Ladders may not be painted, as the paint may conceal damage, defects, labels or other markings.

Ladders must be kept clean, as dirt may conceal damage or defects. Oil or grease accumulation on the rungs of a ladder may cause a person to slip.

Before making use of a ladder, each person must make an effort to remove mud, oil, grease, etc. from his boots.

## 8.13 TEMPORARY WORKS

The PC must ensure that the provisions of CR 12 are adhered to for temporary works to be conducted on site.

All temporary works must be designed by a competent Engineer who is registered with ECSA appointed as Temporary Works Designer as per CR 12.1.

Ground conditions where temporary works structure is to be erected must be tested by a competent person and recommendations implemented.

Temporary works drawings or any other relevant document including construction sequences and methods statements per structure must be kept on site. Drawings to be displayed at the site office.

Temporary works structure must be erected under supervision of a trained and competent Temporary Works Supervisor as per CR 12 (2) who shall ensure that the structure it is stable on the ground and support vertical and lateral loads exerted on them without risk of collapse.

All persons required to erect, move or dismantle temporary works structures must be provided with adequate training and instruction to perform those operations safely.

All equipment used in temporary works structure must carefully examined and checked for suitability by a competent person, before being used.

A contractor must ensure that, all temporary works structures are adequately erected, supported, braced and maintained by a competent person so that they can support all anticipated vertical and lateral loads that may be applied to them, and that no loads are imposed onto the structure that temporary works is not designed to withstand.

Provision must be made for safe access and egress to temporary works as per site working at heights and fall protection plan.

If after erection, any temporary works structure is found to be damaged or weakened to such a degree that its integrity is affected, it must be safely rectified or reinforced immediately as per temporary works designer and site engineer's recommendations.

Casting of concrete on temporary works shall only be conducted once the Temporal Works Designer has inspected the structure and authorised in writing.

Temporary works structure must be inspected by the Temporal Works Supervisor immediately before, during and after concrete placement, after inclement weather or any other imposed load and daily until temporal works structure has been removed. Results must be recorded in a register kept on site.

Temporal works shall only be removed once the Temporal Works Designer has authorised in writing that the concrete has acquired sufficient strength to support its own weight and imposed loads.

Method and safe working procedure for installation and removing of temporary works must be provided and approved before work commencement.

All certificates and inspection records must be kept in the safety file.

## 8.14 LIFTING AND TACKLING

The PC and Sub-Contractors must ensure that lifting and tackling is conducted in a manner approved by the Engineer. Risk assessment, method statements and safe working producers must be provided and approved for all lifting and tackling tasks.

Lifting equipment must be designed and constructed in accordance with the manufactures/designer's specifications as well as generally accepted technical standards and operated, used, inspected and maintained in accordance with the manufactures requirements as well as that of the Driven Machinery Regulation 18 of the OHS Act.

The PC and Sub-Contractors must ensure that all lifting Cranes operations are in compliance with CR 22 in addition to compliance with Driven Machinery Regulations, 2008.

The following requirements as per Driven Machinery Regulations must be complied with:

- The lifting equipment must be operated by a competent person who has valid the medical fitness certificate.

- Lifting equipment must be clearly and conspicuously marked with the maximum mass load (MML) that it is designed to carry safely. When the MML varies with the conditions of use, the table of maximum loads should be used by the driver/operator.
- Lifting equipment fitted with a load limiting device that automatically arrest the lift when the load reaches its highest safe position or when the mass of the load is greater than the MML.
- Every hook or load attaching device must be designed such or fitted with a device that will prevent the load from slipping off or disconnecting.
- Every lifting machine must be inspected and load tested by a competent person every time it has been dismantled and re-erected and every 12 months after that. The load test must be in accordance with the manufacturer's prescription or to 110% of the MML.
- All ropes, chains, hooks or other attaching devices, sheaves, booms, outriggers and pads, brakes, load indicating device, safety devices forming an integral part of a lifting machine must have test certificates not older than 3 months.
- All maintenance, repairs, alterations and inspection results must be recorded in a log book and each lifting machine must have its own log book

Qualified slinger & signallers must be appointed for ensuring safe load hooking, guiding load, landing and unhooking loads. They must communicate effectively using approved signalling techniques with the operator of the lifting crane / truck. No lifting operations shall be conducted without slinger / signaller in place.

Section where lifting operations are taking place must be barricaded. Only authorised personnel shall be allowed in the area.

Before a lifted load is moving, a siren must sound to alert all personnel in the area and it should stop when the load has been positioned.

## 8.15 CONCRETE WORKS

Works to be planned accordingly, temporary works and reinforcement steel to be completed and certified by a competent person before any placement of concrete is done.

Method statement for the works to be provided.

Traffic management plan for the activity to be developed, considering truck routes and parking.

OHS files for the concrete supplier to be approved before the day of the task.

Ground conditions where the pump trucks shall be positioned to be stable, be able to withstand vibrations without safety risk and be approved by a competent person.

Inspection to be done on the done on the structure before concrete pouring.

Personnel involved in the operation to wear PPE; reflective vests, gum boots, long rubber gloves, waterproof aprons, hard hats and goggles. Only authorised, trained and instructed personnel to be allowed in the area.

Operations must be done under supervision and a spotter & signaller who shall clearly communicate with the pump operator to be provided.

When concrete requires to be vibrated, vibrator to be suitable, be inspected for safety before use and be operated by a competent person.

Cleaning of concrete plashes and concrete trucks must be done in manner that will not contaminate the environment.

Method statement and safe working procedures for onsite mixing of concrete must be provided when this mixing is to be done on site. Employees working with cement to wear dust masks, steel toed gum boots and all PPE requirements as per MSDS to be met.

## 8.16 STRUCTURES

A contractor must ensure the following is in place to ensure safety of structures as per CR 11:

- All reasonably practicable steps are taken to prevent the uncontrolled collapse of any new or existing structure or any part thereof, which may become unstable or is in a temporary state of weakness or instability due to the carrying out of construction work;
- No structure or part of a structure is loaded in a manner which would render it unsafe; and all drawings pertaining to the design of the relevant structure are kept on site and are available on request to an inspector, other contractors, the client and the client's agent or employee.
- Inspections of the structure are carried out periodically by competent persons in order to render the structure safe for continued use.
- Completed structures are inspected at least once every six months for the first two years and thereafter yearly.
- The structure is maintained in such a manner that it remains safe for continued use.
- The records of inspections and maintenance are kept and made available on request to an inspector.

## 8.17 CONFINED SPACE

A confined space is a space with limited entry and egress. Examples of confined spaces on site include the interior of a storage tank, pipelines and tunnels; occasionally entered by maintenance workers but not intended for human occupancy. Hazards in a confined space often include harmful dust or gases, asphyxiation, submersion in liquids or free flowing granular solids, combustible or flammable substances. Confined spaces entry points must be secured (locked) to prevent unauthorised entry.

Safe working procedures must be developed for entering confined space. The safe working procedure should address the following:

- Identifying work area as confined space.
- Hazard identification before entering space which includes testing for gases, any liquids or solids substances that are present or could gain entry during maintenance.

- Monitoring plan; monitoring plan for entering confined space must be in place, i.e., tags at the entrance with name of person entering, safety watch of the confined space and radio communication
- Rescue plan; plan for rescuing a person in confined space must be addressed i.e., using of safety harnesses. Rescue personnel must be physically capable of carrying out a rescue.
- PPE issue; suitable PPE as per hazard identification must provide and be in good working order.
- Training; person entering confined space must be trained on hazards associated with works, safe working procedure and PPE use.
- First aid and emergency plan for entering confined space must be in place. First aid must be readily available in the workstation and communications must be available at the worksite to emergency response organizations i.e.; Fire Department, Ambulance
- Entry permit; competent person designated by the Contractor to issue entry permits for entering confirmed spaces after ensuring that all above safety requirements are adhered to. Entry permit to indicate name of the person entering space, description of work, communication used, date, time and duration of work.

## 8.18 LOCKOUT PROCEDURES

Lockout procedure is a planned safety procedure which involves turning off the energy supply of machinery and equipment to ensure safety. This procedure protects workers from the risks posed by live machinery or electricity.

The Contractor should develop set of procedures to cover the requirements of lockout i.e., during the following operations:

- Servicing and/or maintenance of plant, machinery, equipment and electricity
- During breakdowns
- During parking and/or or not using of plant, equipment and machinery
- Prior commissioning of systems, areas
- Refuelling
- Inspections / checklists
- Leaving cab

The contractor must ensure that the following steps for lockout procured are adhered:

- **Pre-lockout** starts with the issue of a lockout work permit by the responsible person. This is followed by the drawing of locks and keys, deactivating the equipment or process through conventional or other means and the securing of the lock on the lockout device. This is accompanied by the completion and hanging of the tag on the lock. This tag must show who is working on the machine and the date on which the lockout was done. It also makes it easy to see if the lockout is currently in use.

- **Mid-lockout** continues by ensuring that the correct control has been locked effectively disconnecting the power. Secure the key on the person who performed the lockout and start the maintenance or other work. This stage continues until all work is complete.
  **Post-lockout** begins with a thorough inspection to remove all tools, loose parts and other maintenance equipment. Replace all the machine guards and other guards. Personnel must all be accounted for and be clear of all moving or hazardous mechanisms. Power is then restored and the necessary tests carried out before resuming normal operation.

