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& infrastructure

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PROCUREMENT DOCUMENTS

***VAN ROOYENSHEK PORT OF ENTRY: APPOINTMENT OF SERVICE PROVIDER FOR
THE MAINTENANCE AND REPAIRS OF BUILDINGS, CIVIL, MECHANICAL,
ELECTRICAL INFRASTRUCTURE AND INSTALLATIONS FOR A PERIOD OF 36
MONTHS***

(APPOINTMENT OF A CONTRACTOR)

Technical & Particular specifications

MARCH 2021

ISSUED BY:
NATIONAL DEPARTMENT OF PUBLIC
WORKS, PRETORIA HEAD OFFICE
CGO BUILDING
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2.3.3 TECHNICAL & PARTICULAR SPECIFICATIONS

A

BUILDING SERVICES

TECHNICAL SPECIFICATION**AA PLUMBING AND DRAINAGE INSTALLATIONS****CONTENTS**

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AA 01 SCOPE

This specification covers the general repair and maintenance of plumbing and drainage installations, which include the following:

- (a) Rainwater disposal systems
- (b) Soil and wastewater drainage systems
- (c) Domestic water distribution and reticulation systems
- (d) Sanitary and brassware equipment
- (e) Fire water piped reticulation networks.

This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and particular specifications compiled as part of this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

AA 02 STANDARD SPECIFICATIONS**AA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

AA 02.01.01 SABS Specifications and codes

SABS 0400	-	The applications of building regulations
SABS 1200 DB	-	Earthworks (pipe trenches)
SABS 1200 LB	-	Bedding (pipes)
SABS 1200	-	Medium-pressure pipelines
SABS 1200 LD	-	Sewers
SABS 0252. Part 1	-	Water supply installations for buildings
SABS 0252. Part 2	-	Drainage installations for buildings

SABS Specifications listed on page 3 of the DPW Specification OW 371

AA 02.01.02 Department of Public Works Specifications

OW 371 - Specification of materials and methods to be used. (Fourth revision, October 1993)
Guide for architects concerning drainage, water supply and stormwater drainage
PW 343 - Building specifications for regional offices
FPO/G61/3E - Guide to architects
Drainage details.

AA 02.01.03 Occupational Health and Safety Act of 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993). Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

AA 02.01.04 Manufacturers' specifications, codes of practice and installation instructions

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

AA 02.01.05 Municipal regulations, laws and by-laws

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

AA 03 GENERAL REPAIRS AND MAINTENANCE

The following specifications shall be adhered to unless otherwise specified in the Particular Specification.

AA 03.01 GENERAL REPAIR AND INSTALLATION REQUIREMENTS

- (a) All materials and equipment supplied and installed shall be new, high quality and designed and manufactured to the relevant specifications and suitable for providing efficient, reliable and trouble-free service.
- (b) All work shall be executed in a workman-like manner by qualified registered plumbers.
- (c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.
- (d) All materials and workmanship which, in the opinion of the Engineer, are inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.
- (e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.

- (f) All new piping shall be installed and positioned so as not to impede on access routes, entrances and other services. The Contractor shall coordinate these new pipe routes taking other services and equipment into account.
- (g) All control equipment and serviceable items shall be installed and positioned so that they will be easily accessible and maintainable.
- (h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and maintenance work to ensure the safety of the public and the User Client.
- (i) Repair and maintenance work shall be programmed in such a manner as to ensure the shortest possible downtime of any service and the least inconvenience to the User Client and the public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

AA 03.02**GENERAL REQUIREMENTS FOR REPAIR AND INSTALLATION OF DOMESTIC WATER INSTALLATIONS**

- (a) All pipes are to be carefully examined for defects and flaws before installation and shall be neatly fitted. They shall be installed in such manner as to prevent the formation of air locks. Automatic air vents shall be installed on all high points of the installation.
- (b) The ends of all the pipes are to be clean, free from burrs, and rough edges, and joined together tightly. Where applicable such as with galvanised piping, an approved pipe jointing compound may be sparingly used with best quality hemp. All surplus or exposed hemp is to be thoroughly cleaned off joints before the painting of pipes. Pipes to be installed underground shall comply with the requirements of SABS 1200L and SABS 1200LB as far as bedding, excavation and backfilling are concerned.
- (c) All vertical pipes must be securely fixed with brackets and supports of approved type, into the wall and not more than 40 mm from the wall. These fixings must be strictly adhered to.
- (d) Pipes installed in service ducts and ceiling voids are to be perfectly plumbed and secured with approved brackets, fixed securely at distances not exceeding the specified distances and not more than 40 mm away from the face of the walls or soffits. Pipes must be free to move in the brackets. Pipes inside buildings and where specified shall be chased into walls, wrapped with building paper and properly secured and covered.
- (e) Pipes passing through walls and concrete floors are to be provided with suitable pipe sleeves extending 10 mm beyond finished floor or wall surfaces. All pipe fixings and throughways shall be free to allow movement for expansion and contraction. Any pipe fitting used to join a pipe which is rigidly secured by a structural element shall be securely anchored to prevent any stress developing between the fitting and the structural element.
- (f) Chromium or nickel-plated metal covering plates are to be provided and fixed securely to pipes passing through the ceilings and walls. This requirement is not applicable to concrete floors and ceilings.

- (g) Pipes passing through the ceilings or floors shall be offset from the wall to the front of the cornice with sufficient clearance to allow for the clear fixing of a ceiling plate. Pipes shall not be installed directly through the cornice. In multi-storey buildings where wall thickness varies, the same shall apply.
- (h) All offsets are to be evenly and symmetrically set, the offsets being as near to the ceiling as possible.
- (i) Pipes shall be installed in such a manner to allow for contraction and expansion.
- (j) During construction all pipe ends shall be kept plugged to prevent any ingress of dirt, rubble, etc.
- (k) Damages, chases, holes, etc, in brickwork, concrete and other finishes resulting from repair, replacement and service work shall be made good to match the existing and shall include plaster, concrete work, brickwork, paint, tiling, ceilings and all required materials for the remedial action.
- (l) The work shall be of a high quality and executed by qualified tradesmen in accordance with the relevant specifications.

AA 03.03 GENERAL REQUIREMENTS FOR REPAIR AND INSTALLATION OF SOIL AND WASTEWATER INSTALLATIONS

The following requirements shall apply to this installation unless otherwise specified.

AA 03.03.01 Underground sanitary drainage installations

- (a) All manhole covers and frames shall be cast into the concrete cover slabs.
- (b) Manholes in trafficable areas shall be provided with type 1A heavy-duty cover and frame and surrounded by concrete slabs.
- (c) Fittings in the ground and below floor slabs shall be without access eyes.
- (d) Sewer pipes in the ground with a slope steeper than 1:5 and/or under surface beds shall be encased in concrete as detailed.
- (e) The sewer outside the boundary of a building complex shall be constructed strictly in accordance with the details and specifications of the local authorities.
- (f) Existing drainage invert levels and positions are to be checked against invert levels given on the drawings before commencing the work. The Contractor shall inform the Engineer immediately of any discrepancy.
- (g) All affected existing services are to be located and exposed before commencing the proposed repair work.
- (h) The drainage system shall be tested according to the specifications laid down by the NBRI. This shall be carried out in the presence and to the satisfaction and approval of the Engineer.
- (i) During construction all pipe ends are to be suitably plugged to prevent any ingress of dirt, rubble, etc.

- (j) Modern technology video surveying equipment and detection equipment shall be utilised if so approved by the Engineer to establish blockage problems and indicate the positions of such problems. The Engineer's Representatives has no authority to approve the use of such surveying equipment.
- (k) Any drainage pipe within the 45° range below building foundations shall be encased in concrete or soilcrete as specified.

AA 03.03.02 Above ground sanitary drainage installations

- (a) All accessible waste and soil fittings above ground level shall have inspection eyes. Inspection eyes shall not be underneath any fittings.
- (b) All single wash hand basins shall be connected to a 40 mm internal diameter waste pipe.
- (c) All groups of wash hand basins and sinks shall be connected to a 50 mm internal diameter waste pipe, unless otherwise indicated.
- (d) All traps up to and including 50 mm diameter shall be of the "deep reseal" (75 mm) type.
- (e) The maximum bend on any single fitting shall be 45°, with the exception of ventilation pipes where bends of up to 90° may be used.
- (f) Drainage pipes and fittings running below concrete slabs and along walls and columns shall be suspended by means of approved type hangers, holderbats, etc, placed at appropriate intervals, to provide a rigid, proper suspended system as required by the manufacturer.
- (g) All ventilation pipes shall be finished off with a suitable durable grating.
- (h) All S-trap WC pans shall have plugged anti-siphon horns fitted to provide for cleaning access.

AA 03.04 PRESSURE TESTING OF WATER PIPES

- (a) All new pipe installations under the repair Contract shall be pressure tested before being taken into use. The Engineer shall witness this pressure test. Tests shall be carried out both on surface-mounted and buried pipework. Buried pipes shall be backfilled except at fittings and joints before being tested.
- (b) Completed sections of the pipe installation shall be filled with water after all branches have been plugged, sealed or closed.
- (c) The section of pipe shall be hydraulically pressure tested by means of a suitable manually-operated or mechanically-driven pressure pump.
- (d) A pressure of at least 1,5 times the working pressure of the class rating of pipes or fittings shall be applied for a period of time specified in the specifications or as recommended by the manufacturers. (Refer to SABS 1200 L for minimum and maximum test pressures.)
- (e) Tests shall not be performed against closed valves.
- (f) Leakage which occurs shall be measured and calculated and checked against the allowable losses, as specified in SABS 1200 L.

- (g) If the completed section of pipe complies with all specifications and passes the tests and inspection, to the approval of the Engineer, and the Contractor shall backfill the open sections of trench at the joints and connections, where applicable.
- (h) The Contractor shall then proceed to build all the valve chambers, inspection chambers, etc, for underground installations and shall close-off around pipes in walls, voids and ducts for above ground installations.

AA 03.05 STERILISING OF WATER PIPES

- (a) Before any repaired and new pipeline is taken into use, the pipeline shall be sterilised over its complete length, including the fittings. The pipe shall be filled with potable water chlorinated to a concentration of 15 mg of chlorine per litre of water, which shall remain in contact with the inner surface of the pipeline for a period of not less than 24 hours. The pipeline shall be filled for sterilising in such a manner that no water-hammer shock is created or air is trapped in the pipeline.
- (b) The Contractor shall submit full details of the proposed method of sterilising the pipeline to the Engineer for approval at least fourteen days prior to the commencement of sterilising.
- (c) The cost of water for filling the pipeline for sterilising shall be borne by the Contractor.
- (d) The Contractor shall provide all necessary materials, tools, equipment and labour required for sterilising the pipeline. After sterilising the pipeline the Contractor shall, at no extra cost, empty the pipeline and dispose of the water in a manner approved by the Engineer.

The Contractor may use the following products as a source of chlorine:

- chloride of lime to SABS 295 yielding 33 % free chlorine by mass;
- calcium hypochlorite to SABS 295 yielding 70 % free chlorine by mass;
- chlorine gas applied by chlorinator.

After sterilisation, an approved water quality test shall be carried out to a minimum number of 10 % of the total water points, randomly selected, evenly spread and marked on drawings. These tests shall include a full bacteriological test as per SABS 241 and the results shall be submitted to the Engineer for approval. All tests shall be for the Contractor's account.

AA 03.05.01 Bacteriological requirements

When tested the water shall comply with the limits given in table AA 03.05.01/1.

TABLE AA 03.05.01/1

PROPERTY	RECOMMENDED MAXIMUM LIMIT	MAXIMUM ALLOWABLE LIMIT
Total coliform bacteria count per 100 millilitre	Nil*	5
Faecal coliform bacteria count per 100 millilitre	Nil	Nil
Standard plate count per millilitre	100	Not specified

- *(a) If any coliform bacteria are found in a sample, a second sample must be taken immediately after the tests on the first sample have been completed. This sample shall be free from coliform bacteria.
- (b) Not more than 5 % of the total number of water samples (from any one reticulation system) tested per year may contain coliform bacteria.

The Engineer shall witness the sterilising of the pipes.

The Contractor shall ensure that during the sterilising procedure the necessary safety precautions are instituted to prevent the intake of water by the user and/or public from the system. On completion the system shall be properly flushed out.

AA 03.06 AIR TEST FOR SEWER AND DRAINS

The following air test requirements are specified in the NBRI information sheet X/BOU 2-34 and are reproduced here. They shall be applicable to all air tests on new sewers and drains installed under the repair work phase, and shall be executed by the Contractor and witnessed by the Engineer.

AA 03.06.01 Method of air testing

All openings in the pipeline are plugged by means of sewer testing plugs. The sewer plug at the lowest end of the pipeline is connected to an air supply hose, which is attached to a mechanically driven air blower, compressor or hand pump. Air is pumped into the pipeline at a pressure of approximately 375 mm water gauge. The pressure is held at this level for a period of two minutes to allow the air temperature to become constant. Subsequently the air supply is closed off and the time recorded for the air pressure to drop from 250 to 125 mm water gauge. If the recorded time is less than the value given in table AA 03.06.01/1 below, it means that the pipeline leaks and does not comply with the required standards of tightness. The apparatus required for the air test is commercially available.

The following requirements have to be taken into account when performing the air test:

- (a) Air-permeable pipelines such as vitrified clay or asbestos cement should preferably be tested when moist or wet.
- (b) The trench should be partially backfilled before the test is carried out. This is to stop possible temperature variations and to prevent damage to the pipeline during subsequent backfilling operations.
- (c) The testing equipment should be shielded from the direct rays of the sun.
- (d) Flexible joints are recommended for sewer and drain pipelines. Good quality flexible joints are superior to cement caulked joints and they also provide the pipeline with flexibility to prevent cracking due to subsequent soil movement.
- (e) The test method is very sensitive to flaws in the pipeline, such as cracks or leaking joints. The actual positions of flaws along the pipeline can be determined by using special equipment.
- (f) If the pipeline is below the water table and subjected to external water pressure, the test method should be modified so that the final pressure value are higher than that of the external water pressure acting on the lowest part of the pipeline.

TABLE AA 03.06.01/1: MINIMUM TIMES FOR PRESSURE DROP OF 250 mm TO 125 mm WATER GAUGE

PIPE (DIAMETER (mm))	MINIMUM TIME (min - s)	CRITICAL LENGTH OF PIPELINE (m) (58 m ² INTERNAL SURFACE AREA)	MINIMUM TIME (S) FOR LONGER LENGTH (L) OF PIPELINE
100	1 - 58	184,6	0,640 L
150	2 - 57	123,1	1,439 L
200	3 - 56	92,3	2,559 L
225	4 - 26	82,1	3,239 L
250	4 - 55	73,8	3,998 L
300	5 - 54	61,5	5,757 L
375	7 - 23	49,2	8,996 L
450	8 - 51	41,0	12,954 L
525	10 - 20	35,2	17,632 L
600	11 - 49	30,8	23,030 L

AA 04 OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance manuals.

All information shall be recorded and captured in electronic format and the Department shall be provided with three sets of hard copies.

AA 05 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencing test.

In the event of the installation not passing the test, the Engineer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Engineer attending the repeated test.

Whenever any installation or equipment is to be operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After completing the installation or system, all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the soundness of all installations.

AA 06 **QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

AA 07 **OPERATING AND COMMISSIONING OF PLANT AND INSTALLATION**

On completion of the repair work and/or the installation of new pipe systems and items of equipment the system and equipment shall be put into operation after all tests have been carried out to the satisfaction of the Engineer. The Contractor shall operate the system for a period of time as specified by the Engineer and train the staff of the User Client to maintain the system. This period of time shall not exceed one month.

Logging of the operation of the installations shall commence immediately upon commencement of their use.

The Contractor shall submit a full commissioning report.

AA 08 **GUARANTEE OF EQUIPMENT AND MATERIAL**

The Contractor shall provide and obtain guarantees from the manufacturer(s) and/or supplier(s) to the effect that each new fitting, pipe or other item of material and equipment supplied and installed under the repair contract, shall comply with the application.

AA 09 **DETAILS OF REPAIR WORK**

AA 09.01 **GENERAL**

During the repair and maintenance Contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

The repair work items shall be listed in tabular form in the Particular Specification with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the specified durations listed in the Appendix to Tender. All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months

from date of issue of a certificate of completion for the repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the plumbing and drainage installations shall be categorised under the following headings:

- (a) Rainwater disposal systems
- (b) Soil and wastewater drainage systems
- (c) Domestic water distribution and reticulation networks
- (d) Sanitary and brassware equipment
- (e) Fire water piped reticulation networks.

AA 09.02 RAINWATER DISPOSAL SYSTEMS

AA 09.02.01 General

Repair work to the rainwater disposal system shall be detailed in the Particular Specification and shall include but not be limited to the following:

- (a) Replacement of damaged, broken, leaking and corroded pipework and fittings;
- (b) Replacement of damaged, broken and missing rainwater outlets, stormwater catch pit gratings, manhole covers and frames and floor drains;
- (c) Repair work to damaged manholes, catch pits, curb inlets, channel drains and drain points including builder's work and benching;
- (d) Initial unblocking and clearing of all rainwater drainage pipes, manholes, catch pits, drain points, channel drains and gutters;
- (e) Repair and upgrading of drainage system where necessary;
- (f) Provision of additional rainwater drainage points where outlets are insufficient and ponding occurs;
- (g) Prevention of the ingress of any unauthorised effluent into this drainage system;
- (h) Realign and fix gutters to correct falls where necessary, including additional brackets where required.
- (i) Reinstatement and making good of walls, tiling, floors, concrete, road surfaces, etc, to approved acceptable levels where any repair, upgrading and/or service work has been executed;

AA 09.02.02 Material and equipment specification for rainwater disposal systems

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

- (a) Vitrified clay pipe and fittings

Vitrified clay pipes shall only be used for underground installations. The pipes and fitting shall strictly conform to SABS 559. The pipes and fittings shall have a minimum crushing strength of 45 kN/m.

The joining method to be used shall be polypropylene couplings with integral rubber seal similar or equal to Vitrosleeve in accordance with SABS 974 allowing up to 2,5° angular movement per joint and 5 mm line displacement per joint. The joint shall retain an effective water seal with regard to above conditions with a 6 m water head.

Pipes shall be cut using an approved pipe cutter and the ends shall then be trimmed by means of a pipe trimmer to remove any sharp edges.

The piping system shall be tested as indicated in this specification under subclause AA 03.06 above.

(b) Supercast cast-iron pipe and fittings

Supercast cast-iron pipes can be used for underground and above ground installations. Plain-ended cast-iron pipes and fittings, manufactured from 150, grade A grey iron in accordance with SABS 1034 shall be used. Fittings and pipes shall be free of pinholes, blowholes, blemishes, flash and foundry sand and have a smooth bore. All pipes and fittings shall be sand-blasted and coated on the inside and outside by submersion in a corrosion inhibiting oxide primer or bitumen paint.

The pipes and fittings shall be joined by means of stainless steel neoprene couplings as supplied by the manufacturer of the pipe system. The coupling shall be installed according to the manufacturer's specification and tightened with a torque wrench to a torque of 6,8 Nm.

(c) uPVC pipe and fittings above ground

uPVC pipes and fittings shall be used for above ground installations.

For pipe sizes larger than 160 mm diameter uPVC class 6 pressure pipe to SABS 966 shall be used with prefabricated uPVC bends and junctions. Prefabrication shall be done by means of hot-air welding of fittings to be covered with three layers of fibreglass reinforced lining over welded sections. The resin to be used shall be as specified by the manufacturer for usage with PVC. Bends shall be manufactured out of 3 to 4 sections per bend. Pipe jointing shall be done by means of couplings fixed with solvent cement for PVC piping. This joint shall be reinforced with a fibreglass lining of three layers.

Piping has to be supported and bracketed with properly sized and designed brackets consisting of two half sections clamped over the pipe and shall with two hanger rods.

Pipes be pressure tested in sections as specified in this specification.

(d) Galvanized steel piping and fittings above ground

Galvanized steel piping shall be used for above ground rainwater drainage systems. The pipe to be used shall be plain ended medium gauge uncoated pipe to SABS 62 galvanized to SABS 763. All fittings are to be manufactured from the same material welded with flanged ends or rolled ends to fit clambon fittings. Fittings are only to be galvanized after manufacturing. All joints to be either flanged or equipped with clambon couplings. All fittings and junction to be 45° sections.

The pipe system shall be properly secured and bracketed at regular intervals with correctly sized and designed galvanized brackets.

Pipes are to be pressure tested in sections as specified in this specification under subclause AA 03.06 above.

(e) Geberit HDPE pipe and fittings

Geberit HDPE pipes and fittings can be used for underground and above ground installations where specified. Pipes shall be plain ended and only Geberit HDPE bends and fittings shall be used. Jointing of pipes and fittings shall be done by butt welding, electro-sleeve couplings and/or flanged joints. Pipes and fittings shall only be installed by Geberit approved installers and the Contractor shall furnish a certificate to this effect. Pipes and fittings shall be installed strictly according to the Geberit application technique.

Pipes to be pressure tested in sections as specified in this specification.

(f) Roof outlets

Where waterproofing is installed, as for roof slabs, an adjustable roof outlet/drainage point to be used consisting of a cast-iron unit with cast-iron ring clamp to fit over waterproofing edge and an adjustable height outlet to fit in with the screed level. For surfaces such as paving and walkways a flat grating of brass or cast iron shall be used with a catch basket. Within paving blocks a square top frame shall be used. For roof outlets a domed grating is to be used. Where roofs are to be covered with stones, a mesh shall be installed to prevent any stones from entering the rainwater system.

Two-way side outlets shall be used in cases where required.

Floor and roof outlets to be fitted to cast-iron pipe by means of SSN couplings.

AA 09.03 SOIL AND WASTEWATER DRAINAGE SYSTEM

AA 09.03.01 General

Repair work to the soil and wastewater drainage system shall be detailed in the Particular Specification and shall include but not be limited to the following:

- (a) Replacement of damaged, broken, leaking, corroded above and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing gully gratings, manhole covers and frames, cleaning eye covers, screws and bolts, inspection eye covers, end caps and vent cowls;
- (c) Repair work to damaged manholes, gullies, cleaning eyes, floor drains, etc, including builder's work and benching;
- (d) Initial unblocking only of all blocked drainage pipework, traps, floor drains, gullies and the cleaning of sanitary ware equipment;
- (e) Video surveying of all underground drainage pipework when so authorised by the Engineer (but not by the Engineer's Representative) to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (f) Repair and upgrading of soil and wastewater drainage systems where necessary;

- (g) Repair work to bracketing systems including fixing and repair of existing brackets and the introduction of additional brackets where required;
- (h) Repair, re-fix and bracket sanitary ware equipment to walls, floors, etc, where required;
- (i) Repair, replace and clean out sanitary ware and equipment traps;
- (j) Test pipe system, traps and equipment for leakage;
- (k) Empty, clean out separators, clean out strainers, and test for leak tightness, repair and recommission oil and grease separators. Check the conformance of the capacities of the oil and grease separators in relation to the facilities they serve; where necessary these shall be upgraded and where no separators have been provided, new separators shall be provided;
- (l) Reinstatement of walls, tiling, floors, concrete finishes, holes, chases, surfaces, etc, to an approved acceptable level where any repair, upgrade and/or service work has been executed;
- (m) Prepare, paint and repaint pipework and equipment where necessary, in accordance with Technical Specification BH: Fittings.

AA 09.03.02 Material and equipment specification for soil and wastewater drainage systems

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Vitrified clay pipe and fittings

As specified in subclause AA 09.02.02(a) above.

(b) Supercast cast-iron pipe and fittings

As specified in subclause AA 09.02.02(b) above.

Where cast-iron stub stack overflow gullies are used with pipe materials such as PVC a rubber O-ring shall be used to fit over the PVC pipe into the cast-iron fitting. The joint shall be grouted up afterwards.

Above ground piping shall be bracketed with properly sized and designed brackets according to the manufacturer's specification at correct intervals.

The piping system shall be tested in accordance with the NBRI information sheet X/BOU 2-34 as specified in subclause AA 03.06 above.

(c) uPVC soil and waste pipe and fittings

UPVC soil, vent and waste pipe systems can be used for underground and above ground drainage installations. This piping shall conform in all respects to SABS 971 for underground systems and to SABS 967 for above ground systems.

All underground pipes, as well as soil pipes above ground, shall be joined by means of rubber ring seal couplings and fittings in accordance with the manufacturer's specification. All waste and vent pipes shall be joined by means of solvent weld fittings and couplings. The solvent weld

glue to be used shall be as specified by the pipe manufacturer, allowing for thermal contraction and expansion.

The piping system shall be pressure tested in accordance with the NBRI information sheet X/BOU 2-34 as specified in subclause AA 03.06 above

(d) Structural wall uPVC pipes and fittings

Structural wall uPVC drainage pipe shall be used for underground drainage systems. This piping system shall be used with standard underground uPVC pipe fittings, equipped with rubber ring joints. The pipe shall be equipped with z-lock type rubber ring joints.

The piping system shall be pressure tested in accordance with the NBRI information sheet X/BOU 2-34 as specified in subclause AA 03.06 above.

(e) Geberit HDPE pipes and fittings

As specified in subclause AA 09.02.02(e) above.

(f) Stainless steel floor traps and floor channels

Stainless steel floor traps and channels shall be manufactured from 304 stainless steel with a load capacity of 1 500 kg. The floor traps shall have a flow capacity of 3 litre/second.

The units shall be fitted with a double water seal, large sludge box and shall be easily dismantable for cleaning purposes. Tiling keys and waterproofing flanges shall be provided where required. Side inlets with diameter of 50 mm shall be provided for waste connections to other equipment where required.

(g) Cast-iron floor traps

Cast-iron floor traps shall be manufactured from cast iron and shall be fitted with a water seal and a large sludge box and lid to be easy removable for maintenance purposes. The unit shall be designed such as to provide access to the drainage system and to be used as a cleaning point.

AA 09.04 DOMESTIC WATER DISTRIBUTION AND RETICULATION NETWORKS

AA 09.04.01 General

Repair work to the domestic water distribution and reticulation networks shall be detailed in the Particular Specification and shall include, but not be limited to the following:

- (a) Replacement of damaged, broken, leaking, corroded above and underground pipe work, fittings and equipment;
- (b) Repair, replace and service valves, which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (c) Where valves do not close properly, all these valves shall be refurbished, descaled or replaced where necessary;
- (d) Repair, clean and service all strainers, including the replacement of strainer elements where corroded and installation of new gaskets;

- (e) Repair, service, test and readjust pressure-reducing valves. Pressure gauges are to be recalibrated and checked. Up and downstream pressures are to be logged. Downstream pressure has to be adjusted to an acceptable level, taking into account the allowable working pressure of the system and its components;
- (f) Repair, service and check the proper functioning of all non-return valves;
- (g) Repair, service, readjust and calibrate all safety and expansion relief valves;
- (h) Repair, service and clean out all air release valves and vacuum breakers;
- (i) Repair work to bracketing systems including fixing and repair of existing brackets and provision of additional brackets where required;
- (j) Hot-water pipe lagging and cladding shall be inspected, repaired, sealed and replaced where required;
- (k) Repair, service and log readings of water meters including cleaning of integral strainers;
- (l) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float and/or filling valves to these tanks are to be serviced and repaired where required;
- (m) Water pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be taken if the results of this sampling indicate that attention is required;
- (n) Water supply has to be sampled and chemically analysed for the suitability to the systems and materials it serves;
- (o) Domestic geysers are to be repaired and serviced in accordance with the manufacturer's specification and SABS 0254 shall include descaling, replacement of elements, testing for any leaks, checking of safety valve operation (replace if required), testing of the thermostat operation and set point (replace if necessary);
- (p) Pressure test and sterilise repaired new installation and equipment;
- (q) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair, upgrade and/or service work has been executed.

AA 09.04.02 Material and equipment specification for domestic water distribution and reticulation networks

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following requirements:

- (a) Copper pipe installation
 - (i) The installation of copper piping systems shall be done in accordance with the manufacturer's instructions and all relevant codes, standards and regulations.
 - (ii) Copper pipes shall only be installed downstream of galvanized mild steel pipes when applicable.

- (iii) Where dissimilar metals are joined, dielectric or isolating couplings shall be used. This is not required where copper and brass dezincified alloys join.
- (iv) Copper pipes shall be of the hard drawn type Class 0 in accordance with SABS 460 and shall be joined by means of capillary soldered type fittings. No compression type fittings shall be allowed unless otherwise specified.
- (v) Copper capillary soldered type fittings shall be used in accordance with ISO 2016, SABS 1067, DIN 2856 or BSS 864.
- (vi) The soldering flux to be used shall be water based and easily flushed out, withstand temperatures above 240 °C and shall contain no ammonia. The flux shall be non-toxic when dissolved in water.
- (vii) The solder to be used shall be in accordance with SABS 24 and shall consist of a material containing 97 % tin and 3 % copper. Solders containing lead, resin core and acid core shall not be used.
- (viii) The heat source to be used shall be propane gas with induction air, at a temperature not higher than 240 °C. The pipe ends and fittings shall be cleaned and waxed with an approved solder flux, before soldering. The pipe and fittings shall then be fitted together and heated to the correct temperature before the solder is applied. Care must be taken not to add too much or too little solder to the joint. Immediately after setting of the solder the joint shall be wiped clean with a wet cloth. Pipes shall be washed out as soon as possible after jointing and all traces of flux shall be removed.
- (ix) All bronze or brass equipment and fittings shall be of the dezincification resistant (DZR) type.
- (x) Copper pipes and fitting shall be installed strictly to the manufacturer's specification which shall include the following:
 - (1) No labour bends;
 - (2) Provision for thermal contraction and expansion of pipes;
 - (3) Pipe brackets shall be installed at appropriate positions where pipes are installed on surface level;
 - (4) Pipes chased or built into walls or floors shall be wrapped with two layers of building paper or similar approved material. Hot and cold water pipes running next to each other shall be at least 50 mm apart;
 - (5) Equipment fixed to copper pipe outlets, where the pipes are surface mounted or built into walls, shall be done by means of copper wall plate fittings on the copper pipes, properly secured to the structure to prevent structural damage to soldered joints.
- (xi) Pipe hangers and brackets shall be of copper, copper alloy or non-conductive materials. No piece of copper pipe shall touch any other conductive surface. Brackets shall be designed to structurally support and fix the pipe system, and shall allow

enough clearance from walls, soffits, etc, to insulate hot-water pipes and maintain equipment.

- (xii) Pipe hangers and brackets shall be installed according to the manufacturer's specification on the following maximum spacings:

PIPE DIAMETER (mm)	HORIZONTAL (metre)	VERTICAL (metre)
15	1,3	1,9
22 and 28	1,9	2,5
35 and 42	2,5	2,8
54	2,5	3,9
67 – 108	2,8	3,9

- (xiii) All copper pipes open to structural damage, shall be protected by steel sleeves or a structurally designed cover.
- (xiv) All pipework shall be pressure tested and sterilised as specified.
- (xv) Where flanged fittings are used, cadmium-plated bolts, nuts and spring washer shall be used to join these flanges.
- (xvi) All hot-water pipes shall be lagged as specified.
- (xvii) Shut-off valves shall be installed on all branch pipes and ball-o-stop valves shall be installed on all connectors to basin pillar cocks, sink mixers, cistern type WCs and other fittings.
- (xviii) All pypes shall be marked in accordance with SABS 0140 or as specified by the Engineer.
- (xix) Approved type expansion bellows shall be installed where required for expansion and contraction to prevent excessive strain on fittings and soldered joints.

(b) Galvanized steel pipe installations

- (i) All galvanized steel pipes shall be medium gauge mild steel screwed and socketed pipes to SABS 62 and shall be normalised and marked as such by the manufacturer. Pipes shall be hot-dip galvanized to SABS 763.
- (ii) All fittings shall be malleable cast-iron fittings to SABS 509 and galvanized to SABS 763.
- (iii) All 80 mm diameter and larger pipes shall be joined with Class 16 flanged couplings to SABS 1123/1600. The bolts, nuts and spring washers to be used on these joints shall be cadmium-plated.
- (iv) In pipe ducts and elsewhere pipes shall be fixed onto walls, soffits, etc, with approved type of supports, holderbats, clamps, etc. Brackets shall be designed to structurally support and fix the pipe system and shall have enough clearance from walls, soffits, etc, to insulate hot-water pipes and maintain equipment.
- (v) Pipes shall be supported according to the manufacturer's specifications with approved brackets at the following maximum intervals:

PIPE DIAMETER (mm)	HORIZONTAL (metre)	VERTICAL (metre)
15 dia to 20 dia	1 200	1 830
32 dia to 40 dia	1 830	2 450
50 dia to 150 dia	2 450	3 050

- (vi) Pipes shall be installed in such a manner as to prevent air locks. A minimum rise of 1:250 shall be maintained to high points, which shall be fitted with suitable air release valves.
 - (vii) All pipes shall be marked according to SABS 0140 or as specified by the Engineer. All surface pipes shall be painted.
 - (viii) Pipes shall be installed flush with brick walls before plastering unless otherwise instructed by the Engineer.
 - (ix) Provision shall be made for thermal contraction and expansion.
 - (x) The type of pipe joint compound shall be approved by the Engineer and used sparingly with good quality hemp. For pipes larger than 80 mm diameter a jointing compound such as Epidermix 32 shall be used.
 - (xi) Any pipe buried shall have at least 900 mm cover and be coated and wrapped to SABS 1117 and tested in the presence of the Engineer.
 - (xii) All exposed hot-water pipes shall be lagged as specified.
 - (xiii) All pipework and fittings shall be pressure tested and sterilised as specified
 - (xiv) Valves shall be installed on all branch pipes and ball-o-stop valves on all connectors to basin pillar cocks, sink mixers, cistern type WCs and other fittings.
 - (xv) Approved type expansion bellows shall be installed where required for expansion and contraction to prevent excessive strain on fittings and pipe joints.
- (c) uPVC underground pipe installations
- (i) uPVC piping shall conform to SABS 966 with rubber ring type joints.
 - (ii) All bends shall be uPVC type fittings with rubber ring joints.
 - (iii) All other fittings such as T-pieces, reducers, flanges, etc, shall be bitumen-dipped cast-iron rubber ring jointed fittings to SABS 546.
 - (iv) No solvent weld type fittings will be allowed.
 - (v) All cast-iron fittings shall be coated and wrapped to SABS 1117.
 - (vi) All pipes shall be laid on a 100 mm sand-bedding cradle and covered with 300 mm sand before backfilling.

(vii) All backfilling shall be in accordance with SABS 1200 DB and to the Engineer's approval.

(viii) Pipe trenching and bedding:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SABS 1200 LB	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90 % of modified AASHTO density

(ix) All thrust blocks shall be cast between the pipe and the undisturbed trench material.

(x) No concrete shall come into direct contact with the UPVC pipe. At the thrust blocks the bend shall be wrapped with a Densopol 80 HT Tape or similar approved.

(xi) HDPE pipe connections to uPVC pipes up to 50 mm can be done by means of SG Iron manufactured saddles with the appropriate gaskets and cadmium-plated bolts and nuts.

(xii) All pipe crossings under roads and parking areas shall be backfilled as specified in subclause CA 04.04.02(b).

(xiii) All pipework shall be pressure tested with all joints uncovered, to the satisfaction of the Engineer.

(xiv) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(d) HDPE underground pipe installations

(i) HDPE piping shall be Type 4 HDPE pipe to SABS 533.

(ii) All fittings shall be of Plasson compression type and shall conform to ISO/DIS 3458.

(iii) All pipes shall be laid on a 100 mm sand bedding cradle and covered with 300 mm of sand of selected material.

(iv) All backfilling shall be in accordance with SABS 1200 DB and to the Engineer's and approval.

(v) Pipe trenching and bedding:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SABS 1200 LB	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90 % of modified AASHTO density

(vi) No concrete shall come into direct contact with the HDPE pipe. At these points the fittings shall be wrapped with Densopol 80 HT tape or similar approved.

- (vii) All pipe crossings under roads and paving areas shall be backfilled as specified in subclause CA 04.04.02(b).
- (viii) All pipework shall be pressure tested with all joints uncovered to the satisfaction of the Engineer.
- (ix) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(e) Valves

- (i) Gate valves underground in valve chambers to connect to uPVC piping (65 mm NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SABS 936 Grade 42, cast-iron nitrile butadiene rubber covered gate, stainless steel spindle, nitrile butadiene rubber O-rings and seals, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valves shall conform to SABS 664 and/or 665 and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with a square key spindle top to close the valves in clockwise direction and socket ends to SABS 665 to fit into uPVC Class 12 pipe and shall be installed to details provided.

- (ii) Gate valves underground in valve chamber to connect to HDPE piping

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valves shall conform to SABS 776 Class 125. The valves shall be able to withstand a working pressure of 1 600 kPa. The valve shall be fitted with a hand wheel on an extended spindle shaft of 700 mm to close in a clockwise direction and shall be installed to details provided.

- (iii) Gate valves above ground for temperatures up to 40 °C to connect to steel piping (65 mm NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SABS 936 Grade 42, cast-iron nitrile butadiene rubber covered gate, stainless steel spindle, nitrile butadiene rubber O-rings and seals, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valves shall conform to SABS 664 and/or 665 and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with flanged ends to SABS 1123, table 16, hand wheel to close the valves in a clockwise direction and installed in an upright position or sideways to a maximum 90 ° from upright.

- (iv) Gate valves above ground for temperatures above 40 °C to connect to steel piping (65 NB mm and larger)

Gate valves shall be equipped with non-rising spindle, spherical graphite iron body to SABS 963 Grade 42, cast-iron gate,

gunmetal seat and gate rings, high-tensile bronze spindle, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valves shall conform to SABS 665 and shall be capable of withstanding a working pressure of 1 600 kPa and a temperature of 90 °C.

The valve shall be fitted with flanged ends to SABS 1123, table 16, hand wheel to close the valve in a clockwise direction and installed in an upright position or side ways to a maximum 90° from upright.

(v) Gate valves above ground to fit to copper pipes (65 mm NB and larger)

Gate valves shall be equipped with non-rising spindle, gunmetal bronze or dezincified brass body, gunmetal or dezincified brass gate and graphite asbestos packing in the gland.

The valve shall be fitted with a hand wheel to close in a clockwise direction and installed in an upright position or sideways to maximum 90° from upright.

The valve shall be equipped with flanges to SABS 1123, table 16, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

(vi) Gate valves above ground for temperatures up to 100 °C (up to 50 mm NB)

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SABS 776, Class 125.

The valves shall be able to withstand a working pressure of 1 600 kPa.

The valve shall be equipped with a hand wheel to close in a clockwise direction.

The valve shall be installed in an upright position or sideways to a maximum 90° from upright and shall be so placed with other fittings to be removable without cutting the pipework.

(vii) Ball-O-Stop valves (15 mm diameter - 25 mm diameter)

These valves shall be full-way ballcock type with BSP threaded ends. The valves shall conform to SABS 1056, Part 3, shall be rated for a test pressure of 2 000 kPa, and shall be chrome-finished where exposed.

(viii) Angle regulating valves

These valves shall be 15 mm chromium-plated angle regulating valves with a 350 mm chromium-plated copper tube and cap nuts where required.