## 8.19 GENERAL MACHINERY

The PC must ensure compliance with the GMR,1988 and amendments thereto, which include inspecting machinery regularly, allowing for and appointing a competent person to inspect and ensure maintenance, allow for supplying and issuing PPE and allowing for training those who use machinery.

### *8.19.1 Portable Electrical Tools*

The PC must ensure that all electrical tools, electrical distribution boards, extension leads, and plugs are kept in a safe working order.

The PC must allow for and ensure the following:

- That a competent person undertakes routine inspections and records are kept on site.
- That only authorized trained persons use the tools.
- That safe working procedures apply.
- That awareness training is carried out and compliance is enforced at all times.
- That PPE is provided and used.
- Tools are inspected by a competent person monthly and records are kept in the register.
- Users inspect the tools daily before use and report any faults.

### *8.19.2 Compressed Gas Cylinders*

The contractor must establish a suitable storage area for oxygen, acetylene, LPG and argon cylinders in compliance with the following requirements:

- The storage area must be located at least 10 metres away from any building, and must be well ventilated;
- The storage area must have a concrete floor;
- The storage area must be enclosed using wire mesh fencing (as this will ensure adequate ventilation). This enclosure must be kept locked. Access into the storage area must be limited and controlled;
- A protective covering or roof must be fitted to the enclosure to provide shade;
- The enclosure may not be used for the storage of any other materials / equipment, and must be kept completely free of all combustible materials at all times;

- Appropriate warning signage (i.e., “no smoking” and “no naked flames”) must be prominently displayed on the enclosure;
- A 9kg dry chemical powder fire extinguisher must be mounted near the entrance to the enclosure
- If electrical lighting is required, it must be of an approved intrinsically safe type;
- Oxygen, acetylene, argon and LPG cylinders must be stored separately in the enclosure. Furthermore, full and empty cylinders must be separated. Separate storage sections must be clearly designated within the enclosure for the different gas types, and for full and empty cylinders, i.e., oxygen – full, oxygen – empty, acetylene – full, acetylene – empty, etc.;
- When a cylinder is empty, the cylinder cap must be replaced to protect the valve. Empty cylinders must be clearly marked (there must be no need to open valves to check if cylinders are full or empty);
- All cylinders must be stored in an upright position and must be secured in this position by chaining, strapping or clamping them individually to a wall, a cylinder trolley, rack or carrier, or some other rigid structure;
- Cylinders must be stored in rows (when necessary due to the number of cylinders) with aisles between the rows to facilitate easy and rapid removal in the event of a fire;
- Oxygen cylinders may never be stored near highly combustible materials, particularly oil and grease, or near fuel gas cylinders. When in storage, oxygen cylinders must be separated from fuel gas (LPG and acetylene) cylinders by a distance of 6 metres or by a 2-metre-high wall made of fire-resistant material;
- The total quantity of gases stored on site must be limited to a 2-week supply.

Compressed gas cylinders must always stand upright (i.e., when being used, stored or transported) and must be properly and individually secured to prevent them from falling over.

Cylinders must be protected from flame, heat and from being struck by moving equipment and falling objects.

When handling gas cylinders (whether full or empty), care must be taken to prevent sudden impacts.

Whenever a cylinder is not in use, the protective cap must be in place to prevent the valve from being damaged.

Gas cylinders may not be carried, dragged, rolled or slid across a floor or surface.

When gas cylinders are to be moved / used, they must be placed in a proper cylinder trolley fitted with a minimum of 4.5kg dry chemical powder fire extinguisher.

Gas cylinders may not be taken into a confined space. Gas hoses that are run into a confined space must be removed during breaks.

A flashback arrestor and a check valve (non-return valve) must be installed between the regulator and the hose and between the hose and the torch on the oxygen line and on the fuel (acetylene) line.

Connection fittings may not be forced, and safety devices associated with cylinder valves or regulators may not be altered / tampered with.

Gas hoses may not be joined. Only approved hose connectors of the crimp type are permitted. Wire and jubilee clamps are prohibited.

Only high-quality ancillary equipment may be used. This includes flashback arrestors, hoses, clamps, spindle keys, nozzles and torches.

Only trained and competent personnel may operate gas welding / cutting equipment and appliances.

When an employee opens the valve to a cylinder, he must stand to one side and open it slowly. Valves may never be left partly open – they must either be closed or be opened fully.

Leaking cylinders must immediately be removed from service and the workplace (if it is safe to do so).

Gas cylinders must be prevented from coming into contact with electrical circuits, e.g., welding leads. Never strike an arc on a cylinder.

### *8.19.3 Pneumatically Powered Tools and Equipment*

When using pneumatic powered tools, the designated tool pressure must be attained by the use of a regulator.

Pneumatic tools to be operated by a trained and competent person.

Pneumatic powered tools must be disconnected when not in use. They must not be disconnected from the air supply until all the residual pressure has been released or contained by a shut-off device. Hoses must not be kinked as a means of containment.

Employees operating pneumatic powered tools, and any potentially affected employee in the vicinity of use, must wear suitable personal protective equipment.

All rotary compressed air tools (e.g., drills) must have the rated revolution per minute (RPM) permanently marked on the casing. Only attachments of compatible RPM must be used with these machines.

The actual RPM of the tool must be checked every three months to ensure that the speed is as rated to manufacture specifications.

Pneumatic powered tools must be secured to the air supply hose by an approved positive means to prevent the tool from becoming accidentally disconnected. Safety clips or retainers must be securely installed and maintained on pneumatic impact (percussion) tools to prevent attachments from being accidentally expelled.

Compressed air must not be used for cleaning purposes to ensure safety. Compressed air must not be pointed at any part of the body or used for cleaning clothing.

### *8.19.4 Fuel Powered Tools and Equipment*

Fuel powered tools must be shut down and allowed to cool before being refuelled, serviced, or maintained. Fuel must be transported, handled, and stored in approved fuel containers. Where possible, diesel driven engines must be used in preference to petrol driven engines. All fuel powered tools must be included on the contractor's Equipment Register only approved equipment to be used on site.

When fuel powered tools are used in enclosed spaces, the space must be ventilated and the atmosphere monitored to measure toxic gas concentrations. This type of activity must only be undertaken in exceptional circumstances and requires the approval by the Safety Agent.

### *8.19.5 Hydraulically Powered Tools and Equipment*

Hydraulic powered tools must use only approved fluid that retains its operating characteristics at the most extreme temperatures to which it will be exposed. The manufacturer's stated safe operating pressures for hoses, valves, pipes, filters and fittings must not be exceeded.

Only manufacturer approved hoses, valves, pipes, filters and fittings must be used.

## 8.20 HAND TOOLS

Employees required to use hand tools must receive training relevant to the tool and have their competency assessed in the operation, inspection and maintenance of the tool. Where necessary, additional applicable personal protective equipment must be worn when using hand tools.

Wrenches, including adjustable, pipe, end, and socket wrenches, must not be used when the jaws are sprung to a point where slippage occurs. Impact tools such as drift pins, wedges and chisels, must be kept free of mushroomed heads. The wooden handles of tools must be kept free of splinters or cracks.

Correct hand tools for the job must be used, e.g., screwdrivers must not be used as chisels, and pliers must not be used as hammers.

All hand tools used in elevated areas, that may be dropped or fall to lower levels must be fitted with safety lanyards and attached to solid structures or in the case of podges, scaffold keys etc., attached by wrist lanyard to the user.

Purpose built tools and equipment may not be used unless a risk assessment has been conducted and authorised by the nominated project management representative.

All tools must be inspected by the user before, during and after use. If any faults are identified, the tool must be taken out of service and not used until repaired. Faulty tools that are not able to be repaired must be tagged “out of service” and removed from site.

*Nuclear Gauge Handling*

Before operating a nuclear gauge, a person must pass a Nuclear Safety course and be issued a thermoluminescent dosimeter (TLD) badge. The badge measures exposure to radiation and is to be worn whenever operating a nuclear gauge.

Exposure to radiation must be limited through time, distance, and shielding. Safe storage and use of equipment to be in place. Safe working procedures to be developed and implemented.

## 8.21 MANUAL HANDLING

Any handling or lifting task that can only be done manually must be planned and rehearsed before the task is done. A risk assessment must be conducted in consultation with employees.

The contractor must plan his work in a manner that shall reduce manual handling as far as reasonably practicable and use by using mechanical means i.e., use of pallet truck, forklift truck, powered hoists.

The following should be considered with conducting the Risk Assessment with regards Manual Handling and also take into consideration the task factors, physical demands and tools involved in the task:

- Load weight/frequency;
- Hand distance from lower back;
- Asymmetrical trunk/load;

- Postural constraints;
- Grip on the load;
- Floor surface;
- Environmental factors;
- Carry distance; and
- Obstacles on route

As a guideline 25 kg is considered to be the limit of what a person can safely handle. Where there are loads exceeding 25 kg the risk of handling the load must be mitigated to assure minimal potential for any injury.