(f) Strainers(i) Strainers for connection to steel or UPVC pipes (65 mm NB and larger)

These strainers shall be of the Y-type with cast-iron body, stainless steel or bronze strainer element and shall be equipped with flanged ends to SABS 1123, table 16. The hole sizes of the strainer element shall be maximum 1 mm diameter and be removable without dismantling of pipework. The strainer shall be suitable for a temperature of up to 90 °C at a 1 000 kPa pressure rating and installed with the element facing downwards or a maximum of 45° sideways.

(ii) Strainers for connection to copper pipes (65 mm NB and larger)

These strainers shall be of the Y-type with bronze or dezincified brass body, stainless steel strainer element and must be equipped with flanged ends to SABS 1123, table 16. The hole sizes of the strainer element shall be maximum 1 mm diameter. The strainer element shall be removable without dismantling of pipework. The strainer shall be suitable for a temperature of up to 90 °C at a 1 000 kPa pressure rating and installed with the element facing downwards or a maximum of 45° sideways.

(iii) Strainers for connection to steel and copper pipes (up to 50 mm NB)

These strainers shall be of the Y-type with bronze or dezincified brass body, stainless steel strainer element and must be equipped with BSP threaded socket ends. The hole sizes of the strainer element shall be maximum 0,8 mm diameter. The strainer shall be suitable for a temperature of up to 90 °C at a pressure rating of 1 000 kPa and installed with the element facing downwards or a maximum of 45° sideways.

(g) Non-return valves(i) Non-return valves for cold water (65 mm NB and larger)

The non-return valve shall be of the spring-loaded dual flap plate type fitted between two flanges (wafer).

The non-return valve shall be equipped with a cast-iron body, aluminium bronze plates, stainless steel springs and neoprene seals on the plates. The valves shall be suitable for a working pressure of 1 000 kPa.

(ii) Non-return valves for hot water (up to 100 mm NB and cold water (up to 50 mm NB)

These non-return valves shall be of the spring-loaded piston type, with bronze or dezincified brass body, stainless steel spring and bronze disc with neoprene seal fitted with BSP threaded socket ends. The valve shall be suitable for a working pressure of 1 000 kPa and a temperature of up to 90 °C. All valves shall be installed as to be removable without extensive pipework removal.

(h) Air release valves and vacuum breakers(i) Double orifice double-acting air release valves with sizes from 50 mm NB to 200 mm NB

This air release valve shall be fitted with small and large orifice. The air release valve shall be fitted with a cast-iron body, stainless steel or fibreglass balls, integral shut-off valve and flanged ends to SABS 1123, table 16.

The valve shall be suitable for maximum pressure of 1 600 kPa.

(ii) Single orifice air release valves for main water lines with sizes from 25 mm NB to 50 mm NB

This air release valve shall be fitted with a small orifice, cast-iron body, fibre glass or stainless steel ball float and BSP threaded inlet.

When the valve is installed a shut-off valve shall be installed on the inlet side.

The valve shall be suitable for maximum pressure of 1 600 kPa.

(iii) Single orifice double purpose air release valves for domestic water lines up to 15 mm NB

This air release valve shall be fitted with a stainless steel float, brass or cast steel body with an integral shut-off valve fitted.

The valve shall be capable to withstand a working pressure of 1 000 kPa at 110 °C.

(iv) Vacuum breaker up to 40 mm diameter

The vacuum breaker shall be fitted with neoprene seal, spring-loaded disc in a dezincified brass or bronze body. The valve shall seal watertight and shall be designed to withstand a working pressure of 1 000 kPa and a temperature of 90 °C.

(i) Pressure-reducing valves(i) Combination pressure-reducing stations

Where a high peak flow as well as a small flow can occur and the small flow is out of the range of the large pressure-reducing valve, a small pressure-reducing valve is installed in parallel with the large pressure-reducing valve. The two pressure-reducing valves in parallel shall be set according to the manufacturer's specification.

(ii) Large pressure-reducing valves (65 mm NB and larger)

This pressure-reducing valve shall be equipped with a cast-iron body, neoprene nylon-reinforced diaphragm, bronze seal disc washer, stainless steel shaft and flanged ends. The valve shall be pilot operated and shall be designed to handle high flows at a minimum head loss.

The valve must be adjustable to handle a wide range of incoming pressures at a constant downstream pressure.

The valve shall be equipped with flanged ends to SABS 1123, table 16.

(iii) Small pressure-reducing valves (15 mm NB to 50 mm NB)

This pressure-reducing valve shall be equipped with brass body, balanced single seat and integral strainer. The valve shall be able to handle a wide range of incoming pressures while the downstream pressure stays constant with maximum inlet pressure of 1 000 kPa and a maximum water temperature of 40 °C.

The valve shall be equipped with BSP male threaded brass union couplings.

(j) Water meters

(i) Combination water meters

Where high peak flow, as well as a small flow, can occur and the small flow is out of the registration range of the large water meter, a small water meter shall be installed in parallel with the large water meter to cater for the small flows with integral automatic change-over valves. These valves shall be designed to have a minimum pressure drop at operating point.

(ii) Water meters (50 mm NB and larger)

These water meters shall be of the dry type with all gears and transmission and roller counters in a dry head, and shall be equipped with flanged ends to SABS 1123, cast-iron body with high quality corrosion-proof coating. The meter shall be protected from magnetic fields and sealed to prevent tampering with adjustments. The meter must be able to work up to a pressure of 1600 kPa under a maximum water temperature of 40 °C. The scale of meter must be in cubic metre (m³) and equipped with needle indicators reading in litres. Accuracy of meter shall be not less than 98 %.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturer's specification.

(iii) Water meters (up to 50 mm NB)

The meter shall be of the volumetric rotary piston type with brass body equipped with union couplers. The meter reading must be in kilolitres. The meter shall have an accuracy of not less than 98 %. The meter must be able to operate up to a water pressure of 1000 kPa at a water temperature of 40 °C.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturer's specification.

(k) Adjustable balancing valves

Adjustable balancing valves shall be supplied and installed as indicated on the applicable drawings. A portable differential pressure meter shall be used, with all the necessary pipes, shut-off valves and air release valves to set the balancing valves. A graph chart shall be supplied to indicate the flow units against the valve adjustment and as the pressure differential over the valve.

The pressure gauge shall be calibrated according to the current accepted SI units.

The calibrated adjustable balancing valves shall be of the angle valve type equipped with bronze valve body, bronze disc, internal seals with BSP threaded ends. The valve shall be fitted with stop-cock connection ends on inlet and outlet onto which the differential pressure gauge can be coupled. The valve shall be equipped with an indicator on the valve handle to show the position of the valve opening. The valve shall be suitable for operating at a temperature of 90 °C against a pressure of 1 000 kPa.

(l) Semi-conductive reheating tape for hot-water pipes

Semi-conductive reheating tape shall be strapped to the hot-water pipes under the thermal insulation. This reheating tape shall be installed strictly according to the manufacturer's specification.

The system shall be fitted with all the necessary end seals, tee splices, straps, etc, as required by the supplier.

The reheating tape shall be of the self-regulating type equipped with a parallel circuit, self-regulating conductive core, polyolefin jacket and tinned copper braid on the outside.

The reheating tape shall be sized to maintain an operating temperature of 60 °C of water inside the pipe.

(m) Expansion bellows

(i) Expansion bellows for pipes (50 mm NB and larger)

Expansion bellows shall be of the rubber-lined type fitted between flanges. These bellows shall be suitable for an operating temperature of -10 °C to 110 °C at an operating pressure of 1 500 kPa. The bellows shall be installed strictly in accordance with the manufacturer's specifications.

(ii) Expansion bellows for copper pipes (up to 40 mm NB)

These expansion bellows shall have a copper body with corrugated stainless steel lining and soldered capillary type couplings. The bellows shall be able to withstand a working pressure of 600 kPa at a temperature of 140 °C. Installation shall be strictly in accordance with the manufacturer's specifications.

(n) Lagging of hot-water pipes

(i) Preformed closed cell flame retarded flexible insulation sections

Where pipes are installed in service ducts, ceiling voids, etc, the pipes shall be insulated with Thermaflex preformed pipe insulation sections. This insulation shall be used with pipe systems where the maximum temperature is 80 °C. For a temperature higher than 80 °C preformed fibreglass sections shall be used with galvanized sheet metal muffs.

All bends and T-pieces shall be cut in a 45° mitre box to form a neat joint. All joints shall be glued together with a contact adhesive supplied by the manufacturer. Pipe sizes larger than

50 mm diameter shall be insulated with preformed fibreglass sections with canvas covers glued together with cold wood glue.

Thermafex thickness for various pipe sizes shall be as follows:

PIPE SIZE (STEEL)	PIPE SIZE (COPPER)	THERMAFLEX THICKNESS
50 mm dia	54 mm dia	20 mm
40 mm dia	42 mm dia	20 mm dia
32 mm dia	35 mm dia	15 mm dia
25 mm dia	28 mm dia	15 mm dia
20 mm dia	22 mm dia	15 mm dia
15 mm dia	15 mm dia	15 mm dia

(ii) Preformed fibreglass sections with galvanized sheet metal muffs

All hot-water pipes in service tunnels, service corridors and where exposed to damage and/or weather shall be insulated with preformed fibreglass sections covered with galvanized sheet metal muffs in a watertight manner. Sheet metal muffs shall be installed with the joints overlapping at least 50 mm and the longitudinal overlap pointing downwards to prevent ingress of water. The sheet metal muff shall be strapped with 10 mm galvanized straps by means of a strapping tool with a minimum of 2 straps/section. All pipe bends, T-pieces, etc, shall be insulated with 25 mm diameter fibreglass rope covered with a 12 mm thick layer of self-setting fibre cement. A reinforcing gauge shall be wrapped over the fibre cement while wet and painted with mastic paint when dry.

Fibreglass section thickness for the various pipe sizes shall be as follows:

PIPE SIZE (STEEL)	PIPE SIZE (COPPER)	FIRBREGGLASS THICKNESS
100 mm dia	108 mm dia	50 mm dia
80 mm dia	76 mm dia	40 mm dia
65 mm dia	67 mm dia	40 mm dia
40 mm dia	54 mm dia	25 mm dia
40 mm dia	42 mm dia	25 mm dia
32 mm dia	35 mm dia	25 mm dia
25 mm dia	28 mm dia	20 mm dia
20 mm dia	22 mm dia	20 mm dia
15 mm dia	15 mm dia	20 mm dia

AA 09.05

SANITARY AND BRASSWARE EQUIPMENT

Repair work to the sanitary and brassware equipment is detailed in the Particular Specification and shall include but not be limited to the following:

- (a) Damaged and/or broken irreparable sanitary and brassware equipment shall be replaced with equal specification equipment or approved alternative. These shall be installed strictly to the manufacturer's specifications.
- (b) Sanitary and brassware equipment that is unsuitable for the purpose and application they serve are to be replaced with suitable equipment.
- (c) The quantities of sanitary and brassware equipment needed for the number of people and application they serve, shall be investigated in accordance with the current SABS 0400 application regulations. If found to be insufficient these items of equipment facilities shall be increased only if approved by the Engineer.
- (d) Loose sanitary ware shall be re-fixed and bracketed to structures in accordance with the manufacturer's specifications.
- (e) Stained sanitary ware equipment shall be cleaned, where possible, with approved cleaning agent in accordance with the manufacturer's specification.
- (f) All cisterns are to be cleaned out and filling and flushing mechanisms shall be serviced and repaired. Where beyond repair status, these items shall be replaced with items of equal specification or approved alternatives.
- (g) Unserviceable flushvalves to be repaired utilizing the manufacturers repair kits only. Valves that are worn or damaged beyond repair shall be replaced with valves of equal specification. The design of the valve shall be of such type that all working components can be replaced or repaired without the necessity of changing the valve body – wear and tear must not affect the body of the valve.

Brushed chrome concealed type with integral vacuum breaker, non hold open feature and shut off device. Chrome plated vandal resistant pushbutton activation, "Through Wall" guide tube, wall fixing and captive linkage rod assembly.

Valve to be of either piston type or diaphragm type with replaceable working cylinder and piston or diaphragm.

- (h) All pillar taps, mixers, sink taps and other taps are to be serviced, utilising repair kits. Where equipment is beyond repair these items shall be replaced with items of equal specification or approved alternatives. Where equipment connections are loose these shall be properly secured to sanitary ware and other equipment.
- (i) Leaking, corroded or damaged chromium-plated flush pipes to water-closets and urinals are to be replaced where required.
- (j) Replace missing and/or damaged shower gratings with gratings of equal specification or approved alternatives.
- (k) Service and repair water metering taps by utilising manufacturer's replacement kits where necessary. Where damaged beyond repair the complete item shall be replaced with one of equal specification or approved alternative.
- (l) Replace missing or damaged tap handles with matching handles from the manufacturer of the tap with a countersunk cap screw for the fixing of the handle to the head pot.

- (m) Readjust all timing mechanisms on flush valves and metering taps to the correct flushing and flow times.
- (n) Replace damaged or missing basin and/or sink mixer swivel arms with items of equal specification or approved alternative.
- (o) Replace missing or damaged toilet seats and covers with items of equal specification or approved alternatives.
- (p) Repair and service urinal syphonic valves with replacement kits from manufacturer. Where no spares are available or equipment is damaged beyond repair, these items are to be replaced with values of equal specification or approved alternatives.
- (q) Repair and clean out all bottle traps. Bottle traps that are damaged beyond repair are to be replaced with traps of equal specification or approved alternatives.
- (r) Repair and service bath taps and mixers by utilising manufacturer's replacement kits. Where damaged beyond repair, the taps and mixers shall be replaced with items of equal specification or approved alternatives.
- (s) All tap handles to be of the crutch type where the handle is fixed to the spindle by factory press fit.

AA 09.06 FIRE WATER PIPED RETICULATION NETWORKS

AA 09.06.01 General

Repair work to the fire water piped reticulation networks is detailed in the Particular Specification and shall include but not be limited to the work described below. This specification only covers the water piped reticulation for the fire water protection system, while the equipment related to this installation, such as fire hydrants, hose reels and extinguishers, are covered and detailed in Technical Specification JC: Conventional Fire Fighting Equipment. This specification has to be read in conjunction with the afore-mentioned specification.

- (a) Replace damaged, broken, leaking, corroded above and underground pipework, fittings and equipment.
- (b) Repair, and service valves which shall include the installation of new gaskets, gland packings, seals, bolt and nuts, etc. If necessary the valves shall be replaced.
- (c) Where valves do not close properly, all these valves are to be refurbished, descaled and if necessary replaced.
- (d) Repair, service and check the proper functioning of all non-return valves and backflow preventers.
- (e) Repair, service, readjust and calibrate all pressure gauges.
- (f) Repair bracketing systems including fixing and repair of existing brackets and the provision of additional brackets where required.
- (g) Report all problems related to fire fighting equipment to the Engineer.
- (h) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float and/or filling valves to these tanks are to be serviced and repaired where required.

- (i) Pressure test and sterilise repaired new installations and equipment.
- (j) Reinstate and make good walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where any repair, upgrade and/or service work has been executed.
- (k) Record pressure readings on supply to installation.

AA 09.06.02 Material and equipment specification for fire water piped reticulation networks

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

- (a) Galvanized steel pipe installation
 - (i) All galvanized steel pipes shall be medium gauge mild steel screwed and socketed pipes to SABS 62 and shall be normalised and marked as such by the manufacturer. Pipes shall be hot-dip galvanized to SABS 763.
 - (ii) All fittings shall be malleable cast-iron fittings to SABS 509 and galvanized to SABS 763.
 - (iii) All 80 mm diameter and larger pipes shall be joined with Class 16 flanged couplings to SABS 1123/1600. The bolts, nuts and spring washers to be used on these joints shall be cadmium-plated.
 - (iv) In pipe ducts and elsewhere pipes shall be fixed onto walls, soffits, etc, with approved type of supports, holderbats, clamps, etc. Brackets shall be designed to structurally support and fix the pipe system and shall have enough clearance from walls, soffits, etc, to maintain equipment.
 - (v) Pipes shall be supported according to the manufacturer's specifications at the following maximum intervals:

NORMAL SIZE (mm)	HORIZONTAL (mm)	VERTICAL (mm)
15 dia to 20 dia	1 200	1 830
32 dia to 40 dia	1 830	2450
50 dia to 150 dia	2 450	3 050

- (vi) All pipes shall be marked according to SABS 0140 or as specified by the Engineer. All surface pipes shall be painted.
- (vii) Pipes shall be installed on the surface, unless otherwise specified.
- (viii) Provision shall be made for thermal contraction and expansion.
- (ix) The type of pipe joint compound shall be approved by the Engineer and used sparingly with good quality hemp. For pipes larger than 80 mm diameter a jointing compound such as Epidermix 32 shall be used.

(x) Any buried pipe shall have at least 900 mm cover and be coated and wrapped to SABS 1117 and tested in the presence of the Engineer.

(xi) All pipework and fittings shall be pressure tested as specified.

(b) uPVC underground pipe installations

(i) uPVC piping shall conform to SABS 966 with rubber ring type joints.

(ii) All bends shall be uPVC type fittings with rubber ring joints.

(iii) All other fittings such as T-pieces, reducers, flanges, etc, shall be bitumen-dipped cast-iron rubber ring jointed fittings to SABS 546.

(iv) No solvent weld type fittings will be allowed.

(v) All cast-iron fittings shall be coated and wrapped to SABS 1117.

(vi) All pipes shall be laid on a 100 mm sand bedding cradle and covered with 300 mm sand before backfilling.

(vii) Pipe trenching and bedding:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SABS 1200 LB	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90 % of modified AASHTO density

(viii) All thrust blocks shall be cast between the pipe and the undisturbed trench material.

(ix) No concrete shall come into direct contact with the uPVC pipe. At the thrust blocks the bend shall be wrapped with Densopol 80 HT tape or similar approved.

(x) HDPE pipe connections to uPVC pipes up to 40 mm diameter can be done by means of SG Iron manufactured saddles with the appropriate gaskets and cadmium-plated bolts and nuts.

(xi) All pipe crossings under roads and parking areas shall be backfilled as specified in subclause CA 04.04.02(b).

(xii) All pipework shall be pressure tested with all joints uncovered to the satisfaction of the Engineer.

(xiii) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(xiv) Duckfoot bends shall be used to all fire hydrants at the foot of fire hydrants. This to be cast into thrust blocks.

(c) HDPE underground pipe installations

(i) All HDPE piping shall be Type 4 HDPE pipe to SABS 533.

- (ii) All fittings shall be of Plasson compression type and shall conform to ISO/DIS 3458.
- (iii) All pipes shall be laid on a 100 mm sand bedding cradle and covered with 300 mm of sand or selected material.
- (iv) All backfilling shall be to the SABS 1200 DB and to the Engineer's approval.
- (v) Pipe trenching and bedding:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SABS 1200 LB	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90 % of modified AASHTO density

- (vi) No concrete shall come into direct contact with the HDPe pipe. At these points the fittings shall be wrapped with Densopol 80 HT tape or similar approved.
- (vii) All pipe crossings under roads and parking areas shall be backfilled as specified in subclause CA 04.04.02(b).
- (viii) All pipework shall be pressure tested with all joints uncovered to the satisfaction of the Engineer.
- (ix) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(d) Valves

- (i) Gate valves underground in valve chambers to connect to uPVC piping (65 mm NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SABS 936 Grade 42, cast-iron nitrile butadiene rubber covered gate, stainless steel spindle, nitrile butadiene rubber O-rings and seals, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valves shall conform to SABS 664 and/or 665 and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with a square key spindle top to close the valves in clockwise direction and socket ends to SABS 665 to fit into uPVC.

Valves are to be provided with locking devices to lock valves in open position.

- (ii) Gate valves underground in valve chambers to connect to uPVC piping

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valves shall conform to SABS 776 Class 125. The valves shall be able to withstand a working pressure of

1 600 kPa. The valve shall be fitted with a hand wheel on an extended spindle shaft of 700 mm to close in a clockwise direction and shall be installed to details provided.

(iii) Gate valves above ground to connect to steel (65 NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SABS 936 Grade 42, cast-iron nitrile butadiene rubber covered gate, stainless steel spindle, nitrile butadiene rubber O-rings and seals, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valves shall conform to SABS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with flanged ends to SABS 1123/1600, hand wheel to close the valves in a clockwise direction and installed in an upright position or sideways to maximum 90° from upright.

These valves shall be equipped with locking devices to lock valves in open position.

(iv) Gate valves above ground (up to 50 mm NB)

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valves shall conform to SABS 776 Class 125.

The valves shall be able to withstand a working pressure of 1 600 kPa.

The valve shall be equipped with a hand wheel to close in a clockwise direction.

The valves shall be installed in an upright position or sideways to maximum 90° from upright and shall be so placed with other fittings as to be removed without cutting the pipework.

The valves shall be equipped with locking devices to lock valves in open position.

AA 10 MAINTENANCE TO INSTALLATIONS, SYSTEMS AND EQUIPMENT

AA 10.01 GENERAL

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

This part of the Contract shall include preventative maintenance, corrective maintenance, and breakdown maintenance, as defined in Additional Specification SA: General Maintenance, for the specified installations described under the section AA 01 of this document.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in the Particular Specification and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised for each maintenance activity under the following headings:

- (a) Rainwater disposal system
- (b) Soil and wastewater drainage systems
- (c) Domestic water distribution and reticulation systems
- (d) Sanitary and brassware equipment
- (e) Fire water piped reticulation networks.

AA 10.02 PREVENTATIVE MAINTENANCE

This maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The maintenance work to be performed and executed shall include, but not be limited to the items listed in tables AA 10.02/1, AA 10.02/2, AA 10.02/3, AA 10.02/4 and AA 10.02/5 below under each heading.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE AA 10.02/1 - RAINWATER DISPOSAL SYSTEM

NO	PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Clean out and clear all rainwater gutters and full bores	Monthly
2	Clean out and clear all catch pits, channel drains and floor outlets	Monthly
3	Clean and unblock all drain pipes	Monthly
4	Check alignments of gutters	Six-monthly
5	Check and inspect all rainwater outlet gratings and replace if necessary	Six-monthly
6	Check gutter and pipe bracketing system and repair and replace if necessary	Four-monthly
7	Check and inspect manhole covers and frames for damages and replace if necessary	Six-monthly
8	Paintwork repairs to surface piping and equipment	Annually
9	Visually inspect and report on total system	Monthly

TABLE AA 10.02/2 - SOIL AND WASTEWATER DRAINAGE SYSTEM

NO	PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation	Monthly
2	Check, service and clean out grease traps	Monthly
3	Check, service and clean out oil separators	Monthly
4	Check, inspect and clean out all floor drains	Monthly
5	Check, inspect and clean out all gullies	Monthly
6	Replace broken or missing gully gratings	Four-monthly
7	Check, inspect, repair or replace all manhole covers and frames and builder's work to manholes	Four-monthly
8	Check, inspect and repair manhole benching.	Four-monthly
9	Check, inspect, repair or replace all inspection eyes, end caps and cleaning eye covers	Four-monthly
10	Check, inspect, repair or replace all bracketing systems	Four-monthly
11	Check, inspect, report and unblock any blockage that occurs	Monthly
12	Check, inspect, repair/replace and clean out all equipment traps	Monthly
13	Paintwork repairs to surface piping and equipment	Annually
14	Video survey and resultant repairs and unblocking of all main sewer lines (See subclause AA 09.03.01(e))	At start of Contract
15	Check, inspect, service, repair/replace all vacuum and two-way vents	Four-monthly

TABLE AA 10.02/3 - DOMESTIC WATER DISTRIBUTION AND RETICULATION SYSTEMS

NO	PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Log all water meter readings	Monthly
3	Log all pressure gauge readings	Monthly
4	Check, inspect, report and repair leaks	Monthly
5	Replace all valve gaskets, gland packings and seals	Annually
6	Sample water supply and chemical analyses to be provided by approved company	Annually

7	Bulk Water storage tanks to be emptied, cleaned out, inspected, repaired and resealed where necessary	Annually
8	Check, inspect, service, repair and readjust all pressure-reducing valves	Six-monthly
9	Check, inspect and test operation of all valves on site	Four-monthly
10	Clean out all strainers	Monthly
11	Check, inspect, service test and repair/replace all safety and expansion release valves	Six-monthly
12	Check, inspect, repair or replace all bracketing systems	Four-monthly
13	Check, inspect, service, repair/replace all air release valves and vacuum breakers	Four-monthly
14	Check, service, repair or replace all ball float valves	Four-monthly
15	Check, inspect, test, service, repair/replace all geyser installations	Four-monthly
16	Check, inspect, test, service and repair/replace all non-return valves	Four-monthly
17	Paintwork repairs to piping, fittings and equipment	Annually

TABLE AA 10.02/4 - SANITARY AND BRASSWARE EQUIPMENT

NO	PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation	Monthly
2	Inspect, repair/replace WC seats and covers	Monthly
3	Replace all tap washers	Six-monthly
4	Replace all tap gland packings	Six-monthly
5	Check, inspect, repair, fix and where necessary replace sanitary ware mountings and brackets	Four-monthly
6	Check, inspect, service, repair/replace all cistern flushing mechanisms	Monthly
7	Check, inspect, service, repair/replace all brassware	Four-monthly
8	Check, inspect, service, repair/replace all sanitary ware	Four-monthly
9	Check, inspect, service, repair, readjust all flushing valves	Four-monthly
10	Replace all flushing valve internal parts with replacement kits	Once per Contract
11	Stained equipment to be cleaned with approved manufacturer's cleaning agent	Six-monthly
12	Check, inspect, report and repair all leaks	Monthly

13	Check, inspect, repair/replace all shower gratings	Four-monthly
14	Paintwork repairs to all equipment	Annually
15	Check, inspect, repair, service, replace all missing valves	Six-monthly
16	Replace missing tap handles	As occur
17	Replace missing bath, basin, sink, etc, plugs	As occur

TABLE AA 10.02/5 - FIRE WATER PIPED RETICULATION NETWORKS

NO	PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Report any failures/breakage of fire fighting equipment to the Engineer	Monthly
3	Log all pressure gauge readings	Monthly
4	Replace all valve gaskets, gland packings and seals	Annually
5	Water storage tanks to be cleaned out resealed/repared if necessary	Annually
6	Check, inspect, service, repair/replace all non-return valves and backflow preventers	Four-monthly
7	Check, inspect, report and repair all leaks	Monthly
8	Inspect, service, readjust and calibrate all pressure gauges	Four-monthly
9	Paintwork repairs to piping, fittings and equipment	Annually
10	Check, inspect, repair or replace all bracketing systems	Four-monthly

AA 10.03**CORRECTIVE MAINTENANCE**

The corrective maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

AA 10.04**BREAKDOWN MAINTENANCE**

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and in accordance with the related specifications, standards, regulations and codes.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance documents.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

PARTICULAR SPECIFICATION**PAA PLUMBING AND DRAINAGE INSTALLATION****CONTENTS**

PAA 01	SCOPE
PAA 02	GENERAL DESCRIPTION OF INSTALLATION
PAA 03	TECHNICAL DETAILS OF EXISTING INSTALLATION
PAA 04	STATUS OF EXISTING INSTALLATION
PAA 05	DETAILS OF REPAIR AND SERVICE WORK
PAA 06	MEASUREMENT AND PAYMENT

PAA 01 SCOPE

- (a) This specification encompasses all aspects regarding the particulars of the repair and maintenance work to the plumbing and drainage installations at the Van Rooyenshek port of entry. This particular specification shall be read in conjunction with the Technical Specification AA: Plumbing and Drainage Installation, and all additional and Technical Specifications compiled as part of this document, and in particular the following Additional Specifications:

- SA General Maintenance
- SB Operating and Maintenance Manuals
- SC General Decommissioning, Testing and Commissioning Procedures
- SD General Training

The intended repair and maintenance work to this installation will restore the existing installation to a safe, efficient, functional system that complies with all statutory regulations and applicable standards, in the process repairing all defects and shortfalls. On completion of the repair work, the installation shall be maintained and serviced by the Contractor for the remainder of the 36-month contract period.

- (b) The project consists of various facilities as listed below which forms part of this Repair and Maintenance Contract for Plumbing and Drainage Installation.
- i. Installation RM1: Operational Area: Structural and Building Related Work
 - ii. Installation RM1: Residential area houses: Structural and Building Related Work
 - iii. Installation RM1: Single quarters area houses: Structural and Building Related Work
 - iv. Installation RM2: Operational area Buildings: Plumbing and Drainage
 - v. Installation RM2: Residential area houses: Plumbing and Drainage

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- vi. Installation RM2: Single quarters area houses: Plumbing and Drainage
- vii. Installation RM3: Fencing, Cleaning of Buildings and Site Keeping
- viii. Installation RM4: Water treatment works, Bulk Water Supply Systems and External Water Networks
- ix. Installation RM5: Wastewater Treatment Works and Sewer Networks
- x. Installation RM6: Roads and Storm Water Drainage

PAA 02 GENERAL DESCRIPTION OF INSTALLATION

The existing plumbing and drainage installation provides potable hot and cold water to the various buildings in this site. The potable cold water installation are provided with supply points from the underground reticulation network just outside the buildings to a above ground reticulation network via service ducts, ceiling voids and chased into walls to outlet points. The potable hot water installation is provided with domestic geysers where applicable.

This contract also provides for repair and maintenance of the fire water piped reticulation network excluding the fire fighting equipment which are dealt with under the Particular Specification PJC: Conventional Fire Fighting equipment.

See section PAA 03 for technical details of sanitary and brassware as well as the plumbing and drainage installations.

PAA 03 TECHNICAL DETAILS OF EXISTING INSTALLATION

At the time of compilation of this document the existing installation consisted of the equipment and plant as listed below with their relevant technical details.

PAA 03.01 SANITARY AND BRASSWARE: GENERAL

	Sanitary ware	Brassware	Trap
WC's (Cistern)	Armitage shanks, white, floor mounted, vitreous china.	Brass shut-off valves	N/A
WC's (Flush)	Wall-mounted, white, CI; white, Wall-mounted, white, vitreous china. Wall-mounted, white, plastic	Brass shut-off valves	N/A
Urinals (Flush valve)	Armitage Shanks, white, wall-mounted, vitreous china; Citimetal stainless steel wall-mounted.	Junior flush valve, exposed type, shut-off valves; Brass shut-off valves	CP bottle trap. Flexi P-trap; Flexi S-trap
WHB	Armitage Shanks, white wall mounted, white enamel; Wall-mounted stainless steel	Cobra 15 mm, CP, star handle pillar taps.	Flexi rubber P-trap.
Showers	Chromium plated shower rose.	Cobra 15 mm, CP, star handle, undertile stopcocks.	Brass P-trap with chromium plated grating.

PAA 03.02

SANITARY DRAINAGE PIPING: GENERAL

	Pipe	Fittings	Equipment
Gullies	CI	CI or plastic grating	N/A
Waste pipes	uPVC GMS	uPVC Brass	N/A
Soil pipes	S&S CI, uPVC	S&S CI, uPVC	N/A
Cleaning eyes	CI (ABC), uPVC	N/A	N/A
Vent pipes	S&S CI, uPVC	S&S CI, uPVC	N/A

PAA 03.03

DOMESTIC WATER PIPING: GENERAL

	Pipe	Fittings	Equipment
Cold water piping	GMS	GMS	Brass gate shut-off valves
Hot water piping	GMS	GMS	Brass gate shut-off valves

PAA 03.04

FIRE WATER PIPING: GENERAL

	Pipe	Fittings	Equipment
Fire water piping	GMS	GMS	See Particular Specification PJC

PAA 03.05**PLUMBING FIXTURE QUANTITIES**

At the time of completion of this document the various facilities were equipped with the following number of plumbing features.

INSTALLATION REFERENCE	BUILDING DESCRIPTION	NUMBER OF PLUMBING FIXTURES							
		WC	Urinal	WHB	Shower	Bath	Sink	Wash trough	TOTAL
		35	6	29	9	10	19	0	98
A	Van Rooyenhek port of entry	35	6	29	9	10	19	0	98

PAA 03.06**FIRE WATER INSTALLATION QUANTITIES**

The following quantities of fire fighting equipment are presently installed, the piped reticulation networks to these equipment shall form part of this contract.

INSTALLATION REFERENCE	BUILDING DESCRIPTION	NUMBER OF FIRE PROTECTION EQUIPMENT	
		FIRE EXTINGUISHERS	FIRE HYDRANTS
A	Van Rooyenhek port of entry	33	4
TOTAL NUMBER OF FIRE PROTECTION EQUIPMENT		33	33

PAA 04**STATUS OF EXISTING INSTALLATION**

At the time of compilation of this document the status of the equipment and installation was briefly as follows:

PAA 04.01**VAN ROOYENHEK PORT OF ENTRY****PAA 04.01.01****Sanitary and Brassware**

The general condition of the Sanitary and Brassware equipment is poor due to vandalism, improper equipment for the purpose it serves and the age of equipment. The following is a common occurrence on this equipment.

- (a) Leaking flush valves in ducts.
- (b) Cast iron cisterns are corroded, broken and damaged.

- (c) Showerheads are missing or broken.
- (d) Shower and tap handles are generally missing.
- (e) WC's and WHB's are damaged, ripped out of walls etc.
- (f) Shower and urinal gratings are missing, resulting excessive blockages.

PAA 04.01.02 Plumbing and Drainage Installation

- (a) The general condition of the plumbing and drainage installation has deteriorated due to corrosion and age to the extent where repair and maintenance will be extensive. The following was witnessed as common problems:
 - (i) Cast iron drainage pipes entering the building tends to leak due to corrosion.
 - (ii) Regular blockages on drainage pipe installation.
 - (iii) Regular leaks developing on the water reticulation network above and underground.
 - (iv) Insufficient shut-off valves on water distribution network.
 - (v) Missing gully gratings, IE covers and CE covers on drainage system.

PAA 05 DETAILS OF REPAIR WORK

The following work shall form part of the repair work to Building Services. This work shall be done in accordance with the relevant regulations, codes, specifications and Technical Specification AA: Building Services Installation as set out in this document.

The repair work included as set out below shall be read in conjunction with the schedule of quantities and technical specifications.

PAA 05.01 GENERAL DESCRIPTION OF REPAIR WORK

- (a) The Contractor shall at the start of the Repair and Maintenance Contract inspect the items, systems, equipment, components and installations listed below. This inspection shall include the establishing of any defects, leaks, conditions, damages, shortfalls, structural soundness, repairs required, details of existing equipment, suitability of equipment for the purpose it serves, etc. The Contractor shall report back to the Engineer in writing on all the above and the following items. No repair work shall commence prior to approval by the Engineer:
 - (i) Sanitary and brassware including traps, brackets, piping, pan connectors, etc;
 - (ii) Sanitary drainage installation, including fittings, traps, floor drains, gullies, cleaning eyes, manholes, grease and oil separators, etc;

PAA.6

- (iii) Domestic water piped installation, including fittings, valves, strainers, lagging and cladding, non-return valves, safety valves, etc;
 - (iv) Fire water piped installation, including fittings, valves, non-return valves, pressure gauges, etc;
 - (v) Bracketing system;
 - (vi) Domestic geysers including valves, pressure reducing valves, strainers, vacuum breakers, safety valves, non-return valves, lagging and cladding, etc.
- (b) The general scope of work at the time of going to tender is defined as follows:
- (i) Replacing of irreparable damaged, missing and unsuitable sanitary and brassware, including the isolation, removal and stripping of the existing equipment;
 - (ii) Replacing of irreparable damaged, corroded and unsuitable sanitary drainage piping, including fittings, brackets, traps, floor drains, oil and grease separators, cleaning eyes and gullies, etc;
 - (iii) Replacing of irreparable damaged, corroded and unsuitable domestic water piping, including fittings, brackets, valves, strainers, water meters, lagging and cladding, etc;
 - (iv) Replacing of irreparable damaged, corroded and unsuitable fire water piping, including fittings, brackets, valves, non-return valves, pressure gauges, etc;
 - (v) Replacing of irreparable damaged and corroded domestic geysers, including valves, pressure reducing valves, air release valves, strainers, non-return valves, vacuum breakers and safety valves;
 - (vi) Servicing, cleaning and repair of existing sanitary ware including removal of stains, repair of chipped off enamel, replacing of damaged seats and lids, de-scaling and cleaning of cisterns and servicing of filling and flushing mechanisms, fixing of loose fixtures and brackets, cleaning of traps, etc;
 - (vii) Servicing, overhauling and cleaning of existing brassware, including dismantling, de-scaling, repair kits, replacing of washers, gland packings and gaskets, replacing of missing tap handles and flushing assemblies, etc;
 - (viii) Servicing, cleaning and repair of existing domestic water and drainage pipe installations, including traps, floor drains, gullies, manholes, valve chambers, grease- and oil separators, brackets, valves, vacuum breakers, strainers, pipe lagging and cladding, etc;
 - (ix) Servicing and repair of existing fire water piped reticulation, including fittings, valves, pressure gauges, brackets, etc;

PAA.7

- (x) Servicing, cleaning and repair of domestic geysers, including de-scaling, testing for leaks, replacing of elements, safety valves and thermostats if required, etc;
- (xi) Handing over of complete systems, to the satisfaction of the Engineer, on completion of the repair work on which the maintenance period shall commence;
- (xii) The supply and compilation of as-built drawings and operating and maintenance manuals;
- (xiii) The testing, adjusting and commissioning of all systems;
- (xiv) The introduction of a maintenance control plan, including logging, recording and control procedures.

PAA 05.02 REPAIR WORK TO PLUMBING AND DRAINAGE INSTALLATION

The repair work to this installation shall at least include, but not be limited to the following items. Any items, components or installations not detailed in this specification but found to be defective or inoperative during the inspection and report phase, shall be repaired or replaced as instructed by the Engineer.

PAA 05.02.01 VAN ROOYENSHEK PORT OF ENTRY

- (a) Service and repair domestic geyser installations and replace geysers that are damaged beyond repair.
- (b) Service and repair sanitary drainage installation and replace items that are damaged beyond repair.
- (c) Service and repair brassware such as taps, flush valves and shut-off valves and replace if damaged beyond repair.
- (d) Replace damaged, missing and cracked sanitary ware such as WC's, urinals and WHB's.
- (e) Supply and install missing WC lids and seats.

PAA 06 MEASUREMENT AND PAYMENT

All new building work and repair work to existing structures and buildings caused by repairs to the Plumbing and Drainage services as scheduled, shall be done in accordance with the Standard and Technical Specifications for the Structural and Building section (A1) included elsewhere in this Tender Document. The cost of such building and repair works shall be deemed to be included in the tendered rates for the applicable items as scheduled in this section.

PAA 06.01 INSPECTION AND REPORT ON EXISTING INSTALLATIONS.....Unit: item

The tendered sum shall include full compensation for the inspection and written report on all items, systems, components, equipment and installations, including the establishment of any defects, leaks, conditions, damages, shortfalls, structural soundness, repairs required, details of existing equipment and suitability of the equipment for the purpose it serves.

PAA 06.02 **AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS**.....Unit: set

The tendered sum shall include full compensation for obtaining, verification, compilation and submission of a full sets of as-built drawings, inventory lists and operating and maintenance manuals in accordance with the Additional Specification SB: OPERATING AND MAINTENANCE MANUALS.

The tendered sum shall also include full compensation for all equipment necessary to establish the exact position and level of underground services as well as the recording of all information on electronic drawing format.

PAA 06.03 **ISOLATION, STRIPPING, DISMANTLING AND REMOVAL OF EXISTING BRASSWARE, SANITARY WARE AND PIPING INSTALLATIONS**.....Unit: number, meter

The tendered rates shall include full compensation for the isolation, dismantling and removal of irreparable damaged, broken and / or unsuitable brassware (flush valves, taps, mixers, shower roses, undertile stop cocks, demand bib taps, hose bib taps, shut-off valves etc.) and sanitary ware (water closets, cisterns, basins, urinals, baths, wash troughs, sinks etc.) including all accompanied pipework, brackets, traps, pan connectors etc.

The tendered rates shall also include full compensation for the isolation, stripping, dismantling and removal of irreparable damaged, broken or unsuitable pipework installed on surface, underground, chased into walls, in ceiling voids and / or in service ducts as well as the plugging off of connections to this pipework.

The tendered rate shall also include full compensation for the removal off site and / or storage of all removed items as mentioned above.

PAA 06.04 **ISOLATION, STRIPPING, DISMANTLING AND REMOVAL OF EXISTING GEYSER INSTALLATIONS**.....Unit: number

The tendered rates shall also include full compensation for the isolation, stripping, dismantling and removal of irreparable damaged, broken and / or corroded domestic geysers, including shut-off valves, non-return valves, strainers, pressure reducing valves, vacuum breakers, air release valves, safety valves, etc. and the removal off site.

PAA 06.05 **SUPPLY AND INSTALLATION OF SANITARY AND BRASSWARE**.....Unit: number

The tendered rate shall include full compensation for the supply, delivery, positioning, installation, testing, cleaning, commissioning and hand over of sanitary and brassware including all necessary pipework, traps, brackets,

fittings, bends, junctions, cleaning eyes etc. to connect the sanitary and brassware to the existing water supply and / or drainage installation.

The tendered rate shall also include full compensation for chasing and / or building into walls and the re-instating of existing surfaces such as floors, walls, ceilings etc.

PAA 06.06

SUPPLY AND INSTALLATION OF DRAINAGE

PIPING INSTALLATION.....Unit: number, meter

The tendered rates shall include full compensation for the supply, delivery, installation, testing, cleaning, commissioning and handover of new drainage piping, installed on surface against walls or soffits, underground, in ceiling voids, chased or built into walls and / or in service ducts, including all necessary bends, junctions, tees, cleaning eyes, covers, traps, floor drains, gratings, brackets, hangers etc. to hand over a complete and effective installation that complies to Local Government regulations.

The tendered rates shall also include full compensation for the necessary underground works such as excavation, pipe bedding, fill blanket, backfilling and compaction and for the re-instatement of existing surfaces such as floors, walls, ceiling, roads, paving etc. as well as connection to the existing drainage installation.

PAA 06.07

SUPPLY AND INSTALLATION OF DOMESTIC

WATER PIPING INSTALLATIONS..... Unit: number, meter

The tendered rates shall include full compensation for the supply, delivery, installation, testing, cleaning, sterilising, commissioning and hand over of new water piping installed on surface against walls or soffits, underground, in ceiling voids, chased or built into walls and / or in service ducts, including all necessary bends, tees, reducers, elbows, valves, strainers, adapters, brackets, hangers etc. to hand over a complete and effective installation that complies to Local Government regulations.

The tendered rates shall also include full compensation for the supply and installation of hot water pipe insulation and cladding.

The tendered rates shall also include full compensation for the necessary underground works such as excavation, pipe bedding, fill blanket, backfilling and compaction and for the re-instatement of existing surfaces such as floors, walls, ceilings, roads, paving etc. as well as connection to the existing domestic water installation.

PAA 06.08

SUPPLY AND INSTALLATION OF DOMESTIC

GEYSER INSTALLATIONS.....Unit: number

The tendered rates shall also include full compensation for the supply and installation of domestic geysers, including shut-off valves, non-return valves, strainers, pressure reducing valves, vacuum breakers, air release valves, safety valves, etc. as well as connection to existing piping and electrical supply.

PAA 06.09 **SUPPLY AND INSTALLATION OF FIRE WATER
RETICULATION PIPEWORK**..... Unit: number, meter

The tendered rate shall include full compensation for the supply, delivery, installation, testing, cleaning, commissioning and hand over of new fire water reticulation pipework installed on surface against walls or soffits and / or underground, including all necessary bends, tees, reducers, elbows, valves, adapters, brackets, hangers, pressure gauges, etc. to hand over a complete and effective installation that complies with Local Government regulations.

The tendered rates shall also include full compensation for the necessary underground work such as excavation, pipe bedding, fill blanket, backfilling and compaction and for the re-instatement of existing surfaces such as floors, walls, ceilings, roads, paving etc. as well as connection to the existing fire water reticulation network.

PAA 06.10 **SERVICING, CLEANING AND REPAIR OF
SANITARY WARE**.....Unit: number

The tendered rate shall include full compensation for the repair or replacement of all damaged or missing parts, servicing of all movable parts, cleaning of stained sanitary ware with approved cleaning agent, fixing of loose fixtures and brackets according to manufacturer’s specifications, de-scaling and cleaning of cisterns and servicing of filling and flushing mechanisms, cleaning of all traps, fixing or replacing of damaged or missing shower-, urinal- and channel outlet gratings and any other work or action to hand over an effective system that complies to Local Government regulations.

PAA 06.11 **SERVICING, OVERHAULING AND CLEANING
OF BRASSWARE**..... Unit: number

The tendered rate shall include full compensation for dismantling, cleaning and de-scaling, replacement of all gaskets, gland packings and seals on all valves, repair or replacement of all damaged or missing parts, replacement kits for worn or leaking flush valves, taps and mixers, repair or replacement of leaking, corroded or damaged flush pipes, re-adjusting of timing mechanisms on flush valves and metering taps and any other work or action to hand over an effective system that complies to Local Government regulations.

PAA 06.12 **SERVICING, CLEANING AND REPAIR OF
DOMESTIC WATER AND DRAINAGE
PIPE INSTALLATIONS**..... Unit: number, meter

The tendered rates shall include full compensation for inspection, sampling testing, servicing, cleaning and repair of existing piping and equipment such as:

- a) Video surveying of all underground drainage pipework to establish root ingress, damaged and corroded pipework, fat build-up, blockages, incorrect falls, sagging and as-built information.
- b) Initial unblocking and cleaning of all drainage pipework, traps, floor drains and gullies.

- c) Pressure testing of piping and taking of water piping samples to determine state of corrosion and scaling.
- d) Repair work to damaged manholes, gullies, cleaning eyes, valve chambers, etc. including builders work and benching.
- e) Repair of existing bracketing systems including fixing and repair of existing brackets and hangers as well as the supply and installation of additional brackets where required.
- f) Emptying, cleaning, checking, testing and repair of oil and grease separators.
- g) Service and repair to all valves, strainers, pressure reducing valves, water meters, non-return valves, air release valves and vacuum breakers, including new gaskets, gland packings and seals.
- h) Taking of water samples and bacteriological testing to determine the compliance to the relevant codes or practice.
- i) Repairing and / or replacement of damaged hot water pipe lagging and cladding.
- j) Preparation, painting and repainting of pipework and equipment in accordance with the Technical Specification BH.
- k) Any other work or action to hand over an effective installation that complies with Local Government regulations.

PAA 06.13

SERVICING, CLEANING AND REPAIR OF DOMESTIC GEYSERS.....

Unit: number

The tendered rate shall include full compensation for the isolation, servicing, cleaning and repair of domestic geysers in accordance with the manufacturer's specifications, including de-scaling, testing for leaks, replacing of elements if required, checking of safety valve operation and replacement if required, testing of thermostat operation and set point and replacement if required and any other work or action to hand over an effective system that complies with Local Government regulations.

PAA 06.14

SERVICING AND REPAIR OF FIRE WATER PIPED RETICULATION NETWORKS.....

Unit: number, meter

The tendered rates shall include full compensation for the inspection, testing, servicing and repair of existing piping and equipment such as:

- a) Pressure testing of piping and taking of pipe samples to determine the extent of corrosion and scaling.

- b) Repair or replacement of damaged, leaking, broken and corroded pipework or fittings.
- c) Repair and service to all valves, including new gaskets, gland packings and seals.
- d) Repair, service, adjustment and calibration of all pressure gauges.
- e) Repair and fixing of existing brackets and hangers and the installation of additional brackets and hangers where required.
- f) Any other work or action to hand over an effective system that complies with Local Government regulations.

**PAA 06.15 CLEANING OUT SEPTIC TANKS AND DISPOSE
OF CONTENTS OFF-SITE**

Unit: number

The unit of measurement shall be the number of septic tanks thoroughly cleaned and pumping the waste into a tanker and disposing of all the waste off site at a wastewater dumping area.

**PAA 06.16 SUPPLY AND INSTALLATION OF DOMESTIC
GEYSER INSTALLATION.....**

Unit: number

The unit of measurement shall be the number of each geyser installation supplied and installed, including all associated pipe work and fittings.

The tendered rates shall include full compensation for the supply and installation of industrial geyser installations including isolating lever-ball valves (from 22 to 50mm), 400kPa expansion relief valve, drain connection, overflow pipe, inline circulating pump (25mm), Temperature and pressure safety valve, electrical control panel, bulk hot water vessel, pump supply cable, dual thermostat, hot water outlet, y-strainer, pressure gauge, non-return valve, temperature gauge, balanced cold water and expansion valve stand pipe.

B

STRUCTURAL ELEMENTS

TECHNICAL SPECIFICATION

BA ROOF COVERINGS

CONTENTS

BA 01	SCOPE
BA 02	STANDARD SPECIFICATIONS
BA 03	REPAIR OF ROOF SHEETING AND WALL CLADDING
BA 04	DETAIL OF REPAIR WORK
BA 05	MAINTENANCE
BA 06	MEASUREMENT AND PAYMENT

BA 01 SCOPE

This specification covers the repair/replacement and the maintenance of existing roof coverings. This specification also covers the supply, delivery, installation and maintenance of new roof coverings for various types of buildings.

Roof coverings shall mean the repair/replacement and maintenance of existing roof coverings, side wall cladding and ancillary items, and maintaining materials and components. Roof coverings shall also mean the installation and maintenance of new roof sheeting and side wall cladding, roofing screws, purlins, flashings, rainwater goods, fascias and barge boards. This specification does not include work related to trusses, ceilings and paintwork specified elsewhere.

The complete scope of repair work shall be as described in BA 04: Detail of repair work.

Maintenance of this part of the installation shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BA 02 STANDARD SPECIFICATIONS

BA 02.01 GENERAL STANDARD SPECIFICATIONS

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

OW 371	-	Specification of materials and methods to be used (Fourth revision, October 1993)
SABS 1200 HB	-	Cladding and sheeting
SABS 653	-	Softwood bracking and battens
SABS ISO 1461	-	Hot-dip galvanised coatings on fabricated iron and steel articles
SABS 1273	-	Fasteners for sheet roof and wall coverings

BA 02.02 ADDITIONAL SPECIFICATIONS

Technical Specification BB: Carpentry and joinery
 Technical Specification BC: Waterproofing of concrete roofs
 Technical Specification BJ: Painting

BA 03 REPAIR OF ROOF SHEETING AND WALL CLADDING**BA 03.02 ADDITIONAL REQUIREMENTS FOR REPAIR OF PROFILED ROOF SHEETING (NON-CONCEALED AND CONCEALED FIXING)****BA 03.02.01 Roof cladding**

Existing roof sheeting shall either be replaced or repaired as scheduled in the Schedule of Quantities. Where new sheeting is specified, the existing roof sheeting must be removed. Each day's removed sheeting shall be fully covered with new sheeting at the end of the day. Plastic membranes or approved equivalent protection shall be used to minimise the possibility of damage caused by rain, etc, and to protect the personnel occupying the buildings. The new roof sheeting shall be 0,6 mm thick galvanised (or Chromadek) IBR or approved equivalent for roof slopes exceeding 15 °. Concealed fixed type Chromadek roof sheeting will generally be used to cover roofs with slopes not exceeding 15 °. The sheeting must be laid in long lengths without end overlaps. The broad flutes must be turned up at the apex to form a dam, and turned down at the eaves and valley gutters to form a drip. Metal closers 0,8 mm thick galvanised (or Chromadek), complete with polyclosers set in one run of silicone sealant, are required at apexes, ridges, side and head walls, etc. All holes for fasteners shall be drilled. Punching of holes and nailing of cladding and flashings will not be permitted. Cutting of cladding and flashings with an angle grinder may only be done by using a tungsten steel blade.

The Contractor shall take all necessary measurements and dimensions on site prior to manufacturing and installation. Z275 galvanising spelter shall be used and the Contractor shall provide SABS certificates of compliance to the Engineer. Various standard dark colours shall be used for Chromadek-finished roof sheeting, flashings, gutters and down pipes. To prevent unnecessary damage to galvanised or colour-coated sheets, proper measures must be taken to prevent contamination by moisture while material is still bundled or nested in stacks. Only stages 1 and 2 "white rust" on sheets will be permitted, provided that the white rust is successfully removed in accordance with ISCOR recommendation. The Contractor shall provide a guarantee for the Chromadek materials obtained from the manufacturer. In all cases the roof sheeting must be laid strictly in accordance with the manufacturer's specifications.

In certain cases the removed existing roof sheeting can be reused to repair agricultural sheds and similar types of structures.

The following paragraphs in specification PW 371 must be read in conjunction with this technical specification:

- Paragraph 7.6, excluding 7.6.1(i), 7.6.2(a) and 7.6.2(e)
- Paragraph 7.7, excluding 7.7.1, 7.7.5 and 7.19.1(a).

BA 03.02.02 Main fasteners to timber purlins: Galvanised/Chromadek IBR sheeting (or approved equivalent)

No. 12 (5,5 mm) x 90 mm type 17 hexagon head (H/H) carbon steel (C/S) zinc-plated self-drilling roofing screws shall be used for timber. The roofing screws with no.12 x 25 mm diameter x 1,0 mm thick low carbon EPDM/galvanised bonded washers are used as main fixing for the roof sheeting to timber purlins. 65 mm long x no 14 H/H C/S Topspeed or Posidriv main fasteners for steel purlins with the same washers are to be used. Fasteners shall be provided at alternating ribs, excluding side lap ribs.

BA 03.02.03 Side lap fasteners: Galvanised/Chromadek IBR sheeting (or equivalent approved)

Stitching shall be done with Leak King plugs for IBR roof sheeting @ 600 c/c maximum. An approved 8 x 3 mm thick butyl rubber sealer strip (PG Sealer Strip or approved equivalent) with nylon cord between sheets shall be provided.

BA 03.02.04 Flashings

Flashings must be 0,8 mm thick Chromadek/galvanised flashings at ridge caps, side and head walls, drips, corners, etc, as described elsewhere. The minimum length of an overlap between flashings is 150 mm. Apply two runs of silicone sealant between flashings. Flashings are to be stitched together with no. 10 (4,8 mm) x 16 mm x H/H C/S zinc-plated self-drilling stitching screws. The stitching screws with no. 12 x 19 mm diameter x 1,0 mm thick low carbon EPDM/galvanised bonded washers are to be used at end laps and longitudinally @ 400 c/c maximum at ribs, etc. The Contractor shall take all necessary measurements and dimensions on site prior to manufacturing and installation.

BA 03.02.05 Sealant

Silicone sealant with an amine cure system with primer shall be used to waterproof all flashings and rainwater goods, viz gutters and down pipes. Two runs of silicone shall be provided at end overlaps.

BA 03.02.06 Pipe flashings

Dektite or equivalent approved pipe flashings shall be used to waterproof pipe protrusions through the roof sheeting. Installation shall be done strictly in accordance with the manufacturer's specification and shall include the application of Dektite silicone sealant and fastening of flashing to the surface with TEKS or approved equivalent self-drilling fasteners.

BA 03.02.07 Insulation

No insulation repairs are required. In certain cases insulation may be necessary to reduce heat load or to comply with hygiene requirements as in abattoirs. Refer to section 7 part 7.6.3 of OW 371.

(a) Specification for non-visible roof insulation material:

Super Sisalation 420 RSA or equivalent approved reinforced reflective aluminium foil (heavy grade) laid on 1,6 mm diameter galvanised (unless noted otherwise) straining wires 300 mm centres to the manufacturer's specification. The insulation shall be laid longitudinally over the purlins and lapped 150 mm at joints.

(b) Specification for visible roof insulation material:

White Alucushion (code 2906) or equivalent approved white bubble foil on aluminium foil backing laid on 1,6 mm diameter white plastic (PVC) coated straining wires at 383 mm centres to the manufacturer's specification. The insulation shall be laid longitudinally over the purlins and lapped at joints.

BA 03.02 ADDITIONAL REQUIREMENTS FOR REPAIR OF PROFILED SIDE WALL CLADDING (NON-CONCEALED AND CONCEALED FIXING)**BA 03.02.01 Side wall cladding**

Existing sidewall cladding shall either be repaired or replaced as scheduled in the Schedule of Quantities. Where new cladding is specified, the existing side wall cladding must be removed. Each day's removed cladding shall be fully covered with new cladding

by the end of the day. The new side wall cladding shall be 0,6 mm thick galvanised (or Chromadek) IBR or approved equivalent. The sheeting must be laid in long lengths without end overlaps. Metal closers 0,8 mm thick galvanised (or Chromadek), complete with polyclosers set in one run of silicone sealant, are required at apexes, gables, side and head walls, etc.

The Contractor shall take all necessary measurements and dimensions on site prior to manufacturing and installation. Z275 galvanising spelter shall be used and the Contractor shall provide SABS certificates of compliance to the Engineer. Heavy-duty profiled polycarbonate sheets shall be used for translucent sheeting. Various standard dark colours for Chromadek finished sidewall cladding, flashings, and gutters and down pipes shall be used. In all cases the cladding must be laid strictly in accordance with the manufacturer's specifications.

BA 03.02.02 Main fasteners to timber girts: Galvanised/Chromadek IBR (or approved equivalent) and profiled translucent sheeting

No. 12 (5,5 mm) x 90 mm type 17 hexagon head (H/H) carbon steel (C/S) zinc-plated self-drilling roofing screws for timber. The roofing screws with no.12 x 25 mm diameter x 1,0 mm thick low carbon EPDM/galvanised bonded washers are used as main fixing for the roof sheeting to timber girts. 65 mm long x no 14 H/H C/S Topspeed or Posidriv main fasteners for steel girts with the same washers are to be used. Fasteners shall be provided at alternating ribs, excluding side lap ribs. Correct installation procedures must be followed, especially in respect of the drilling speed and torque settings of the drill for various materials.

BA 03.02.03 Side lap fasteners: Galvanised/Chromadek IBR (or approved equivalent) sheeting

Stitching shall be done with Leak King plugs for IBR roof sheeting @ 600 c/c maximum. Provide an approved 8 x 3 mm thick butyl rubber sealer strip (PG Sealer Strip or approved equivalent) with nylon cord between sheets.

BA 03.02.04 End overlaps

If unavoidable, the end overlap shall be 300 mm minimum between sheeting and sealed with two rows of silicone sealant between the sheeting. Bolt the ribs in the overlap region with the (polycarbonate) translucent sheeting with galvanised no. 14 gutter bolts, bonded washers and nuts through every alternative rib.

BA 03.02.05 Side overlaps: Vertical profiled translucent sheeting

Stitching shall be done with 6 mm cadmium-plated cladding bolts and nuts x 25 mm long @ ± 300 c/c with no. 12 x 19 mm diameter x 1,0 mm thick low-carbon EPDM/galvanised bonded washers.

BA 03.03 RAINWATER GOODS

BA 03.03.01 Gutters

(a) Standard size for houses:

Gutters shall be 100 x 75 x 0,6 thick standard Chromadek/galvanised non-supporting beaded gutter. Galvanised brackets are to be provided at every second truss. Brackets shall be painted with water-based pure acrylic emulsion paint to Technical Specification BJ 03.01.03(g). Alternatively, standard 140 x 127 x 83 x 0,6 mm thick Brownbuilt or similar continuous rolled approved Chromadek fascia gutter with galvanised gutter clips can be used.

(b) Typical size for other buildings:

125 x 100 x 0,8 thick standard Chromadek self-supporting beaded gutter to detail.

Dark colours shall be used where indicated by the Engineer.

The following paragraphs in specification OW 371 must be read in conjunction with this technical specification:

7.15, 16.12 and 16.13.

The Contractor shall take all necessary measurements and dimensions on site prior to manufacturing and installation.

BA 03.03.02 Joints in gutters, valleys, etc

150 mm overlap sealed with an approved silicone and riveted together with two rows of sealed pop rivets. Linings to valleys and secret gutters, etc, shall have an overlap of 225 mm.

BA 03.03.03 Accessories and ancillary items

(a) End stops:

0,6 mm thick Chromadek/galvanised finished end stop shall be joined to gutter on site and sealed as for joints in gutters. Thickness to be the same as for gutter.

(b) Outlets:

0,6 mm thick Chromadek/galvanised finished outlets shall be fixed to gutter with pop rivets and sealed with an approved silicone. Outlet to slip into down pipe. Thickness shall be the same as for gutter.

(c) Fascia straps:

25 mm wide x 1,0 mm thick galvanised straps at +/- 686 mm c/c.

(d) Corner joints:

Overlaps are to be neatly mitred, pop riveted together and sealed with an approved silicone.

(e) Sealant:

Clear silicone sealant with an amine cure system and primer shall be used to waterproof gutters and down pipes.

BA 03.03.04 Down pipes

Standard sizes:

100 x 75 x 0,6 thick Chromadek/galvanised down pipes

100 x 100 x 0,8 thick Chromadek/galvanised down pipes

Dark colours shall be used where indicated by the Engineer.

Down pipes are to have double-seamed joints. Down pipes, shoes, offsets, etc, shall be joined together by means of 100 mm slip joints and pop riveted together.

The Contractor shall take all necessary measurements and dimensions on site prior to manufacturing and installation.

BA 03.03.05 **Down pipe accessories**

(a) Brackets:

Standard galvanised brackets shall be spaced at centres not exceeding 2,4 metres.

Brackets shall be primed and painted with water-based pure acrylic emulsion paint as specified in Technical Specification BJ 03.01.03(g).

(b) Shoes, offsets and spreaders:

Shoes, offsets and spreaders must be manufactured from 0,8 mm thick Chromadek/galvanised material, cut and mitred to suit. All joints are to be sealed with an approved silicone sealant.

BA 03.04 **GENERAL**

The Contractor shall be responsible to ensure the stability of the supporting structure during and after the removal of existing roof cladding and sheeting.

SABS 1200 HB: Cladding and Sheeting shall be applicable for the erection of all new roofs.

The Contractor shall submit a 3-year guarantee for the watertightness of the roofs and for workmanship. **The manufacturer must issue a certificate of acceptance and compliance on completion to the client.**

BA 04 **DETAIL OF REPAIR WORK**

The detail of the work is described in the Schedule of Quantities.

BA 05 **MAINTENANCE**

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

All components forming part of the repaired/replaced work for roof coverings shall be maintained as part of the maintenance of installations as defined in Additional Specification SA: General Maintenance.

Maintenance shall include all repair work, replacing of components, routine inspections, fixing of defects or any other actions or rectifying measures necessary to maintain the perfect functional condition of the roof coverings in accordance with the operation and maintenance manuals and as specified. All roofs and rainwater goods shall be kept leak free.

Maintenance on the repaired/replaced work shall also include all other actions related to (or resulting from) maintenance, such as tightening or replacing of loose roof fasteners, premature corrosion of galvanising, replacing of sealant that has failed, and cleaning of gutters and down pipes of leaves and other rubbish.

Remuneration for maintenance of the roof coverings shall be deemed included in the tendered monthly payment for maintenance of the applicable installation.

BA 06 **MEASUREMENT AND PAYMENT**

BA 06.01 **INCLUSION OF COSTS**

Where applicable, standard SABS 1200 measurement and payment items shall be used for Structural Steelwork (1200 H) and Cladding and Sheeting (1200 HB).

All sheeting, cladding and accessories are to be supplied by a South African based manufacturer and the work carried out is subject to a three year written guarantee for watertightness and workmanship.

All material scheduled to be removed shall be deemed to be existing damaged material. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material used in repair work shall be of approved equal quality, colours, profiles, thickness, etc and shall in all cases match the existing materials and shall be fixed to existing material or surfaces.

All removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be removed or taken out shall be deemed to include the cleaning and perforation of the remaining sections, areas, or work to receive the new material or work specified.

Repair work shall also include all cutting, grinding, cutting into, welding, bending, strengthening, drilling, etc, necessary to repair or to improve the items or areas to match the existing.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pop rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc, required to leave the items and fully functional.

All new work is measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pop rivets, nails, adhesive, grout, putty, etc, as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc.

BA 06.02 **DETAILS OF MATERIAL TO BE USED**

For detail descriptions of materials, thicknesses, dimensions and ancillary items to be used, as specified in the various payment items of roof sheeting, cladding, flashings, etc, refer to the scheduled lists PROVIDED IN THE Particular Specifications.

BA 06.03 **SCHEDULED ITEMS**

Standard measurement and payment items shall be those used for Structural Steelwork (1200 H) and Cladding and Sheeting (1200 HB)

BA.01 **SUPPLY AND INSTALL RAINWATER GOODS**

(a) Description of material to be used:

(i) Description of itemUnit: m, No

The unit of measurement for rainwater goods installed shall be metre or number.

Sundry items such as stop-ends, bends, shoes, etc, are deemed to be included in the tendered rates per metre.

Separate items will be scheduled for each type, finish, shape, and when relevant, profile of rainwater goods. The rates tendered shall include full compensation for the cost of supplying, delivery, storing on Site, handling, moving, installing and fixing the goods complete with all necessary fasteners, etc as specified in BA 03.03 (all complete and subject to a three year written guarantee on watertightness and workmanship). The rates shall also cover the cost of cutting, notching and waste, and of all scaffolding, temporary supports, hoisting facilities and safety precautions (see Subclause 8.1.1 of SABS 1200 HB).

BA.02 **ALTERATIONS AND REPAIRS TO EXISTING STRUCTURES**

(a) Indication of repairs, alterations, removal or sealing, etc:

(i) Description of work to be repaired, altered, removed, sealed, etc Unit: As scheduled

The unit of measurement for alteration or repair work shall be as scheduled.

The tendered rates shall include full compensation for providing all labour, material and equipment required to carry out the work, for all preparatory work, for all additional costs to repair, refix, remove, cutting into, realign, taking off, temporary store etc as specified in the applicable Specifications and for carrying out the work scheduled in a workmanlike manner to leave the work to match all existing work and/or finishing-off and cleaning up when the work has been completed. Refer also to the inclusion of costs in BA 06.01

TECHNICAL SPECIFICATION**BB CARPENTRY AND JOINERY FOR ROOFS AND CEILINGS****CONTENTS**

BB 01	SCOPE
BB 02	STANDARD SPECIFICATIONS
BB 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
BB 04	DETAIL OF REPAIR WORK
BB 05	MAINTENANCE
BB 06	MEASUREMENT AND PAYMENT

BB 01 SCOPE

Carpentry and joinery shall mean the repair and maintenance of materials and components such as removal of existing timber roof trusses, purlins, ceilings, etc, and the installation of new timber trusses and other timber roof members, structural beams, purlins, battens and ceilings. This specification does not include work related to roof coverings and paintwork, which are specified elsewhere.

This specification covers the repair of existing timber members in roof trusses, the removal and replacement of existing timber members from roof trusses and associated timber roof members and ceilings. This specification also covers the supply, delivery and installation of new timber trusses, purlins, battens and beams for various types of timber related structures and ceilings.

The complete scope of repair work shall be as described in BB 04: Detail of repair work.

Maintenance of this part of the installation shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BB 02 STANDARD SPECIFICATIONS**BB 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

OW 371	-	Specification of Materials and Methods to be used (Fourth revision, October 1993)
SABS 0243	-	The design, manufacture and erection of timber trusses
SABS 266	-	Gypsum plasterboard
SABS 563	-	Stress-graded softwood: general structural timber
SABS 653	-	Softwood banding and battens
SABS 803	-	Fibre-cement boards
SABS 1245	-	Stress-graded softwood engineering timber

BB 02.02 ADDITIONAL SPECIFICATIONS

Technical Specification BA: Roof coverings
 Technical Specification BD: Walls
 Technical Specification BJ: Paintwork

BB 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS**BB 03.01 ADDITIONAL REQUIREMENTS FOR REPAIR OF TIMBER ROOF STRUCTURES****BB 03.01.01 Timber trusses****(a) Replacing timber trusses**

The Engineer shall inspect timber trusses for defects and establish which timber trusses must be replaced.

Reasons for replacing trusses will include but not be limited to the following:

- (i) Deflection exceeding acceptable limits;
- (ii) Inadequacy in design, eg structural strength, structural instability, load conditions;
- (iii) Decay of large portions of truss members (defective timber);
- (iv) Large portions of truss members having so many defects, eg cracked timber, corroded connector nail plates, etc, that it will be uneconomical to repair the defects.

(b) Repair of timber trusses

Repair work shall include but not be limited to the following:

- (i) Strengthening of truss members, connections, splices and anchorage at supports;
- (ii) Strengthening of truss members due to unforeseen loads, notching and cutting for services by other contractors;
- (iii) Repair of truss members where large knots and waness occur;
- (iv) Replacing metal plate connectors in cases of corrosion, incorrect application of connector plates, incorrect size of connector plates, unsymmetrically fitted connector plates, connector plates with teeth flattened, minimum bite of less than 65 mm of a connector plate on a truss member;
- (v) Replacing of decayed timber, particularly rafter ends at roof overhangs and at roofing screws. Timber subjected to insect attack and fungal decay should be treated with an appropriate preservative. Where there is a low risk of decay or insect attack, two coats of Creosote may be applied to the timber. Refer to clauses 8.1 and 8.2 in OW 371 for the preservation of wood in high-risk regions;
- (vi) Replacing and/or repair of cracked timber members. Galvanised connector plates and metal straps may be considered;
- (vii) Maximum slenderness ratio must be less than 180 for compression members that carry forces resulting from dead and live loads. Compression members 36 mm thick and longer than 1,8 m must have a continuous longitudinal runner centrally placed (or T-bracing) and properly connected and braced. For members that resist loads caused by wind, the slenderness ratio must be less than 250;
- (viii) Plumb of trusses should not exceed 100 mm or total span/20 whichever is the least;
- (ix) Exposed portions of the trusses shall be painted to match existing appearance.

The roof trusses shall be fully braced. The Engineer shall give instructions regarding the provision of bracing members to the roof system.

BB 03.01.02 Purlins (for sheeted roofs, battens for tiled roofs)**(a) Replacing timber purlins**

The Engineer shall inspect timber purlins for defects and possible reuse. The Engineer shall establish which timber purlins need to be replaced.

Reasons for replacing purlins will include but not be limited to the following:

- (i) Decayed timber, particularly at gable overhangs;
- (ii) Broken, warped and brittle timber;
- (iii) Worn-out roof screw holes;
- (iv) Inadequacy in design, eg structural strength and excessive deflection due to large spans;
- (v) Inappropriate spacing of purlins for the specific roof covering.

(b) Repair of timber purlins

Repair work shall include but not be limited to the following:

- (i) For roof pitches under 45° the purlins shall be erected on edge (narrow edge).
- (ii) All purlins shall be secured to rafters at each intersection in addition to nails. In roof voids a single 3,2 mm diameter galvanised wire tie bound twice with twisted ends or a galvanised bent plate connector shall be used for securing purlins to rafters. On roof overhangs only galvanised bent plate connectors shall be used for securing purlins to rafters.
- (iii) Splices shall be staggered. Splices that do not conform to the requirements of clause 8.8 of OW 371, or clauses 8.5.1 and 8.5.2 of SABS 0234, must be repaired. Nailed galvanised plate connectors on either side of purlins are also acceptable.
- (iv) Exposed portions of the purlins shall be painted to match existing appearance.

Skew nailing of purlins to trusses shall not be closer than 30 mm from the edge of the member.

BB 03.01.03 Structural timber**(a) Replacing structural timber**

The Engineer shall inspect members of structural timber, ie beams and columns, for defects and shall establish which of these members must be replaced. Reasons for replacement will include but not be limited to the following:

- (i) Deflection exceeding acceptable limits;
- (ii) Inadequacy in design, eg structural strength, structural instability, load conditions;
- (iii) Decay of a large portion of the member (defective timber);
- (iv) Replacing of decayed timber, particularly at ends of beams.

(b) Repair of structural timber

Repair work shall include but not be limited to the following:

- (i) Strengthening of members, connections, splices and anchorage at supports;
- (ii) Strengthening of members due to unforeseen loads, notching and cutting for services by other contractors;
- (iii) Exposed portions of structural timber shall be painted to match existing appearance;
- (iv) Bolt connections shall be in accordance with the requirements of SABS 0163.

BB 03.01.04 Ceilings

New ceilings shall be installed in accordance with section 9 of OW 371.

(a) Branding to ceilings

Branding to ceilings shall be replaced where:

- (i) Ceiling boards are replaced;
- (ii) Branding is broken, rotten and beyond any further use.

New branding shall be provided in accordance with clause 9.4 of OW 371. The branding shall continue over at least three bays and shall be staggered to ensure that splices do not all occur in one line. Branding must be provided for light fitting support.

(b) Gypsum ceiling boards

Repairs to existing ceilings shall include the installation of new 6,4 mm thick gypsum ceiling boards with metal H-section jointing strips. The new ceiling boards shall be nailed to branding with galvanised or cadmium-plated clout-headed nails.

Gypsum ceiling boards shall not be used in wet areas such as in ablutions, abattoirs, kitchens and bathrooms.

Ceiling boards shall be in long lengths, symmetrically arranged with smaller panels, closely butted and secured at 150 mm centres to branding as specified.

Where it is necessary to replace ceiling boards onto existing branding, new boards shall be installed by first drilling through and then securing with cadmium-plated flat headed wood screws, or alternatively by shot nailing to suit, to avoid unnecessary vibration or impact damage to adjacent elements.

Gypsum cove cornices 76 mm wide shall be provided where existing cornices are to be replaced.

Existing trap doors in ceilings shall be reused. If required, new 650 x 650 mm trap doors shall be installed.

No ceiling insulation must be provided unless specified.

Painting of the ceiling shall be done in accordance with Technical Specification BJ: Paintwork.

(c) Fibre cement ceiling boards

Fibre cement ceiling boards shall be installed in wet areas such as in ablutions, abattoirs, kitchens and bathrooms.

Fibre cement ceiling boards shall be 6 mm thick, complying with the requirements of SABS 803 and of the flat pressed type.

The boards shall be nailed to the branding with 2 mm diameter galvanised or cadmium-plated clout-headed nails, spaced at 100 mm centres at edges of boards and 150 mm centres along the intermediate branding. Ceiling boards shall be in long lengths, symmetrically arranged with smaller panels as required and closely butted.

Replacement of new ceiling boards onto existing branding shall be done as described in BB 03.01.04(b) above.

Fibrous plasterboard cove cornices to ceilings shall be of 100 mm girth, provided by an approved manufacturer. Gypsum cove cornices 76 mm wide can be used in kitchens and bathrooms of houses. Powder-coated wall angles 25 mm wide shall be used for cornices in abattoirs.

Existing trap doors in ceilings shall be reused. If required, new 650 x 650 mm trap doors shall be installed.

Painting of the ceiling shall be done in accordance with Technical Specification BJ: Paintwork.

(d) Exposed T-system suspended ceilings

Repairs to existing suspended ceilings will include but not be limited to the following:

- (i) Replace damaged panels with new ceiling boards;
- (ii) Replace sections of damaged T-strips or H-strips;
- (iii) Replace cornices;
- (iv) Tension, fix and realign existing hangers;
- (v) Install new hangers as required;
- (vi) Clean ceiling boards, including washing of the ceiling boards with a mixture of water and sugar soap and wiping dry, or painting the ceiling boards.

(e) External gable fibre cement boards for side cladding

External tongued and grooved boarding shall be removed and replaced with 6 mm thick flat pressed fibre cement boarding. The boarding shall be fixed to new bracing as specified in this section. Provide painted 25 x 25 mm meranti quarter rounds at edges as required.

The boarding shall be painted in accordance with Technical Specification BJ: Paintwork.

BB 03.01.05 Fascia and barge boards

Repairs to fascia and barge boards shall include but not be limited to the following:

- (a) Replace damaged and broken fibre cement fascia and barge boards.
- (b) Replace missing, corroded and damaged H-profile jointing strips.
- (c) Replace all nails with suitable length and diameter brass screws. Provide nylon plugs to timber where necessary.
- (d) Align and fix existing fascia and barge boards.
- (e) Paint fascia and barge boards in accordance with Technical Specification BJ: Paintwork. All sides including the edges must be painted.
- (f) The roof covering shall cover the top edge of the fascia on gables.

BB 03.01.06 Timber trusses, purlins and battens

(a) Existing timber trusses and roof structure

- (i) General
 - (1) The Contractor shall establish proper access and install adequate lighting to the roof voids to enable detailed inspections of structural deficiencies by the Engineer. Temporary scaffold planks shall be laid across bottom chords to allow access to all critical areas. After inspection, the extent of repairs is to be agreed with the Engineer.

- (2) All completed work shall be inspected and approved by the Engineer.
 - (3) All new timber work shall comply with SABS 0163.
 - (4) Timber grade shall be S5 and replacement sizes are to match existing unless otherwise agreed.
 - (5) Repair details on attached sheets R1 to R3 shall form the basis for repairs. Any deviations from or variations to these details are to be approved by the Engineer. Any types of failure not covered by these details shall be discussed with the Engineer who will then issue the necessary repair instructions.
- (ii) Procedures (watermarked and slightly rotten members)
- (1) Watermarked and slightly rotten members need not be replaced or repaired if the following test indicate these members to be satisfactorily:

Using a 3,5 mm nail, make scratch marks in all these members to expose good unaffected timber. If scratch depth is 2 mm or less, it is acceptable and these members need only to be treated as described in (2) below.
 - (2) The members shall be wire-brush cleaned, free of any loose or deleterious material, then treated with 1 coat of creosote, or similar approved. Apply by brush to affected areas and 200 mm beyond, all to the manufacturer's specifications. Safety precautions shall be taken against possible health or fire hazards as specified by manufacturer.
- (iii) Procedures (cracked and failed members)
- (1) All members that are cracked right through will be regarded as failed members. Members with minor longitudinal cracks shall be repaired, following procedure 5 on sheet R3.
 - (2) The Contractor must allow for propping and/or bracing at failed members to ensure complete structural stability during repairs.
 - (3) Failed members as indicated in details 1 to 4 on sheets R1 to R3 shall be realigned by means of clamping with temporary backing pieces, after which repairs can proceed.
 - (4) Members that are damaged too badly to effect repairs will have to be replaced or doubled up to suit the circumstances.
 - (5) Once all repair work has been completed the Contractor must clean out the ceiling void, free of all rubbish, excess building material and all other foreign matter and make good any damage caused to ceilings, etc.
 - (6) Any alternative repair proposal shall be submitted in writing to the Engineer.

BB 04 DETAIL OF REPAIR WORK

The detail of the work is described in the Schedule of Quantities.

BB 05 **MAINTENANCE**

[Note: There will be no maintenance work required for carpentry and joinery for roofs and ceilings in this contract.]

This specification shall be read in conjunction with Additional Specification SA: General Maintenance.

All components forming part of this specification for carpentry and joinery for roofs and ceilings shall be maintained as part of the maintenance of installations as defined in Additional Specification SA: General Maintenance.