The following measures must be in place when handling loads to ensure safety:

- Reduce carrying distances, material to be delivered as close to the working area as possible
- Assessing the weight to be carried to carried and ensure sufficient man power.
- Ensure proper grasping. Get a firm grip. The roots of the fingers and the palm of the hand should grip the load.
- Ensure good handling and lifting techniques i.e., keep the load as close to the body, waist as far as possible, avoid twisting the back or leaning sideways, keeping the head up, moving smoothly
- Plan for rest midway where the distance is long
- Clear communication & good coordination to be in place
- If more than one person is involved in a task a communication procedure must be agreed in advance. Lowering the load must be done in a controlled manner. Dropping a load is dangerous and must be avoided.
- Extra care should be taken when lifting awkwardly shaped objects

## 8.22 VIBRATION

As far as possible, exposure to vibration must be eliminated.

However, if this is not possible, short-term solutions to decrease exposure include:

- Reducing the vibration levels;
- Removing the person from the vibrating equipment / tools;
- Reducing the period of time that the person works with the vibrating equipment / tools (at least 30 minutes break after 30 minutes working with a machine that vibrates excessively).

In order to reduce exposure to vibration:

- Consider buying equipment that operates effectively at lower speeds;
- Buy equipment with built-in damping materials;
- Buy lighter tools if they are available - they require less of a grip;
- Maintain the equipment;

- Make sure equipment is balanced and there are no worn parts;
- Use remote controls when they are available;
- Reduce your grip on the equipment when it is safe. The less time you actually have your hands on the equipment the better. Relax your hands during these brief breaks;
- Take scheduled breaks; and
- Do other tasks that allow you to move away from vibrating tools and equipment.

## 8.23 HAZARDOUS CHEMICAL SUBSTANCES

All employees required to use Hazardous Chemical Substances (HCS) or products containing HCS must be adequately and comprehensively trained with regard to the requirements of the Hazardous Chemical Substances Regulations,1995 and amendments thereto, the potential sources of exposure and the potential risks to their health caused by exposure.

Only authorised and trained personnel should handle / work in areas with hazardous chemical substances.

No chemical substance may be brought onto site unless it has been approved construction manager and it appears on the approved chemical substances register which will be made available to all contractors.

The register will contain the following information:

- Trade name / product name of substance;
- Manufacturer / supplier of substance;
- Maximum inventory;
- Storage requirements and precautions;
- Inventory of special emergency items held for handling spillages, fires, etc. (e.g., reagents to neutralise spillages, firefighting foam, etc.); and
- Approved disposal methods.

Any chemical substance brought onto site without adherence to the requirements stipulated above shall be removed from site immediately.

The contractor must ensure that a Material Safety Data Sheet (MSDS) is obtained for each chemical substance brought onto site. A file, or files, containing all of the MSDS's must be maintained and must be readily available to all personnel on site (particularly first aiders) as well as other potentially affected parties (e.g., emergency services personnel, persons from the local community, etc.). The MSDS's must be in the language(s) commonly used on site.

The contractor must appoint a trained and competent Hazardous Chemical Substances Coordinator who understands and is able to evaluate the risks associated with a wide variety of substances. This person shall be responsible for:

- Assessing the hazardous properties and risks associated with all chemical substances brought onto site by the contractor and appointed sub-contractors (using the MSDS's);
- Determining precautions and safe practices for transportation, use, handling, storage and disposal (including PPE requirements) (using the MSDS's);
- Determining first aid and emergency response requirements / procedures (using the MSDS's);
- Maintaining the MSDS file;
- Managing and monitoring the consumption of inventory; and
- Providing an "as needed" service to site personnel and suppliers.

The risks associated with the transportation, use, handling, storage and disposal of all hazardous chemical substances brought onto site must be assessed and managed by the contractor through a process that incorporates risk assessment.

Whenever a task-based risk assessment is carried out, consideration must be given to the use of chemical substances (e.g., greases, solvents, etc.).

The contractor must provide safe work procedures for the transportation, use, handling, storage and disposal of all hazardous chemical substances to be used on site.

The contractor must provide his employees with all of the PPE that is necessary to prevent exposure / injury while handling / using the hazardous chemical substances that they will be required to work with. Appropriate PPE must be selected with consideration given to the potential hazards, permeability, penetration, resistance to damage and compatibility with the work tasks.

The contractor's employees must be trained in the safe transportation, use, handling, storage and disposal of the hazardous chemical substances that they will be required to work with or may come into contact with. The training must specifically address PPE requirements (including the correct selection, fitment and use thereof).

All personnel must be trained to understand the potential health effects associated with exposure to hazardous chemical substances and therefore the importance of Safe Work Procedures and PPE. All personnel must be trained on emergency response procedures and first aid measures.

An emergency response plan for incidents involving hazardous chemical substances must be in place. Regular and appropriately staged emergency drills (possibly involving external spill response and ambulance support services) must be held and lessons learnt must be incorporated into the emergency response plan.

The contractor must provide appropriate storage facilities for all hazardous chemical substances to be used on site. The storage facilities must be secure and protected from damage. They must also be designed for easy access for firefighting purposes. Where applicable, the storage facility must protect chemical containers from physical damage due to temperature extremes, moisture, corrosive mists or vapours, and vehicles.

The inventory of hazardous chemical substances stored on site must be kept to a minimum. The quantity of each chemical stored must be justifiable.

Storage and segregation requirements for all hazardous chemical substances to be used on site must be based on:

- The quantities of the substances stored;
- The physical state of the substances (solid, liquid or gas);
- The degree of incompatibility; and
- The known behaviour of the substances.

Access to areas where hazardous chemical substances are stored and handled must be limited and controlled.

Every chemical substance container must be adequately and clearly labelled to identify its contents, to indicate precautionary requirements for the substance, and to indicate the date of expiry (if applicable). Pipes used to transfer / convey / distribute chemical substances must be clearly identified (e.g., colour coding). Directional flow must be indicated where practical.

Before any item, equipment or empty container containing a chemical residue is disposed of as general waste, it must be properly decontaminated (where applicable). Before being disposed of, empty chemical containers must also be rendered unusable for carrying water (by puncturing, cutting or crushing them).

Hazardous chemical substance waste (i.e., redundant / expired hazardous chemical substances, containers containing residues, contaminated items / materials, etc.) must be disposed of in accordance with the EMPr.

A system must be in place to ensure that the risks are assessed before any changes are made to equipment and / or processes for the transportation, storage, handling, use or disposal of a hazardous chemical substance.

A programme must be in place to continually investigate possibilities / opportunities for replacing hazardous substances with safer alternatives.

## 8.24 FUEL / FLAMMABLE LIQUID

Method statement for refuelling on site must be provided. Construction Manager to approve all fuel storages on site.

If the on-site storage of a fuel or a flammable liquid is approved, the contractor must ensure the following:

- The quantity of fuel / flammable liquid to be stored on site must be kept to the minimum that is required;
- The storage area must be located in a well-ventilated area at least 10 metres away from any building, drain, boundary or any combustible material;
- If more than 200 litres of fuel / flammable liquid are to be stored, the tank must be installed / the containers must be positioned within and be approved by Local Fire Chief Inspector.
- The bund must be impermeable. It must have a solid concrete floor and the walls must be constructed out of brick and must be plastered on the inside;
- The bund must be fitted with a lockable drain valve (for draining away rainwater), which must remain locked in the closed position. The valve may only be opened under supervision and in accordance with a written procedure;

- The fuel / flammable liquid storage area may not be used for the storage of any other materials / equipment, and must be kept completely free of all combustible materials (including rubbish, brush and long grass) at all times;
- Access to the storage area must be controlled
- Appropriate warning signage (i.e., “flammable liquid”, “no smoking” and “no naked flames”) must be prominently displayed at the storage area. The contents and volume of each tank must be indicated;
- In order to contain spillages, the offloading / refuelling bay at the fuel / flammable liquid storage area must have a solid concrete base surrounded by bund walls, ramps or humps and / or spill trenches (covered with steel grating) that lead into a sump;
- Fuel dispensing pumps must be protected against impact damage;
- All fuel / flammable liquid storage tanks and dispensing equipment must be electrically bonded and properly earthed;
- All electrical installations and fittings must be of an approved intrinsically safe type;
- Two 9kg dry chemical powder fire extinguishers must be mounted in an easily accessible position near the entrance gate to the fuel / flammable liquid storage area. Depending on the size of the storage area, additional fire extinguishers may be required to ensure that an extinguisher is no further than 15 metres away from any point on the perimeter of the storage area;
- Smoking or open flames within 10 metres of a fuel / flammable liquid storage / refuelling area is strictly prohibited;
- No petrol- or diesel-powered vehicle or equipment may be refuelled while the engine / motor is running;
- Cellular phones must be switched off in fuel / flammable liquid storage / refuelling areas;
- Spill clean-up kits (containing a suitable absorbent fibre product) must be provided;
- Any spillages must be cleaned up immediately and all contaminated cleaning materials must be disposed of in accordance with the applicable legislation;
- Emergency plan for spillages must be provided. If a flammable liquid is spilt or is leaking from a container / vessel, the area must be cordoned off and appropriate warning signage must be displayed to keep unauthorised personnel away from the affected area. Every effort must be made to contain the spillage. All hot work in the vicinity must be stopped immediately. If the leak or spillage cannot be contained or stopped, then appropriate emergency response procedures must be activated including the evacuation of all persons in the vicinity. Suitable firefighting equipment must be positioned ready for use should the spilt product ignite.
- Drip trays must be used wherever required;
- All tanks, drums, cans, etc. containing flammable liquids must be tightly closed and properly sealed except for when a container is being Filed or when a product is being decanted;
- The transport or storage of corrosive or flammable liquids in open containers is strictly prohibited
- Only required quantities of flammable liquids (paints, solvents, etc.) must be stored on site. Each product must be kept either in its original container or in an approved container which must be properly sealed. Each container must be clearly labelled to indicate its contents. When not in use, all such containers must be stored in a well-ventilated steel cabinet which must be kept locked to prevent unauthorised access;

- Safe Work Procedures must be compiled for the transportation (including delivery), offloading, storage, handling and use of any fuel / flammable liquid on site;
- Safe working procedure for vehicles refuelling must be displayed on site
- All personnel that will be required to work with or may come into contact with a flammable liquid must be made aware of the hazards associated with the product and must be thoroughly trained in the safe transportation, use, handling and storage thereof.