Maintenance shall include all repair work, replacing of components, routine inspections, fixing of defects or any other actions or rectifying measures necessary to maintain the perfect functional condition of carpentry and joinery for roofs according to the operation and maintenance manuals and as specified in this specification.

All timber trusses and members of timber roofs shall be preserved in a good condition, ie failure free, free from insect attack and decay due to exposure to moisture.

Maintenance on the carpentry and joinery for roofs shall also include all other actions related to (or resulting from) maintenance, such as:

- Cleaning of the site and ceiling voids of rubbish and dirt;
- replacing any element that has failed;
- tightening, fixing or replacing of loose fasteners, premature corrosion of galvanised items like screws, nail plates, etc.

Remuneration for maintenance of the complete carpentry and joinery for roofs shall be deemed included in the tendered monthly payment for maintenance of the applicable installation.

BB 06 **MEASUREMENT AND PAYMENT****BB 06.01** **MEASUREMENT AND RATES****BB 06.01.01** **General inclusion of costs****Notes:**

All material scheduled to be removed shall be deemed to be existing damaged materials in small or large sections. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material used for repair work shall be of approved equal quality, colours, profiles, thickness, etc and shall in all cases match the existing materials and shall be fixed (internally or externally) to existing material or surfaces.

All replacement, removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be removed or taken out shall be deemed to include the cleaning and preparation of the remaining sections, areas, or work to receive the new material or work specified.

Repair work shall also include all cutting, grinding, cutting into, welding, bending, strengthening, drilling, etc to repair or to improve the items or areas as new and to match the existing.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pip rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc to leave the items as new and totally functional.

All new work are measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pip rivets, nails, adhesive, grout, putty, etc, as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc.

Unless scheduled otherwise, new ceilings and ceilings in patchwork shall be fixed to existing brandering and the Contractor must take special care not to damage the existing brandering when removing damaged ceiling boards.

BB 06.02 **SCHEDULED ITEMS**

NEW WORK

BB.01 **Structural timber:**

- (a) Plates (sizes indicated) Unit: m
- (b) Beams (sizes indicated)..... Unit: m
- (c) Joists (sizes indicated) Unit: m
- (d) Rafters (sizes indicated)..... Unit: m
- (e) Purlins (sizes indicated) Unit: m
- (f) Roof trusses complete (drawing number indicated) Unit: number
- (g) Etc

The unit of measurement shall be the metre of individual types of timber elements or number of complete trusses installed.

The tendered rates shall include full compensation for the supply of all materials, manufacture, cutting, waste, jointing, scaffolding, temporary supports, hoisting facilities and installation of the timber as specified, scheduled or shown on the Drawings.

BB.02 **Ceilings:**

- (a) Ceiling boards, trapdoors, cornices, cover strips, etc
(type and/or thickness indicated):
 - (i) Thickness, shape and description of applicationsUnit: m², m, number
 - (ii) Etc for other thicknesses, shapes, etc

The unit of measurement shall be the number, metre or square metre of ceiling boards, trapdoors, cornices, etc installed complete as specified and scheduled.

The tendered rates shall also include full compensation for the construction of the ceilings, trapdoors, cornices, cover strips, etc including jointing strips, insulation blankets and brandering as specified.

BB.03**Joinery:**(a) Items measured by number:

- (i) Doors, etc (type and size indicated) Unit: number
- (ii) Etc for other items measured by number

(b) Items measured by linear metre:

- (i) Skirtings, rails, cover strips, quadrant beads, etc (size indicated) Unit: m
- (ii) Etc for other items measured by length

(c) Items measured by area:

- (i) Eaves covering, etc (type and thickness indicated) Unit: m²
- (ii) Etc, for other items measured by area

The units of measurement shall be the number, metre or square metre of each type and/or size of joinery item specified and installed complete.

The tendered rates shall include full compensation for the supply of all materials, manufacture, cutting, waste, fixing, scaffolding, temporary supports, hoisting facilities and installation of the joinery items.

Ironmongery to be included in the rates tendered for doors shall be as specified in the Technical Specification BD: Walls.

New joinery, will except where otherwise specified, be fixed or hung to existing material or surfaces.

ALTERATION WORK**BB.04****Alterations and repairs to existing structures:**(a) Indicate if repairs, alterations, removal or sealing, etc:

- (i) Description of individual items to be repaired, replaced, altered, removed, sealed, etc Unit: m³, m², m, number

The unit of measurement for items repaired, replaced, altered, removed, sealed, etc shall be cubic metre, square metre, metre or number as scheduled. No distinction between sizes or profiles will be made for the removal of structural timber elements.

The tendered rates shall include full compensation for all costs to repair, refix, remove, cutting into, re-align, taking off, handling, temporary store, scaffolding, temporary supports, hoisting facilities and preparing existing remaining material or surfaces where applicable to receive new items as well as for credit for the redundant material becoming the property of the Contractor, etc as specified in the Standard and Technical Specifications and shall allow for all necessary labour, plant and new material needed for the repairs, replacement or alterations, etc to leave the scheduled items as new and to the approval of the Engineer. Refer also to the general inclusion of costs in BB.06.01.01."

BB.05 Repairs to watermarked and slightly rotten timber roof members:Unit: m

The unit of measurement shall be the linear metre of timber roof members repaired as specified. No distinction will be made for size, type of member or position.

The tendered rate shall include full compensation for the complete repair work, wire brushing, creosote, etc. as specified by the Engineer.

BB.06 Repairs to damaged masonry, plastering and surface finishes:

- (a) Items measured by number:
 - (i) Description of item..... Unit: No
 - (ii) Etc.....Unit: m

- (b) Items measured by linear metre:
 - (i) Description of item..... Unit: No
 - (ii) Etc.....Unit: m

The unit of measurement shall be the number or metre as applicable to each item.

The tendered rates shall include full compensation for the making good of masonry (stock or face bricks), beam-filling, plastering, painting, closing ends to troughs of sheet metal roof sheeting, repairs to structure at ends of rafters and purlins, protruding through brick walls, etc.

The tendered rate shall also cover the cost of cutting, notching and waste and of all scaffolding, temporary supports, etc.

BB.07 Painting to top cords of timber trusses in roof voids:..... Unit: m

The unit of measurement shall be the metre.

The tendered rate shall include full compensation to prepare existing top cords (where applicable) to receive one coat creosote. No distinction will be made for size, type, new or existing members. The rate shall also cover the cost for waste, all scaffolding, etc.

BB.08 Painting of existing members in overhangs:Unit: m

The unit of measurement shall be the metre.

Separate items will be listed for paint and/or creosote as specified.

The tendered rate shall include full compensation to prepare existing overhangs to receive paint or creosote as specified. No distinction will be made for size of existing members. The rate shall also cover the cost for waste, all scaffolding, etc.

TECHNICAL SPECIFICATION**BC WATERPROOFING OF CONCRETE ROOFS****CONTENTS**

BC 01	SCOPE
BC 02	STANDARD SPECIFICATIONS
BC 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
BC 04	DETAIL OF REPAIR WORK
BC 05	MAINTENANCE
BC 06	MEASUREMENT AND PAYMENT

BC 01 SCOPE

This specification covers the repair/replacement of existing cement screeds and waterproofing, including all sundries, the removal of waterproofing and the supply, delivery, installation of new cement screeds, waterproofing and sundries for various types of concrete roofs.

Waterproofing shall mean the work to be carried out to repair/replace and maintain waterproofing materials and components, such as the repair/removal and maintenance of existing cement screeds and waterproofing and the installation of new cement screeds and waterproofing. This specification does not include work related to concrete work, plastering, gutters and downpipes specified elsewhere.

The complete scope of the repair work shall be as described in BC 04: Detail of repair work.

Maintenance of this part of the installation shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BC 02 STANDARD SPECIFICATIONS**BC 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments to date of the following specifications, publications and codes of practice, shall be read in conjunction with this specification and shall be deemed part to form part thereof:

PW 371-	Specification of Materials and Methods to be used (Fourth revision, October 1993)
SABS 10021	- SABS code of practice: Waterproofing of buildings.

BC 02.02 ADDITIONAL SPECIFICATIONS

Technical Specification BE: Floors
Technical Specification BF: Structural concrete

BC 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS**BC 03.01 ADDITIONAL REQUIREMENTS FOR REPAIR OF WATERPROOFING ON CONCRETE ROOFS****BC 03.01.01 Introduction**

Section 6 Parts 6.4.1, 6.4.2 and 6.4.4 of OW 371 shall be adhered to when open concrete roofs are waterproofed. Existing waterproofing that leaks shall be replaced.

BC 03.01.02 General

Waterproofing materials shall be transported, handled and stored with care and laid strictly in accordance with the manufacturer's instructions. A clean, dry, smooth, firm and structurally adequate base with a fall of at least 1 in 50 (depending on the material selected) is required, with drainage to gutters and/or rainwater outlets on roof edges, as relevant. Attention shall be given to the detailed design of openings, projections, gutters, down pipes and finishes to make adequate provision for run-off water and to minimise blockages.

Corners and edges shall be covered or angle-rounded. Run-off over the edges of slabs shall be eliminated as this causes stains to the building. Fillets of 75 x 75 mm shall be provided at upstand corners.

The necessary gradient for waterproof membranes are normally provided on top of structures in low-density screeds and then finished, if necessary, with a cement/mortar topping. Screeds and toppings shall be of sufficient quality to provide a firm base. The following screed characteristics are suggested for waterproofing purposes:

- (a) Compressive strength of at least 25 MPa at 28 days;
- (b) Steel-trowel finish (light);
- (c) Drying shrinkage of less than 0,2 % when tested in accordance with the testing conditions specified in SABS 836;
- (d) Minimum screed thickness of 40 mm;
- (e) Maximum moisture content of screeds:
 - (i) Applications with a density of less than 500 kg/m³ : 10 %
 - (ii) Applications with a density exceeding 500 kg/m³ : 7 %.

The screed should be cast or sawn into panels that do not exceed 9 m² to cater for drying shrinkage and to control cracking.

BC 03.02 MATERIALS

The more commonly used waterproofing materials are listed below, as well as some general comments on these materials. It is suggested that the manufacturers be consulted with regard to specific products. The Engineer's approval of the selected product shall be obtained prior to ordering.

BC 03.02.01 Bituminous materials

- (a) Polymer modified bitumen membranes
- (b) Reinforced bitumen emulsions.

BC 03.02.02 Plastomeric membranes

Plastics such as polyvinyl chloride (PVC) are applied as single-layer systems and are loose-laid or fully bonded. A high degree of skill is required for the laying of these membranes.

BC 03.02.03 Reinforced liquid applied systems

Membranes based on acrylic polymer (or modified acrylic polymers) binders, reinforced with woven polyester or polypropylene fabrics, perform well as waterproofing membranes and are durable. These fully bonded systems require detailed specifications and strict supervision during application to prevent malpractice.

BC 04 DETAILS OF REPAIR WORK

The Schedule of Quantities indicates approximate quantities of work. Detailed instructions will be issued during construction.

BC 05 MAINTENANCE

[Note: There will be no maintenance work required for waterproofing of concrete roofs in this contract.]

This specification shall be read in conjunction with Additional Specifications SA: General Maintenance.

All components that form part of the waterproofing of concrete roofs shall be maintained during the maintenance phase of the Contract.

Maintenance shall include all repair work, replacing of components, routine inspections, repairing of defects or other actions or rectifying measures required to maintain the perfect functional condition of waterproofing on concrete roofs in accordance with the operation and maintenance manuals and as specified. All roofs shall be kept leak-free and watertight.

Maintenance of the waterproofed concrete roofs shall include all related actions such as replacing/repairing loose and blistering waterproofing, including cracked waterproofing membranes, loose seams, painting of waterproofing membranes, and cleaning and removing rubbish from waterproofed concrete roofs.

Remuneration for maintenance of the complete waterproofing of concrete roofs shall be deemed included in the tendered monthly payment for the maintenance thereof.

BC 06 MEASUREMENT AND PAYMENT**BC.01 MEASUREMENT AND RATES****BC.01.01 General inclusion of costs****Notes:**

New waterproofing material scheduled shall be deemed to include all preparation of existing concrete or waterproofed areas and jointing of new to existing material. Where new material is to join existing material, the new material shall be of the same type and system as the existing waterproofing system. All waterproofing shall come with a ten year written guarantee for water-tightness and the cost of such guarantee shall be deemed to be included in the applicable tendered rates.

BC.02 **SCHEDULED ITEMS**

NEW WORK

BC.02.01 **Approved waterproofing system to:**

(a) Description of waterproofing system:

(i) Area of application or description of detailed item Unit : m², m, number

The unit of measurement shall be the square metre, meter or number of areas or items waterproofed as specified and scheduled.

The tendered rates shall include full compensation for the supplying, delivering, storing on site, handling, moving, applying or installing and fixing the waterproofing system complete with all necessary sundry items, such as forming turn-ups or turn-downs, any flashing strips, dressing waterproofing around pipes and into outlets and channels.

The tendered rates shall also cover the cost for cutting and waste and for scaffolding, hoisting facilities, etc. All turn-ups and turn-downs will be deemed to be included in the area measured for the waterproofing and will not be paid for separately.

ALTERATION WORK

BC.02.02 **Remove existing waterproofing and sundry items:**

(a) Description of waterproofing material to be removed and location Unit: m²

(b) Etc. for other material and locations

The unit of measurement shall be square metre of material removed.

The tendered rate shall include full compensation for the removing of existing waterproofing, flashing strips, sundry items, etc.

BC.02.03 **Prepare existing surfaces:**

(a) Prepare existing concrete surface to receive new screed as specified..... Unit: m²

(b) Prepare existing concrete or screeded surface to receive new waterproofing system Unit: m²

The unit of measurement shall be the square metre of the exposed surface prepared to receive the new screed or waterproofing material.

The tendered rates shall cover the cost for preparing the existing surfaces as specified and scheduled in (a) and (b) to receive new screeds or waterproofing.

BC.02.04 **Roof screeds:** Unit: m²

The unit of measurement shall be the square metre of exposed surfaces to be screeded.

The tendered rate shall include all costs for supplying, delivering, storing on site, handling, etc of the materials necessary for the screed, including mixing and laying of screeds to currents and falls and forming of sundry items such as fillets, etc complete. The tendered rate shall also cover the cost for forming of screeds around outlets, waste, and of all scaffolding, temporary supports, hoisting facilities, etc.

BC.02.05 **Repair bituminous based waterproofing system** Unit : m²

The unit of measurement shall be the square metre of the horizontal and vertical surfaces of waterproofing repaired to the approval of the Engineer. All turn-ups and turn-downs will be deemed to be included in the area measured for the waterproofing and will not be paid for separately.

The tendered rate shall include all costs for supplying, delivering, storing on site, handling, moving, installing and fixing the waterproofing system complete with all necessary sundry items, such as flashing strips, dressing waterproofing around pipes and into outlets and channels. The tendered rate shall also cover the cost of cutting and waste and for scaffolding, hoisting facilities, etc.

TECHNICAL SPECIFICATION**BD WALLS****CONTENTS**

BD 01	SCOPE
BD 02	STANDARD SPECIFICATIONS
BD 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
BD 04	DETAIL OF REPAIR WORK
BD 05	MAINTENANCE
BD 06	MEASUREMENT AND PAYMENT

BD 01 SCOPE

This specification covers the repair and maintenance of existing interior and exterior walls including all related building elements such as plastering, partitioning, wall tiling, windows, doors, etc, which form an integral part of an installation.

In determining the remedy for any repair work, the Engineer must take the climatic conditions in which all building elements have to function into consideration. Allowance should be made accordingly for the strength and durability of all components in relation to their purpose and application.

This specification does not include any work related to paintwork as this is specified elsewhere.

The complete scope of repair work shall be in accordance with the section BD 04: Detail of repair work.

Maintenance of this part of the installation shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BD 02 STANDARD SPECIFICATIONS**BD 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof. All other relevant and applicable SABS regulations are also to be considered as minimum requirements, and in particular SABS 0400: The Application of the National Building Regulations.

OW 371	-	Specification of materials and methods to be used (Fourth revision, October 1993)
SABS 022	-	Glazed ceramic wall tiles and fittings
SABS 227	-	Burnt clay masonry units
SABS 545	-	Wooden doors
SABS 622	-	Gypsum cove cornice
SABC 680	-	Glazing putty for wood and steel sashes
SABS 727	-	Windows and doors made from rolled mill steel sections
SABS 10107	-	The fixing of glazed wall tiles
SABS 1236	-	Silvered glass mirrors for general use
SABS 1263	-	Safety and security glazing materials for buildings

BD 02.02 ADDITIONAL SPECIFICATIONS

Technical Specification BG: Metalwork
 Technical Specification BH: Fittings
 Technical Specification BJ: Paintwork

BD 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS**BD 03.01 ADDITIONAL REQUIREMENTS FOR REPAIR OF PLASTERED AND UNPLASTERED WALL SURFACES****BD 03.01.01 Introduction**

A detailed survey of all existing building elements may reveal the necessity for remedial work of varying degree. The Engineer shall make an assessment of all aspects that need to be addressed.

BD 03.01.02 Plastering: General

All plaster shall comply with the requirements of SABS 523 and section 14 of PW 371. All plastering shall be painted in accordance with Technical Specification BJ: Paintwork, or tiled according to this specification BD.

The Engineer shall inspect the plaster surfaces and establish which wall plastering must be repaired. Reasons for replacing existing plastering will include, but not be limited to the following:

- (a) Excessive plaster cracking
- (b) Loose (delaminated) and spalling plaster
- (c) Dusting
- (d) Scaling and flaking
- (e) Defective plaster mix.

All chases shall be marked out in straight lines and neatly cut on either side of the recess for the pipe/conduit with an angle grinder. The width of the removed plastering must extend at least 30 mm beyond the edge of the chasing. Pipes or conduits shall be fixed before commencing grouting and plastering.

After the pipe has been put in place, the void shall be filled with a non-shrink cement grout of 60 MPa compressive strength at 28 days. The chases shall then be covered by fixing with shot-fired nails an expanded mesh strip (30 mm longway x 10 mm shortway x 0,5 mm thick expanded metal lath) before applying the final plaster.

BD 03.01.03 Plastering: Walls of wet areas

Where necessary, hack off and remove existing internal plaster to walls. The substrates must be prepared to be sound, free from cement, grout, laitance, loose or segregated materials, voids or flaws and substances that could interfere with bonding of the new plaster. This preparation work can be done by means of chipping away with a chisel, steel-wire brush and angle grinders to the satisfaction of the Engineer. Smooth concrete must be chipped mechanically to prepare for bonding of new plaster. Before plastering commences, the substrates must be well wetted with clean water.

Only approved ready-mixed or pre-mixed bagged plaster mortar with 10 MPa compressive strength or equivalent may be used for plastering. Mix a liquid waterproofing admixture in a dilution of one part by volume with ten parts by volume of clean water. The diluted admixture is added to the appropriate dry cement/sand mixture. The mortar shall be produced in such quantities that will be used within one hour after mixing. The finished plasterwork shall be of an even and smooth trowelled surface finish.

When dry, apply two coats of an approved water dispersed epoxy resin coating to the plastered surfaces of the walls that are to be painted.

BD 03.01.04 External plastering

The Engineer shall mark out areas that need to be renovated. The Contractor shall neatly cut with an angle grinder in straight lines the edges of the poor patches of plaster that must be removed.

The substrate of the brick walls must be prepared to be sound, free from cement grout, laitance, loose or segregated material, voids or flaws and substances that might interfere with the bonding of the new plaster.

The surface must not be powdery or crumbly, and must exhibit adequate tensile strength. The preparation work can be done by means of chipping away with a chisel, steel-wire brush and angle grinders to the satisfaction of the Engineer.

Smooth surfaces must be chipped to provide mechanical bonding for new plaster. Before plastering commences the substrate must be well wetted with clean water.

Only approved ready-mixed or pre-mixed bagged plaster mortar with 5 MPa compressive strength or approved equivalent may be used for plastering. The Contractor shall submit the design mix with the volume of water to be added to the mortar mix for approval by the Engineer. An approved bonding agent must be added to the mortar mix.

The mortar shall be produced in quantities that will be used within one hour after mixing. Care shall be taken not to mix old mortar into any new batch.

The finished plasterwork shall be made even and smooth by means of a wooden trowel (surface finish with rounded edges at sharp corners) to the satisfaction of the Engineer. The plasterwork shall be cured for seven days by any approved method to prevent loss of moisture.

Three (3) test cubes shall be taken for every 1000 m² plaster area. Cube moulds for nominal size 100 mm complying with the requirements of SABS Method 863 must be used. Final instructions for sampling, moulding, cutting and testing will be issued to the Contractor on site.

BD 03.01.05 Rough-cast plaster

Rough-cast plaster shall be applied in two coats. The undercoat shall be composed of one part cement and five parts sand finished with a wooden float. The finishing coat shall be composed of one part cement and three parts stone aggregate that will pass through a 4 mm sieve. The finishing coat shall be flicked on with a machine before the undercoat has set to obtain an even texture to match the existing rough-cast plaster.

Where the undercoat has already been plastered, the undercoat shall be prepared to receive the finishing coat. The surface of the undercoat plaster shall be chipped adequately to form a key and wetted before the finishing coat is applied.

BD 03.01.06 Fine rough-cast plaster

Fine rough-cast plaster shall be as for rough-cast plaster but the finishing coat shall be composed of one part cement and three parts coarse sand.

BD 03.01.07 **Internal plastering**

The surface of internal plaster shall be steel trowelled to a smooth, even and true finish. External plaster shall be finished to a true and even surface with a wood float. All plaster surfaces shall be free from blemishes, cracks, blisters or other defects. Plaster shall turn into reveals and soffits of openings, and all angles shall be true and straight with salient angles slightly rounded.

Plastering of a surface shall be executed in one operation, as no joint marks will be allowed. Plaster on walls shall not be less than 12 mm or more than 20 mm thick and plaster on concrete shall be not less than 10 mm or more than 15 mm thick, except where specifically specified otherwise.

Only approved ready-mixed or pre-mixed bagged plaster mortar with 5 MPa compressive strength or approved equivalent may be used for plastering. The Contractor must submit the design mix with the volume of water that will be added to the mortar mix to the Engineer for approval.

BD 03.02 **PARTITIONS**

All internal non-load-bearing walls shall be inspected and the Engineer shall determine whether partitioning such as laminated plastic particleboard, polyester painted steel, vinyl clad gypsum panels or any other demountable partitioning should be replaced.

Where partitioning must be relocated or replaced, such new partitioning shall be non-combustible, provide acoustical privacy and comply with SABS 0400.

All new partitions shall assemble into a rigid structure and all units shall be readily removable from either side without disturbing adjacent units.

All exposed trims for doorframes, glazing and skirting are to be of aluminium, or alternatively be painted in accordance with Technical Specification BJ: Paintwork.

The type of boarding and jointing or cover strips shall be in accordance with the Schedule of Quantities.

BD 03.03 **WALL CRACKS**

Wall cracks shall be evaluated to determine the nature and severity of the occurrence of the cracks. The Engineer shall inspect all plastered and unplastered walls and identify the underlying factors causing cracks. Repairs shall be carried out in accordance with the Particular Specifications.

BD 03.04 **FACE BRICKS**

Face bricks shall be inspected for dirt, efflorescence, staining, oil, paint, lichens and mosses, water, smoke and soot, rust, or damage caused by chemical reaction.

Where efflorescence appears, light brushing and hosing down with clean water is recommended for most cases. The brickwork must be saturated with clean water before applying any chemical and washed down with clean water afterwards. Cleaning can also be achieved with scrubbing, water jetting with cleaning agents and soaps, etc. Staining caused by non-water-soluble salts, such as vanadium, manganese and iron, shall be treated as follows:

- (a) Remove vanadium staining by washing the wall with a solution of 100 g caustic soda to 1 litre of water. (Use the corresponding secondary potassium salts where available, as these will be less likely to cause visible secondary efflorescence.) If secondary efflorescence occurs, wash it off with clean water.

- (b) Manganese stains must be removed using proprietary brand chemical compounds based on hydrochloric acid with modifiers and sodium fluoride. These solutions should be applied as recommended by the manufacturer.
- (c) Where rust/iron stains occur, wash the affected area with a solution of 50 g oxalic acid, 20 g sodium fluoride, 15 g citric acid in 1 litre of fresh, clean water. Apply the solution to a dry wall and leave it on the wall until the stain has dissolved. Wash down using a solution of 50 g bicarbonate of soda in one litre of water.

External environmental stains and smears caused by soot, smoke, industrial pollution and spillage of oil, paint and other compounds, including micro-organic growths such as fungi, lichens and mosses on brickwork, must be identified and dealt with in an appropriate and approved way.

Care shall be taken to test the effect of some of the chemicals and compounds for possible harmful effects on the colours of the brickwork and on adjacent materials, as well as for possible toxicity to human, animal and plant life. All cleaning procedures shall be carried out with full knowledge of all the potential dangers to human and animal health, and the appropriate safeguarding and precautionary measures shall be put in place.

BD 03.05 WALL TILING

BD 03.05.01 General

Tiling shall comply with the requirements of SABS 22 and section 15 of OW 371. The code of practice for the fixing of glazed wall tiles, SABS 0107 and the recommendations of the South African Ceramic Tile Manufacturer's Association (SACTMA) must be adhered to.

All tiled areas must be checked for damaged surfaces or to determine where tile adhesion to subsurface may turn out to be of non-satisfactory standard. In cases where tiled surfaces need to be redone, proper care shall be taken in removing all damaged tiles, as well as any adhesive remains on the subsurface.

Matching of existing size and colour should be pursued wherever possible.

BD 03.05.02 Glazed wall tiling

White glazed tiles 150 x 150 x 5 mm thick, first grade, must be laid in a cement-based powder adhesive, strictly in accordance with the manufacturer's specification. Drying periods for backgrounds and substrates must be strictly adhered to. All tiles must be correctly bedded. This can be achieved by using a 6 mm square notched wall trowel to spread the fixative to the required thickness of 6 mm. Bed the tiles dry and move them firmly into position, ensuring that they are in proper overall contact with the bed and form an even surface.

A minimum of 2 mm grouting joints shall be allowed between tiles. Under no circumstances should the tiles be butt-jointed. Do not fill joints between tiles until at least 24 hours after the tiles have been bedded. Ensure that the joints are free of tile adhesive residue and any foreign matter. Fill joints with waterproof white cement. Existing joints must be cleaned and refilled with new white cement.

BD 03.05.03 Ceramic wall tiling

Glazed ceramic wall tiles 230 x 115 x 11, 5 mm thick, with grade 1 acid resisting quality finish are to be used. Apply an approved epoxy grout into the tile joints and finish off with a wetted nosing tool to a smooth glazed finish. Ceramic tiles include special tiles, such as bull nose and corner tiles. Repairs include replacing damaged tiles and pointing between tiles with an approved epoxy grout.

BD 03.05.04 Corner protectors

Install 75 x 75 x 5 mm thick aluminium angle corner protectors to external vertical wall corners for protection with 8 mm diameter impact nails x 80 mm long @ 300 mm c/c to a maximum height of 1,6 m. Seal the interface gap with approved silicone.

Install for abattoirs and dairies 75 x 75 x 3 mm thick stainless steel grade 304 angle corner protectors, polished to a No 2B finish with a grit 180, to external vertical wall corners. Fix the corner protectors with 8 mm diameter impact nails x 80 mm long @ 300 mm c/c to a height of 1,8 m. The interface gap must be sealed with an approved polyurethane sealant.

BD 03.05.05 Expansion joints

Expansion joints for glazed wall tiling shall be provided at 3,5 m centres maximum (vertically and horizontally). The joints shall be 5 mm wide. Prepare the joints by cleaning them thoroughly. The joints shall be primed and sealed with an approved one component 5 x 5 mm white polyurethane joint sealant.

Expansion joints for ceramic wall tiling shall be provided at 4 m centres maximum (vertically and horizontally). The joints shall be 10 mm wide maximum. Prepare the joints by cleaning them thoroughly. The joints shall be primed and sealed with approved one component 10 x 10 mm white polyurethane joint sealant.

BD 03.06 WINDOWS**BD 03.06.01 General**

All windows shall be inspected to assess the level of workability, paying special attention to hinges, handles, stays, catches, etc. Should any window be found unsuitable due to damage to the frame, opening section or any other part thereof, such window shall be replaced.

The Contractor shall take great care to make sure that the appropriate waterproofing details are applied strictly to ensure adequate protection against any water penetration.

BD 03.06.02 Steel windows

The Engineer shall inspect for any deficiencies in residential and industrial type steel windows and cell windows. Where necessary, windows shall be serviced and repainted in accordance with Technical Specification BJ: Paintwork.

BD 03.06.03 Burglar bars to steel windows

Where manganese bars are incorporated in the fixed mullions of the windows, this shall be done in such a way that the bars are not wider apart than 15 cm/centre. The bars shall have at least a section of 30 x 16 mm, penetrating at least 100 mm in the lintels and sills. Heavy duty burglar bars shall be 15 mm diameter or 12 mm square. Loose burglar bars shall be site welded to the window frames.

BD 03.06.04 Timber windows

All wooden windows are to be inspected and treated according to the condition of the timber as stipulated in Technical Specification BJ: Paintwork.

BD 03.06.05 Aluminium windows

When working with mortar or plaster great care shall be taken to protect all aluminium sections from staining by applying a film protector or motor oil on the aluminium surface.

BD 03.07 GLAZING

BD 03.07.01 Glass

Cracked and broken glazing shall be replaced. The glazing and fixing of glass in buildings shall be carried out strictly in accordance with SABS Code of Practice 0137.

BD 03.07.02 Putty

Care shall be taken to remove all chipped, flaked or damaged putty. The Engineer shall indicate on site which putty must be replaced.

All new putty shall comply with the requirements of the SABS 680. The putty shall be delivered on the site in sealed containers marked with the SABS mark.

Type I putty as specified shall only be used for glazing in wood sashes and Type II only in steel sashes.

Paintwork on putty shall not commence until putty has properly dried out, which may necessitate the addition of an accelerating agent. The Contractor shall therefore take programming of trades in prison areas into consideration.

BD 03.08 DOORS

BD 03.08.01 General

All existing doors shall be inspected for the general condition and integrity of hinges, locking mechanisms, etc.

All steel doors shall comply with the requirements of SABS 727 and 1129 and section 13 of PW 371.

All new external doors are to be fitted with 1½ pair heavy duty hinges.

Door signage, such as door numbers, etc, shall be in accordance with Technical Specification BH: Fittings, and the Schedule of Quantities.

Special attention shall be given to the condition of striker plates and hinges that need to be replaced, or properly secured where possible. Doors shall be painted to the requirements of Technical Specification BJ: Paintwork.

BD 03.08.02 Doors, sidelights and fanlights

All wooden stock doors shall comply with the requirements of SABS Standard Specification 545 and section 8, clauses 8.33 and 8.34 of OW 371.

BD 03.08.03 Flush doors

The Contractor shall inspect all doors, internal and external. Where any door needs to be replaced, such door shall be a 40 mm thick solid laminated door as specified for interior or exterior use and shall be capable of withstanding the raking, deflection, puncture and moisture resistance tests for the desired application.

Unless otherwise specified, face veneer shall be rotary cut, and shall be of the timber specified, or where doors are to be painted, shall be of timber suitable for painting. Painting shall be done in accordance with Technical Specification BJ: Paintwork, and the Schedule of Quantities.

Edge strips for concealing the vertical edges of doors shall be of the same timber as the face veneer and for single doors and hinge edges of double doors shall not be less than 10 mm thick, and for rebated meeting edges of double doors not less than 20 mm thick. The top and bottom edges of doors showing end grain shall be sealed with lacquer or other suitable material if the edges were disturbed in any way.

BD 03.08.04 Toilet doors in ablutions

Doors showing signs of erosion due to water penetration shall be either replaced or cut short 150 mm from finished floor level. If the existing semi-solid door panel is to be retained, it should be cut short 150 mm from the floor level. A 38 x 50 mm SAP insert must be glued and nailed in at the bottom edge. The steel frame must also be cut short and filled in with grout at the cut edges and fixed to the wall with 2 x 8 mm diameter heavy duty impact nails.

BD 03.08.05 Doors for abattoirs and dairies

Doors in abattoirs and dairies shall be made of 0,5 mm white Chromadek sheet-metal glued onto 40 mm thick 16 kg/m³ density polystyrene core with chemical glue.

The door leaf shall be finished off around the edges with 46 x 30 x 2,5 mm thick anodised aluminium channels and sealed with white silicone sealant.

The doorframe shall be manufactured from 1,6 mm thick grade 430 stainless steel, polished to No 2B finish.

The existing timber door panels must be replaced with the above-mentioned type door panels. Where instructed the steel door frames will only be replaced if they are severely corroded and/or damaged. The new steel frames must be built into the brick walls with the necessary steel lugs (3 per side) and the core of the frame must be filled with mortar. All other requirements shall be complied with as specified in clause 13.6 of OW 371.

BD 03.09 IRONMONGERY

BD 03.09.01 General

All ironmongery shall comply with the requirements of section 11 of OW 371. All ironmongery shall be approved by the agent/representative before fixing. Articles shall be fixed with screws of similar metal and shall be eased, oiled, adjusted and left in perfect working order on completion.

All ironmongery shall be inspected to assess the level of workability, paying special attention to door handles, locks, door closers, door stops, door catches, fixing of these fittings, etc. Should any of these fittings be found unsuitable due to damage, corrosion, etc, they shall be replaced. Where existing holes in wood are worn out, these holes must be plugged with wood to receive the screws.

Toilet doors in ablutions must be fitted with approved D-type natural anodised aluminium pull handles and 150 x 150 mm plate. Install 15 mm diameter concealed steel roller ball catch with chromium-plated striker plate with circular hole for roller ball catch. Fix this plate to door frame with two aluminium pop rivets.

BD 03.09.02 Door locks

Each lock shall be provided with two keys and no key shall pass a second lock. All mortice locks, mortice latches and night latches, rim and cylinder rim night latches, and escutcheon for locks shall comply with the requirements of the SABS. The Contractor shall supply all screws, etc, required for completion of the work.

BD 03.09.03 Cupboard doors

Where required according to the Schedule of Quantities, built-in cupboard doors in sleeping quarters are to be provided with 2 x angle iron sections of 35 x 80 x 3 mm thick x 10 mm diameter hole for a padlock that must be fixed to the inside of the cupboard door.

Locker doors shall be provided with a 50 x 50 x 5 mm thick mild steel angle x 10 mm diameter hole for a padlock site welded to the locker.

BD 04 DETAIL OF REPAIR WORK

The detail of the work is described in the Schedule of Quantities.

BD 05 MAINTENANCE

[Note: There will be no maintenance work required for walls in this contract.]

BD 06 MEASUREMENT AND PAYMENT

BD 06.01 MEASUREMENT AND RATES

BD 06.01.01 General inclusion of costs and specific specifications

Notes:

Where applicable, standard SABS 1200 measurement and payment items shall be used for Earthworks (Small Works) (1200 DA), Site Clearance (1200 C) and Concrete (Structural) (1200 G).

All material scheduled to be removed shall be deemed to be existing damaged materials in small or large sections. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material shall be deemed to be in patchwork and shall be of approved equal quality, colours, profiles, thickness, etc and shall in all cases match the existing materials and shall be fixed (internally or externally) to existing material, frames or surfaces.

All replacement, removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be replaced shall be deemed to include for the careful removal of the damaged existing material as a whole or partly, as specified, for the cleaning and preparation of the remaining surface(s), frames, etc as well as for the new material scheduled or specified to replace the damaged material.

All work scheduled to be removed, hacked off, or taken out shall be deemed to include the cleaning and preparation of the remaining surfaces, areas where material were removed, or remaining work to receive new material or work specified.

Repair and service work shall also include all removing, cutting, grinding, cutting into, welding, bending, strengthening, drilling, tightening, fastening, oiling, greasing, adjusting and providing missing or damaged screws or bolts, etc to repair and service or to improve the items or areas as new and to match the existing. The servicing of windows will be measured in number irrespective of the type of window or the amount of opening sashes present in the overall window size. The rates tendered for this or similar items shall be deemed to include for servicing all opening sashes and the total overall frame.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pip rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc to leave the items as new and totally functional.

All new work are measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pop rivets, nails, adhesive, grout, putty, etc, as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc. The supply and installation of new window handles, pegs, stays, etc as well as the service of windows shall include for sealing all bolts and screws of handles, stays, etc with epoxy after fixing or tightening into positions.

The removal of doors, gates or windows shall include for the removal of all existing locks, handles, striking plates, etc but exclude the hinges, etc, which shall be used for the new replaced items. All repair work (excluding paintwork) around and in the thresholds of new door frames, gates or windows build into existing brickwork in new or existing positions shall be deemed to be included in either the rates tendered for the new replacement item or the removal payment item of the frame, window, etc.

The new doors to toilets and wet areas as specified shall be fitted with rubber door stops, D-profiled pull handle and backplate sets, 15 mm roller ball catches with striking plates and all other ironmongery needed to install the doors complete. All new ironmongery shall be measured and paid for separately.

The new doors to offices, etc, as specified shall be fitted with rubber door stops, 4 lever mortice locksets with handle sets to match existing, striking plates and all other ironmongery needed to install the doors complete. All new ironmongery shall be measured and paid for separately.

All ironmongery installed on the project shall bear the SABS approved trademark and codes. Samples of all ironmongery scheduled must be according to the samples of the Department of Public Works and samples must be handed to the engineer for approval before ordering the material.

All brickwork shall include for damp proofing membranes, galvanized brickwork reinforcement to every third course, wire ties and wall anchors as needed.

Tilework to walls shall include all cutting, spacers, waste, jointing, mitres, corners, epoxy grout and joint filler.

Ordering of certain specified material ie NCI industrial type wall tiles needs special and urgent attendance and should be ordered timeously as to prevent any construction delays.

All new glass mirrors shall be silvered float glass copper backed mirrors with polished edges all round and shall, unless otherwise scheduled, be fixed to walls with chromium plated dome capped mirror screws with rubber buffers.

Specific specification : Welding of thin steel plates

Thin steel plates covering the external side of doors must be welded to the door frame members. The existing paint must be removed from the welding areas prior to site welding. A coded or experienced welder must submit the proposed welding procedure to the Engineer for approval. The aim of the site welding is two fold, viz to fix the steel plate to the frame and secondly, to prevent water ingress into the inside of the door. The perimeter of the individual plate sections of the door must be sealed with continuous impervious welds.

Specific specification : Repairs and replacements to calve kraals

Replace diamond mesh fence:

Existing diamond mesh shall be removed and replaced with new diamond mesh. The diamond mesh or wire netting shall be secured by means of soft binding wire at 1,2 m centres along the top and bottom straining wires and at 3 m centres along each of the other fencing wires unless otherwise specified.

Diamond mesh

- (a) Diamond mesh (chain-link) fencing shall comply with the requirements of SABS 1373. The edge-finish shall be both sides clinched or barbed.
- (b) The nominal diameter of the wire shall be 2,5 mm and the mesh size shall be 40 mm x 40 mm.
- (c) The wire shall be fully galvanized

Tensioning fence wires:

All fencing wire shall be carefully strained and hung without sag, and with true alignment, care being exercised not to strain the wire so tightly that it will break, or that end, corner, straining or gate posts will be pulled up. Each strand of fencing wire shall be securely fastened in the correct position to each post with soft galvanised binding wire.

Smooth wire:

- (a) Smooth wire shall comply with the requirements of SABS 675 and shall be of the types specified below:
- (b) Straining wire shall be 4,0 mm diameter and fully galvanized.
- (c) Fencing wire shall be high tensile grade, 2,24 mm diameter wire fully galvanized.

- (d) Tying wire shall be 2,5 mm diameter, mild steel, galvanized wire for tying fencing wire to standards and droppers, and 1,6 mm diameter, mild steel, galvanized wire for tying netting and mesh wire to fencing wire.

BD 06.02 **SCHEDULED ITEMS**

NEW WORK

BD.01 **Doors and windows:**

- (a) (Type of doors, windows, locks, etc and material indicated):

- (i) Description of item..... Unit : number

The unit of measurement shall be the number of doors, windows, locks, etc installed complete as specified.

The tendered rates shall include full compensation for the manufacturing and installation of the steel doors, windows, locks, frames, etc complete with hinges, handles, locks, barrel bolts, retaining devices, door stops, stays and any other work necessary to complete the work as specified, scheduled or as shown on the Drawings. The tendered rates for windows shall also include full compensation for glazing, window sills and damp-proof sheeting as specified or to match existing.

BD.02 **Wall panelling:**

- (a) Description of material to be used:

- (i) Description of item and/or position to be fixed Unit m, m², number

The unit of measurement shall be the number, metre, etc for each item as scheduled.

The tendered rates shall include full compensation for all costs of material, waste, labour, plant, transport, delivery, access, scaffolding, fuel, etc to install the material as specified and to match the existing to the Engineer's approval.

BD.03 **Joinery:**

- (a) Items measured by number:

- (i) Doors, etc (type and size indicated) Unit: number
 (ii) Etc for other items measured by number

- (b) Items measured by linear metre:

- (i) Skirtings, etc (type and size indicated) Unit: m
 (ii) Etc for other items measured by length

- (c) Items measured by area:

- (i) Eaves covering, etc (type and thickness indicated) Unit: m²
 (ii) Etc, for other items measured by area

The units of measurement shall be the number, metre or square metre of each type and/or size of joinery item specified.

The tendered rates shall include full compensation for the supply of all materials, manufacture, cutting, waste, fixing and installation of the joinery items.

BD.04 Ironmongery, steelwork, glass, wall finishings, etc:

(a) Measured by number:

- (i) (Description of item) Unit: number
- (ii) Etc

(b) Measured by linear metre:

- (i) (Description of item) Unit: m
- (ii) Etc

(c) Measured by area:

- (i) (Description of item) Unit: m²
- (ii) Etc

The unit of measurement shall be the number, metre or square metre as applicable to each item.

The tendered rates shall include full compensation for manufacturing, providing and installing each item to new or existing steel, wood or plaster complete as per specifications, drawings, descriptions as scheduled or as the existing and shall include for all labour, material, waste, plant, transport, delivery, access, scaffolding, fuel, etc to the Engineer's approval.

ALTERATION WORK

BD.05 Alterations and repairs to existing structures:

(a) Indicate if repairs, replace, alterations, removal or sealing, etc:

- (i) Description of individual items to be repaired, altered, removed, sealed, etc Unit: m³, m², m, number

The unit of measurement for items repaired, replaced, altered, removed, sealed, etc shall be the cubic metre, square metre, metre or number for each item as scheduled.

The tendered rates shall include full compensation for all costs to repair, replace, refix, remove, cutting into, re-align, taking off, temporary store, etc as specified in the Standard and Technical Specifications and shall allow for all necessary labour, plant and new material needed to do the specified work and to leave the scheduled items as new and to the approval of the Engineer. Refer also to the general inclusion of costs in BD 06.01.01."

TECHNICAL SPECIFICATION**BE FLOORS****CONTENTS**

BE 01	SCOPE
BE 02	STANDARD SPECIFICATIONS
BE 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
BE 04	DETAIL OF REPAIR WORK
BE 05	MAINTENANCE
BE 06	MEASUREMENT AND PAYMENT

BE 01 SCOPE

Floors shall mean the work to be carried out to repair and maintain materials and components such as removal of existing floors and installation of new floor coverings, skirtings, screeds, concrete floors and paving. This specification does not include work related to metalwork and paintwork, which are specified elsewhere.

This specification covers the removal of existing floor coverings, screeds and concrete surface beds, the repair of existing floor coverings, screeds and concrete surface beds. This specification also covers the supply, delivery and installation of new floor coverings, screeds and concrete surface beds for various types of buildings.

The complete scope of repair work shall as described in BE 04: Detail of repair work.

Maintenance of this part of the installation shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BE 02 STANDARD SPECIFICATIONS**BE 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

OW 371	-	Specification of Materials and Methods to be used (Fourth edition, October 1993)
SABS 281	-	Hardwood block and strip flooring
SABS 581	-	Semi-flexible vinyl floor tiles
SABS 786	-	Flexible vinyl flooring
SABS 978	-	Wood mosaic flooring
SAB 10070	-	The laying of thermoplastic and similar types of flooring
SABS10043	-	The laying of wood floors
SABS 10186	-	The laying of textile floor coverings
SABS 1449	-	Ceramic wall and floor tiles

BE 02.02 ADDITIONAL SPECIFICATIONS

Technical Specification BF: Structural concrete
 Technical Specification BG: Metalwork

BE 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS**BE 03.01 ADDITIONAL REQUIREMENTS FOR REPAIR OF FLOORS****BE 03.01.01 Floor coverings**

Existing floors shall be inspected to determine the extent of any damaged floor areas. The existing floors and other building elements shall be protected from damage during the progress of any repair work and on completion shall be cleaned and handed over in a perfect condition. Only skilled workmen experienced in laying any type of floor finishes shall carry out the work.

BE 03.01.02 Preparation of floor slab and surface beds for new floor screeds

The existing concrete screed shall be removed in patches designated by the Engineer.

All laitance on the surface of the existing surface bed must be removed completely. Mechanised plant such as scabblers or abrasive blasters must be used. The Contractor shall take all necessary precautions to keep dust pollution to a minimum inside the building during the breaking out and removing of existing concrete screeds, as well as during the preparation of the existing concrete surface bed.

After the mechanical cleaning of the slab surface to expose the coarse aggregate, all dust and debris must be removed, and the surface must be thoroughly wetted and kept wet for at least 12 hours before application of the new concrete screed.

BE 03.01.03 Surface preparation of existing floor screeds for new floor coverings

The following procedure is suggested where vinyl tiles were laid with bitumen adhesive:

- (a) The Engineer will indicate the area where existing vinyl tiles are to be removed.
- (b) The bitumen must be removed mechanically and/or chemically. Remove as much bitumen and other contamination as possible by scraping. Bitumen can be heated to soften it.
- (c) Sweep or vacuum sub-floor thoroughly to remove dust and grit.
- (d) An approved solvent based degreasing and cleaning compound can be used to remove the bitumen chemically. The Contractor shall ensure the safety of the workers and the building against possible fire.
- (e) The concrete surface must be smooth. Even the surface with Pavelite or approved equivalent before laying the new vinyl tiles. The Pavelite must be applied in accordance with the manufacturer's specifications.
- (f) Vacuum clean the floor surface again before the adhesive is applied to lay the vinyl tiles.

BE 03.01.04 Cement screed

Cement screeding shall be carried out in accordance with clause 14.18 of OW 371. The Engineer shall determine which existing cement screeds are to be replaced. The cement screed shall have a maximum thickness of 30 mm. Where required the cement screed shall be modified with an approved alkali compatible acrylic emulsion by preparing the cement screed with a mixture of the latex and water in the required ratio.

Before the new screed is applied, remove all surface water from the slab. Apply a bond coat to the slab/surface bed, consisting of a 1:1 mix of cement and clean fine sand with just enough water to provide the consistency of slurry. Mix in equal parts an approved alkali compatible acrylic emulsion specially modified for use in cement mortars with water, and add Portland cement to form the slurry. Spread the bond coat evenly using a stiff fibre brush. Do not leave standing pools. Place screed before the bond coat dries out. The screed must be laid and compacted in one layer.

Curing should commence as soon as the finishing operations have been completed and should be continued for at least 7 days. The Engineer must approve the method of curing.

Joints must be formed in the screed at all existing contraction and expansion joints, as well as at intermediate positions at 3 m maximum spacing.

BE 03.01.05 Concrete screeds

(a) General

Concrete screeds shall have a minimum thickness of at least 50 mm. The Engineer shall determine the areas where the concrete screeds need to be replaced.

Only ordinary Portland cement, CEM 1 42,5 in accordance with SABS ENV 197-1, shall be used.

Coarse aggregate maximum size:	10 mm
28-day cube strength:	35 MPa.

The use of an approved plasticizer is recommended to reduce the water content of the mix to the absolute workable minimum.

The mix design must be submitted to the Engineer in advance for approval.

A set of three test cube samples shall be taken for every 500 m² floor area for the testing of the compressive strength of the concrete.

(b) Concrete floor hardener

Concrete natural non-ferrous aggregate floor hardeners shall strictly be applied in accordance with the manufacturer's specification and under his supervision.
Note: The Contractor shall furnish a certificate of compliance, together with a written guarantee after completion.

(c) Compressive strength

At 7 days:	50 MPa
At 28 days:	70 MPa

All other aspects of the construction of new concrete screeds shall be adhered to as specified in Technical Specification BF: Structural concrete.

BE 03.01.06 Laying of material (ceramic excluded)

The laying of vinyl and similar flooring material in tile and sheet form and the fixing of plastic skirtings, nosings, etc, shall be carried out in accordance with SABS 043 and section 10, clause 10.3 of OW 371.

The laying of wood block and wood mosaic flooring shall be carried out in accordance with SABS 043 and section 10, clause 10.2 of OW 371.

The laying of textile floor coverings shall be done in accordance with SABS 0186.

Vinyl floor tiles shall be laid with continuous joints in both directions. Tiles shall be cut with a "jointer" at saw and expansion joints. Laying of tiles over these types of joints will not be permitted. Only latex-resin type adhesive shall be allowed to glue tiles to the concrete screed or surface bed.

BE 03.01.07 Granolithic screed finish

Granolithic screed finish to floors, treads of steps, thresholds and similar surfaces shall, unless otherwise specified, not be less than 25 mm thick. The granolithic screed shall be composed of three parts granite, or other approved hard stone chips, or approved hard, coarse sharp washed granitic or quartzite sand, half part clean sand and one part of cement, hand or mechanically trowelled to a true and smooth surface. No dry cement powder, grout or wet slurry mix shall be applied to the surface.

New granolithic screed shall be laid before the concrete surface bed or floor matures in order to allow for proper binding. If this is not possible, then the top of the surface bed or floor shall be hammered, chipped and then cleaned with a wire brush and a coat of neat cement grout applied immediately before the granolithic is laid.

The granolithic shall be laid in panels not exceeding 6 m² in area and jointed to lines of panels with V-joints. The joints between the panels shall coincide with joints in the concrete surface bed or floor.

Granolithic finish to stair risers, sides of curbs and other vertical surfaces shall, unless otherwise specified, not be less than 12 mm thick.

All granolithic work shall be done by experienced workmen only and shall be protected from damage caused by rain or other extreme weather for 12 hours after being laid. Protection shall be provided against too rapid drying whilst hardening by means of covering with wet sacks or other suitable material. The screed shall also be protected from damage and discoloration during the progress of the remaining work.

Edges of granolithic floor butting against different floor finishes and edges of margins, etc, shall be true and sharp, and shall be protected by fixing temporary wood strips which shall remain in position until the laying of the adjoining floor has commenced.

Where a non-slip granolithic floor finish is required, the granolithic shall be laid as specified above. Alundum grit shall then be sprinkled over the surface at the rate of 1 kilogram per square meter, lightly tamped in and allowed to set.

BE 03.01.08 Vinyl floor finishes

Existing floors should be inspected and where vinyl tiles need to be replaced, such tiles shall comply with the requirements of SABS 786, and be 300 x 300 x 2 mm thick unless otherwise specified. The flooring shall be of marbled pattern and of an approved colour (to be specified by the Engineer).

Vinyl floor tiles or sheets shall be laid with an adhesive recommended by the manufacturer. All the preparation and work in connection with the laying and fixing of the specified flooring and vinyl skirtings shall be done in accordance with SABS 070 and to the satisfaction of the Engineer.

The flooring shall, where necessary, be cut and neatly fitted against adjoining floors, thresholds, etc. Where required the Contractor shall carefully remove existing timber floor skirtings and/or quarter rounds for re-use where vinyl tiles are laid against walls. Reinstate skirtings and/or quarter rounds.

Vinyl floor tiles shall, unless otherwise specified, be laid with continuous joints in both directions and vinyl floors shall, unless otherwise specified, be in standard widths with cut sheets at sides of floors as necessary, all to the entire satisfaction of the Engineer.

The vinyl flooring and skirtings shall be covered up and protected from damage during the progress of remaining work and on completion be cleaned and, unless otherwise specified, polished with the type of polish recommended by the manufacturer of the vinyl flooring.

BE 03.01.09 Skirtings

Loosened hardwood skirtings must be cleaned and where necessary removed and/or replaced by 76 x 19 (or 25 mm) mm thick hardwood skirting with one rounded top edge plugged to the wall. Painting shall be in accordance with Technical Specification BJ: Painting.

In selected areas skirtings shall be 100 mm high x 6 mm thick unglazed ceramic tiles glued to walls with an approved cement grout. The Engineer shall specify these areas.

Vinyl cove skirtings shall be of approved manufacture and colour and, unless otherwise specified, be 70 mm high.

BE 03.01.10 Sealing of vinyl flooring

The newly laid tiles shall, after four days, be scrubbed with a diluted neutral detergent/stripper complying with SABS 825 and rinsed thoroughly. After the floor has dried, apply two coats polymer/acrylic sealer combination containing a minimum of 22 % solids using an applicator pad. Ensure that the surface has set hard before allowing traffic on the floors.

BE 03.01.11 Wood block floors

(a) Replacement of wood block floors

Where required, wood blocks that must be replaced shall, unless otherwise specified, be Clear Grade, Class H with nominal sizes of 75 mm wide, 225 mm long and 20 mm thick, and shall comply with the requirements of SABS 281. Wood blocks that are loose must be re-laid using an approved hot or cold adhesive after the old bitumen has been removed and the surface prepared.

The moisture content of the blocks shall be as specified in the above-mentioned specification, and the blocks shall be treated with timber preservative as specified. The blocks shall, unless otherwise specified, be laid to a basket pattern with an approved hot or cold adhesive and shall be sanded on completion all in accordance with the SABS Code of Practice, SABS 043 and to the satisfaction of the Engineer

Wood block floors shall be covered up and protected from damage during the progress of the remaining work, and unless otherwise specified, a sealer shall be applied to the final sanded surface and then polished all in accordance with the above-mentioned Code of Practice.

(b) Partial repairs to parquet floors

Only very loose wood blocks identified by the Engineer shall be repaired. The Contractor shall carefully remove the wood blocks for re-use. Scraping and any other suitable means shall be used to remove the old bitumen. The concrete surface bed or cement screed shall be cleaned from dust and bitumen residue as specified in BE 03.01.02. If the concrete or cement screed is in a poor condition, the poor patches shall be removed according to BE 03.01.04. The Contractor will be allowed to use rapid hardening cement grouts to reduce drying time of concrete and cement screeds in order to suit the working programme. The screeds must be laid at such a level as to enable the workmen to lay the cleaned wood blocks at the same level as the surrounding wood flooring blocks. The cleaned blocks shall be laid in a basket pattern (or

the same existing pattern) with approved hot or cold bitumen at the same level as the surrounding blocks. Missing blocks must be replaced.

BE 03.01.12 Sealing of timber floors

Existing timber floors must be mechanically belt-sanded to remove all traces of existing sealer in strict compliance with SABS 043. Where necessary, existing flooring, skirtings and quarter rounds should be temporarily removed. Before applying the new wooden floor sealer, ensure that the surfaces are dry, sanded smooth and free from varnish or oil. Vacuum the dust from the prepared floor surfaces.

Apply three coats of clear, lead free wooden floor sealer with preservative and anti-fungal properties according to the manufacturer's specification.

Apply the first coat until an even glossy, wet surface is achieved. Leave to dry thoroughly. Apply at least two other coats in the same way, and finally a fourth and final coat. It is proposed that the Contractor first do a trial section to satisfy himself that he can handle this procedure. The final appearance of the wooden floor must be smooth and have a uniform non-gloss finish.

Reinstate skirtings and quarter rounds.

BE 03.01.13 Tiling (general)

Tiles shall be solidly bedded and jointed in cement mortar and, unless otherwise specified, joints shall be 6 mm wide.

The joints in all tiling are to be continuous in both directions. The pointing is to be carried out by well pressing in half-dry cement mortar. Under no circumstances may liquid cement grout be used for pointing.

All tiling shall be properly covered and shall be protected against any possibility of staining, discolouring or any other damage.

At completion, all tiling is to be exposed, checked for damage, repaired where necessary and cleaned off with soft soap and cold water and left in a perfect condition. The application of oil on tiling is not allowed.

BE 03.01.14 Ceramic and quarry floor tiles

(a) General requirements

The Engineer shall determine which tiles need replacement. The existing floor screed and floor tiles must be removed in patches and/or areas as determined by the Engineer.

Ensure that the base for floor tiling is rigid, stable and level unless required to have a fall in one or more direction(s). The surface preparation and cement screed (if required) are described in BE 03.01.03 and BE 03.01.04 respectively. When proprietary brand adhesives are being used for fixing ceramic floor tiles it is essential that the surface to which the tiles are to be fixed is clean, dry, flat and true.

Lay approved unglazed ceramic split floor tiles (230 x 115 x 11,5 mm thick and of a selected or matching colour) in professional floor grouting with 8 - 10 mm wide joints. The floor grout must be applied with a 10 mm square notched floor trowel evenly over an area not exceeding 1 square metre at a time. Coved skirting tiles including external and internal skirting corners must be laid against walls in abattoirs. Setting out must be done correctly. The finished installation must be level plumb and true unless specified otherwise. In abattoirs the floor tiles must be laid to specified falls.

Mortar beds for dust-pressed tiles and quarry tiles shall be formed with a slurry of 1:1 cement and clean fine sand to a thickness of about 3 mm on an area not exceeding 1 square metre at a time. The joints will be 6 - 8 mm wide depending on the size of the tile.

The tiles must be laid in professional cement-based powder adhesive, strictly in accordance with the manufacturer's specifications. The Code of Practice for the fixing of tiles in accordance with SABS 1449 and the recommendations of the South African Ceramic Tile Manufacturer's Association (SACTMA) shall be followed. Important points to be taken into consideration are summarised below:

- (i) Sufficient time must be allowed between building operations.
- (ii) Drying periods for backgrounds and substrates must be strictly adhered to.
- (iii) No tiling may commence prior to the prescribed time.
- (iv) All tiles must be correctly bedded. The tiles must be properly bedded into a fixative that is spread evenly to the required thickness using a square notched rubber mallet (10 mm for ceramic tiles). Bed the tiles dry and move firmly into position, ensuring that they are in proper overall contact with the bed, and form an even surface.
- (v) A minimum of 6 - 10 mm grouting joints must be allowed between extruded and split tiles (3 mm minimum for pressed tiles). Ensure that the joints are free of tile adhesive and any foreign matter.
- (vi) Setting out must be done correctly.

(b) Filling of joints

Do not fill joints between tiles until at least 24 hours after the tiles have been bedded. Before applying the joint epoxy grout ensure that the joints are free of tile adhesive residue and any foreign matter. Apply the approved epoxy grout into the tile joints. The finishing-off must be completed with a wetted nosing tool or spatula so that a smooth glazed surface finish can be achieved. Application of the epoxy grout must be done strictly in accordance with the manufacturer's specifications. Finally, the tiles must be thoroughly cleaned.

BE 03.01.15 Movement joints in tiling

(a) General requirements

Movement joints are to be provided in tile work to allow for thermal expansion and contraction and crack control at existing expansion joints in the surface bed.

- (i) Provide movement joints in the tile work, screed and bedding down to the concrete surface bed or slab. The spacing of these joints depends on the position of existing joints, column and wall layouts and slab thickness. The maximum spacing of joints should be limited to 30 times the slab (surface bed) thickness or 4,5 m, whichever is the lesser. The length-to-width ratio of tile panels should be limited to between 1,0 and 1,5.
- (ii) Provide isolation joints around the perimeter of the floor, around columns, walls and other fixed structural elements.
- (iii) Joints shall be aligned with no offsets. Irregular shaped tile panels must be avoided. Where included angles are unavoidable, they should be less than 60 degrees.
- (iv) The width of the joint shall be 6 mm minimum and 10 mm maximum. Provide an approved closed-cell expanded polyethylene foam joint filler with a hinged temporary blocking piece in the movement joints. The size of the blocking piece must be the same as the joint width.

(b) Joint sealing

The joints shall be prepared and primed prior the application of the joint sealant.

The liquid sealant in joints shall be an approved one part grey polyurethane sealant with a shore hardness of A45 and an elongation of 400 %. The manufacturer's specifications must be strictly followed.

(c) In abattoirs

Clean and dry all tile surfaces. All loose material must be removed by means of a wire brush or by water while all tile adhesives are cleaned from the edges of the tiles.

Ensure that all traces of release agents, curing compounds and existing joint sealant compounds are removed. Install a suitable closed-cell expanded polyethylene bond breaker cord in the expansion and isolation joints after which the complete substrate is primed with a component solvent free primer which penetrates into the tile and pulls all dust particles with it. Proceed with the final application of an approved one part grey polyurethane sealant with a shore hardness of A45 and an elongation of 400 %. The manufacturer's specifications must be strictly followed.

BE 02.02 **PAVING**

Repairs to paving shall include the improvement of existing paving, drainage channels and the replacement of paving that can not be repaired. Different paving types exist, eg concrete, precast segmental paving and regular blocks, bricks and slasto. This specification only covers pedestrian paving around buildings.

The Engineer shall identify the paving areas that are to be repaired. Defects to paving will include but not be limited to the following aspects:

- (a) Failure of subbase material and subsidence of sub-soil due to excessive water erosion;
- (b) Broken and severely damaged paving;
- (c) Distorted and disturbed paving;
- (d) Drainage problems, eg ponding of water on the paving and in drainage channels, incorrect falls, etc;
- (e) The omission of edge restraint;
- (f) Intrusion of weed or hostile root penetration.

BE 03.02.01 **Preparing foundation**

If the subbase and/or subgrade have failed, this soft and unstable material shall be replaced. Existing paving must be carefully removed and stack for re-use. The new earth filling shall be of inert material, having a maximum plasticity of 10, free from large stones, etc, spread, levelled, watered and compacted in layers not exceeding 150 mm thick to a density of 95% of modified AASHTO density. Cement stabilization to improve the existing subgrade may be considered to improve the characteristics of the material. The blocks shall be laid true to line, levels and grade on a 25 mm thick layer of approved bedding sand. The bedding sand must not be used to fill hollows in an uneven subgrade or subbase surface. Where specified, plastic sheeting must be provided below the bedding sand layer. Refer also to BE 03.02.06.

The Contractor shall be responsible for carrying out all necessary process control tests on the density and moisture content of the completed subgrade, subbase, etc, to ensure that the required compaction is being attained.

BE 03.02.02 Laying of segmental block paving

The existing blocks shall be preselected for re-use. Broken and severely damaged paving blocks shall be replaced. New paving blocks shall comply with SABS 1058 Class 30 compressive strength. All blocks shall be laid true to line and level. Care shall be taken to ensure that joint lines are straight and square. The blocks shall have a minimum thickness of 60 mm.

After laying the blocks, the paving shall be compacted by means of vibrating plate compactor with joints between the blocks filled in, after compaction, by sweeping in fine sand. The jointing sand shall pass a 1,18 mm sieve and contain 10-50 % material passing the 75 micron sieve. The sand shall be free of all soluble salts or contaminants likely to cause efflorescence or staining.

Areas against curbs, manholes, etc, that require infilling and which exceed 25 % of a full block unit shall be filled with units cut to size using a mechanical or hydraulic guillotine, bolster or angle grinder. Infill areas constituting less than 25 % of a full block area and are of 25 mm minimum dimension shall be filled with 25 MPa concrete. Smaller areas shall be filled with 1:4 cement mortar.

BE 03.02.03 Laying face brick pavers, precast concrete blocks and slasto

The existing blocks shall be preselected for re-use. Broken and severely damaged paving blocks shall be replaced. All blocks shall be laid true to line and level. Care shall be taken that joint lines are straight and square. Slasto shall be to match existing pattern.

After laying the blocks (except slasto), the paving shall be compacted by means of vibrating plate compactor. Clean the top of the blocks before and after compaction. Thoroughly wet compacted area after compaction and leave 24 hours to dry. The joints between the blocks must be filled in, after compaction, with a 1:4 cement mortar. The joints shall be pointed with a steel tool to a smooth surface finish.

BE 03.02.04 Laying of cast in-situ concrete paving and drainage channels

Severely cracked and/or damaged concrete paving and drainage channels shall be replaced. The Engineer shall indicate which panels and sections of drainage channels are to be removed. Cutting out will be done with an angle grinder or saw cutting machine. Concrete panels must be removed in sizes where the ratio of the sides does not exceed 1:1,5. The foundation material must be improved as specified in BE 03.02.01.

New concrete panels and drainage channels must be cast with a compressive strength of 25 MPa. Concrete paving to the specified thickness must be finished off with a smooth wood trowel surface finish or must match the existing surface finish. Edges must be finished off with a steel nosing tool with a radius of 5 mm. Expansion joints must be provided where specified. Drainage channels must be cast in lengths not exceeding 1 metre. Channels must be finished off to have a smooth steel trowel finish.

BE 03.02.05 Precast concrete edge beams, curbs and channels

Edge restraints shall be installed before paving commences. Edge restraints may be cast in-situ, or consist of precast units. Precast edge blocks shall have dimensions of 75 mm wide x 300 mm deep. Cast in-situ beams with 25 MPa concrete shall have dimensions of 300 x 300 mm and cast in lengths not exceeding 1 metre.

Precast concrete curbs and channels shall comply with SABS 927, generally in 1 metre lengths and finished smooth from the mould on exposed surfaces. Curbs and channels shall be bedded on and jointed in 1:3 cement mortar and pointed with keyed joints. Bases to curbs shall be Class B prescribed mix of unreinforced concrete.

BE 03.02.06 Weed control

Two types of weed killing shall be carried out:

- (a) Mixing weed killer to subbase for rehabilitated paving;
- (b) Spraying existing paving excluding concrete paving.

After the base course has been approved and the curbing completed, the prepared base must be treated with a weed killer similar or equal to HYVAR X at a rate of 4 kg/m². Plastic sheeting with a thickness of 375 micron shall be laid to prevent the penetration of grass underneath the segmental paving.

BE 03.02.07 Site clearance

Excess sand and all other debris shall be removed before the pavement is opened to traffic. The site shall be left in a tidy condition.

BE 04 DETAIL OF REPAIR WORK

The detail of the scope of work is described in the Schedule of Quantities.

BE 05 MAINTENANCE

[Note: There will be no maintenance work required for floors in this contract.]

BE 06 MEASUREMENT AND PAYMENT

BE 06.01 MEASUREMENT AND RATES

BE 06.01.01 General inclusion of costs and specific specifications

Notes:

Where applicable, standard SABS 1200 measurement and payment items shall be used for Earthworks (Small Works) (1200 DA), Site Clearance (1200 C) and Concrete (Structural) (1200 G).

All material scheduled to be removed shall be deemed to be existing damaged materials in small or large sections. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material shall be deemed to be of approved equal quality, colours, profiles, thickness, etc and shall in all cases match the existing materials and shall be fixed (internally or externally) to existing materials or surfaces.

All replacement, removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be removed, hacked off or taken out shall be deemed to include the cleaning, removing of contact glue or bitumen and preparation of the remaining surfaces, and areas where materials were removed.

Repair work shall also include all cutting, grinding, cutting into, welding, bending, strengthening, drilling, etc to repair or to improve the items or areas as new and to match the existing.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pop rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc to leave the items as new and totally functional.

All new work is measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pop rivets, nails, adhesive, grout, putty, etc, as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc.

Tilework to floors shall include all cutting, spacers, waste, jointing, mitres, corners, epoxy grout and joint filler.

Ordering of certain specified materials ie NCI industrial type floor tiles needs special and urgent attendance and should be ordered timeously as to prevent any construction delays.

BE 06.02 SCHEDULED ITEMS

NEW WORK

BUILDING WORK

BE.01 Floor screeds:

(a) (Thickness indicated) Unit: m²

(b) Etc for other thicknesses

The unit of measurement shall be the square metre of floor screed laid, as specified, on floors, steps or areas shown on the Drawings or as designated by the Engineer.

The tendered rates shall include full compensation for the construction of the floor screeds, including the supply of all materials, mixing, laying, finishing, the forming of nosings, reedings, skirtings, etc.

BE.02 Joinery:

(a) Items measured by number:

(i) Doors (type and size indicated) Unit: number

(ii) Etc for other items measured by number

(b) Items measured by linear metre:

(i) Skirtings (size indicated) Unit: m

(ii) Etc for other items measured by length

(c) Items measured by area:

(i) Eaves covering (type and thickness indicated) Unit: m²

(ii) Etc, for other items measured by area

The units of measurement shall be the number, metre or square metre of each type and/or size of joinery item specified.

The tendered rates shall include full compensation for the supply of all materials, manufacture, cutting, waste, fixing and installation of the joinery items.

BE.03 **Floor tiling and finishes, etc:**(a) Measured by number:

(i) (Description of item) Unit: number

(ii) Etc

(b) Measured by linear metre:

(i) (Description of item) Unit: m

(ii) Etc

(c) Measured by area:(i) (Description of item) Unit: m²

(ii) Etc

The unit of measurement shall be the number, metre or square metre as applicable to each item.

The tendered rates shall include full compensation for manufacturing, providing and installing each item complete as per specifications, drawings, descriptions as scheduled or as the existing and shall include for all labour, material, waste, plant, transport, delivery, access, scaffolding, fuel, etc to the Engineer's approval.

ALTERATION WORK**BE.04** **Alterations and repairs to existing structures:**(a) Indicate if repairs, alterations, removal or sealing, etc:(i) Description of individual items to be repaired, altered, removed, sealed, etc Unit: m³, m², m, number

The unit of measurement for items repaired, altered, removed, sealed, etc shall be cubic metre, square metre, metre or number as scheduled.

The tendered rates shall include full compensation for all costs to repair, refix, remove, cutting into, realign, taking off, temporary store, etc as specified in the Standard and Technical Specifications and shall allow for all necessary labour, plant and new material needed to leave the scheduled items as new and to the approval of the Engineer. Refer also to the general inclusion of costs in BE 06.01.01".

SUPPLEMENTARY SERVICES SPECIFICATION**BF PEST CONTROL****CONTENTS**

BF 01	SCOPE
BF 02	STANDARDS
BF 03	SAFETY REQUIREMENTS
BF 04	INITIAL PEST CONTROL PROCEDURE
BF 05	MONITORING AND REPORTING OF PEST CONTROL STATUS
BF 06	PREVENTATIVE PEST CONTROL
BF 07	TRAINING OF EMPLOYER'S PERSONNEL
BF 08	LOGGING AND RECORDING
BF 09	NOTIFICATION OF INTENTION TO ADMINISTER PEST CONTROL
BF 10	PREPARATION OF THE AREA AFFECTED BY PEST CONTROL
BF 11	CLEARANCE AFTER PEST CONTROL
BF 12	PERFORMANCE MEASUREMENT
BF 13	MEASUREMENT AND PAYMENT

BF 01 SCOPE

This Specification covers the application of pesticides and herbicides in the facility(ies) set out in the Project Specification for the purpose of pest control. Pest control, in this instance, shall imply the eradication of pests which cause structural and other damage to buildings and installations at the facility in question.

Structural damage shall include:

- Damage to the structural elements of buildings.
- Damage to finishes of buildings.
- Damage to building electrical installation.
- Damage to building wet services (plumbing and drainage)

BF 02 STANDARD SPECIFICATIONS**BF 02.01 GENERAL STANDARD SPECIFICATIONS**

The following standards and publications contain provisions, which, through reference in this text, constitute provisions of this specification. The most recent editions of the standards indicated below shall be used:

- | | |
|------------|--|
| SANS 10072 | - Code of practice for the safe use of household insecticides and Agricultural remedies. |
| SANS 10124 | - Code of practice for the application of certain soil insecticides for the protection of buildings. |
| SANS 10133 | - Code of practice for the application of pesticides in food handling, Food processing, and catering establishments. |
| SANS 10080 | - Code of practice for the rodent proofing of buildings. |
| SANS 10005 | - Code of practice for the preservation treatment of timber. |
| SANS 10206 | - Code of practice for safety procedures for the disposal of surplus pesticides and associated toxic waste. |
| SANS 10204 | - Code of practice for the application of fumigants. |

National Departments of Agriculture Publication

A guide to the control of household and industrial pests.

BF 03 SAFETY REQUIREMENTS

No pesticide shall be used for any purpose other than that recommended on the manufacturer's label of the pesticide container. All warnings and precautions set out on the manufacturer's label shall be adhered to. The manufacturer's label shall never be removed from the container.

A Pest Control Operator shall be appointed by the Contractor and the relevant certification, as specified in sub clause BE 08.03 below, shall be submitted to the Engineer before the first pesticide application.

The Pest Control Operator (PCO) will at all times ensure that pesticides are kept secure and out of reach of the general public. The PCO shall be responsible for the safe disposal of surplus pesticides as well as all empty pesticide containers.

The PCO will further ensure that no member of the general public is at any time in danger of being contaminated with the pesticide. Should a member of the general public be contaminated the PCO will immediately follow the first-aid and emergency treatment outlined in the standards.

BF 04 INITIAL PEST CONTROL PROCEDURE

BF 04.01 COMPILING OF A PEST CONTROL PROGRAMME

Before any pest control is to be administered the Contractor shall inspect the various buildings and installations at each facility and subsequently compile and submit a report, to the Engineer, detailing the comprehensive preventative pest control programme to be implemented. The report submitted to the Engineer shall include but shall not be limited to the following:

- (a) The status of the pest infestation of the various buildings and installations at each facility.
- (b) The initial "clean up" procedure to be implemented.
- (c) The procedures of how to close off all entry points for rodents.
- (d) The routine monitoring and reporting procedures.
- (e) Estimated costs for the above.

BF 04.02 INITIAL "CLEAN UP" AND RODENT PROOFING

The Contractor shall implement the initial "clean up" procedure and the rodent proofing of the various installations, as described in the pest control programme, buildings and only after instructions from the Engineer have been obtained.

BF 05 MONITORING AND REPORTING OF PEST CONTROL STATUS

The status of pest infestation shall be monitored. The Contractor shall compile a report on the condition as well as recommendations at the intervals specified in the Particular Specifications. The report shall include but shall not be limited to the following details:

- (a) Report on the type and status of damage caused by pests.
- (b) Report on the visual observation of the presence of pests.
- (c) Report on the pest control monitoring results.
- (d) Report on the standing of the preventative pest control.
- (e) The recommended pest control procedure.

This report is to be submitted to the Engineer. Only upon instruction from the Engineer shall the recommended pest control procedures be implemented.

If, at any intermediate period, the need for pest control should arise the Contractor shall submit a report and recommendations to the Engineer and await his instructions.

BF 06 PREVENTATIVE PEST CONTROL

The Contractor shall administer preventative pest control as often as required but in accordance with the intervals specified by the manufacturer of the pesticide.

The Contractor shall report on the standing of pest activity and damage caused by the pests after each inspection as outlined in clauses PFE 02, PFE 03, PFE 04 and PFE 05 of Particular Specification PFE. The report is to be submitted to the Engineer (as in clause BF 05 above). The Contractor shall obtain the permission of the Engineer before any additional preventative pest control is to commence.

BF 07 TRAINING OF EMPLOYER'S PERSONNEL

Pests are attracted to areas where food and water are in abundance. Good housekeeping techniques can improve the likelihood of keeping an area pest free. It is therefore essential to train the Employer's relevant personnel in the essential housekeeping techniques. The objectives of the training shall be to ensure that the following be achieved:

- (a) The identification of possible attractions for pests.
- (b) The elimination of waste disposal situations which may attract pests.
- (c) Reducing the overall cost of pest control by keeping the areas as clean and pest free as achievable.

The training course shall be in accordance to the Additional Specification SD: General Training and shall furthermore include at least the following:

- (a) The effective methods of waste disposal in order not to attract pests.
- (b) The effective methods of storing foodstuffs in order not to promote the nesting and infestation of pests.
- (c) Cleaning of facilities to avoid attracting pests.

The Contractor is to develop a training syllabus in accordance with Additional Specification SD: General Training. The training syllabus shall include but shall not be limited to the following information:

- (a) The effective methods of waste disposal in order not to attract pests.
- (b) The effective methods of storing foodstuffs in order not to promote the nesting and infestation of pests.
- (c) Cleaning of facilities to avoid attracting pests.
- (d) General information about the various pests which may be found at the facility.

BF 08 LOGGING AND RECORDING

The Contractor shall institute a logging and recording system as part of his management control plan. This shall consist of a file containing the particulars as described in detail below:

BF 08.01 PESTICIDE QUALITY

A sample of each batch of each type of pesticide used shall be taken and stored in a sealed clean glass container. The container shall be clearly marked. These samples are to be kept in safe and appropriate storage by the Contractor in case of a dispute arising from insufficient control of vermin or contamination of any sort.

BF 08.02 LOGGING OF PESTICIDE APPLICATIONS

After each application of pesticides a Pesticide Application Log Sheet (Form PC-1, that forms part of this specification) is to be completed and submitted to the Engineer. The Pesticide Application Log Sheet (Form PC-1) includes the following details:

- Name of the pest control operator
- Name and address where the pesticide application was administered
- Date of the pesticide application
- Manufacturer of the pesticide
- Pesticide name and active ingredient
- Batch identification of the pesticide
- Formulation and concentration of the pesticide
- The pest and type of control aimed at
- Type of application i.e. residual spray, fumigant, bait etc
- Area of application
- Quantity of product used

BF 08.03 RECORDS OF PEST CONTROL OPERATORS

All pest control operators shall be in possession of the National Certificate in pest control, as approved by the Department of National Education. The Pest Control Operator (PCO) shall be in possession of a Registration Certificate issued by the Department of Agriculture in accordance with Act 36 of 1947.

The Pest Control Operator's details and certifications shall be made available for inspection by the Engineer prior to the application of pesticides.

A copy of the Pest Control Operator's details and certifications shall be submitted together with the Pesticide Application Log Sheet (Form PC-1) completed for each pesticide application.

BF 09 NOTIFICATION OF INTENTION TO ADMINISTER PEST CONTROL

Before pest control procedures may commence a notification shall be submitted to the Employer's representative responsible for the facility. The Notification of Intent to Administer Pest Control (Form PC-2 that forms part of this specification) shall include the following details:

- The name and address of the person being notified
- The pest control procedure to be employed and the purpose of the pest control
- The pesticide to be employed
- The date and time of commencement

The pest control operator is to sign the notification to acknowledge responsibility for the precautions to be taken before, during and after operations.

The Employer's representative responsible for the facility is to sign the notification to acknowledge receipt of the notice.

Pest control procedures may only be implemented once the notification has been completed and signed by all relevant parties.

BF 10 PREPARATION OF THE AREA AFFECTED BY PEST CONTROL

The PCO shall arrange, with the Engineer via the Contractor, a suitable time for the pest control area to be vacated and provide an approximate time for the completion of pest control.