## 8.25 STACKING OF MATERIALS

Stacking and storage of materials must be performed under the supervision of a Competent Person who has been appointed in writing as required by CR.

Storage areas must be designated, kept neat and under control. In addition to the abovementioned the requirements of General Safety Regulations,1986 must be complied with.

Adequate space stacking, storage and lay down areas must be provided on site.

Stacking, storage and laydown areas must be demarcated and be kept neat.

The base of any stack is level and capable of sustaining the weight exerted on it by the stack. The items in the lower layers can support the weight exerted by the top layers.

The height of the stack must not be higher than 3 times the size of the base.

Stacked material with a risk of rolling i.e., pipes must be secured with roll chocks suable material.

All site material must be stored within the barricaded site, in the event that material is stored outside the fenced site, it must be barricade with a strong physical barrier that is clearly visible to prevent access.

Hazardous chemical substances must be stored in dry storeroom as per specifications of their material safety data sheets.

All irregular shaped items must be stacked at floor / ground level in designated stacking areas on a level, firm base capable of withstanding the weight of the commodities being stacked and stacked in such a manner that the items do not topple over or change position due to subsidence or weight transfer when being moved.

Where these materials are stacked on shelves or racks, the shelves or racks must be designed to carry the weight of the commodity being stacked.

All racks or shelves where heavy material or commodities are stacked must have a weight carrying limitation clearly marked on the structure and have a safety factor of at least +10% of maximum total carrying capacity.

All materials, which could be damaged due to inclement weather, must be stored under cover.

Waste material that is combustible must not be allowed to accumulate in sufficient quantities to create a hazard.

The storage of material, small equipment, tools, files and general items in cupboards and on shelves must be neat and controlled at all times. Incompatible substances must not be stored in or on the same cupboard or shelf.

## 8.26 FIRE PROTECTION AND PREVENTION

The Contractor must compile a fire protection and prevention plan for the work that will be carried out on site.

The Contractor must assess / survey his area of responsibility and identify locations where the risk of fire is high. Cognisance must be taken of the fact that certain locations may need to be designated as high risk due to the presence of large quantities of flammable or combustible materials / substances. For all high-risk areas, the contractor must ensure that additional precautions are taken to prevent fires and strict control is exercised over any hot work (i.e., welding, cutting, grinding, etc.) that is carried out.

The contractor must supply and maintain all required firefighting equipment. The type, capacity, positioning, and number of firefighting appliances must be to the satisfaction of the nominated project management representative and must meet the requirements of the applicable legislation.

Firefighting equipment, fixed and portable, must be strategically located with a view to being able to rapidly deploy the equipment in order to bring potentially dangerous and destructive fires under control while still in their infancy.

All fire extinguishers (and any other firefighting equipment) placed on site must be:

- Conspicuously numbered;
- Recorded in a register;
- Visually inspected by a competent person on a monthly basis (the results of each inspection must be recorded in the register and the competent person must sign off on the entries made); and
- Inspected and serviced by an accredited service provider every year (the Agent may require that this frequency be increased depending on the environmental conditions (e.g., high dust levels, water, heat, etc.) to which the fire extinguishers are exposed).

Any fire extinguisher that has a broken seal, has depressurised, or shows any sign of damage must be sent to an accredited service provider for repair and / or recharging. Details must be recorded in the register.

Firefighting equipment may not be used for any purpose other than fighting fires. Disciplinary action must be taken against any person who misuses or wilfully damages any firefighting equipment.

Access to firefighting equipment, fixed or portable, must be kept unobstructed at all times.

Approved signage must be in place to clearly indicate the location of each permanently mounted fire extinguisher, fire hose reel, etc.

The contractor must ensure that all persons working in / entering his area of responsibility are made aware of where all firefighting appliances and alarm points are located.

The contractor must ensure that his employees (and those of any appointed sub-contractors) are trained in firefighting procedures and the use of firefighting equipment.

The contractor must compile an emergency response procedure detailing the actions that must be taken in the event of a fire or a fire / evacuation alarm.

All personnel working within the contractor's area of responsibility must be trained, and all visitors must be instructed, on this procedure. Copies of the procedure must be prominently displayed in the workplace in all languages commonly used on the site.

A person discovering a fire must extinguish the fire if he can do so safely, and then immediately report the incident to his supervisor. If the person cannot extinguish the fire, he must raise the nearest alarm and then report the fire as quickly as possible to his supervisor, the person responsible for the area, and / or Security.

On hearing a fire / evacuation alarm, all persons must make any operational plant or equipment safe, and then proceed to the nearest emergency assembly point and await instructions.

All incidents of fire (including the use or misuse of any firefighting equipment) must be reported to the Agent immediately. Used fire extinguishers must be replaced by the contractor without delay.

No hot work (i.e., welding, cutting, grinding, etc.) or any other activity that could give rise to a fire may be performed outside of a designated workshop without a Permit to Work having been issued.

Wherever hot work is being carried out, a fire extinguisher must be at hand. Where the risk assessment determents that it is necessary, a fire watch must be stationed.

Supervisors must carry out workplace inspections regularly to ensure adherence to fire prevention measures and procedures.

At the end of every working period (i.e., before each tea / lunch break and at the end of every shift / day), the workplace must be thoroughly inspected to ensure that no material is left smouldering and no condition / situation exists that could give rise to a fire.

The contractor must ensure that all supervisors and all employees carrying out or assisting with any hot work or any other activity that could give rise to a fire have been trained in firefighting procedures and the use of firefighting equipment. The training must be conducted by an accredited training provider.

When using electrical equipment, all cables must be in good condition and the nearest convenient socket must be used.

No power socket may be loaded beyond its rated capacity through the use of adaptors, etc.

Makeshift electrical connections are not permitted under any circumstances.

Water-based firefighting equipment must not be used on electrical equipment or burning liquids.

Each construction plant used on site for work purposes and each item of mobile equipment with a diesel or petrol engine must be fitted with a permanently mounted fire extinguisher.

Smoking is only permitted in designated smoking areas. Cigarette ends / butts must be properly stubbed out in the ashtrays provided and never thrown into waste bins.

The contractor must ensure that good housekeeping practices are enforced, as this is crucial to the prevention of fires.

All combustible waste materials must be removed from the workplace on a daily basis (at the end of each shift) and placed in waste receptacles located at least 5 metres away from any structure.

The accumulation of waste materials in out-of-the-way places is prohibited.

Offices, desks, cabinets, etc. must always be kept tidy and uncluttered. Waste paper bins must be emptied regularly.

All walkways, passages and stairways must be kept clear (i.e., must be unobstructed) at all times, as they may need to be used as a means of escape.

The areas around and the routes to all exits, fire escape doors, and fire extinguishers must be kept clear (i.e., must be unobstructed) at all times.

"No Smoking" signs must be conspicuously displayed in and around all storage areas / rooms.

Waste may not be burned under any circumstances.

Whenever any work is carried out involving the use of a flammable substance / material, the area must be cordoned off and appropriate warning signage (i.e. “no unauthorised entry”, “no smoking” and “no naked flames”) must be displayed.

## 8.27 INSTALLATION OF SERVICES

Prior to any connection / installation of services i.e., civil, electrical and mechanical services, permission to work must be obtained from the engineer. All works to be conducted as per engineer’s drawings / specification.

Method statement for all work to be done on services must be provided and approved prior commencement of works. A lock out procedure must be provided and approved.

Work done in all services to meet / be in line with their respective SANS standard’s.

## 8.28 DEMOLISHING

Prior to demolishing a detailed structural engineering survey should have carried out on the structure by the contractor. A demolishing method statement should be established based on said survey and it should be fully implemented during demolishing to ensure safety.

Demolishing shall only take place once the demolishing method statement is approved by the Agent.

Personnel that are not involved in the task must not be allowed in the demolishing area.

Section under demolition by me demarcated to be prevent unauthorised entry. Personnel involved in demolition to be trained and wear PPE which included hard hats, safety boots, overalls, gloves, dust masks.

High standards good housekeeping must be implemented and maintained. The area must be continuously cleaned and waste to be removed to dedicated areas that will be demarcated. Waste that can gain flight to be weighted down. Waste to not be allowed to accumulate on site and be continuously disposed of in an approved site.

## 8.29 SMOKING

The contractor must not permit smoking on site except within designated smoking areas selected in accordance with the applicable legislation. Such an area must be clearly demarcated and the required signage must be displayed.

Any person found smoking or discarding a cigarette butt outside of a designated smoking area must be disciplined accordingly.