The PCO shall provide the Employer's representative responsible for the facility with a written list of all materials and articles that must be removed from the facility before the administering of pesticides may commence.

After the PCO is satisfied that all materials, which might be damaged or contaminated during the application of pesticides, have been removed he will conduct a thorough inspection of the area before pest control application may commence.

BF 11 CLEARANCE AFTER PEST CONTROL

Upon completion of the application of pesticides the PCO shall ensure that the area is well ventilated and that the levels of harmful gases are safe for re-occupancy.

The area shall be checked for any damage or contamination caused by the application of the pesticides and all dead rodents shall be removed from the area.

The PCO shall deliver a written Clearance Notification (Form PC-3, that forms part of this technical specification), declaring the area safe for re-occupancy, to the Employer's representative responsible for the facility.

BF 12 CLEARANCE AFTER PEST CONTROL

The Contractor's performance shall be evaluated as follows:

BF12 .01 SCORE-CARD

The Engineer shall inspect each facility monthly after the commencement date of the Contract. The Engineer shall use a score-card to measure the quality of pest control service rendered by the Contractor during the preceding month. The score-card shall serve to evaluate ten performance indicators each month in the manner set out below.

BF12 .02 PERFORMANCE INDICATORS

The Contractor and the Engineer shall each have the opportunity to select five (5) performance indicators each month which shall focus on the measurement of the quality of pest control service rendered, against the relevant clauses of this specification for the month ahead. All ten (10) performance indicators are known to both the Engineer and the Contractor. The Contractor shall aim to perform satisfactorily on all ten performance indicators. All indicators shall be selected from the scope of his normal routine activities based on the pest control programme as specified in sub-clause BF 04.01. The work shall either be satisfactory or unsatisfactory and the Contractor shall score one (1) or zero (0) respectively per indicator.

BF12 .03 **SATISFACTORY PERFORMANCE**

The Engineer shall inspect the Site on an arbitrary day to measure the quality of the pest control against the 10 selected performance indicators. Should the Contractor score the maximum points (10) he shall receive his full payment that month under pay item BF.05 for providing a good-quality pest control service during the previous month. Should the quality of the service provided by him be unsatisfactory according to the score-card, the Contractor will not receive full payment that month due to a reduced service level. In this manner the Employer will be protected against a reduced or unsatisfactory service level.

A copy of the score-card including a guideline for the use thereof is included in this specification.

BF 13 **MEASUREMENT AND PAYMENT****BF .01** **Compiling Of the Pest Control Programme
For Each Location****Unit: Sum**

The unit of measurement shall be the number of comprehensive pest control programmes compiled for the different locations in each facility. Each programme shall include initial steps to be taken as well preventative pest control procedures.

The programme shall be subject to revision by the Engineer.

The tendered rate shall include full compensation for ascertaining the status of the pest infestation, for all testing; including re-testing where applicable as well as for the cost of providing all instrumentation, tools, equipment and labour that may be required.

BF .02 **Initial "Clean Up" And Rodent Proofing****Unit: Sum**

The unit of measurement shall be a lump sum.

The sums tendered for the different locations in each facility shall include full compensation for the preparation of the area affected by the pest control procedure, for notifications as in clauses BF 09, BF 10 & BF 11 for the supply, preparation, delivery and the application of the pesticides, for the safe disposal of empty pesticide containers and for storage, transport and handling.

The tendered sum shall include full compensation for the cost of all materials required for the rodent proofing of the facility as well as for the supply, delivery, storage, handling, transport and installation of such materials.

The tendered sum shall also include full compensation for all testing, including re-testing where applicable for all instrumentation, tools, equipment and labour that may be required as well as for the logging and recording of all required data as described this specification.

BF .03 **Monitoring And Reporting Of Pest Control Status****Unit: Sum**

The unit of measurement shall be the number of reports with recommendations compiled and submitted for each location in each facility.

The tendered rate shall include full compensation for monitoring the pest control status, for the supply of all equipment used during monitoring, for delivery of relevant equipment, and for the cost of compiling the reports with recommendations.

The tendered rate shall also include full compensation for all testing, including re-testing where applicable, for all instrumentation, tools, equipment and labour that may be required as well as for the logging and recording of all required data as described in this specification.

BF .04**Preventative Pest Control****Unit: Sum**

The unit of measurement for the preventative pest control at each location in each facility for the period between inspections and for reporting as outlined in clauses PBF 02, PBF 03, PBF 04 and PBF 05, shall be a lump sum.

The tendered sum shall include full compensation for the preparation of the area affected by the pest control procedure, for notifications as in clauses BF 09, BF 10 & BF 11, for the preparation, supply, delivery, and the application of the pesticides, for the safe disposal of empty pesticide containers and for storage, transport and handling.

The tendered sum shall also include full compensation for all testing, including re-testing where applicable, for all instrumentation, tools, equipment and labour that may be required as well as for the logging and recording of all required data as described in this specification.

BF .05**Maintaining Quality Of Pest Control Service****Unit: Sum**

The unit of measurement shall be a point. Each month shall represent a maximum of 10 points and a minimum of zero points, depending on the performance of the contractor in providing quality service.

Ten points per month, determined by using the rate tendered per point, shall include full compensation for executing the work as specified and for all risks, liabilities and obligations described or implied in the Conditions of Contractor, this specification, Portion 1 of the Project Specifications and in Particular Specifications SABS 1200A and 1200AB as amended in Portion 2 of the Project Specifications.

The combined tendered rate for 10 points shall also include full compensation for quality control, for all taxes, levies and insurances that may be applicable and for all other incidentals necessary to provide the service and for which no provision for payment has been made under other payment items.

The rate tendered for this item shall not be less than ten per cent (10%) of the total price tendered for the pest control service.



NATIONAL DEPARTMENT OF PUBLIC WORKS PESTICIDE APPLICATION LOG SHEET

Name of Pest Control Company: _____

Name of Pest Control Operator: _____

Name and location of pesticide application: _____

Date: _____

Pesticide Manufacturer: _____

Name of applied pesticide: _____

Active Ingredient: _____

Batch identification: _____

Formulation and Concentration of pesticide applied: _____

Type of application: _____

Area of pesticide application (description and dimensions): _____

Quantity of products applied (verified by Engineer): _____

Engineer's name and signature: _____

Pest and type of control aimed at: _____



NATIONAL DEPARTMENT OF PUBLIC WORKS
NOTIFICATION OF INTENT TO ADMINISTER PEST CONTROL

TO: _____

LOCATION OF PEST CONTROL: _____

DATE: _____

DATE OF PEST CONTROL APPLICATION: _____

TIME: _____

PURPOSE OF PEST CONTROL: _____

TYPE OF PEST CONTROL: _____

PESTICIDE TO BE EMPLOYED: _____

The undersigned takes full responsibility for the precautions to be taken before, during and after the pest control application.

DATE: _____

SIGNED (Pest Control Operator): _____

The undersigned acknowledges receipt of this notice.

DATE: _____

SIGNED (Employer's Representative responsible for facility): _____



**NATIONAL DEPARTMENT OF PUBLIC WORKS
CLEARANCE NOTIFICATIONS**

TO: _____

LOCATION OF PEST CONTROL: _____

DATE: _____

DATE OF COMMENCEMENT OF
PEST CONTROL: _____

DATE OF COMPLETION OF PEST
CONTROL: _____

PURPOSE OF PEST CONTROL: _____

TYPE OF PEST CONTROL: _____

PESTICIDE EMPLOYED: _____

The undersigned confirms that the area in which pest control was conducted is safe for re-occupancy and that all relevant checks and test have been conducted.

DATE: _____
SIGNED (Pest Control Operator): _____

The undersigned acknowledges receipt of this notice of clearance

DATE: _____
SIGNED (Employer's Representative responsible for facility): _____

TECHNICAL SPECIFICATION**BH FITTINGS****CONTENTS**

BH 01	SCOPE
BH 02	STANDARD SPECIFICATIONS
BH 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
BH 04	DETAIL OF REPAIR WORK
BH 05	MAINTENANCE
BH 06	MEASUREMENT AND PAYMENT

BH 01 SCOPE

Fittings shall mean the work to be carried out to repair and maintain materials and components related to cupboards, shelving, signage and counters.

The complete scope of repair work shall be as described in BH 04: Detail of repair work.

Maintenance of this part of the installation shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BH 02 STANDARD SPECIFICATIONS**BH 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

PW 371-	Specification of Materials and Methods to be used (Fourth edition, October 1993)
SABS 929	- Plywood and composite board
SABS 1099	- Hardwood furniture timber
SABS 1383-3	- Softwood timber for industrial use
SABS 1385	- Kitchen cupboards of steel, composite board and timber

BH 02.02 ADDITIONAL SPECIFICATIONS

Technical Specification BD: Walls
 Technical Specification BG: Metalwork
 Technical Specification BJ: Paintwork

BH 03 **VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS****BH 03.01** **ADDITIONAL REQUIREMENTS FOR REPAIR OF FITTINGS****BH 03.01.01** **Built-in cupboards**

The Engineer shall inspect all cupboards for defects and shall establish which components are to be replaced or repaired. Reasons for replacement will include, but not be limited to:

- (a) Severely chipped or damaged block board;
- (b) Severely chipped or damaged decorative laminates;
- (c) Inadequacy of design, eg strength of hinges, failure of door furniture, etc;
- (d) Corroded steel elements.

Fixing of defects will include repairing or replacing damaged, corroded and worn-out fittings, eg door handles, knobs and hinges, door catches and holders, door locks, cupboard door vents, drawer slide rails, drawer handles, knobs and locks. Moving parts shall be serviced by cleaning, oiling, tightening loose screws, reinstating missing screws or aluminium pop rivets, etc. Refer to BD 03.08 and BD 03.09 of Technical Specification BD: Walls, for repairs or replacements of cupboard doors and ironmongery.

BH 03.01.02 **Kitchen cupboards**

Kitchen cupboards shall be inspected for defects. Defects will include repairing or replacing damaged, corroded and worn-out fittings, eg door handles, knobs and hinges, door catches and holders, door locks, cupboard door vents, drawer slide rails, drawer handles, knobs and locks. Moving parts shall be serviced by cleaning, oiling, tightening loose screws, reinstating missing screws or aluminium pop rivets, etc. Where the baked enamel of steel cupboards is scratched and worn off, the steel surface shall be sanded and painted with an approved gloss epoxy paint to match the existing colour. Severely corroded or damaged steel cupboards shall be replaced with approved new steel cupboards complying with SABS 1385, with the baked enamel complying with SABS 783 Type II.

Damaged kitchen cupboards manufactured from composite board with laminated plastic covering shall be repaired where possible by gluing loose laminated plastic covering or replacing components with new similar matching finished elements.

Damaged kitchen cupboards manufactured from timber shall be repaired by replacing cracked and broken timber components. Painted surfaces shall be varnished with water-resistant varnish (with matching stain) or painted with approved polyurethane paint. Refer to Technical Specification BJ: Paintwork.

All cupboards shall be properly screwed and fixed to walls and floors with suitable corrosion resistant screws and plastic plugs, washers, etc.

Work tops and sinks against walls shall be sealed with an approved white one part polyurethane sealant. The sealant shall be applied strictly according to the manufacturer's specifications. Old worn-out and damaged sealant shall also be replaced. Drop-in sink bowls shall also be sealed with this approved polyurethane sealant. Where the possibility exists that water can penetrate composite board, these joints in the worktops shall also be sealed.

BH 03.01.03 **Shelving**

The stability of shelves must be checked to determine the occurrence of sagging. Where required, provide adequate support for the specific application, eg steel tubing struts, additional timber bearers, steel brackets, etc.

BH . 3

Broken timber shelving shall be replaced with approved wrought hardwood or solid laminated pine varnished or painted to specification. Composite board will not be permitted. Shelves shall be in single lengths. Heads of nails and brass countersunk screws in exposed faces of joinery shall be sunk and pelleted.

BH 03.01.04 Signage

Safety signs shall comply with the requirements of SABS 1186 (1997).

The Engineer shall survey all signage and list those items that prove to be illegible. Signs that need to be replaced shall be done in the same fashion and material as to match similar signs in the same application. The size of the signs shall be as shown on the schedules.

Where required proper and appropriate signage must be provided for door numbers, room size and room description. The size, colour, position on the door, wall, height above floor level of the lettering, etc., shall be as instructed by the Engineer on site or shown on the schedules. The lettering must be stencilled on to the doors and walls.

All other fire protection signage will be provided for hydrants, hose reels, etc, shall be provided under separate contract.

BH 03.01.05 Counters

The Engineer shall inspect all counters and counter tops for defects and shall establish which components are to be replaced or repaired. Special attention shall be given to the condition of hinges at service hatches.

All joinery liable to be damaged shall be covered with temporary coverings to the satisfaction of the Engineer and special care shall be taken to protect surfaces that are to be varnished.

Where necessary, timber counters shall be sanded down, uneven surface spots filled with an approved wood filler, all blemishes removed and then finished off in order to restore the wood to its original state.

Steel tops that have been damaged excessively shall be replaced.

BH 04 DETAIL OF REPAIR WORK

The detail of the scope of work is described in the Schedule of Quantities.

BH 05 MAINTENANCE

[Note: There will be no maintenance work required for fittings in this contract.]

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

All components forming part of the fittings shall be maintained as part of the maintenance of installations as defined in Additional Specification SA: General Maintenance.

Maintenance shall include all repair work, replacing of components, fixing of defects or any other actions or rectifying measures necessary to maintain the perfect functional condition of any fittings in accordance with the operation and maintenance manuals and as specified in this specification. All timber elements shall be preserved in a good condition, viz failure free, free from insect attack and from decay due to exposure to moisture. Moving parts of fittings shall be serviced regularly.

Maintenance on the fittings shall also include all other actions related to (or resulting from) maintenance work.

Remuneration for maintenance of the complete fittings shall be deemed included in the tendered monthly payment for maintenance of the installation under which it falls.

BH 06 **MEASUREMENT AND PAYMENT**

BH 06.01 **MEASUREMENT AND RATES**

BH 06.01.01 **General inclusion of costs**

Notes:

All material scheduled to be removed shall be deemed to be existing damaged materials in small or large sections. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material shall be of approved equal quality, colours, profiles, thickness, etc and shall in all cases match the existing materials and shall be fixed (internally or externally) to existing materials or surfaces.

All replacement, removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be removed or taken out shall be deemed to include the cleaning and preparation of the remaining sections, areas, or work.

Repair and service work shall also include all removing, cutting, grinding, cutting into, welding, bending, strengthening, drilling, tightening, fastening, oiling, greasing, adjusting, and providing missing or damaged screws or bolts, etc to repair or to improve the items or areas as new and to match the existing. The service of cupboard doors and drawers shall be deemed to include for servicing all locks, hinges, slides, tracks, etc.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pop rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc to leave the items as new and totally functional.

All new work is measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pip rivets, nails, adhesive, grout, putty, etc, as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc.

The removal of doors, gates or windows shall include for the removal of all existing locks, handles, striking plates, etc but exclude the hinges, etc, which shall be used for the new replaced items. All repair work (excluding paintwork) around and in the thresholds of new door frames, gates or windows built into existing brickwork in new or existing positions shall be deemed to be included in either the rates tendered for the new replacement item or the removal payment item of the frame, window, etc.

The new doors to toilets and wet areas as specified shall be fitted with rubber door stops, D-profiled pull handle and backplate sets, 15 mm roller ball catches with striking plates and all other ironmongery needed to install the doors complete. All new ironmongery shall be measured and paid for separately.

The new doors to offices, etc, as specified shall be fitted with rubber door stops, 4 lever mortice locksets with handle sets to match existing, striking plates and all other ironmongery needed to install the doors complete. All new ironmongery shall be measured and paid for separately.

All ironmongery installed on the project shall bear the SABS mark and codes. Samples of all ironmongery scheduled must be according to the samples of the Department of Public Works and samples must be handed to the engineer for approval before ordering the material.

BH 06.02 SCHEDULED ITEMS

NEW WORK

BH.01 Joinery:

- (a) Items measured by number:
 - (i) Timber cupboard doors, shelves, complete cupboards, etc (type and size indicated) Unit: number
 - (ii) Etc for other items measured by number
- (b) Items measured by linear metre:
 - (i) Timber rails, planks, frames, shelves, etc (size indicated) Unit: m
 - (ii) Etc for other items measured by length
- (c) Items measured by area:
 - (i) Pinning boards, shelves, work tops, etc (type and thickness indicated) Unit: m²
 - (ii) Etc, for other items measured by area

The units of measurement shall be the number, metre or square metre of each type and/or size of joinery item specified.

The tendered rates shall include full compensation for the manufacturing and supplying of all materials, for transport, labour, cutting, waste, fixing, screws, bolts, clamps, etc and installation of the joinery items.

BH.02 Steelwork:

- (a) Items measured by number:
 - (i) Steel cupboard or locker doors, shelves, complete cupboards, etc (type and size indicated)..... Unit : number or units
 - (ii) Etc, for other items measured by number
- (b) Items measured by linear metre:
 - (i) Steel rails, shelves, frames, etc (size indicated) Unit : m
 - (ii) Etc, for other items measured by length

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(c) Items measured by area:

- (i) Shelves, plates, etc (type and thickness indicated) Unit : m²
- (ii) Etc, for other items measured by area

The unit of measurement shall be the number, metre or square metre of each type and/or size of steelwork item specified.

The tendered rates shall include full compensation for the manufacturing, supplying of all materials and transport, and for all labour, cutting, welding, waste, fixing and installation of the steelwork items complete with a red oxide or equal approved steelwork primer or baked enamel paint finishing as specified.

ALTERATION WORK

BH.03

Alterations and repairs to existing fittings:

(a) Indicate if repairs, alterations, removal or sealing, etc:

- (i) Description of individual items to be repaired, altered, removed, sealed, etc Unit: m³, m², m, number

The unit of measurement for items repaired, altered, removed, sealed, etc shall be cubic metre, square metre, metre or number as scheduled.

The tendered rates shall include full compensation for all costs to repair, refix, remove, cutting into, realign, taking off, temporary store, etc as specified in the Standard and Technical Specifications and shall allow for all necessary labour, plant and new material needed to leave the scheduled items as new and to the approval of the Engineer. Refer also to the general inclusion of costs in BH 06.01.01".

TECHNICAL SPECIFICATION**BJ PAINTWORK****CONTENTS**

BJ 01	SCOPE
BJ 02	STANDARD SPECIFICATIONS
BJ 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
BJ 04	DETAIL OF REPAIR WORK
BJ 05	MAINTENANCE
BJ 06	MEASUREMENT AND PAYMENT

BJ 01 SCOPE

This specification covers the painting/repainting and maintenance of new and existing building components and maintenance thereafter for various types of buildings and structures.

Paintwork shall mean the scope of work related to the preparation, painting and maintenance of new and existing building components. This specification does not include work related to galvanising of steelwork, which is specified elsewhere.

The complete scope of paintwork shall be as described in BJ 04: Detail of repair work.

Maintenance of this part of the installation (the works) shall be performed in accordance with Additional Specification SA: General Maintenance, and the specific requirements included in this Technical Specification.

BJ 02 STANDARD SPECIFICATIONS**BJ 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SABS 515	-	Decorative paint with a non-aqueous solvent base for interior use
SABS 630	-	Decorative high gloss enamel for interior and exterior
SABS 631	-	Decorative oil gloss paint for interior and exterior use
SABS 633	-	Emulsion paints for interior decorative purposes
SABS 634	-	Emulsion paints for exterior use
SABS 678	-	Primers for wood for interior and exterior use
SABS 681	-	Undercoats for paints
SABS 683	-	Roof paints (relevant sections)
SABS 723	-	Wash primer (metal etch primer)
SABS 801	-	Epoxy-tar paints
SABS 887	-	Varnish for interior use
SABS 926	-	Two-pack zinc-rich epoxy primer
SABS 1227	-	Textured wall coatings, emulsion base, for interior and exterior use
SABS 1319	-	Zinc phosphate primers for steel
SABS 10064	-	-Preparation of steel surfaces for coating
PW 371	-	Specification of Materials and Methods to be used (Fourth edition, October 1993): Section 18

BJ 02.02 **ADDITIONAL SPECIFICATIONS**

Technical Specification BG: Metalwork
Paint manufacturers' specifications. These specifications shall take precedence over all others.

BJ 03 **VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS****BJ 03.01** **ADDITIONAL REQUIREMENTS FOR PAINTWORK****BJ 03.01.01** **General**(a) Quality control

- (i) Application of all paints must be supported by the relevant paint manufacturer's technical quality control systems with regard to preparation, application, film thickness, colour/pigmentation, mixing, etc.
- (ii) The Contractor must submit his programme to the Engineer well in advance, particularly where high-risk surface applications (sheet metal roofs, etc) are concerned, in order to keep the manufacturer's technical personnel informed. Paint application may not commence until the manufacturer has inspected the surface preparation and given written approval thereof to the Engineer.

(b) Paint systems

- (i) All paint shall be delivered to the site in the unopened containers on which the manufacturer's name and trademark appear.
- (ii) All materials for paintwork shall comply with the requirements for standards from the country from which it originated and shall be approved by the Engineer.
- (iii) The Contractor shall submit copies of the paint manufacturer's specifications, recommendations and datasheets to the Engineer for approval. The minimum requirement is written confirmation from the paint manufacturer that the paints to be used, comply with the relevant SABS standards.
- (iv) The coating system shall be from one manufacturer unless otherwise specified. The paint manufacturer's instructions shall be strictly adhered to.
- (v) Paints, etc, shall be suitable for application on the surfaces on which they are to be applied and various coats must be compatible with each other. Those paints used externally shall be of exterior quality or suitable for exterior use.

BJ 03.01.02 **General preparation of new and existing work**

All walls and ceilings, etc, shall be thoroughly cleaned prior to commencement of painting and the premises kept clean and free from dust during painting operations. Protect all surfaces not to be painted against spotting and spilling. Clean down and make good as necessary. Locks, door handles and similar fittings or fixtures shall be removed (or masked) and refitted on completion of painting.

(a) Plaster

- (i) All surfaces, sills, ceilings, etc, shall be thoroughly dry before painting operations are started. Porous surfaces must be sealed with the appropriate sealer, thinned if necessary, before applying the paint system.
- (ii) Exterior surfaces: Any cracks shall be scraped out and filled with an approved filler or patching plaster and rubbed down flush; the whole surface shall be well brushed down to remove all loose dust and powdery material before applying the first coat of the specified paint system.
- (iii) Interior surfaces: All cracks, blow holes, etc, shall be filled with suitable stopping and rubbed down flush. The whole surface shall be smoothed to an even finish and dusted down. Any grease marks, crayon marks, etc, shall be cleaned off with sugar soap and thoroughly rinsed with clean water. The surface shall be thoroughly dry before painting operations are started.
- (iv) Ceilings: Ceilings shall be brushed down and free of all dust and powdery materials. Cover strips and cornices shall be stopped where necessary and rubbed down smooth. All nail heads shall be primed, stopped and rubbed down flush. The surface shall then be wiped or brushed free of all loose or powdery materials before applying the recommended paint system.
- (v) Fibre cement: Fibre cement surfaces shall be cleaned down and primed with an approved sealer and undercoat.

(b) Metalwork

- (i) Iron and steel: New iron and steel metalwork shall be cleaned with an approved degreaser and the most effective method available (shot or sand blasting, mechanical wire brushing, hand wire brushing) used to remove all rust and millscale. Any salt deposits resulting from a marine or industrial environment shall be removed by washing with water prior to priming.
- (ii) Galvanised surfaces: New galvanised surfaces shall be well cleaned to remove all traces of oil and dirt with galvanised iron cleaner and rinsed with clean water.

(c) Woodwork

New woodwork shall be brushed down and the surface prepared as follows:
 Knots shall be given a coat of an approved patented knotting. The surface shall be primed overall and all holes shall be filled. The surface shall then be rubbed down with glass paper until smooth and even. Woodwork that needs to be oiled, stained or varnished shall be free of all stains, pencil marks and other surface discolourations and blemishes and shall be stopped with tinted stopping and rubbed down.

(d) General

- (i) Colours: All colours and tints are to be submitted to the Engineer for approval. Sample colours are to be prepared in all cases for the final coat and all work must be finished to colour approved by the Engineer. Where necessary, universal undercoat must be tinted to a shade lighter than the finishing coat.
- (ii) Doors and windows: All doors and opening sections of windows must be left ajar after painting or varnishing until the paint is perfectly dry.

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- (iii) Protection and cleaning off: All necessary precautions are to be taken for the protection of all finished work and other trades during painting, and all ironmongery shall be removed where possible prior to the commencement of painting and re-fixed after completion. All paint spots, stains, etc, are to be cleaned off floors, walls, glass, etc, after completion.
- (iv) Edges of sound paint surfaces that remain in place for overcoating must be sanded down to a feathered edge finish so that, once overcoating has been completed, there is no visible evidence of previous paintwork.
- (v) Where paint surfaces have excess fat, oil, tar, etc, deposits, they must be cleaned down with a suitable degreaser in accordance with manufacturer's specifications, instead of the normal sugar soap solution.

BJ 03.01.03 Paint specifications for various components(a) Fibre cement (ceilings)(i) New work(1) InteriorCeilings to wet areas (ablutions, kitchens and laundries):

- Polyurethane alkyd enamel:
Prepare and apply one coat synthetic copolymer primer. Stop with interior crack filler, seal crack filler with above primer. Apply two coats of polyurethane alkyd enamel interior quality paint.
- Universal fungicidal additive:
To be added to above in proportions specified by the manufacturer. This additive will only be required in specific cases.

(2) Exterior

Preparation: Clean down to remove all dirt and grease, etc., fill nail-heads with exterior crack filler and sand down to a smooth and even surface.

Finishing coat (emulsion): Apply two coats of super acrylic copolymer PVA emulsion or polyurethane alkyd enamel.

(ii) Renovation (existing) work(1) InteriorCeilings previously painted, in good condition:

Preparation: Clean down to remove all dirt and grease, etc, fill nail-heads, cracks and defects with interior crack filler and sand down to a smooth and even surface. (See BJ 03.01.02 – (d) – (v)).

Finishing coat: Apply two coats of super acrylic copolymer PVA emulsion or polyurethane alkyd enamel.

Ceilings previously painted, in poor condition (to be finished in an emulsion system):

Preparation: Remove all loose and flaking paint, clean down to remove all dirt, grease, etc, prime nail-heads with zinc phosphate primer for steel. Apply one coat of primer to existing ceiling boards diluted with 20 % turpentine. Fill nail-heads, cracks and defects with interior crack filler and sand down to a smooth and even surface. Seal all repaired areas with above-mentioned primer.

Finishing coat: Apply two coats of super acrylic copolymer PVA.

Ceilings to wet areas:

Preparation as above, but to be followed by one coat synthetic copolymer primer and two final coats polyurethane alkyd enamel interior quality paint (with fungicidal additive, only if specified).

In cases where fungicidal attack is prevalent the prepared surface must be washed down with antiseptic solution, followed by sodium hyperchlorite and allowed to react for 15 minutes before washing down with water. Once dry, primer and finishing coats may be applied.

(2) Exterior

Not Applicable

(b) Woodwork truss/rafters (overhangs)

(i) New work

(1) Interior

Not Applicable

(2) Exterior

- Egg-shell/High-gloss enamel:
Prepare and touch up knots with spirit soluble resin type knotting. Apply one coat of primer for wood. Stop with wood filler where necessary. Apply one coat of universal undercoat. Apply two coats of enamel.
- Creosote coating:
Prepare surface to be clean, dry and sound Apply on coat of creosote wood treatment coating.

(ii) Renovation (existing) work

(1) Interior

Not Applicable

(2) Exterior

Woodwork truss/rafters (overhangs) previously painted, in good condition (to be painted in egg-shell/high-gloss enamel):

Preparation: Clean down and sand to a smooth finish. Spot prime where necessary with primer for wood. Allow 24 hours drying. Stop with wood filler.

Undercoat: Apply one coat of universal undercoat. Allow 24 hours drying.

Finishing coat: Apply two coats of enamel paint.

Woodwork truss/rafters (overhangs) previously painted, in poor condition (to be finished in egg-shell/high-gloss enamel):

Preparation: Remove existing paint and sand down thoroughly. Touch up knots and resinous areas with knotting.

Primer: Apply one coat of universal undercoat. Allow 24 hours drying. Stop with wood filler and sand to a smooth finish.

Undercoat: Apply one coat of universal undercoat. Allow 24 hours drying.

Finishing coat: Apply two coats of enamel paint.

Creosote coating:

Preparation: Prepare surface. Apply two coats creosote wood treatment coating.

(c) Metalwork - steelwork and miscellaneous metal work (including general pipework)

(i) New work

(1) Interior

Unpainted:

Prepare and apply one coat zinc phosphate primer for steel. Apply one coat of universal undercoat. Apply two coats of high gloss enamel paint.

Shop-primed:

Touch up damaged primer with zinc phosphate primer for steel. Apply one coat of universal undercoat. Apply two coats of high-gloss enamel paint.

Cast-iron waste pipes:

Prepare and remove as much bitumen as possible. Apply one coat of aluminium paint. Apply one coat of universal undercoat. Apply two coats of high-gloss enamel paint.

(2) Exterior

Unpainted:

Prepare and apply one coat zinc phosphate primer for steel. Apply one coat of universal undercoat. Apply two coats of high-gloss enamel or oleoresinous aluminium paint (where applicable).

Shop-primed:

Touch up damaged primer with zinc phosphate primer for steel. Apply one coat of universal undercoat. Apply two coats of high-gloss enamel or oleoresinous aluminium paint (where applicable).

Cast-iron waste pipes:

Prepare and remove as much bitumen as possible. Apply one coat of universal undercoat. Apply two coats of high gloss enamel or oleoresinous aluminium paint (where applicable).

(ii) Renovation (existing) work

(1) Interior

Previously painted metalwork, in good condition (steel windows, door frames, miscellaneous steelwork, etc):

Preparation: Wash down with sugar soap and rise with clean water. Sand lightly and apply one coat universal undercoat. (See BJ 03.01.02 – (d) – (v)).

Finishing: Apply two coats high-gloss enamel.

Previously painted metalwork, in poor condition:

Preparation: Remove all existing paint by means of scraping or wire brushing and sanding. Tightly adhering paint that cannot be removed may remain and be overcoated. Remove all signs of rust back to bright metal by sanding with emery cloth. Wash down with an approved degreaser, rinse with clean water to remove all traces thereof and allow to dry. Treat rusted areas with a water-based rust converter.

Primer: Apply one coat of zinc phosphate primer for steel. Allow overnight drying.

Undercoat: Apply one coat of universal undercoat. Allow overnight drying.

Finishing coat: Apply two coats high-gloss enamel. Allow overnight drying between coats.

(2) Exterior

Previously painted metalwork, in good condition:

Preparation: Wash down with sugar soap, followed by light sandpapering. Rinse with clean water.

Undercoat: Apply one coat of universal undercoat. Allow 24 hours for drying.

Finishing coat: Apply two coats of high-gloss enamel or oleoresinous aluminium paint (where applicable).

Previously painted metalwork, in poor condition:

Preparation: Remove all existing paint by means of scraping or wire brushing and sanding. Tightly adhering paint that cannot be removed may remain and be overcoated. Remove all signs of rust back to bright metal by sanding with emery cloth. Wash down with an approved degreaser, rinse with clean water to remove all traces thereof and allow to dry. Treat rusted areas with a water-based rust converter.

Primer: Apply one coat of zinc phosphate primer for steel. Allow for 24 hours drying.

Undercoat: Apply one coat of universal undercoat. Allow for 24 hours drying.

Finishing coat: Apply two coats of high-gloss enamel or oleoresinous aluminium paint (where applicable).

(3) Aggressive environments

Not Applicable

(d) Gypsum board (ceilings, etc)

(i) New work

(1) Interior (dry areas)

- Super acrylic PVA:
Prepare and apply one coat synthetic copolymer primer for gypsum board diluted with 20 % turpentine. Stop with interior crack filler, seal crack filler with above-mentioned primer. Apply two coats of super acrylic copolymer PVA paint.

(2) Exterior (dry areas)

- Super acrylic PVA:
Prepare and supply one coat of synthetic copolymer primer for gypsum board diluted with 20 % turpentine. Stop with interior crack filler, seal crack filler with above-mentioned primer. Apply two coats of super acrylic copolymer PVA paint.

(ii) Renovation (existing) work

(1) Interior

Previously painted gypsum board with PVA in good condition:

Preparation: Wash down with sugar soap to remove all dirt, grease, etc, and rinse off with clean water. When dry, make good all cracks and defects with interior crack filler and sand to a smooth and even surface. Seal crackfiller with above primer.

Finishing coat: Apply two coats super acrylic copolymer PVA.

Previously painted gypsum board, in poor condition:

Preparation: Clean down. Remove all paint by sanding and scraping or by other suitable means without damaging existing board surface.

Primer: Prepare and prime as for new work above. Stop cracks and holes with interior / exterior crackfiller. Seal crack filler with above primer and allow to dry.

Finishing coat (emulsion): Apply two coats of super acrylic copolymer PVA.

(2) Exterior

Not Applicable

(e) Cement plaster (walls / soffits) and concrete surfaces

(i) New work

(1) Interior

- Polyurethane alkyd enamel (in wet areas, kitchens, etc):

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Prepare and apply one coat bonding liquid, followed by one coat of synthetic copolymer primer for new plaster. Apply two coats of polyurethane alkyd enamel paint.

- Acrylic emulsion:
Same as above, but apply acrylic emulsion with smooth velvet sheen interior quality paint.
- Gloss / eggshell enamel:
Same as for polyurethane alkyd enamel, but apply two coats high-gloss enamel.
- Super acrylic PVA:
Prepare and apply one coat of synthetic copolymer primer. Apply two coats of super acrylic copolymer PVA.
- Semi-gloss pure acrylic finish:
Prepare and apply one coat of synthetic copolymer primer. Apply two coats of pure acrylic paint.

(2) Exterior

- Pure acrylic:
Prepare and apply one coat of alkali resistant synthetic resins bonding liquid. Stop with exterior crack filler. Apply one coat of copolymer primer. Apply one final coat of pure acrylic paint.
- Pure acrylic with Teflon:
Preparation, priming and application as above.
- Super acrylic PVA:
Prepare and apply one coat of synthetic copolymer primer. Apply two coats of super acrylic copolymer PVA.
- Acrylic emulsion (external textured):
Preparation as above, followed by two coats textured exterior acrylic emulsion, allowing one hour drying time between coats.

(ii) Renovation (existing) work

(1) Interior

Previously distempered:

Preparation: Remove all distemper with a peeling agent. Rinse with clean water. Allow 48 hours to dry. Fill cracks and defects with interior crack filler. Sand down to a smooth and even surface.

Primer: Apply one coat of bonding liquid, allow a minimum of 24 hours and maximum of 72 hours for drying. Final primers as specified in BJ 03.01.03(e)(i).

Undercoat: Apply one coat of universal undercoat. Allow 24 hours drying.

Finishing coat: Apply similar paints to suit as specified in BJ 03.01.03(e)(i).

(2) Interior and Exterior

Previously painted cement plaster (walls) and surfaces, in good condition:

Preparation: Wash down thoroughly with sugar soap. Rinse with clean water. Fill with suitable exterior crack filler. Sand smooth. Prime with one coat bonding liquid. (See BJ 03.01.02 – (d) – (v)).

Undercoat: Apply one coat of universal undercoat – Allow 24 hours drying.

Finishing coat: Apply similar paints to suit as specified in BJ 03.01.03(e)(i).

Previously painted cement plaster (walls) and surfaces, in poor condition (ie peeling – Plaster in good condition)

Preparation: Remove all paint and fill with suitable exterior / interior crack filler. Sand down.

Primer: Apply one coat alkali resistant plaster primer, allow to dry for a minimum of 24 hours and a maximum of 72 hours.

Undercoat: Apply one coat of universal undercoat – Allow 24 hours drying.

Finishing coat: Apply similar paints to suit as specified in BJ 03.01.03(e)(i).

- (3) Previously painted, in poor condition (i.e. peeling crazing, **extensive** plaster cracks, etc)

Preparation: Remove all paint and fill with suitable exterior crack filler.

Prime coat: Prime with one coat bonding liquid, allow to dry for a minimum of 24 hours and a maximum of 72 hours.

Final coats: Apply similar paints to suit as specified in BJ 03.01.03(e)(i)

(f) Fibre cement board (fascias, etc) - General

(i) New work

(1) Interior

New and wet fibre cement sheets shall be allowed to dry out before painting is commenced.

Boards must be well primed on both sides with an approved sealer/undercoat before fixing.

- Super acrylic PVA:
Prepare and apply one coat of sealer/undercoat. Prime nail heads with metal primer. Stop with filler. Apply two coats of super acrylic copolymer PVA.

(2) Exterior

New and wet fibre cement sheets shall be allowed to dry out before painting is commenced.

Fascia boards and barge boards shall be well primed on both sides and edges painted with sealer/undercoat before fixing.

All sides of fascia boards must receive final coatings.

- Super acrylic PVA:
Prepare and apply one coat sealer/undercoat. Prime nail heads with zinc phosphate metal primer. Stop with filler. Apply two coats of super acrylic copolymer PVA.

(ii) Renovation (existing) work

(1) Interior

Previously painted fibre cement board with emulsion paint, in good condition:

Preparation: Clean down thoroughly to remove any signs of dirt or grease. Fill all screw heads with a flexible resistant filler after screw heads have been primed.

Finishing: Apply two coats of super acrylic copolymer PVA paint.

Previously painted fibre cement board in poor condition:

Preparation: Remove previous paint coatings with super paint stripper. Thoroughly wash down with sugar soap and rinse with clean water. Prime nail and screw heads with zinc phosphate metal primer. Allow to dry.

Primer: Apply one coat of synthetic copolymer primer to all surfaces including back and edges, allow to dry. Fill all screw heads with weather resistant filler, allow to dry, sandpaper smooth and touch up with primer.

Finishing: Apply two coats of super acrylic copolymer PVA paint.

(2) Exterior

Previously painted fibre cement board with emulsion paint in good condition:

Preparation: Clean down thoroughly to remove any signs of dirt or grease. Fill all screw heads with a flexible weather resistant filler after screw heads have been primed.

Finishing: Apply two coats of super acrylic copolymer PVA paint.

Previously painted fibre cement board, in poor condition:

Preparation: Remove previous paint coatings with super paint stripper. Thoroughly wash down with sugar soap and rinse with clean water. Prime nail and screw heads with zinc phosphate metal primer. Allow to dry.

Primer: Apply one coat of sealer/undercoat to all surfaces including back and edges, allow to dry. Fill all screw heads with weather resistant filler. Allow to dry and sandpaper smooth. Touch up with primer.

Finishing: Apply two coats of super acrylic copolymer PVA paint.

(g) Galvanised iron roof (also gutters and rainwater pipes)

(i) New work

(1) Interior

Not Applicable

(2) Exterior

Galvanised iron - roofs: Water-based pure acrylic emulsion paint:

Scrub down thoroughly with degreaser, followed by a cleaner for galvanised iron. Rinse off thoroughly and ensure that all traces of cleaner have been removed and that the surfaces are free of any grease and oil. Apply one coat of galvanised metal primer. Allow to dry for 5 hours. (Must be overcoated within 24 hours maximum.) Apply one coat of water-based pure acrylic emulsion paint with non-fading pigment.

Galvanised iron - roofs: Mat acrylic roof paint:

Scrub down thoroughly with degreaser, followed by a cleaner for galvanised iron. Rinse off thoroughly and ensure that all traces of cleaner have been removed and that the surface is free of any grease and oil. Apply two coats of mat acrylic roof paint.

Galvanised iron - gutters and rainwater pipes: Gloss enamel:

Scrub down thoroughly with degreaser, followed by a cleaner for galvanised iron. Rinse off thoroughly and ensure that all traces of cleaner have been removed and that the surface is free of any grease and oil. Apply one coat of primer for galvanised iron. Allow to dry for 5 hours. (Must be overcoated within 24 hours maximum.) Apply two coats of gloss enamel paint with non-fading pigment.

(ii) Renovation (existing) work

(1) Interior

Not Applicable

(2) Exterior

Previously painted galvanised iron, in good condition:

Preparation: Thoroughly scrub down with fibre scrubbing brushes and sugar soap and rinse with clean water.

Finishing coat: Apply one coat water-based pure acrylic emulsion paint with non-fading pigment.

Unpainted or previously painted galvanised iron, in poor condition (ie flaking, peeling and rusting):

Preparation: Remove all previous paint coatings with steel wire brushes, plumber's egg-shaped lead scrapers, and coarse floor sandpaper. Remove all traces of rust with emery cloth back to bright metal and apply approved rust converter. Thoroughly scrub down using galvanised iron cleaner and rinse with clean water.

Primer: Apply one coat of galvanised metal primer. Allow a minimum of 5 hours and a maximum of 72 hours for drying.

Finishing coat: Apply two coats of water-based pure acrylic emulsion paint with non-fading pigment.

(h) Timber (doors, cornices, window frames, counters, skirtings, etc)

(i) New work

(1) Interior

- Polyurethane alkyd enamel (wet areas, kitchens, etc):
Prepare knots with spirit soluble resin type knotting. Prime with primer (sanding sealer) for wood. Fill imperfections where necessary with wood filler. Apply one coat of universal undercoat. Apply two coats of polyurethane alkyd enamel.
- High-gloss/egg-shell enamel:
Prepare knots with spirit soluble resin type knotting. Prime with primer (sanding sealer) for wood. Fill imperfections where necessary with wood filler. Apply one coat of universal undercoat. Apply two coats of enamel.
- Gloss/suede varnish (interior quality solvent based):
Prepare knots with spirit soluble resin type knotting. Fill imperfections with wood filler. Sand surfaces to a smooth finish in grain direction and dust off.
Thin first coat down in a ratio of 3 parts varnish to 1 part mineral turpentine and apply. Allow to dry for 24 hours. Apply two full-strength final coats with 24 hours drying time between applications.

(2) Exterior

- High-gloss/egg-shell enamel:
Prepare with spirit soluble resin type knotting. Apply one coat of primer for wood. Fill where necessary with wood filler. Apply one coat of universal undercoat. Apply two coats of high gloss enamel.
- Gloss/suede varnish (exterior quality ultraviolet resistant solvent based):
Prepare knots with spirit soluble resin type knotting. Fill imperfections with wood filler. Sand surfaces to a smooth finish in grain direction and dust off.
Thin first coat down in a ratio of 3 parts varnish to 1 part mineral turpentine and apply. Allow to dry for 24 hours. Apply two full-strength final coats with 24 hours drying time between applications.

(ii) Renovation (existing) work

(1) Interior

Previously painted woodwork, in good condition (to be finished in polyurethane alkyd enamel):

Preparation: Wash sown with sugar soap to remove all dirt, grease, etc, then rinse off with clean water. Sand down to a smooth and mat surface. Make good cracks and defects with wood filler and after 24 hours drying, sand down again. (See BJ 03.01.02 – (d) – (v)).

Finishing coat: Apply two coats of polyurethane alkyd enamel. Allow 24 hours for drying between coats.

Previously varnished woodwork in good condition (to be finished with interior quality varnish):

Repair defects with wood filler. Sand surfaces to a mat finish and apply two final coats varnish with 24 hours drying time between applications.

Previously painted woodwork in poor condition (to be finished with high-gloss/egg-shell enamel):

Preparation: Remove all paint, varnish and stain with super paint stripper. Wash down thoroughly with sugar soap and rinse with clean water. When surface is completely dry, sand down and apply one coat of spirit soluble resin type knotting to all knots. Fill all cracks and defects with wood filler and after 24 hours of drying, sand down to a smooth and even surface. Apply one coat oleoresinous wood primer. Apply one coat universal undercoat.

Finishing coat: Apply two final coats enamel.

Previously stained and varnished or painted woodwork in poor condition (to be finished in polyurethane alkyd enamel):

Preparation: Remove all paint, varnish and stain with super paint stripper. Wash down thoroughly with sugar soap and rinse with clean water. When surface is completely dry, sand down and apply one coat of spirit soluble resin type knotting to all knots. Fill all cracks and defects with wood filler and after 24 hours of drying, sand down to a smooth and even surface. Apply one coat oleoresinous wood primer.

Finishing coat: Apply one coat polyurethane alkyd enamel.

Previously varnished woodwork in poor condition (to be finished with interior quality varnish):

Remove all varnish with paint stripper. Wash down to dry completely. Further preparation and applications as for BJ 03.01.03(h)(i): New work - interior.

(2) Exterior

Previously painted woodwork, in good condition (to be repainted with high-gloss/egg-shell enamel):

Preparation: Clean down and sand to a smooth finish. Spot prime where necessary with oleoresinous wood primer. Allow 24 hours for drying. Stop defects with a flexible weather resistant wood filler.

Undercoat: Apply one coat of universal undercoat. Allow 24 hours drying.

Finishing coat: Apply two coats of enamel.

Previously varnished woodwork in good condition (to be finished with exterior quality ultraviolet resistant solvent based varnish):

Preparation and application as for similar interior item above.

Previously stained and varnished or painted woodwork, in poor condition (to be finished in high-gloss/egg-shell enamel):

Preparation: Remove all paint, varnish and stain with super paint stripper. Wash down thoroughly with sugar soap and rinse with clean water. When surface is completely dry, sand down and apply one coat of spirit soluble resin type knotting to all knots. Fill all cracks and defects with wood filler and after 24 hours drying, sand down to a smooth and even surface. Apply one coat oleoresinous wood primer. Apply one coat universal undercoat.

Finishing coat: Apply two final coats of enamel.

Previously stained and varnished or painted woodwork, in poor condition (to be finished in polyurethane alkyd enamel):

As for similar interior item above.

Previously varnished woodwork in poor condition (to be finished with exterior quality ultraviolet resistant solvent based varnish):

Preparation and application as for similar interior item above.

(i) Concrete, cement surfaces and window cills - floor paint

(i) New work

(1) Exterior and interior

Preparation: Remove laitance, residual cement spillage, etc, by means of carborundum grinding and vacuum clean to remove all dust. Remove oil, grease or any other surface contaminants with degreaser and wash off with clean water. Allow to dry. The surface must have less than 5 % moisture content before painting may be done.

Finishing coats: Apply two coats of an alkali resistant solvent based stoep (modified alkyd) paint. The first coat may be thinned with 25 % mineral turpentine. Sixteen hours drying time must be allowed between coats.

(ii) Renovation (existing) work

(1) Exterior and interior

Previously painted concrete and cement surfaces, in good condition:

Preparation: Remove any loose and flaking paint by means of carborundum grinding, back to firm feathered edges. Remove any polish, grease, oil and other contaminants with degreaser, wash clean and allow to dry. Sand old paint to a mat finish and vacuum clean to remove all dust.

Finishing coats: Apply two coats as for new work above.

Previously painted concrete and cement surfaces, in poor condition:

Strip completely by suitable means and treat as for new work above.

(j) Cement plaster or facebrick walls and concrete surfaces where damp penetration is evident

(i) Renovation

(1) Exterior and interior

Preparation: Remove all damaged paintwork, efflorescence, loose friable material, etc, back to bare and sound substrate. Repair all damaged surfaces with suitable approved materials to match original surface.

Surfaces may remain damp and in some cases will require additional wetting, depending on the particular coating used.

Damp sealing coats: Apply two coats approved synthetic polymer modified water barrier coating in strict accordance with the particular product manufacturer's specifications. Allow 24 hours between coats unless otherwise specified.

Finishing coats: Apply decorative finishing coats to suit, as in BJ 03.01.03(e).

BJ 04 **DETAIL OF REPAIR WORK**

The detail of the scope of work is described in the Schedule of Quantities.

BJ 05 **MAINTENANCE**

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

All components forming part of the repaired/replaced work shall be maintained during the maintenance phase of the Contract.

Maintenance shall include any repair work, replacing of components, routine inspections or any other actions or rectifying measures necessary for complete operation of the repaired/replaced work in accordance with the operation and maintenance manuals and as specified.

Maintenance on the repaired/replaced work shall also include all other actions related to (or resulting from) maintenance, with respect to rectification of paint failures such as blistering, peeling, chalking, fading, erosion, etc.

Remuneration for maintenance of the complete repaired/replaced work shall be deemed included in the tendered monthly payment for maintenance thereof.

BJ 06 **MEASUREMENT AND PAYMENT**

BJ 06.01 **MEASUREMENT AND RATES**

BJ 06.01.01 **General inclusion of costs and specific specifications**

Notes:

All material scheduled to be removed shall be deemed to be existing damaged material. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material shall be deemed to be in patchwork and shall be of approved equal quality, colours, profiles, thickness, etc and shall in all cases match the existing materials and shall be applied (internally or externally) to existing material or surfaces.

All removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be removed or taken out shall be deemed to include the cleaning and preparation of the remaining sections, areas, or work to receive the new material or work specified.

Repair work shall also include all cutting, grinding, cutting into, welding, bending, strengthening, drilling, etc to repair or to improve the items or areas as new and to match the existing.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pip rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc to leave the items as new and totally functional.

All new work are measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pip rivets, nails, adhesive, grout, putty, etc, as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc.

All paintwork shall include for surface preparation, cleaning, primer(s), undercoat(s) and final coat(s) as specified by the manufacturers and in the Technical Specifications. Scheduled items in the Schedule of Quantities are mainly brief descriptions of the final coat(s) to identify the paint system as specified in the Specifications.

Most steel surfaces such as gratings, screens, gates, doors, mesh, louvres, burglar proofing, windows, etc are measured both sides on the net flat overall area of the item. Paint to roof covering and side cladding, etc are measured wet on the flat overall area of the items and not along the girth of the sheeting. All final re-measurements for payment purposes will be done on the same principles.

Rates tendered for paintwork shall be deemed to include for all "line cutting" between different colours of paint specified by the Engineer in dados, skirtings, etc.

Rates tendered for paintwork on ceilings and cornices shall be deemed to include for paint on cover and jointing strips.

Rates tendered for paintwork on ceilings, wall panelling, divisions, etc shall be deemed to include for timber door frames, jointing and cover strips, skirtings, cornices, quadrant beads, etc if painted with the same specified paint material and in the same colour schemes.

Where specified to be painted in contrasting colours, varnished or with a different paint material the paintwork on the door frames, skirtings, cornices, beads, cover strips, etc will be measured and paid for separately per linear metre.

Specific specification for floor paint

Preparation:

The concrete floor must have less than 3% moisture before painting is attempted. Remove laitance, residual cement spillage, etc. by Carborandum grinding. Vacuum clean to remove all dust. Remove oil, grease, or any other surface contaminant with degreaser. Allow to dry thoroughly before painting.

Paint system:

Apply one coat of an alkali resistant solvent based stoep (modified alkyd) paint. The first coat may be thinned with approximately 25% mineral turpentine to aid penetration.

Apply one finishing coat of an alkali resistant solvent based stoep (modified alkyd) paint.

Protection of existing furniture, carpets, finishings, cupboards, etc during paint procedures

Protection, sheets and screens:

All existing finishings, carpets, floors, furniture, etc shall be carefully handled, moved when instructed within the specific room, building or area to be painted, covered with sheets, screens or other approved methods to protect the items or finishings against damage or spilled paint spots or stains. Any damage caused to the mentioned existing items shall be rectified or replaced by the Contractor without additional payment.

The costs of sheets, covers, screens and all labour to address the above shall be deemed to be included in the tendered rates for the individual payment items or in the general preliminary cost items. No claims by the Contractor in this regard will be entertained.

BJ 06.02 SCHEDULED ITEMS

NEW UNPAINTED SURFACES:

BJ.01 Paint to new unpainted surfaces:

(a) Description of surface:

(i) Brief description of final paint type:

(a) Description of application area or item

to be painted Unit: m², m, number

- (b) Etc, for other areas or items

The unit of measurement shall be the number, metre or square metre as applicable to each item.

The tendered rates shall include full compensation for manufacturing, providing and applying each item complete as per specifications, drawings, descriptions as scheduled or as the existing and shall include for all labour, material, preparation work, waste, plant, transport, delivery, access, scaffolding, fuel, miscellaneous items and material, etc to the Engineer's approval.

PREVIOUSLY PAINTED SURFACES:

BJ.02

Paint to previously painted surfaces:

- (a) Description of surface:

- (i) Brief description of final paint type:

- (a) Description of application area or item to be painted..... Unit: m², m, number
 - (b) Etc, for other areas or items

The unit of measurement shall be the number, metre or square metre as applicable to each item.

The tendered rates shall include full compensation for manufacturing, providing and applying each item complete as per specifications, drawings, descriptions as scheduled or as the existing and shall include for all labour, material, preparation work, waste, plant, transport, delivery, access, scaffolding, fuel, miscellaneous items and material, etc to the Engineer's approval.

PREVIOUSLY PAINTED SURFACES IN POOR CONDITION:

BJ.03

Paint to previously painted surfaces in poor condition:

- (a) Description of surface:

- (i) Brief description of final paint type:

- (a) Description of application area or item to be painted Unit: m², m, number
 - (b) Etc, for other areas or items

The unit of measurement shall be the number, metre or square metre as applicable to each item.

The tendered rates shall include full compensation for manufacturing, providing and applying each item complete as per specifications, drawings, descriptions as scheduled or as the existing and shall include for all labour, material, preparation work, waste, plant, transport, delivery, access, scaffolding, fuel, miscellaneous items and material, etc to the Engineer's approval.

TECHNICAL SPECIFICATION FOR CONCRETE CONSTRUCTION

BK STRUCTURAL CONCRETE

CONTENTS

BK 01	SCOPE
BK 02	STANDARD SPECIFICATIONS
BK 03	PROJECT SPECIFICATION
BK 04	DETAIL OF REPAIR WORK

BK 01 SCOPE

This specification covers the repair of existing structural concrete elements and the supply, delivery and implementation of the repair procedures for the various types of structures.

Structural concrete shall mean the scope of work to repair all structural concrete components such as walls, columns, stairs and suspended slabs and floors. Joint repairs also form part of this specification. This specification does not include work related to metalwork and paintwork that are specified elsewhere.

BK 02 GENERAL STANDARD SPECIFICATIONS

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- PW 371 - Specification of Materials and Methods to be used
(Fourth Edition, October 1993)
- SABS 1200 G - Concrete (structural)
- SABS 1200 GA - Concrete (small works)
- SABS 1200 GB - Concrete (ordinary buildings)
- SABS 1200 GE - Precast concrete (structural)
- SABS 1200 GF - Prestressed concrete
- SABS 0100 - Structural use of concrete
- SABS 110 - Sealing compounds for the building industry, two component,
polysulphide base
- SABS 1077 - Sealing compound for the building and construction
industry,
two-component, polyurethane-base
- SABS 1254 - Sealing compounds for the building industry, oleoresinous
base, for interior and exterior use
- SABS 1305 - Sealing compounds for the building industry, one component,
siliconed-rubber-base

BK 02 **PROJECT SPECIFICATION**

This Project Specification takes precedence over the Standard Specification, except in the case where an aspect is not covered by the Project Specification, in which case the Standard Specification will apply.

BK 02.01 **CONCRETE MATERIALS**

SANS standards: All concrete materials shall comply with the relevant SANS standards.

BK 02.01.01 **Concrete mix designs**

All mix designs for 20MPa and higher grades of concrete shall be tabled and approved by the Engineer in writing, before these mix designs may be used. Each mix design shall clearly state the type, origin and quantity per cubic metre of concrete for each constituent material.

The mix design and constituent materials shall be such so as to produce low shrinkage, crack-free concrete.

BK 02.01.02 **Cement types**

Only cements of type CEM I and CEM IIA as per SANS 50197-1 may be used. In addition, only cements of strength class 42,5MPa and higher may be used. Cement shall not be stored for more than 4 weeks before it is used.

BK 02.01.03 **Cement extenders**

Cement extenders such as fly-ash and slag may not be used in conjunction with CEM IIA. Should the Contractor wish to use cement extenders with CEM I, then he shall obtain the Engineer's prior approval. The Engineer might approve cement extenders of up to 15% in the warmer months of the year, but excluding May, June, July and August.

BK 02.01.04 **Minimum cement content**

The minimum cement content of CEM I or CEM IIA cements are: 280 kg/m³ for 25MPa, 300 kg/m³ for exposed 25MPa, 310 kg/m³ for 30MPa and 330 kg/m³ for 35MPa concrete.

BK 02.01.05 **Water**

The maximum water / cement ratio is as follows: 0,67 for 25MPa, 0,60 for 30MPa and 0,53 for 35MPa concrete. Admixtures such as water-reducing agents or plasticizers may be used, but then only strictly according to the manufacturer's instructions.

BK 02.01.06 **Aggregates**

The coarse aggregate (stone) shall be 19mm natural stone unless otherwise specified. The total mass of coarse aggregate (stone) shall exceed the total mass of fine aggregate (sand) per cubic metre of concrete. Aggregates used in concrete for sewage treatment works, channels and tunnels shall be dolomitic aggregate. A non-dolomitic filler sand may be used.

BK 02.02 **REINFORCING STEEL MATERIALS**

SANS standards: All reinforcing steel shall comply with the relevant SANS standards.

BK 02.02.01 **Steel types**

Mild steel (R-steel) shall not be replaced by high tensile steel (Y-steel).

BK 02.02.02 **Steel bar dimensions**

Steel bars shall be cut and bent strictly to the dimensions and radii stipulated on the project's bending schedules.

BK 02.03 **FORMWORK CONSTRUCTION****BK 02.03.01** **Formwork design**

- a) All formwork shall be designed by a competent person or a competent company, and the requirements for continuous propping and / or multi-level propping shall be calculated to a theoretical model acceptable to the Engineer. Design loads will be supplied by the Engineer on request. The Contractor shall make provision for the continued support of slabs and beams while the formwork pans / panels are being removed. No back-propping is allowed.
- b) Wall formwork ferrules: The lay-out and positioning of ferrules shall be approved by the Architect / Engineer. In the case of water-retaining structures ferrules shall be of a type which does not leave holes through the walls.
- c) Formwork quality: All formwork shall be sturdy, leak-proof and lightly oiled.
- d) Formwork finish: All formwork finishes shall be at least of class SMOOTH to Degree of Accuracy II, or class SPECIAL to Degree of Accuracy I when so specified on the concrete drawings. Top surfaces of wood- and steel-trowelled concrete floors are to be class SPECIAL.
- e) Upward cambers: All beams, bands and slabs shall have the following upward cambers, unless otherwise indicated on the concrete drawings: Cantilever spans: span ÷ 200 and other spans: span ÷ 500.

- f) Construction joints: Positions of construction joints in beams and slabs shall be discussed with, and approved by the Engineer, and shall be formed using planks or well supported chicken wire.
- g) Cast-in items: The Contractor shall ensure that all cast-in items, eg conduits, sleeves, pockets, etc, of all the various building disciplines are accurately placed and secured before concrete is cast.

BK 02.03.02 Removal of formwork

Formwork and props may only be removed after “n” 24h days:

Walls and columns:	2 (hot / normal)	3 (cold)
Slabs with props left underneath:	4	7
Beams with props left underneath:	7	12
Slab props:	10	17
Beam props:	14	21

BK 02.04 REINFORCING STEEL FIXING

- a) Steel shall be fixed using the specific project's fixing plans and bending schedules.
- b) Steel must be inspected and approved in writing by the Engineer before concrete may be cast. The Contractor shall give the Engineer at least 2 days' notice of inspections.
- c) Steel must be properly fixed in position, and purpose-made plastic or concrete spacer blocks must be in position before inspections.
- d) The concrete cover to reinforcing bars shall be as specified on the plans and schedules, but under no circumstances shall the cover be less than: 20mm for plastered and internal slabs and beams; 30mm for exposed concrete surfaces and concrete columns; 40mm in the case of water-retaining structures; 75mm for concrete cast against soil.
- e) No welding of reinforcing steel bars is allowed.

BK 02.04 CONCRETE CONSTRUCTION

- a) Concrete shall be discharged in the position needed and not moved sideways with vibrators.
- b) Concrete shall be properly vibrated using an adequate number of mechanical vibrators.
- c) Concrete may only be cast when the ambient temperature is between 5°C and above 32°C. No concrete may be cast during rain and hail, or shortly before a rain storm.
- d) All concrete elements shall be cured with either, tight wrapping with plastic, or a 50mm layer of wet sand, whichever appropriate, for the following durations: 5 days when hot / normal and 7 days when cold.
- e) Other curing methods must be approved.

BK 02.05 CONSTRUCTION TOLERANCES

- a) All concrete shall at least be constructed to Degree of Accuracy II (SMOOTH

- finish), and Degree of Accuracy I (SPECIAL finish) when so specified on the concrete drawings, as well as in the case of precast concrete elements.
- b) Each permissible deviation is binding in itself, no cumulative effect will be allowed.
- c) Permissible deviation (PD) of dimensions. Some selected values are:

PD:	DoA II:	DoA I:
Cross-section dimensions	-5 / +15 mm	-5 / +5 mm
Flatness of a plane surface	5 mm	3 mm
Abrupt change in continuous surface	5 mm	2 mm
Linear dimension (not cross-sections)	-20 / +20 mm	-10 / +10 mm
Verticality (per metre height)	5 mm	2 mm
Wood- / steel-trowelled top surfaces	-3 / + 3 mm	-3 / +3 mm

BK 02.06**CONCRETE TESTING**

- a) A set of concrete test cubes shall be made for every 50m³ of concrete produced, and at least one set of each day's concrete produced. Cubes shall be made strictly according to the SABS prescribed method, and shall be cured and tested by an independent laboratory.
- b) A set of test cubes comprises 6 cubes, 3 to be tested on 7 days, and 3 on 28 days.
- c) When ready-mixed concrete is used, the Contractor must still make cubes on site. Process cube results from a ready-mix plant are not acceptable.
- d) A set of 3 cubes tested at 28 days passes when the average strength is at least 2MPa higher than the specified strength, and when no single cube tests lower than 3MPa below the specified strength.

BK 02.07**CONCRETE SCREEDS****(a) General**

Concrete screeds shall have a minimum thickness of at least 50 mm. The Engineer shall determine the areas of which the concrete screeds need to be replaced.

Only cements of type CEM I and CEM IIA as per SANS 50197-1 may be used. In addition, only cements of strength class 42,5MPa and higher may be used. Cement shall not be stored for more than 4 weeks before it is used.

Coarse aggregate maximum size:	10 mm
28-day cube strength:	30 MPa OR 35 MPa. (as specified)

The use of an approved plasticizer is recommended to reduce the water content of the mix to the absolute workable minimum.

The mix design must be submitted to the Engineer in advance for approval.

Refer to BK 02.06 for the testing requirements of concrete.

(b) Preparation

All laitance on the surface of the slabs must be removed, using mechanical Equipment such as scabblers, so as to expose the coarse aggregate of the concrete.

Before commencement of the screed, remove all loose material and dust, and keep the slabs thoroughly wet for eight hours, before placement of the screed.

(c) Placement of the screed

Remove all surface water from the slab. Apply a grout to the slab surface, which consists of a 1:1 mix of cement and clean fine sand, with just enough water to provide the consistency of a slurry. Vigorously brush the grout into the scabbled surface of the slabs using brooms. Strike off all surplus grout, leaving a thin layer of grout.

Place the screed concrete in one layer, in a checker board pattern, while the grout layer is still visibly wet. Compact the concrete very well using small mechanical vibrators.

(d) Finishing

The surface finish shall be SPECIAL as per SABS 1200G attained by steel trowelling.

Power floating should not commence until such time as the concrete surface, has lost its sheen and barely shows footprints.

All laitance on the surface of the fresh concrete screed resulting from the compaction of concrete, must be struck off prior to mechanical trowelling. Over-trowelling, causing excessive cement-water paste to come to the surface, must be strictly avoided.

(e) Joints

The screed shall have construction joints and expansion joints, in all the exact Same positions as the underlying concrete slab.

In addition the screed shall be divided into panels of no larger than 3 x 3m. The Length to width ratio of these panels shall not exceed 1.5.

All joints shall be formed with side formwork. An expansion joint former Specifically developed for the intended applications must be used as specified by the Engineer.

Joints must be sealed with an approved 1-part polyurethane joint sealer for the intended purpose according to the Engineer's specification.

(f) Curing

Curing of the screed concrete shall commence directly after the finishing Operation stops, and shall continue for 7 days. The method of curing shall be by means of well held down plastic sheeting and with the daily adding of water.

BK 03 **MOVEMENT JOINTS**

BK 03.01 **Joint Former**

Ensure all concrete surfaces are free from base grit and dust. Apply glue in vertical strips \pm 100 mm wide and 25 mm from the top to avoid the tear-off strip from sticking to the concrete face.

Allow the glue to dry (according to manufacturer's instructions) and then stick the joint former onto the glued concrete face.

Cast the next section of concrete as required. Take care not to let the wet concrete get behind joint former as this will result in a wavy joint.

When the joint sealant is about to be applied, simply peel the tear-off strip out of the formed joint, leaving an even groove of uniform depth for filling with sealant.

BK 03.02 **Joint Sealant**

Joints < 10 mm are normally designed for crack control and therefore they are not movement / expansion joints. The joint width to depth ratio is important at the time of the application of the sealant (guide value of +10°C).

BK 03.03 **Application Method /Tools**

After suitable joint and substrate preparation, insert Backing Rod to required depth and apply primer if necessary. Insert cartridge into sealant gun and firmly extrude joint sealant into joint, making sure that it is full contact with the side of the joint. Fill the joint, avoiding air entrapment. The joint sealant must be tooled firmly against joint sides to ensure good adhesion.

Masking tape must be used where sharp exact joint lines or exceptionally neat lines are required. Remove the tape whilst the sealant is still soft. Slick joint with smoothing liquid for a perfect sealant surface.

BK 03.04 **REQUIREMENTS FOR REPAIR OF STRUCTURAL CONCRETE**

BK 03.04.01 **Concrete repair**

All existing structural concrete to be inspected to determine the extent of damage and repair work required. All remedial concrete work to be classified into the following categories by the Engineer/Department's representative:

• **Surface concrete repair**

Cosmetic repair of concrete surfaces where no reinforcing is exposed, where cover to reinforcement is not a problem (non-aggressive environment) and for non-structural repairs.

- **Mild to moderate concrete repair**

When the reinforcing is exposed and the extent thereof is small compared to the size of the element under consideration.

- **Severe concrete repair**

Where the front of the reinforcing is exposed in large areas or reinforcing is Exposed totally. Generally when the defective areas have adverse structural implications.

The above categories do not apply to off-shutter concrete, which will be treated on merit.

Any structural concrete elements that are damaged to such an extent that they cannot be classified under severe concrete repair, will be treated on merit. Detailed instructions will be issued during repair for the rehabilitation of such structural concrete elements.

BK 03.04.02 **Surface concrete repair procedure**

The following procedure, or similar approved by the Engineer/Department's representative to be used:

- Remove all loose and defective material and clean around affected area to expose aggregate.
- Saw-cut 10 mm vertically around edges of repair area and break out concrete within to avoid tapered feathering.
- Wet area well, approximately 30 minutes before commencement of repair.
- Apply an approved shrinkage compensated pre-mixed ready to use single component polymer modified, cementitious repair mortar in strict accordance with the manufacturer's specifications.
- The repaired surface to be cured by covering with plastic sheeting and keeping wet for
- 48 hours or as otherwise specified.

BK 03.04.03 **Mild to moderate concrete repair procedure**

The following procedure, or similar approved by the Engineer/Department's representative to be used:

- Remove all loose and defective material and break out to a minimum depth of 10 mm.
- Saw-cut 10 mm vertically around edges of repair area and break out concrete within, to avoid tapered feathering.

- Ensure that concrete is free from laitance, oil, grease, etc, and is sound, firm and clean.
- Exposed reinforcing to be wire brushed clean and free of all rust and then coated with an approved single component epoxy zinc primer.
- The concrete to be thoroughly wetted and kept wet for a minimum of 12 hours before applying remedial product, loose standing water to be removed prior to application of repair mortar.
- Apply an approved shrinkage compensated pre-mixed ready to use single-component polymer modified, cementitious repair mortar in strict accordance with the manufacturer's specifications.
- The repaired surface to be cured by covering with plastic sheeting and keeping wet for 48 hours or as otherwise specified.

BK 03.04.04 Surface concrete repair procedure

The following procedure, or similar approved by the Engineer/Department's representative to be used:

- Propping of structure may be necessary during repair period.
- Chop around defective area removing all loose and suspect material taking care not to damage the existing reinforcing.
- Exposed reinforcing to be wire brushed clean and free of all rust and then coated with an approved single component epoxy zinc primer.
- The damaged area to be chopped rectangular in shape to expose the sound aggregate, and feathered edges to be saw-cut vertically and broken out to a minimum depth of 10mm.
- Ensure that the cavity is clean, dry and free of any debris.
- Apply an approved epoxy resin repair compound strictly in accordance with the manufacturer's specifications.
- Apply an approved shrinkage compensated pre-mixed ready to use single-component polymer modified, cementitious repair mortar in strict accordance with the manufacturer's specifications.

BK 03.05 EXPANSION JOINT REMEDIAL PROCEDURE

The following procedure to be used for remedial work to expansion joints.

- Remove all damaged sealant from expansion joint.
- Joint former/filler must be removed.
- Remove all loose materials mechanically to ensure a sound, clean and dry concrete surface.
- Where required, the sides of the concrete joint to be cut smooth and straight with an angle grinder or diamond saw.
- Where required, the edges of the expansion joints to be provided with a fillet. Engineer/Department's representative to determine on site.
- Install a non-bituminous, non-extruding resilient joint filler where existing joint former/filler was removed.

- Install a closed cell resilient foam cord or release film or bond breaking tape before applying sealant.
- A primer coat to be applied to all surfaces, brushed well into the faces of the joint.
- Install a single component fast curing polyurethane joint sealer strictly according to the manufacturers specifications.
- All materials to be submitted to the Engineer/Department's representative for approval prior to installation.

BK 03.06

CONCRETE CRACKS

All existing concrete to be inspected to determine the extent and damage due to cracking of concrete. The cause of cracking is to be established to determine the correct remedial action to be taken. The Engineer/Department's representative will determine the extent of repair work required, which will in most cases, require individual specifications to suit.

BK 03.06.01

Concrete crack repair procedure

(Generally used where cracking could adversely affect the structure)

The following procedure, or similar approved by the Engineer/Department's representative to be used:

- The surface over the entire length of the crack should be wire brushed to remove laitance or any other deleterious materials from the concrete.
- If the surface of the concrete is unsound, chase/grind a vee cut into the crack.
- All debris to be removed.
- Drill holes into the crack. The size, depth and centres etc. as specified for the crack injection product to be used. Blow out holes free of drill dust.
- Install injection nipples into the holes as specified. Allow for air release holes.
- Seal the face/s with an approved epoxy.
- Pump in approved epoxy liquid to suit crack size/width.
- The above repair system to be done strictly in accordance with the manufacturers specifications and requirements, and must be carried out by approved specialists or suitably trained persons.

BK 03.06.01

Concrete crack repair procedure

(Generally used for small cracks and where cracking could cause leaking through the concrete)

The following procedure, or similar approved by the Engineer/Department's representative to be used:

- The surface over the entire length of the crack should be wire brushed to remove laitance or any other deleterious materials from the concrete.
- If the surface of the concrete is unsound, chase/grind a vee cut into the crack.
- All debris to be removed.
- Inject in an approved polyurethane 1-part joint sealant to suit crack size/width. The width of the crack must be 1.25 times the depth of the crack or in accordance with the manufacturer's specification.
- The above repair system to be done strictly in accordance with the manufacturer's specifications and requirements, and must be carried out by approved specialists or suitably trained persons.

BK 04

DETAIL OF REPAIR WORK

The Schedule of Quantities shows approximate quantities of work. Detailed instructions will be issued during construction.

C

CIVIL INFRASTRUCTURE

TECHNICAL SPECIFICATION**CA ROADS****CONTENTS**

CA 01	SCOPE
CA 02	STANDARD SPECIFICATIONS
CA 03	OPERATING AND MAINTENANCE MANUALS
CA 04	EXECUTION OF REPAIR WORK
CA 05	MAINTENANCE
CA 06	MEASUREMENT AND PAYMENT

CA 01 SCOPE

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of existing roadways, parking areas, miscellaneous areas subjected to vehicular traffic and other miscellaneous paved areas. It covers both surfaced and unsurfaced roadways and includes appurtenant works such as kerbing, road markings and road signs.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CA: Roads, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

CA 02 STANDARD SPECIFICATIONS**CA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

PW 371	-	Specification of Materials and Methods to be used, fourth edition, October 1993
SABS 1200 D	-	Earthworks
SABS 1200 DM	-	Earthworks (roads, subgrade)
SABS 1200 M	-	Roads (general)
SABS 1200 ME	-	Subbase
SABS 1200 MF	-	Base
SABS 1200 MG	-	Bituminous surface treatment
SABS 1200 MH	-	Asphalt base and surfacing
SABS 1200 MJ	-	Segmented paving
SABS 1200 MK	-	Kerbing and channelling
SABS 1200 MM	-	Ancillary roadworks
COLTO 7100	-	Concrete pavements

CA 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CA 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, applied, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CA 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CA 03 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be required for Roads.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CA 04 EXECUTION OF REPAIR WORK

CA 04.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the existing roadways, parking areas, miscellaneous areas subject to vehicular traffic and other paved areas shall be categorised under the following headings:

- (a) Repair of gravel wearing course
- (b) Surface repairs of concrete pavements
- (c) Pavement layers and surface repairs
- (d) Surface patching of surfaced roads
- (e) Crack sealing
- (f) Surface treatment of surfaced roads
- (g) Erection and repair of permanent road traffic signs
- (h) Road markings
- (i) Chemical control of vegetation and eradication of undesirable vegetation.

CA 04.02 REPAIR OF GRAVEL WEARING COURSE

This section covers the reprocessing or replacement of an existing gravel wearing course over part of or over the full road width.

CA 04.02.01 Construction

The Engineer will demarcate any areas to be repaired, and shall instruct the Contractor with regard to the repair work to be done.

The reshaped wearing course shall be constructed true to line, level and cross-section as shown on the drawings or as directed by the Engineer.

The reshaping process shall in general be carried out using the existing wearing course. This material shall be graded to form the correct road profile. If necessary, the Engineer shall instruct the Contractor to rip, redistribute and recompact the wearing course in order to achieve the correct road profile.

Unsuitable or excess material from the road prism shall be removed from the site of to spoil. Any shortfall in material shall be made up by importing suitable material.

Material which is ripped or imported shall be placed, watered, mixed and compacted to a minimum of 93% of modified AASHTO density.

The Contractor's attention is specifically drawn to the requirement that only material approved by the Engineer may be imported.

During the reshaping process, the roadside drains and cut and fill slopes shall be trimmed and finished true to line, level and cross-section. No additional payment will be made for trimming and finishing of cut and fill slopes.

CA 04.02.02 Quality standard

The gravel wearing course shall be constructed true to line, level and cross-section as shown on the drawings or as directed by the Engineer.

CA 04.02.03 Materials

The materials shall comply with SABS 1200 ME and the additional requirements detailed below:

Additional material requirements for wearing course - natural gravel

Maximum size	37,5 mm
Oversize index (I_o) ^a	≤ 5 per cent
Shrinkage product (S_p) ^b	100 - 365 (maximum of 240 preferable)
Grading coefficient (G_c) ^c	16 - 34
CBR: ≥ at ≥ 95 per cent modified AASHTO compaction and OMC ^d	

- a) I_o = Oversize index (per cent retained on 37,5 mm sieve)
 b) S_p = Linear shrinkage x per cent passing 0,425 mm sieve
 c) G_c = (Per cent passing 26,5 mm - per cent passing 2,0 mm) x per cent passing 4,75 mm/100
 d) Tested immediately after compaction

CA 04.03 SURFACE REPAIRS OF CONCRETE PAVEMENTS

This section covers the repair of spalled concrete at joints, the forming and sealing of new joints and the sealing or resealing of existing joints and random cracks in existing concrete pavements, and the patching of existing concrete.

Repairs to concrete are regarded as specialist work and shall be undertaken by approved subcontractors with relevant experience.

CA 04.03.01 Construction

Patching, resealing of joints and sealing of cracks in concrete pavements shall be done at the positions indicated by the Engineer.

(a) Resealing of joints and cracks**(i) Preparation of joints for resealing**

The old deteriorated sealant in the top of the joint to be resealed shall be cut or scraped loose from each joint face with equipment that will not damage joint edges or the concrete surface. Care shall be taken not to damage, spall or bevel the joint edges.

The joints shall be initially cleaned to the full depth of the old sealant plus its backing material, as well as of all foreign material in the joints. A vacuum process, and not compressed air, shall be used to remove all loosened material from the joints. The Contractor shall continuously remove debris from the road surface and keep the surface clean. After the removal of the old material has been completed, refacing of the joint planes shall be done with an abrasive wheel or a power-driven concrete saw to widen each face of the sealant reservoir portion of the joint by a minimum of 2,0 mm and a maximum of 5,0 mm. No sealant may be applied to other than freshly cut concrete faces. The freshly cut concrete faces shall be degreased to such extent that adhesion of the sealant to the concrete in every respect satisfies the sealant manufacturer's guarantee.

CA . 5

Immediately after the sawing operation, the joint grooves shall be thoroughly vacuumed and washed out with a jet of clean water to remove all remaining loose material resulting from the sawing operation. Any slurry resulting from the wet sawing shall be removed from the road surface.

Sweeping up old joint material and other debris with hand brooms shall be a continuous process during joint preparation. The joints shall be finally cleaned again prior to resealing, but in no case shall the cleaning precede the sealant by more than 30 m of joint length.

(ii) Preparation of cracks for sealing

Sealing shall be considered only for cracks that are open wide enough to permit entry of joint sealant or mechanical routing tools. The decision of whether a crack is to be sealed or not shall rest with the Engineer. Sealant in previously sealed cracks shall be removed as described in subclause CA 04.03.01(a)(i) above.

A groove of at least 12 mm wide by 18 mm deep shall be made along the crack with a machine capable of closely following the path of the crack without causing excessive spalling or other damage to the adjacent concrete. Cleaning of the cracks after the grooving operation shall be done as described in subclause CA 04.03.01(a)(i) above.

(b) Patching of concrete

Patching of concrete shall be done where indicated by the Engineer.

Unless otherwise instructed by the Engineer, the patching shall have a neat rectangular shape with sides parallel to existing joints. The concrete within the area to be patched shall be broken up and removed to its full depth. The vertical face of the existing concrete adjacent to the patch shall be planed with an abrasive wheel or power-driven concrete saw, if necessary, to provide a smooth face.