In all designated smoking areas, adequate non-combustible commercial ashtrays and / or cigarette butt receptacles (butt cans) must be provided.

Ashtrays and other receptacles provided for the disposal of smoking materials must not be emptied into rubbish bins or any other container holding combustible materials.

"No Smoking" signs must be strictly observed.

## 8.30 HOUSEKEEPING

Housekeeping must be implemented on site as per CR 27.

Housekeeping program must be developed for the site, and be well resourced. Housekeeping supervisor and housekeeping team should be appointed. Housekeeping program should outline procedures for implementing and maintaining good housekeeping on site at all times.

All items of scrap, unsuitable of cuts and rubble should be continuously removed from working to dedicated temporal waste collection areas.

All hand tools and working material are properly store in designated areas.

An area designated for temporal storage of rubble should be demarcated.

Large quantities of waste must not be allowed to accumulate on site. Waste must be disposed of in an approved land fill site.

Site must be maintained free of dust, all dust affecting site must be controlled through watering. Measures to be in place to ensure watering is done on site as requited.

## 8.31 WASTE MANAGEMENT

Waste management plan must be developed.

Waste must be stored on site in a manner that will not create safety hazards to site and environment.

Separate bins for general and hazardous waste must be provided on site.

Spill kits must be provided on site. Drip trays must be provided for keeping under stationery plant.

Waste should be disposed of properly in approved landfill site as per hazard it contains.

## 8.32 WORKING IN MALARIA ENDEMIC AREA

Malaria is a serious and sometimes fatal disease caused by a parasite that commonly infects a certain type of mosquito which feeds on humans. People get infected by malaria if they get bitten by an infected female Anopheles mosquito.

People who get malaria are typically very sick with high fevers, shaking chills, and flu-like illness.

Pregnant women, travellers and people with HIV or AIDS are at higher risk of severe infection.

Malaria does not spread from person to person.

Malaria can be prevented through preventing mosquito bites.

Mosquitoes which carry malaria generally bite between dusk and dawn and the following measures shall be taken to prevent exposure:

- Close windows and doors and remain indoors during this time.
- Wear long-sleeved, light-coloured clothing, long trousers and socks
- Use mosquito repellent on exposed skin
- Spray your accommodation with an aerosol insecticide or use mosquito coils.
- Sleep under a net (preferably impregnated with an approved insecticide).

Visitors to be trained before they come to site on sources of exposure and prevention measures.

Continuous awareness on Malaria control to be done for site employees and also adhering to local Malaria control program rules.

Treatments for malaria can stop mild cases from getting worse.

Seeking of immediate medical attention if you have flu-like symptoms for up to six months after visiting a malaria are

## 8.33 WELFARE FACILITIES

The PC must allow for and supply:

- Change room facilities, separate for each gender which shall include personal storage facilities and shower facilities; at least one shower facility which must have hot and cold water for every 15 employees.
- Ablution facilities must be provided as per CR 30(1), separate facilities must be provided for males and females. Toilet paper must be provided.
- Hand washing facilities with running water and soap must be provided at ablution areas.
- Where chemical toilets are used, they must be serviced weekly and slips for servicing must be kept on the file.
- Sheltered eating areas must be provided, eating areas to be adequate for number of employees on site. Eating areas must have sits and table that accommodates all employees.
- Portable water must be provided on site. Employees must be encouraged to bring their own empty containers for collecting drinking water.
- Contractor must ensure that his facilities are maintained safe and hygienically. Cleaning program must be developed and resourced.

## 8.34 HEALTH, SAFETY AND HYGIENE MANAGEMENT PROGRAM

Construction site shall must maintain a safe and healthy environment through compliance with the requirements of this specification. The contractors health and safety plan must demonstrate how site shall me maintained safe and hygienically.

## 9. CLOSE OUT REQUIREMENTS

Upon completion of the project, the PC and Sub –Contractors shall submit a well-documented consolidated Health and Safety file (to be in electronic form) to the appointed Health and Safety Agent, confirming the Health and Safety history of the project.

The following summary of information is required, to be filed in a disc format, but not limited to:

- Monthly Health and Safety Audits by the Health and Safety Agent
- Monthly Sub – Contractors Audits by the PC
- Minutes of the Health and Safety meetings
- Monthly site Health and Safety Reports
- Incidents, Accidents & Injuries on Duty
- Workman's Compensation Claims
- Environmental rehabilitation status
- The PC's / Sub Contractors Project Health and Safety File

Handover of the consolidated health and safety file can only commence once all personnel have been demobilized and nil man-hours are recorded. Electronic submission must be provided to the Health and Safety Agent

The Health and Safety Agent will evaluate the Health and Safety performance of the PC i.e., compliance, performance, quality and refer in a cover letter which will be added to the PCs consolidated file.

## 10. COST OF COMPLYING WITH THE OHASA AND CR 2014

Contractor to complete Health and Safety Bill of Quantities for this project in line with the Occupational Health and Safety Act, 1993 and related legislation, the Construction Regulations 2014, and the OHS Specification for the works.

Should the Contractor fail to comply with any of the provisions of themAct, Construction Regulations 2014, or OHS Specification, he shall be liable for penalties as provided for in any of the aforementioned documents.

## 11. CONCLUSION

Due to fact that this document is based on legislative requirements, the Client requires that all Contractors comply with the requirements of this document and all other relevant legislative requirements not covered by this document.

The Client or its duly appointed representative reserves the right to stop any Contractor or Sub-Contractor from working whenever Safety, Health or Environmental requirements are being violated. Any resultant costs of such work stoppages will be for the relevant Contractor's account.

The requirements as specified by the Client in this document must not be deemed to be exhaustive and the Client reserves the right to make changes as and if the Client deems fit.

The Client will not entertain any claim of any nature whatsoever which arises as result of costs incurred or delays being experienced due to the Contractor not complying with the requirements of this document and/or any other applicable legislative requirements imposed on the Contractor.

## *SECTION B: BASELINE RISK ASSESSMENT*

### 1. BACKGROUND

Section 8 (2)(d) of the Occupational Health and Safety Act No.85 of 1993 states that an employer must establish as far as reasonably tractable, what hazards to the health or safety of persons are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used which is used in his business and he shall as far as reasonable practicable, further establish what precautionary measures should be taken with respect to such work, article, substance, plant or machinery in order to protect the health and safety of persons and shall provide necessary means to apply such precautionary measures.

Phungashe Health and Safety Consulting (PTY) LTD, the Construction Health and Safety Agent for this project has considered the geographic conditions and process or activities to be conducted to identify likely risk to be faced by the Contractor(s) and Public in executing the Construction of Ntshongwe Police Station in Umkhanyakude District.

### 2. RISK RATING METHODOLOGY

Semi quantitative risk rating method shall be used to rank the identified risks in order of priority. Semi quantitative risk assessment involves the use of a matrix based on the probability of exposure to a hazard and the consequence of such exposure as per table 1 & 2 below. This estimation enables us to position the hazard within the matrix so to determine the acceptability of the risk according to three categories:

- High where immediate action is required no matter what the cost, designated in the red area.
- Medium where risk should be should be reduced as low as reasonably possible, designated in amber area
- Low where future reduction of risk is unnecessary, designated in green area

**Table 1: Risk Rating Matrix**

| Consequence (C) | Probability (P) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 4 | M | H | H | H | H |
| 3 | M | M | M | H | H |
| 2 | L | M | M | M | E |
| 1 | L | L | M | M | M |

**Table 2: Risk Rating (R) Definitions**

| PROBABILITY CATEGORY | DEFINITION |
|---|---|
| 5 | Possibly repeated incidents |
| 4 | Isolated incidents known to have occurred |
| 3 | Possibility of occurring sometime |
| 2 | Unlikely to occur |
| 1 | Practically impossible |
| **CONSEQUENCY CATEGORY** | **DEFINITION** |
| 4 | Serous long- or short-term safety and health effects that may be fatal |
| 3 | Serious adverse safety and health effects that would require offsite medical attention |
| 2 | Non-life-threatening safety and health effects that may require on site first aid treatment |
| 1 | Little if any adverse safety and health effects |

## 3. PROJECT BASELINE RISK ASSESSMENT

**Site Establishment**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Establishment of the site | Insufficient space for safe and adequate allocation of offices, staff facilities, parking, workshops and traffic movement<br><br>Unsafe ground conditions i.e., slopping ground | Property damage<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Adequate space to be allocated for site establishment in consideration to facilities to be provided.<br>Access roads, office areas, employees' facilities, parking areas and stacking areas to be properly designated.<br><br>Ground surfaces to be stable with safe gradient and free from slipping, tripping and falling hazards. |
| Access control | Unauthorised access to sites | Loss of property<br><br>Disruptions on site<br><br>Injuries to unauthorised personnel<br><br>Injuries to site personnel | 3 | 3 | M | Site to be fenced with bonox fence of 1.6 to 1.8, fence to be hoarded with shade cloth<br><br>Lockable gates to be provided to control access.<br><br>The site entrance to be provided with a warm body security who shall also record site entrance and exit activities. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Placing of signs and notices | Insufficient information and warning on site requirements<br><br>Warning on site hazards and risk areas | Disruptions<br><br>Injury to employees<br><br>Injury to public<br><br>Damage to property | 5 | 4 | H | Construction safety warning signs to be placed at the entrance of the site camp entrance and should contain the following information minimum:<br>• Construction activities ahead<br>• No unauthorised entry<br>• Speed limit 20 km / h<br>• Personal protective equipment signs which include “safety boots, reflective vests & helmets signs”<br>• Visitors to report t site office<br><br>First aid kits, name of first aiders and fire extinguishers signs to be displayed where they are located. Assembly point sign and all other required warning signs as per hazards on site to be erected appropriately /where the hazard exists.<br><br>Signs indicating offices, safe drinking water, ablution facilities and eating areas to be displayed. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Delivery of containers | Lack of planning; poor access routes and roads to site<br><br>Soft, sloping grounds<br><br>Non – complying delivery vehicles and machines<br><br>Incompetent operators<br><br>Existing services; overhead cables and underground services<br><br>Employees walking under container once it is in the air<br>Unsafe practices | Property damage<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Site access routes to be planned and be suitable for the vehicles/ plant safe access.<br><br>Address overhead cables.<br><br>Engineer to approve stability of the area for placing containers.<br><br>Competent persons to operate construction vehicles and plant. Lifting machines to comply with the mass loads designed to carry.<br><br>Ropes and chains for the lifting machine to have a safety factor with respect to load they designed to lift.<br><br>Lifting machines operators to have competency certificates from an Organisation approved by the Chief Inspector.<br><br>Inspections to be in documented<br><br>Supervisor t& Banksman to be provided.<br><br>Area to be demarcated, provided with signage<br>Full PPE by personnel involved in the task; reflector vests, overalls, boots, hard hats and gloves. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Temporal electrical installation | Uncertified installer<br><br>Loose wires exposed<br><br>Caples running over the ground<br><br>Obtaining power from an unsafe source<br><br>Poor maintenance of temporal electrical installations | Electrocution; injuries and fatalities<br><br>Fire<br><br>Property damage<br><br>Tripping and falling | 3 | 4 | H | All electrical installations to a conducted an electrician registered with Department of Labour.<br><br>Power to be obtained from a safe source.<br><br>All cables to run safely underground Certificate of Compliance to be provided for all installations.<br><br>Temporal electrical installations to be inspected weekly by a competent person |
| Provision of welfare facilities | Not of having essential services for health and wellbeing | Disease & infection<br><br>Fatigue and dehydration<br><br>Low moral<br><br>Poor productivity | 3 | 4 | H | Safe drinking water to be provided<br><br>Changerooms with shower facilities must be provided on site.<br><br>Ablution facilities to be provided as per legislation requirements and chemical ablutions to be serviced weekly.<br><br>Ablutions to have toilet paper and be maintained in a hygienic manner.<br><br>Hand washing facilities to have soap and running water.<br><br>Sheltered eating areas with seats to be adequately provided for employees on site. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Emergency preparedness | Inability to attend to emergencies on site<br><br>Lack of adequate measures to attend to emergencies<br><br>Fires<br><br>Animal's encounter<br><br>Drowning | Injuries<br><br>Fatalities<br><br>Property damage<br><br>Emergency services taking long to reach site<br><br>Health issues | 5 | 4 | H | Detailed emergency plan to be provided as per emergency situations that can be encountered which included:<br>• Fire<br>• Community unrests<br>• Flash floods<br>• Structure collapse<br>• Animal's encounter (snakes [research to be done of common snakes found in the area], bees and scorpions)<br>The following emergency equipment to be provided:<br>• Warning alarms<br>• First aid kits to be provided<br>• Fire extinguishers to be provided (dry chemical powder 9 kg)<br>• Spill kits to be provided<br><br>Competent team which includes emergency coordinator, first aiders and fire fighters to be appointed.<br>Emergency drills to be conducted every six months.<br><br>Site camp to have fire breaks along parameters, width to be 2.5 m width or more. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Stacking, storage and laydown of material | Inadequate space for storage various materials.<br><br>Poor / unsafe storage of material<br><br>Poor housekeeping | Accidents<br><br>Damage to property | 4 | 5 | H | Allow sufficient space for lay down and storage of material and waste during planning stage of site layout. All material to be stacked within the barricaded sites boundaries.<br><br>Stacking, storage and laydown areas to have easy and safe access and be demarcated.<br><br>Material that can roll down to be properly secured.<br><br>Stacks to be not three times higher than the base.<br><br>Hazardous chemical substances to be stored as per material safety data sheets.<br><br>Good housekeeping to be maintained in the stacking areas |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Adverse weather conditions during works | Extreme heat<br><br>Slippery conditions during rain<br><br>Thundering<br><br>Extreme cold | Dehydration, fatigue, heat exhaust and heat stroke during extreme heat conditions<br><br>Car accidents due slippery conditions and personnel slips and falls during rainy weather<br><br>Personnel being struck by lightning<br><br>Inability to properly grip hand tools due to cold weather thus injuries | 5 | 4 | H | Heat evaluation must be conducted on site. The following heat control measures must always be in place for works in hot environments:<br>• Have certificates of medical fitness certifying them to work in that environment<br>• Must be acclimatised for working in such environments<br>• Must take 600 millilitres of water per hour<br><br>First aid measures must be readily available for heat exhaust and heat stroke Works to be stopped during rainy and slippery days on the roads and site camp<br><br>Works to stop during thundering and lighting conditions and employees to take shelter away from poles and trees.<br><br>Employees to wear warm cloths and gloves during extreme cold days. |

**DRIVING ON GRAVEL ROAD TO SITE & TRANSPORTATION OF EMPLOYEES**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Driving on gravel road to site | Difference car handling when adjusting from paved to unpaved road<br><br>Reduced ground traction - tyres slipping and skidding<br><br>Wild life and stray animals | Loss of control<br><br>Accidents<br>Injuries<br>Property damage<br>Fatalities | 3 | 4 | H | Adherence to speed limit and further reduction to safe driving speed depending on the car used.<br><br>Ensuring safe following distance<br><br>Drivers to be extra vigilant for animals.<br><br>Cars to be road worthy, tyres to be in good condition and have uptodate service history. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Transportation of site employees | Non – compliant vehicles transporting employees<br><br>Vehicle overturning or running out of control with employees<br><br>Employees falling from vehicles | Injuries<br><br>Fatalities<br><br>Property damage | 4 | 4 | H | Vehicles transporting employees to be road worthy and compliant Construction. Regulation's requirements.<br><br>All employees to be seated during transportation and have seat belts on.<br><br>Vehicle to obey road rules during transportation of employees.<br><br>The PC shall not allow employees to be transported in a goods vehicle unless the portion of the vehicle in which the employees are being conveyed is enclosed to a height of: –<br><br>• at least 350 mm above the surface on which employees are seated; or |

**SITE CLEARANCE**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Clearing and grubbing | Faulty vehicle and plant<br><br>Employees working in the vicinity of plant<br><br>Faulty equipment and hand tools<br><br>Animal's encounter (bees, snakes and scorpions encounter)<br><br>Noise<br><br>Dust<br><br>22kv overhead cable | Property damage<br><br>Injuries<br><br>Fatalities<br><br>Hearing loss<br><br>Nose and throat irritation, allergic reactions, silicosis<br><br>Electrocution, fatalities and property damage | 4 | 4 | H | Method statement for site clearance to be provided.<br><br>Safe and SABS approved equipment and tools to be used for the tasks, inspection records to be in place.<br><br>Employees working in clearing and grubbing activities to wear PPE:<br>- Long sleeves overalls<br>- Ankle covering safety boots and leg protectors / steel toed gum boots<br>- Long sleeves leather gloves<br>- Helmets/ sun hats<br>- Reflective vests<br><br>Employees working near plan to be visible to operators and be vigilant,<br><br>Emergency procedures for animals encounter to be developed.<br>Common snakes in the area to be identified.<br><br>Clearance and signage for cable safety to be in place for cable |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Waste Management | Excessive accumulation of waste on site<br><br>Improper storage of waste<br><br>Unapproved means of final disposal | Harbouring of animals i.e., snakes<br><br>Fire<br><br>Tripping, falling & injuries | 3 | 3 | M | Cradle to grave waste management method statement to be provided<br><br>Waste must be continuously removed from workstations and be placed in dedicated areas as per Environmental Management Plan<br><br>Fire prevention plan must be developed<br><br>Fire extinguishers must be readily available in case of fire<br><br>Internal fire breaks must be implemented around stacking areas |

**CONTRUCTION VEHICLE OPERATION**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Construction vehicle selection | Vehicle without capacity to operate safety under site conditions | Accidents<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Construction vehicle selected for site operations must be able to be operated without any safety risks.<br>An assessment must be conducted on site terrain and intended use; information obtained must be used to ensure plant selected shall operate safely |
| Parking of construction vehicles | Vehicle parking in non-designated areas<br><br>Vehicles running off during parking<br><br>Oil leaks on parked plant | Vehicles crashing<br><br>Property damage<br><br>Accidents with may result in injuries | 3 | 3 | M | Sufficient space to be provided for parking of construction vehicle and plant at site camp.<br><br>All vehicles and plant to park in designated areas.<br><br>Construction vehicles and plant to have wheel stoppers.<br><br>Drip trays to be placed under parked plant. |
| Construction vehicle operations near power lies | Clearance not determined<br><br>Plant hitting powerlines | Property damage<br><br>Electrocution; injuries & fatalities<br><br>Fire | 5 | 4 | H | Clearance of all powerlines from the ground to be determined.<br><br>Warning / controls such as goal posts and signage to be installed on both sides of the powerline for only plant that can pass through safely to be allowed.<br><br>Tipping under power lines to be prohibited. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| General operation of construction vehicle and mobile plant on site | Construction vehicle and plant driven by incompetent / unauthorised operators<br><br>Faulty plant or vehicle<br><br>Construction vehicles trucking or running over personnel<br><br>Plat/ vehicle crushing other vehicles<br><br>Construction vehicles or plant colliding with each other or public vehicles<br><br>Vehicles overturning<br><br>Vehicle running out of control<br><br>Noise<br><br>Dust | Accidents<br><br>Property damage<br><br>Injuries<br><br>Fatalities<br><br>Health effects; nuisance, allergic reactions, threshold shift, permanent hearing loss | 5 | 4 | H | Full compliance with CR 23 & authorised and competent persons to operate plant.<br><br>Maximum speed to be as per traffic management plan<br><br>Daily safety checks should be conducted on the plant, non-conformances to be immediately rectified<br><br>Road and safety rules and signs to be obeyed during vehicle operations<br><br>Construction vehicles to be directed by a spotter when reversing to work areas<br><br>Parking in blind sports of plant / articulated dump trucks to be avoided<br><br>Drugs testing to be conducted on operators and all personnel on site<br><br>Construction vehicle operators to wear full PPE, which is overalls, reflective vests & safety boots<br><br>Plant to be maintained to ensure emitting noise is within safety standards<br><br>Water spraying to be continuously implemented to control dust created by construction vehicles and plant |

**CONSTRUCTION OF ACCESS ROADS**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Traffic Controlling during construction of access roads | Construction vehicle and plants collisions<br><br>Construction plant crushing light duty vehicles<br><br>Construction vehicle or plant crushing employees | Property damage<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Traffic management plan to be developed.<br><br>Road work areas / work stations to be demarcated with delineators that are at least 5 meters apart.<br><br>At work stations, traffic must controlled through installation signs and provision of a flagman.<br><br>Traffic safety warning signs and speed control signs to be adequately displayed prior work stations on both entrances of the construction site.<br><br>At inception of work station display prohibition of unauthorised entry sign, workman sign, station flag man, display speed reduction to 20 km /hour. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Employees movement around construction sites | Employees struck by passing traffic and vehicles accessing or exiting to/from works site | Injuries<br><br>fatalities | 5 | 4 | H | All personnel on the road to wear safety boots and reflective vests/ jackets<br><br>Employees to be always alert of construction vehicle and plant<br><br>Construction vehicle and plant to be driven at speed stipulated for the site (20km / hour where there is activities)<br><br>Construction vehicle to have functional audio and light warnings |

**CONSTRUCTION OF PLATFORMS**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Traffic management | Construction vehicle and plant collisions<br><br>Construction plant crushing light duty vehicles<br><br>Construction vehicle or plant crushing employees<br><br>Construction plant and vehicle overturning | Property damage<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Traffic management plan to be developed<br><br>Speed to be maintained at 20km during works or 40 km /h upon consultation with site Engineer and Safety Agent<br><br>Warning signs and speed control signs to be adequately displayed.<br><br>Light duty vehicle to be provided with buggy whips for visibility to Construction plant.<br><br>All personnel on site to wear reflective clothing.<br><br>Operators to be adequately trained on the safety requirements for operations |
| Construction of haul roads | Poor visibility<br><br>Inadequate width | Property damage<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Roads to be designed to ensure good visibility for all construction vehicles.<br><br>Road's width to meet permissible standards for the plant and vehicles to be operated on it. |
| Stormwater / excessive rainfall management | Damage to rods and working areas | Accidents<br><br>Property damage | 3 | 3 | M | Temporal storm water controls during for construction to be designed to allow for adequate storm water management. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Earthworks | Soft grounds, unstable grounds or underground water courses<br><br>Existing services<br><br>Rollover for plant and equipment<br><br>Falling into open excavations / dislodging of excavation | Property damage<br><br>Injuries<br><br>Fatalities | 5 | 4 | H | Ground conditions to be established by a survey to identify the type of ground in which the excavation is to be carried out. The need for support to be determined.<br><br>Underground and overhead services to be identified and controlled.<br><br>All excavations dipper than 1.5 meters to be sloped or battered to a safe angle of repose.<br><br>Open excavations to be barricaded.<br><br>Safe slope gradients to be designed for platforms and steep grades or high ledges to be avoided. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Hauling of cut material | Overloading material on trucks<br><br>Speeding<br><br>Poor visibility | Material falling along routes<br><br>Accidents, injuries, property damage and fatalities | 5 | 4 | H | Traffic management to be provided and implemented, Construction traffic flow to be controlled as per site conditions.<br>Signage indicating construction vehicle activity and speed limit requirement of 20km/h to be displayed.<br><br>All construction vehicle to have warning lights and audio.<br><br>Trucks to be not overloaded with material, controls to be in place.<br><br>Housekeeping to be maintained, material fallen along the route to be continuously removed. |
| Stockpiling of material | Unauthorised entrance to stockpile area<br><br>Poor storage of material, high stacks | Stacks collapse<br><br>Accidents, injuries and fatalities | 3 | 3 | M | Material stockpile area to be fenced.<br><br>Stacks to be kept at less than 2 meters high.<br><br>Housekeeping to be kept in the area. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Embankment maintenance | Unstable banks or walls<br><br>Banks being weathered from effects of water overtime.<br><br>Unstable material or rocks falling high walls.<br><br>Vehicles driving over embankments. | Injuries<br><br>Fatalities<br><br>Property damage | 5 | 4 | H | Banks to be constructed with safe gradient to mitigate collapse.<br><br>Banks that require retaining to prevent collapsed to be safely retained.<br><br>Lose material which includes stones that could fall from the overhead bank walls to be removed / secured.<br><br>Guardrails to be constructed along shoulder of unpaved roads with embankment.<br><br>Banks to be maintained and water to be drain away from banks face.<br><br>Warning signs to be provided in the vicinity |

**USING OF HAND TOOLS AND EQUIPMENT**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Operating hand tools | Tools in poor condition<br><br>Substandard work and possible damage to plant and equipment. | Hand, foot, back injury. Substandard work and possible damage to plant and equipment. | 4 | 3 | H | Set standards of tools to be bought by buying department: only SABS approved tools to be used on site.<br><br>Monthly checks to be done on tools and records to be on file.<br><br>Employees to be trained on inspecting and reporting faulty tools daily before use |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Operating pneumatic powered tools | Incompetent operator<br>Unsafe tools<br>Improperly functioning tool<br>Oil leaks<br>Noise<br>Vibration<br>Dust<br>Flying objects<br>Ergonomics | Whipping hose<br>Over speeding tool<br>Under operating tool<br>Injuries<br>Noise induced hearing loss<br>Blanching of fingers, loss of sensation and loss of grip strength<br>Eye injuries<br>Back injuries | 5 | 4 | H | A trained and competent operator to operate pneumatic tools as per manufacturer's instructions.<br><br>Daily inspection records to be in place<br><br>Ensure air hose are properly fasted and correct pressure is used.<br>The tool must be properly serviced before use.<br><br>Employees to wear full PPE during equipment operation: safety boots, vibration reducing gloves, ear muff, dust masks and goggles.<br><br>Training on PPE use by all in the vicinity of the hazard.<br><br>Ensure proper spacing of employees<br>Operators to properly grip the tools when in used.<br><br>Employees to ensure their backs are straight during works.<br><br>Employees to work in pair to take breaks and relieve another from body vibration.<br><br>Employees to take 15 minutes breaks every hour during operation. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Fuel powered tools / electrically powered tools | Incompetent operator<br><br>Improper refuelling procedures<br><br>Noise<br><br>Vibration<br><br>Dust<br><br>Oil Leaks | Hands, arms vibration disorder<br><br>Noise induced hearing loss<br><br>Nose throat and lung irritation, allergic reactions<br><br>Body and feet injuries<br><br>Environmental contamination | 5 | 4 | H | Employees operating tools with vibration must wear vibration reducing gloves, earmuff, dust masks and safety boots.<br><br>Machines to be well maintained and kept in safe working condition.<br><br>No fuel / oil leaks on the machine. When the equipment has leaks, it should not be used and be fixed to prevent leaking<br><br>Leaks must be cleaned from the environment, waste to be temporary placed in hazardous chemical subcases bin that must be emptied of in an approved landfill site.<br><br>Tools must be inspected for safety before use, and record to be kept on the file. |
| Working in the vicinity of tools operations | Danger of exposure to hazards<br><br>Noise<br><br>Dust<br><br>Flying objects | Body injuries<br><br>Noise induced hearing loss<br><br>Check infections and allergic Reactions<br><br>Eye injuries | 3 | 3 | M | Employees to avoid working too close to others. Adequate space to be allowed between employees.<br><br>Employees to take reasonable care of others at work.<br><br>PPE to be used by employees exposed to hazards (ear protection and dust masks) |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Use of Nuclear Density Soil Gauge | Radiation exposure | Skin burns<br><br>Cancer / cardiovascular diseases | 5 | 4 | H | Competent laboratory to conduct density tests.<br><br>Before operating a nuclear gauge, a person must pass a Nuclear Safety course and be issued a thermoluminescent dosimeter (TLD) badge. The badge measures exposure to radiation and is to be worn whenever operating a nuclear gauge.<br><br>Exposure to radiation must be limited through time, distance, and shielding.<br><br>Safe storage and use of equipment to be in place.<br><br>Safe working procedures to be developed and implemented. |

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Welding Works. | Fires<br>Explosion<br>Gases & fumes emissions<br>Exposure to intense ultraviolet radiation<br>Hot surfaces<br>Electrocutions<br>Noise | Fatalities<br>Property damage<br>Eye damage<br>Burns<br>Electric shocks<br>Heat stress<br>Metal fume fever | 5 | 4 | H | Proper PPE to be used to protect employees from exposure i.e.:<br>• Welding helmets with welding glasses and face shields<br>• Earmuffs<br>• Leather, fire-resistant high-topped boots<br>• Welding Spats<br>• Fire resistant insulated welding gloves<br>• Full body covering overalls<br>• Leather welding aprons<br>Welding PPE must be inspected daily before use and be maintained in clean and good condition following manufacture's guidelines.<br>Welding area must be ventilated to keep fumes and dust away from breathing zones.<br>Employees working in hot environment where time weighed average index over 1 hour exceeds 30 must meet the following criteria:<br>• Have certificates of medical fitness certifying them to work in that environment<br>• Must be acclimatised for working in such environments<br>• Must take 600 millilitres of water per hour<br>• First aid measures must be readily available for heat exhaust and heat stroke |

**EXCAVATIONS**

| ACTIVITY | POTENTIAL HAZARDS IDENTIFIED | HEALTH AND SAFETY AND RISKS | RISK ANALYSIS | | | CONTROL MEASURES |
|---|---|---|---|---|---|---|
| | | | P | C | R | |
| Opening of excavations by plant | Encountering underground services<br><br>Cave-ins<br><br>Plant / employees falling into excavations<br><br>Employees working in close proximity to plant<br><br>Communities and animals falling into excavations<br><br>Dust | Damaging underground services/ incidents due to encounter<br><br>Plant striking employees<br><br>Property damage<br><br>Injuries and fatalities | 5 | 4 | H | Detect underground services<br><br>Soil composition must be identified and control systems to be designed as per condition.<br><br>Excavation's dipper than 1.5 meters / with unstable material to be battered at an angle of repose. Or be provided with bracing or shoring.<br><br>Plant to keep 1 meter excavation edges to prevent.<br><br>Employees to keep a safe distance from plant.<br><br>All personnel working in the area to wear reflector vests and masks where dust is produced.<br><br>All excavations to be barricaded with a strong physical barrier to restrain person / animals from fall in.<br><br>All personnel to wear PPE i.e., reflective vests and dust masks. |

# CONSTRUCTION OF NTSHONGWE POLICE STATION
# HEALTH AND SAFETY BILL OF QUANTITIES

## PROPOSED SAFETY AND HEALTH BILL OF QUANTITIES

Prizing of the following Bill of Quantities is a legal requirement contemplated in the Construction Regulations (CR) 5(1)(g):

*"A Client must ensure that potential principal contractors submitting tenders, have made adequate provision for the cost of health and safety measures*"
and CR 5(1)(h)

"A *client must ensure that principal contractor to be appointed has the necessary competencies and resources to carry out the construction work safely.*

**Note to Principal Contractor**

Prior to pricing the principal contractor **must familiarize him/herself** with the **Occupational Health and Safety Specification for the Project that has been developed in line with requirements of the Occupational Health and Safety Act No. 85 of 1993, Construction Regulations 2014, the National Environmental Act No. 107 of 1998 and its Regulations, other relevant Regulations and Standards as well as project specific Safety& Health specifications.**

**Note to Principal Contractor and Quantity Surveyor**

After pricing of the health and safety bill of quantities, the **Contractor** must sign the **Certificate of Acquaintance** as evidence that he is having good knowledge regarding the contents, obligations and demands of the **Occupational Health and Safety Specification, Occupational Health and Safety Act No. 85 Of 1993**, **Construction Regulations 2014, the National Environmental Act No. 107 of 1998 and its Regulations, other relevant Regulations and Standards as well as project specific Safety& Health Specifications.**

| | DESCRIPTION | UNIT | QTY | RATE | TOTAL |
|---|---|---|---|---|---|
| 1 | Allow for the necessary Workman's Compensation Fund or FEM contributions for the duration of the project with and including renewals | Item | | | |
| 2 | Allow for the preparation and approval of project-specific H&S Plan & File [CR 7(1)(a)] | Item | | | |
| 3 | Allow for the implementation and maintenance of project-specific H&S Plan & File. [CR 7] | Months | | | |
| 4 | Allow for the appointment of a Full-Time Competent Construction Health & Safety Officer registered with SACPCMP to assist in the control of all health and safety related aspects on site as per [CR 8(5)] | Months | | | |
| 5 | Provide for appointment of responsible and competent person/s to manage and supervise the works and administer and enforce health and safety on site as per [CR 8(1), &(7) | Months | | | |
| 6 | Allow for provision of telecommunication, facilities for the appointed Construction Health & Safety Officer | Months | | | |
| 7 | Allow for provision of compliant ladders, scaffolding and edge protection | Item | | | |
| 8 | Allow for safety and environment compliance of construction vehicles and plant | Item | | | |
| | **EMERGENCY PREPAREDNESS** | | | | |
| 9 | Allow for provision of Basic Emergency Preparedness and Response equipment & at least Level 2 First Aider/s and Fire Fighters | Months | | | |
| 10 | Allow and maintain metal box first aid kit and for the provision of fire extinguishers with servicing and maintenance | Item | | | |
| 11 | Provision of air horns | Item | | | |
| 12 | Maintenance of emergency equipment | Item | | | |
| 13 | Erect and maintaining fencing 1.8m high on the perimeter of the construction site and Fencing is to be covered with 80% shade netting and controlled gate | Item | | | |
| 14 | Allow for security company, day and night security | Months | | | |
| | **Provide, supply and maintenance for <u>each</u> worker the following SANS approved personal protective** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | **equipment & clothing as per the site-specific risk assessments:** | | | | |
| 15 | Hard Hats(High Density polyethylene, & 6-point lining) & including visitors | No. | | | |
| 16 | Overall/work suit (100% Cotton) Min 2 per staff per year | No. | | | |
| 17 | Rain suits | No. | | | |
| 18 | Safety shoes (Steel-Toe) | No. | | | |
| 19 | Safety Gumboots (Steel-Toe) | No. | | | |
| 20 | Safety gloves | No. | | | |
| 21 | Ear Plugs/Muffs | No. | | | |
| 22 | Dust Mask (at least FFP type) | No. | | | |
| 23 | Safety goggles/ Eye Protective Equipment | No. | | | |
| 24 | High visibility reflective vests for all employees on site min 2 per staff per year | No. | | | |
| 25 | Personal Fall arrest and rescue equipment with and including life lines and associated equipment | No. | | | |
| 26 | Temporary warning signs and symbols, Signages | No. | | | |
| 27 | SANS approved safety netting (orange colour with minimum of 1,2 meters high) | Meters | | | |
| 28 | Provision for the supply and maintenance of Road Traffic Signs as in terms of the South African Road Traffic Signs Manual complete | Item | | | |
| 29 | Allow for Pre-employment medical examinations: yearly | Yearly | | | |
| 30 | Allow for exit medical examinations | No | | | |
| | **HEALTH AND SAFETY EDUCATION** | | | | |
| 31 | Allow for HIV/AIDS awareness and Implementation programmes, including STI and TB, Malaria and COVID 19 management | Once off | | | |
| 32 | Allow for all compulsory health and safety awareness programme (e.g. Inductions, daily task instruction, toolbox Talks, Safety Promotions, Risk Assessment, First Aid, Fire Fighting, Work at heights, H&S related training, Legal Liability/SHE Representative) | Item | | | |

| | | | | | |
|---|---|---|---|---|---|
| | **ENVIRONMENT & HYGIENE** | | | | |
| 33 | Provide for adequate handling and storage of materials so as to safety, compliance and minimize contamination of ground, air or water. | Item | | | |
| 34 | Provide and maintain Ablution Facilities separate for males and females and Eating Area for workers. | Item | | | |
| 35 | Provide and maintain changerooms with personal storage facilities separate for males and females | Item | | | |
| 36 | Provide eating area adequate for employees on site and sub-contractors persons . Tables and sits | Item | | | |
| 37 | Provide hand washing facilities with soap | Item | | | |
| 38 | Provide portable drinking water | Item | | | |
| 39 | Provide for rehabilitation on completion of site areas | Item | | | |
| 40 | Provide for adequate dust control measure, including regular watering of access route | Item | | | |
| | **MALARIA CONTROL** | | | | |
| 41 | Provide accredited company to implement malaria control program:<br>**T**raining, signage and notices, spraying facilities every six months, providing permanent employees with bed nets, prevention of standing water free environment | Item | | | |
| 42 | Provision of permanent employees with antimalaria treatment by medical practitioner before coming to site | Item | | | |
| | **COMPULSORY BREAKDOWN FOR THE ADJUSTMENT OF PRELIMINARIES** | | | | |
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*CONSTRACTOR TO ENSURE FULL CONSIDERATION OF SUBCONTRACTORS HEALTH AND SAFETY*