Immediately prior to the placing of new concrete, the surface of the underlying pavement layer shall be compacted with either hand or mechanical equipment, depending on the space available, to ensure a firm foundation surface.

An isolation joint shall be constructed between all interfaces of existing and new concrete. The isolation joint shall consist of a joint filler, a bond breaking strip and a polysulphide sealant. The isolation joint shall only be sealed between 21 and 28 days after the casting of the concrete, at which time the uppermost portion of the joint filler shall be raked out, the bond breaking strip inserted and the polysulphide sealant applied.

As the patching of concrete will generally occur in trafficked areas, the Contractor shall allow fully in the relevant rates for accommodation of traffic to enable safe construction conditions. No additional payment will be made over and above the tendered rates for the work.

No traffic shall be allowed over concrete patches for a period of seven (7) days after casting.

CA 04.03.02 Materials

(a) Polysulphide sealant

The polysulphide sealant shall be a two-component material that complies with the requirements of SABS 110.

(b) Additional materials for polysulphide sealant

The sealant shall be supported by a bond breaker backing strip, and, unless otherwise recommended by the manufacturer and approved by the Engineer, the faces of the joint groove shall first be treated with a primer.

Supporting and priming materials shall be compatible with adjacent materials or surfaces in contact with the materials and shall be in accordance with the manufacturer's recommendations and subject to approval by the Engineer.

Primers, bond breakers and back-up material shall comply with instructions and recommendations issued by the manufacturer of the approved liquid sealant used.

CA 04.03.03 Quality standard

Surface repairs shall be executed and finished strictly in accordance with the prescribed requirements.

Repair work shall be carried out in such a manner as to blend in colour, texture and finish with adjacent concrete surfaces as far as possible.

CA 04.04 PAVEMENT LAYERS AND SURFACE REPAIRS

CA 04.04.01 General

This section covers the work in connection with the repair of localised failures of the pavement layers.

The work comprises excavating the deformed areas and reconstructing the pavement and surfacing layers, including treatment of the floor of the excavation prior to backfilling.

CA 04.04.02 Execution of work

(a) Removal of distressed pavement layers

The Engineer will demarcate any failed areas to be repaired, and shall instruct the Contractor with regard to the repair work to be done. The Contractor shall provide assistance and temporary traffic control facilities for marking out failed sections of the road.

Unless otherwise instructed by the Engineer, the patching shall have a neat rectangular shape, at right angles to the direction of traffic. The existing material shall be excavated and removed to the specified depth. Asphalt layers and surfacing shall be cut with approved cutting equipment.

Excavation for patching shall be cut with sideslopes of approximately 60° to the horizontal.

Excavated material from each pavement layer shall be placed in separate stockpiles adjacent to the patch. The stockpiled material shall be reused or removed from the site in accordance with the Engineer's instructions.

After completion of the excavation to the specified depth, the Engineer shall be afforded the opportunity to examine the excavation. Where required, the floor of the excavation shall be compacted to the specified density for the layer concerned. These densities as percentages of modified AASHTO density are as follows:

Subbase	(150 - 300 mm below final base course level)	95%
Selected	(300 - 600 mm below final base course level)	93%
Fill	(Lower than 600 mm below final base course level)	90%

Materials excavated from the various pavement layers shall not be contaminated if the reuse of excavated material for backfilling is instructed by the Engineer.

Excavated material shall be removed from the site, unless reuse of material is instructed by the Engineer. Under no circumstances shall excess material be dumped in side drains or side banks.

(b) Backfilling

Prior to backfilling, the base and sides of the excavation shall be cleaned of all loose material. The top 150 mm of all excavations shall be regarded as base and all other backfill up to 500 mm below the final road level shall be regarded as subbase. Deeper excavations shall be backfilled with approved gravel to a density of 90% modified AASHTO density.

Backfilling of the excavation shall be done as follows:

- (i) The Engineer may instruct the Contractor to use stabilized material excavated from the existing pavement as backfilling, either for subbase layers only or for both subbase and base course layers.

Material shall be broken down and 60 kg/m³ of ordinary Portland cement shall be added. Water shall be uniformly mixed into the material. The material shall then be returned to the road and compacted to 95% of modified AASHTO density for the subbase layers and to 97% of modified AASHTO density for the base layers.

- (ii) Where required by the Engineer, backfilling for the base course layer shall be done with imported material of G3 or better quality, treated with bitumen emulsion. Ordinary Portland cement or Portland blast furnace cement shall be added at a rate of 25 kg/m³ and mixed off the road by means of a concrete mixer or hand labour if approved by the Engineer. All mixing shall result in a homogenous mixture of additives and parent material which is to the satisfaction of the Engineer.

Thereafter the material shall be treated with a 60% anionic stable-grade bitumen emulsion diluted with five parts water to one part emulsion and added at a rate of 70 litres/m³ of crushed stone. All mixing shall result in a homogeneous mixture of additives and parent material which is to the satisfaction of the Engineer.

The mixed material shall then be transported to the excavated area, placed and compacted, all within five hours of the commencement of the mixing process. Thereafter 0,6 litres/m² of the diluted 60% bitumen emulsion shall be applied to the base or layer to ensure a sealed surface.

The density of the backfilling of the base layer shall be at least 100% of modified AASHTO density.

- (iii) Where required by the Engineer the backfilling of the base layer shall be done with continuously graded asphalt base compacted to 95% of Marshall density.

The excavated areas shall be tacked at a spray rate of 0,40 litre/m² using 60% cationic emulsion. The asphalt base material shall be spread and compacted so that the final surface is neat and uniform.

- (iv) All the backfilling shall be completed in geometric patterns of squares or rectangles and in each case it shall be finished off neatly to 40 mm \pm 10 mm below the levels of the surrounding sound road surface.

(c) Surfacing

A tack coat of 60% cationic emulsion shall be applied to the floor at top of base layer level at a rate of 0,4 litre/m² before backfilling is commenced or as otherwise instructed by the Engineer.

A layer of hot continuously graded medium asphalt shall be applied, compacted to 94% of Marshall density to bring the level of the patch up to final road level.

(d) Alternative for application of surfacing layer for limited localised repair work

Where instructed by the Engineer, a cold premixed bituminous mixture may be used for application of the surfacing layer for minor repair works. The mixture shall either be an approved cold mix from commercial sources, or can be prepared and mixed in a suitable concrete or other type of mixer, and shall have the following mix proportions:

- | | | |
|-------|--|--------|
| (i) | 9,5 mm nominal sized aggregate: | 1 part |
| (ii) | 6,7 mm nominal sized aggregate: | 1 part |
| (iii) | Crusher sand (fine grade): | 1 part |
| (iv) | 60% stable mix-grade emulsion
(prepared from 80/100 penetration grade: between 75 and 90 litre/m ³
aggregate mix bitumen) | |

Before spreading the mixture, the surface shall be prepared by painting it with one layer of bituminous emulsion at a rate of 0,6 litre/m², which must be allowed to dry. The mixture shall then be placed on the areas to be sealed and screeded off in a layer of uniform thickness. After the emulsion has broken and the layer has attained sufficient stability, it shall be rolled with a small steel wheeled roller to obtain compaction. The thickness of the layer shall be the same as that of the adjacent seal.

(e) Production limitations

As far as it is practically possible the size of the area to be repaired shall be limited to that which can be excavated, backfilled and opened to traffic within a single working day. Where this is impractical the Contractor shall consult with the Engineer regarding the signs requirements for controlling the traffic during night time. No area that is to be prepared, shall be left exposed if rain is imminent.

The asphalt base material shall be placed in layers not exceeding 80 mm and crushed stone material be placed in layers not exceeding 100 mm measured in the loose. The surfacing material shall be placed in one layer at a thickness of 40 mm \pm 10 mm.

(f) Testing

Modified AASHTO densities shall be determined using TMHI Method A16T (Preparation of Material) and Method A7 (Compaction of Material).

CA 04.04.03 Quality standard

The repaired area shall be rectangular in shape.

The edges of the completed surfacing shall not be more than 3 mm above the existing surface. Nowhere shall the edges be below the surrounding road surface.

The thickness of the asphalt surfacing at any point shall be 40 mm \pm 10 mm.

The cross-fall of the completed area shall be equal to that of the adjacent surface to within a tolerance of \pm 0,5% cross-fall.

When tested with a 3 metre straight edge laid parallel to or at right angles to the road centre line the surface of the area shall not deviate from the bottom of the straight edge by more than 7 mm.

The reconstruction of the pavement layers shall require a standard of workmanship to produce a patch that will not deteriorate within the contract period.

CA 04.04.04 Plant and equipment

All equipment shall be suitable for the specified use and size of working areas and shall be capable of obtaining the specified results.

Only approved cutting or sawing equipment may be used for cutting or sawing asphalt layers. The equipment must be capable of cutting asphalt layers to depths of 200 mm in one operation without fragmenting the material, and in straight lines within the required tolerances.

The following items of plant and equipment shall also be available and in good working order:

- (a) A vibratory roller having a mass approximately equal to that of a Bomag 90 or similar vibratory roller, with an adjustable amplitude and frequency of vibration;
- (b) A mobile compressor capable of producing at least 3 m³/minute compressed air at 750 kPa;
- (c) Appropriate paving breakers;
- (d) Manually-operated pneumatic compactors as required, and
- (e) Appropriate concrete mixers.

CA 04.04.05 Materials(a) Crushed stone

Crushed stone for use as backfill in patches shall be of G3 or better quality, from an approved commercial source, and shall comply with SABS 1083 in general and the following in particular:

- | | | | |
|------|--|---|----|
| (i) | Plasticity index (maximum) | = | 6 |
| (ii) | Maximum flakiness index of the -26,5 mm,
+ 13,2 mm material | = | 35 |

- (iii) Maximum aggregate crushing value = 29
- (iv) The grading shall comply with the following grading envelope:

<u>Sieve size</u>	<u>Percentage passing (mass)</u>
37,50	100
26,50	100
19,00	85 - 95
13,20	71 - 84
4,750	42 - 60
2,000	27 - 45
0,425	13 - 27
0,075	5 - 12

(b) Stabilising agent

The stabilising agent shall be ordinary Portland cement or Portland blast furnace cement (PBFC complying with SABS 626) and shall comply with requirements of category ENV 197-1.

(c) Hot-mix asphalt base and surfacing mix requirements

The mix shall be a continuously graded asphalt and shall have the properties specified in table CA 04.04.05/1 below:

TABLE CA 04.04.05/1: PROPERTIES FOR CONTINUOUSLY GRADED ASPHALT BASE AND SURFACING	
PROPERTY	RANGE
Marshall stability (kN)	8 - 16
Marshall flow (mm)	2 - 4
Stability/Flow (kN/mm)	3 minimum
Static creep modulus (MPa)	60 minimum
Indirect tensile strength @ 25 °C (kPa)	1 000 minimum
Dynamic creep modulus (MPa)	16 minimum
% Air voids	3 - 6
Immersion index %	75 minimum

A 60/70 penetration grade bitumen shall be used and the binder type shall comply with the requirements of SABS 307.

Grading limits and mix proportions are given in table CA 04.04.05/2.

TABLE CA 04.04.05/2: GRADING LIMITS AND MIX PROPORTIONS FOR CONTINUOUSLY GRADED ASPHALT BASE AND SURFACINGS

PERCENTAGE PASSING THROUGH SIEVE BY MASS					
SIEVE SIZE (mm)	ASPHALT BASE		ASPHALT SURFACING		
	37,5 mm maximum	26,5 mm maximum	COARSE	MEDIUM	FINE
53,000	-	-	-	-	-
37,500	100	-	-	-	-
26,500	84 - 94	100	100	-	-
19,000	71 - 84	85 - 95	85 - 100	-	-
13,200		71 - 86	71 - 84	100	
9,500	50 - 67	62 - 78	62 - 76	82 - 100	100
6,700			-	-	-
4,750	36 - 53	42 - 60	42 - 60	54 - 75	64 - 88
2,360	25 - 42	30 - 48	30 - 48	-	-
1,180	17 - 34	22 - 38	22 - 38	27 - 42	35 - 54
0,600		16 - 28	16 - 28	18 - 32	24 - 40
0,300	10 - 22	12 - 20	12 - 20	11 - 23	16 - 28
0,150		8 - 15	8 - 15	7 - 16	10 - 20
0,075	5 - 12	5 - 10	4 - 10	4 - 10	4 - 12
NOMINAL MIX PROPORTIONS (BY MASS)					
Aggregate	94,5%		93,5%	93,0%	93,0%
Bitumen	5%		5,5%	6,0%	6,0%
Active filler	0,5%		1,0%	1,0%	1,0%

(d) Tack coat

The tack coat shall be 60% cationic emulsion complying with SABS 548.

CA 04.04.06 Variation from specified nominal rates of applications or nominal mix proportions

The various sections of these specifications specify nominal rates of applications or nominal mix proportions for materials such as bituminous materials, aggregates, fillers, stabilizing agents, paint and other relevant materials. Tenderers shall base their tenders on these nominal rates of applications and mix proportions.

Where such nominal rates of applications or mix proportions are specified, provision is made for deviations in the quantities of material in consequence of the rates of application or mix proportions prescribed by the Engineer in each particular case in consideration of the available materials and the site.

Where the actual rates of applications or mix proportions used in the works vary from the specified nominal rates and mix proportions, adjustment to compensation will be made as:

- (a) payment to the Contractor in respect of any authorised increase in quantities which exceed those specified and where such increase has been ordered in writing by the Engineer;
- or
- (b) a refund to the Employer in respect of the decrease in quantities that are less than those specified, irrespective of whether such decrease results from an authorised decrease in the rates of applications or mix proportions, or from unauthorised reductions on the part of the Contractor.

Payment for a prescribed rate of application or mix proportion shall be based on the actual rate of application or mix proportion used, provided that this does not exceed the prescribed rate of application or mix proportion, plus any tolerance in the rate of application or mix proportion allowed. If the actual rate of application or mix proportion exceeds the prescribed rate or proportion, payment shall be based on the prescribed rate of application or mix proportion plus any tolerance allowed. If the actual rate of application or mix proportion is below the prescribed rate of application or mix proportion specified or instructed by the Engineer, payment shall be based on the actual rate of application or mix proportion regardless of any tolerance allowed. Notwithstanding the above, the Engineer shall be entitled to reject work which has not been constructed in accordance with the specifications or the rates of applications or mix proportions prescribed by him.

The Employer shall be refunded for any decrease in the specified rates of application or mix proportions at the same rate per unit of measurement as that tendered by the Contractor for additional materials required by an increase in the rates of applications or mix proportions.

CA 04.05 SURFACE PATCHING OF SURFACED ROADS

CA 04.05.01 General

This section covers the repair of potholes and edge breaks that have developed in the surface of surfaced roads, where there is no evidence of base failure. Potholes are local failures covering an area of less than 1 m². The repair of larger areas will be defined as surface repair. Edge break treatment is necessary for finishing off and/or repairing the edges of the paved road, and also for repairing the edges of the road so that they line up with the true edge of the original road or with other edges as may be required. Pay items CA.04.01 and CA.04.04 shall only apply to edge break widths of 200 mm or less. Edge breaks wider than 200 mm shall be classified as surface repair and paid for under items CA.04.02 and CA.04.03.

CA 04.05.02 Execution of work

Pothole and edge break repairs shall consist of trimming away ravelled edges and loose material to the full depth of the pothole or edge break and the backfilling thereof with asphalt.

(a) Excavation

Potholes: The existing material shall be removed in a neat rectangle to sound base, with a minimum dimension of 200 mm x 200 mm. All sides shall be at right angles or parallel to the direction of traffic. The minimum depth of excavation (layer thickness) is 30 mm and the maximum thickness of each layer shall be 50 mm.

Edge breaks: Loose and cracked edges shall be trimmed back in a neat rectangular shape as demarcated by the Engineer, parallel and at right angles to the centre line of the road to sound surrounding surfacing or base and excavated down to sound base. All edges shall be saw cut to a minimum depth of 30 mm below the road surface and the maximum thickness of each layer shall be 50 mm.

(b) Backfilling

After completion of the excavation the Engineer shall be afforded the opportunity to inspect it. The exposed layer shall be trimmed of all undulations to ensure a firm flat base and sides and shall be tacked with 60% cationic stable-grade bitumen emulsion at a rate of 0,6 litre/m². Continuously graded medium asphalt shall be placed and compacted to the level of the existing surrounding surface.

The asphalt shall be placed and well compacted in layers not exceeding 40 mm after compaction. The Contractor shall use suitable compaction equipment and shall ensure that 94% of Marshall density is obtained for the mix used, to produce a dense asphalt layer.

Where the excavation ends up deeper than 100 mm below the existing surface the Engineer may order the reinstatement to be executed in accordance with Section CA 04.04: Pavement layers and surface repairs.

Where instructed by the Engineer, a cold premixed bituminous mixture shall be used for limited localised surface patching, compacted level with the surface of the existing surrounding surface.

The mixture shall either be obtained from approved commercial sources or prepared and mixed in a suitable concrete or other approved type of mixer in the following proportions:

- | | | |
|-------|--|--|
| (i) | 9,5 mm nominal sized aggregate: | 1 part |
| (ii) | 6,7 mm nominal sized aggregate: | 1 part |
| (iii) | Crusher sand (fine grade): | 1 part |
| (iv) | 60% stable mix-grade emulsion
(prepared from 80/100 penetration grade): | Between 75 and 90
litre/m ³ aggregate mix
bitumen |

Before spreading the mixture, the surface shall be prepared by painting it with one layer of bituminous emulsion at a rate of 0,6 litre/m², which shall be allowed to dry. The mixture shall then be placed on the areas to be sealed and screeded off in a layer of uniform thickness. After the emulsion has broken and the layer has attained sufficient stability, it shall be compacted with a steel wheeled roller. The thickness of the layer shall be the same as that of the adjacent seal.

CA 04.05.03 Quality standard

The repaired area shall be rectangular in shape.

The edges of the completed surfacing shall not be more than 3 mm higher than the existing surface. Nowhere shall the edges be below the surrounding road surface.

The thickness of the asphalt surfacing at any point shall be 40 mm \pm 10 mm.

The cross-fall of the completed area shall be equal to that of the adjacent surface to within a tolerance of \pm 0,5% cross-fall.

When tested with a 3 metre straight edge laid parallel to or at right angles to the road centre line the surface of the area shall not deviate from the bottom of the straight edge by more than 7 mm.

The reconstruction of the pavement layers shall require a standard of workmanship such that a patch will not deteriorate within the contract period.

CA 04.05.04 Material

(a) Tack coat

The tack coat shall be 60% cationic emulsion complying with the requirements of SABS 548 and shall be applied at a rate of 0,6 litre/m².

(b) Surfacing material

The asphalt shall be a continuously graded medium asphalt either mixed on site or obtained from commercial sources. The asphalt mix to be used shall have the mix properties as specified in table CA 04.04.05/1.

A 60/70 penetration grade bitumen shall be used and the binder type shall comply with the requirements of SABS 307.

Grading limits and mix proportions for continuously graded asphalt applying to asphalt surfacing as stated in table CA 04.04.05/2 shall apply to asphalt used for surface patching.

CA 04.06 **CRACK SEALING****CA 04.06.01** **General**

This section deals with all work in connection with the sealing of cracks in the road surface wider than 3 mm. No cracks less than 3 mm wide shall be sealed unless so instructed by the Engineer.

The following classification of cracks shall apply:

- | | | |
|---------|---|------------------------------------|
| Class 1 | : | Cracks smaller than 3 mm |
| Class 2 | : | Cracks between 3 mm and 15 mm wide |
| Class 3 | : | Cracks more than 15 mm wide |

The work shall include the following:

- (a) Cleaning of all cracks wider than 3 mm with hot or cold compressed air;
- (b) Spraying weed killer in the cracks if required;
- (c) The application of a prime coat if required;
- (d) Filling of the crack with a bituminous mixture and/or overbanding the crack with a proprietary brand bandage;
- (e) Treating the road surface surrounding the crack where the edges have lifted.

CA 04.06.02 **Execution of work**(a) Crack cleaning

The cracks shall be blown out with heated ("hot dog lance") or cold compressed air according to the method specified by the Engineer. All dirt, grit and other foreign matter shall be blown out and be removed from the cracks and road surface.

(b) Priming of cracks

Cracks shall be primed if specified using the prime injectors as detailed. The prime shall be jetted as deep as possible into the crack using compressed air propulsion. The sides of the cracks shall be thoroughly wetted without flooding the crack. The prime shall be allowed 12 hours to soak and dry, before the first application of crack sealant is applied. The primed cracks shall be kept clean at all times and if soiled shall be re-cleaned at the Contractor's cost.

When heated air is used for crack cleaning, no priming will be required where so specified. In this case the crack shall be filled with sealant within eight minutes of the cleaning operation so that minimal heat is lost. If the crack is not filled within the prescribed time, the Contractor shall prime the crack at his own cost.

(c) Sealant

Cracks shall first be cleaned and primed as specified before sealing the crack. The sealant shall be forced into the cracks by means of the specified sealant applicator. The Contractor shall ensure that the sealant mixture actually penetrates the crack and does not merely cover the crack in the form of a bandage. All excess sealant more than 50 mm wide on each side of the crack and 1 mm thick shall be removed from the road surface.

A 12 hour period shall be allowed between the application of sealant and the application of a seal bandage (if required). This will ensure that the crack is completely filled.

(d) Seal bandage

The Sealmac or similar approved geotextile bandage or a bitumen rubber prefabricated crack seal patch shall be tacked down and secured in accordance with the manufacturer's instructions and specifications.

(e) Rectifying raised crack edges

Where crack edges are raised, they shall be rectified by applying a solution of 1 part RC250 and 2 parts dieselene 300 mm wide either side of the crack by means of a paint brush at a rate determined on site. This serves to soften the surface so that it can be rolled flat. Care must be taken not to flood the surrounding surface or the crack itself.

The normal crack sealing procedure is then followed after a period of four hours has elapsed. After a further 24 hours, roll the crack with a 1,0 ton roller until a smooth, uniform surface is obtained. Any excess sealant shall be removed.

(f) Filling cracks wider than 15 mm

The cracks shall be cleaned using cold compressed air. A mixture of 1 part washed river sand, 1 part slaked lime and water to make a wet slurry shall be poured into the crack until the crack is filled to a depth 20 mm below the surrounding surface. After allowing a period for this mixture to settle and dry, refill if necessary and then prime using MSP/1 or equivalent and fill to the level of the surrounding surface using a rubber crumb/crusher dust slurry as specified. Finish off the seal operation by applying a seal bandage as specified.

(g) Precautions

The sealant shall only be applied with pressure type spray equipment to ensure that the cracks are filled rather than covered.

The Contractor shall ensure that all equipment is kept clean so as to prevent blockages and resultant poor workmanship.

(h) Weather limitations

- (i) The minimum road surface temperature at which the cracks shall be sealed is 10 °C.
- (ii) No work will be allowed within 12 hours after rain has fallen on the sections to be sealed.
- (iii) Crack sealing shall not take place when the conditions are excessively windy or dusty as determined by the Engineer.

(i) General

The Contractor is to note that one application of the sealant is generally insufficient and that a repetition of the application of the binder will be required. This reapplication forms part of the measured metre of crack sealing completed and is not measured separately.

CA 04.06.03 Material

The type of bituminous binder/sealant used to seal/fill a crack will depend on the width of the crack after the crack has been cleaned and prepared as described in this section.

The width limits with applicable sealant are as follows:

CLASS	CRACK WIDTHS	BINDER/SEALANT TYPE
Class 1	Less than 3 mm	Not sealed unless otherwise instructed. If sealed, an applied polymer modified bitumen emulsion shall be used.
Class 2	3 mm to 15 mm	Hot applied SBS/SBR modified bitumen or bitumen rubber with softening point of 65 °C or 80 °C. A cold applied polymer modified bitumen emulsion can be used for cracks up to 5 mm.
Class 3	Wider than 15 mm	Fill the crack with a sand/lime slurry to a depth of 20 mm below the surrounding surface and then fill to the level of the surrounding surface using a rubber crumb/crusher dust slurry. Finish off the seal operation by applying a seal bandage.

(a) Bituminous binders

All bituminous binders, where applicable, shall conform to the following standards:

Penetration grade bitumens : SABS 307

Bitumen emulsion: anionic : SABS 309

Bitumen emulsions: cationic : SABS 548

(b) Prime

The prime shall consist of an "inverted emulsion" prime manufactured from a base bitumen of 80/100 penetration grade. An MSP/1 prime or equivalent shall be used.

(c) Emulsion for cold applied sealant

The emulsion for the crack treatment shall consist of an anionic stable grade emulsion or cationic spray grade emulsion. When blended on site, Revertex or other rubber latex emulsion shall be added to the bitumen emulsion to give 8% nett rubber on nett bitumen content. If a proprietary brand blend is used, the constituents shall conform to the manufacturer's specification.

(d) Bitumen rubber

(i) Rubber crumbs

The rubber obtained by processing and recycling tyres shall comply with the requirements specified in table CA 04.06.03/1 below:

TABLE CA 04.06.03/1

PROPERTY	MINIMUM	MAXIMUM	TEST METHOD
Natural rubber content (m/m) as % of total hydrocarbon content	30%	-	BS 903
Grading (m/m)			BR6T
Passing 1,18 mm sieve	100%	-	
Passing 0,60 mm sieve	50%	70%	
Passing 0,075 mm sieve	-	5%	
Fibre length	-	6 mm	BR6T
Relative density (t/m ³)	1,10	1,25	BR9T
Loose non-rubber content		0,1%	BR6T
Resilience	40%	-	BR7T

(ii) Extender oil

The extender oil shall be a distillate of high aromatic and shall comply with the requirements specified in table CA 04.06.03/2 below:

TABLE CA 04.06.03/2

Ignition temperature	200 °C minimum
Percentage saturates by mass	25% maximum
Percentage aromatic/unsaturated hydrocarbons	50% minimum

(iii) Diluent

The diluent shall be a hydrocarbon distillate.

(iv) Bitumen rubber blend

The actual value of penetration of the bitumen used shall also be stated on a certificate. The results of these tests must be reported to the Engineer. The bitumen rubber blend containing extender oil and/or diluent, where necessary, shall comply with the requirements specified in table CA 04.06.03/3 below:

TABLE CA 04.06.03/3

Percentage of rubber by mass of the total blend	28% minimum
Percentage extender oil by mass of total blend	4% maximum
Percentage diluent by mass of total blend	4% maximum
Blending/reaction temperature (°C)	180 - 210 °C
Reaction time since last addition of rubber crumbs (hours)	0,5 - 4,0 hours

The pre-blended binder shall meet the specifications given in table CA 04.06.03/4 when sampled five minutes, or less, before application.

TABLE CA 04.06.03/4

PROPERTY	LIMIT	TEST METHOD
Ring and ball softening point	65 °C to 80 °C	ASTM D36
Resilience	30% minimum	BR 2T
Viscosity	1500 centipoise minimum	BR 5T
Sampling	4500 centipoise maximum	BR 1T

The applicable bitumen rubber test methods appear in Manual 3, 1988 of the SABITA publication entitled *Test Methods for Bitumen-rubber used in Seals*.

The Contractor shall supply the Engineer with the time/temperature relationships of the above-mentioned properties for his specific product prior to commencement of the operation.

(e) Modified bitumen

(i) General

The particular values within the limits of the specifications given below will depend on the specific application of the product and the technology employed by the manufacturer.

For each batch of modified bitumen the manufacturer shall issue a certificate stating that the processes have been controlled during manufacture and handling.

The actual value and range of penetration of bitumen shall also be stated on the certificate. The results of these tests must be reported to the Engineer daily.

(ii) Modified bitumen blend

The modified bitumen blend shall comply with the requirements specified in table CA 04.06.03/5.

TABLE CA 04.06.03/5

PROPERTY	LIMIT	TEST METHOD
Grade base bitumen	80/100	SABS 307
Softening point R and B (°C)	65 - 80	ASTM D36
Ductility at 10 °C (cm)	100 minimum	ASTM D113
Elastic recovery by means of ductilometer at 10 °C	50 minimum	ASTM D113 (mod)

(f) Weed killer

Hyvar X or similar type of non-selective total herbicide approved for this purpose by the Department of Agriculture shall be used.

(g) Rubber crumb slurry for filling cracks wider than 15 mm

This slurry is intended for filling cracks more than 15 mm wide prior to the application of a seal bandage.

The nominal composition of the rubber crumb slurry per volume shall be the following:

- 10,0 parts aggregate mixed as follows: 8 parts rubber crumbs (CA 04.06.03(d)(i)) to 2 parts crusher dust (2,36 mm maximum size)
- 4,5 parts 60% anionic stable grade bitumen emulsion
- 1,1 parts SBR (nett rubber) Revertex or equivalent
- 0,2 parts cement (any type of Portland cement)
- Water (as directed by the Engineer) (approximately 5 parts)

CA 04.06.04 Plant and equipment(a) Blowing out cracks

The Contractor must provide a mobile compressor capable of discharging 3 m³/minute compressed air at 650 kPa pressure. The compressed air shall be free of deleterious matter which may adversely affect the bond between the sealant and the cracks. The compressor shall be free of oil and diesel leaks.

A lance shall be used to direct the force of the air into the cracks and must be manoeuvrable enough to follow the path of the crack accurately.

If hot air is specified, the compressed air must be heated by a hot-air lance capable of achieving a temperature of 300 °C in the combustion chamber.

(b) Prime injectors

A special prime injector for injecting prime into open cracks using compressed air propulsion shall be manufactured. Essentially the equipment shall consist of a blow pipe with nozzle to direct the jet of compressed air into the cracks, a venturi or similar device shall be fitted to the blow pipe for sucking in prime from the storage vessel. A suitable throttling valve shall be fitted on the prime supply line to adjust the prime flow, ie to adjust the compressed air to prime ratio. The blow pipe shall be of approximately 20 mm diameter steel tubing,

threaded at the open end so that suitable bitumen spray nozzles can be fitted. The other end shall have a suitable coupling to connect to the compressor, complete with a shut-off valve to isolate the injector from the compressed air source.

The injectors, blow pipes, storage vessel interconnecting piping, etc, shall all be capable of safely withstanding the pressure generated by the compressors. Design sketches of the equipment shall be submitted to the Engineer for approval.

(c) Sealant

The sealant shall be applied through an applicator manufactured specifically for this purpose. Essentially the equipment for the hot sealant shall consist of a mobile vessel capable of heating the sealant to the required application temperature by indirect heat, controlled by a thermostat to prevent overheating. A calibrated thermometer shall be fitted in an accessible position to accurately measure the sealant temperature in the tank. Special pumps which can deliver the sealant to the crack in a controlled fashion shall be used.

Proprietary brand seals shall be applied as specified by the suppliers.

(d) Seal bandage

The bandage shall be applied according to the manufacturer's specification and recommended applying techniques.

(e) Equipment for the application of modified bitumen emulsion in small cracks where applicable

The modified bitumen emulsion shall be applied in a controlled manner using pressure type spray equipment with lances fitted with 2 mm nozzles. A backpack type spray unit may be used. Under no circumstances will the use of buckets, watering cans or tins be allowed to apply the sealant.

(f) Rectifying raised crack edges

A vibrating pedestrian roller of 1,0 ton effective mass shall be used to roll the raised crack edges.

CA 04.06.05 Quality standard

The work shall be executed and finished strictly in accordance with the prescribed requirements.

The sealed cracks shall be watertight, look neat and the sealant shall not project above the road surface by more than 3 mm.

CA 04.07 REPAIR OF SEGMENTED PAVING

This section covers the replacement of an existing area of segmented paving as well as the reprocessing and/or replacement of the underlying pavement layers. An area of 2.5 m x 2.1 m must be lifted due to water ponding on a pavement.

CA 04.07.01 Construction

The Engineer will demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

The demarcated area shall be repaired true to line, level and cross-section as shown on the drawings or as directed by the Engineer.

The demarcated area of damaged segmented paving shall be removed. Unless otherwise instructed by the Engineer the pavement layers shall be reinstated as follows:

- (i) Selected layers shall be of at least a G5 quality and shall be compacted to at least 93% of modified AASHTO density.
- (ii) Material for the subbase layers shall be stabilized with 3% cement and compacted to 95% of modified AASHTO density, and shall be of at least a G5 quality.
- (iii) The material for the base layer shall be stabilized with 5% cement and compacted to at least 97% of modified AASHTO density, and shall be at least a G3 quality.

Pavement layers of segmented paved areas under pedestrian traffic only, shall be excavated and replaced by natural gravel compacted to 93% modified AASHTO density. Damaged concrete edge beams and intermediate beams shall be replaced with class 30 concrete edge beams and intermediate beams similar in dimension to existing undamaged edge beams and intermediate beams in accordance with the relevant SANS specifications or as directed by the Engineer. After the repair of the underlying pavement layers and when the concrete edge beams and intermediate beams have reached sufficient strength, segmented paving blocks, similar to the existing undamaged segmented paving blocks shall be replaced in accordance with the relevant SANS specifications or as directed by the Engineer.

Unsuitable or excess material shall be removed from the site of to spoil. Any shortfall in material shall be made up by importing suitable material.

The Contractor's attention is specifically drawn to the requirement that only material approved by the Engineer may be imported.

CA 04.07.02 Quality standard

The repaired segmented paving shall be constructed true to line, level and cross section as shown on the drawings or as directed by the Engineer.

CA 04.08 REPAIR OF KERBING

This section covers the patching and replacing of damaged kerbs.

CA 04.08.01 Construction

Where the damage to kerbs can be repaired satisfactorily by surface patching of the kerb units, the Engineer will authorize such work to be done. The contractor shall use products and material approved by the Engineer to repair the authorized kerbs to the satisfaction of the Engineer. This section covers the patching and replacing of damaged kerbs

Where kerbs or channel units are severely damaged or have been moved out of position, such units will be replaced with similar undamaged units. Precast units and its installation will comply with the relevant SANS specifications and cast in situ concrete work will be done in accordance with the relevant SANS specifications.

CA 04.08.02 Quality standard

The repaired kerbing shall be constructed true to line, level and cross-section as shown on the drawings or as directed by the Engineer.

CA 04.09 ERECTION AND REPAIR OF ROAD TRAFFIC SIGNS AND TRAFFIC-CONTROL DEVICES

CA 04.09.01 General

This section covers the erection of permanent road traffic signs. It includes the repair and replacement of faded, damaged or not clearly visible existing signboards and reference marker boards.

Specifications relating to manufacturing of road signs are not included in this document, as relevant specifications regarding manufacturing will be issued to a nominated subcontractor who shall be a recognised manufacturer of road signs.

The signs shall be the standard regulatory, guidance, warning and information signs and fabricated in accordance with the South African Road Traffic Signs Manual (July 1993) except where otherwise specified, indicated on drawings or directed by the Engineer.

The erection and placement of any signs, whether temporary or permanent, shall be in accordance with the South African Road Traffic Signs Manual (June 1999).

CA 04.09.02 Storage and handling

All road signs or parts of road signs shall be transported, handled and stored in a weather-proof storeroom in such a manner as to prevent any damage and deformation.

Sign boards shall be stored on blocks in the vertical position so that the signs are not in contact with the ground. There shall be sufficient space between the finished road sign boards to permit free air circulation and moisture evaporation. Contact of road sign boards with treated timber and diesel, or storage where road sign boards come into contact with dirt or water will not be permitted.

When required, existing or newly erected road signs shall be fully or partially covered with burlap or other approved adequately ventilated material to obscure destinations that are temporarily inapplicable or irrelevant. The covers shall be neatly and firmly fixed in position so that they will be able to withstand strong gusts of wind or eddies caused by passing traffic. The fixing shall be done in a way that will not cause any damage to the road sign face.

CA 04.09.03 Execution of the work

All road signs or parts of road signs shall be transported, handled and stored in a weather-proof storeroom in such a manner as to prevent any damage and deformation.

(a) Position

Road signs shall be erected in the positions shown on the drawings or indicated by the Engineer.

(b) Excavation and backfilling

Excavations for the erection of road signs shall be made according to the dimensions shown on the drawings. Where the excavations are to be backfilled with soil, a 1:12 cement/soil mixture (soilcrete) shall be prepared if instructed by the Engineer. The soil or soil-cement mixture shall then be placed at optimum moisture content in 100 mm thick layers in the excavation and shall be compacted to a minimum of 90% of modified AASHTO density.

Where posts or structures are to be fixed in concrete, or where concrete footings are to be cast, the concrete, formwork and reinforcement shall comply with the relevant requirements. The holes shall be completely filled with concrete up to the level shown on the drawings or indicated by the Engineer. The upper surface of the concrete shall be neatly finished with sufficient fall to ensure proper drainage. This subclause shall apply to ground-mounted signs only. Excavating and backfilling for the foundations of overhead steel structures are specified and regarded as specialised structural work. Excavation in rock shall be paid for under item CA.07.05. Where material from the excavations is not suitable for backfilling or for the preparation of soilcrete, suitable material shall be obtained as instructed by the Engineer.

(c) Erection

Road sign boards must be inspected by the Engineer and approved in writing before the boards are taken from the camp site to the erection site. The Contractor shall notify the Engineer at least one (1) week before the said inspections are required.

Road signs shall be erected strictly in accordance with the details and instructions on the drawings and as directed by the Engineer.

During erection the structural steelwork shall be firmly bolted and protected to prevent buckling or damage being caused during erection, or by the equipment used for erection.

Posts to which road signs are to be fixed shall be vertical and the undersides of road signs shall be horizontal after having been erected.

Where timber posts are used for erecting the signs, all holes that are drilled in the timber shall be retreated with the approved preservative. A road sign identification number (as indicated on the layout drawings) shall be painted with white enamel paint on the reverse side of the road sign board, above the month and year of manufacture, in 50 mm high letters and numbers on the side closest to the road shoulder as directed by the Engineer.

Any sign damaged during transit to the erection site or during the erection process shall be replaced or repaired to the satisfaction of the Engineer at no extra cost to the Employer.

(d) Field welding

All welding done during erection shall comply with the requirements for welding during manufacture.

(e) On-site painting

All painting done after the road signs have been erected shall comply with the requirements for painting during manufacture.

All places where the paintwork has been damaged during erection shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

(f) Time of erection

Road signs shall be erected immediately prior to the road being opened to public traffic, unless otherwise decided by the Engineer.

(g) Attachment of overlays

The type of overlay to be used will be specified by the Engineer and will consist either of 1 mm thick Chromadek plate, "pop-riveted" onto the existing sign plate, or System 5 overlay or similar approved. Before the application of the overlay to any structure, the existing sign board shall be thoroughly cleaned.

(h) Repair of signs

The Engineer may require that certain existing signs be dismantled for repair work or storage and later re-erected. The signs shall be repainted or repaired by replacing the 200 mm profiles or straightening the sheet metal as specified during the manufacturing process. New materials shall be used for part or all of the supporting structure. This work shall be done with as little damage as possible to the signs.

CA 04.09.04 Execution of the work

(a) Timber posts for road sign supports

Timber posts for road sign supports shall conform to the requirements of SANS 754, shall be equal to or better than strength group B timber posts and shall be stamped with the SANS mark. The exposed surface of the cut shall be given two coats of creosote. Any holes drilled in the timber posts after treatment with creosote shall be retreated.

(b) Corrosion-protection tape

Corrosion-protection tape used between aluminium and steel shall be black PVC tape not less than 0.25 mm in thickness, shall be resistant to ultra-violet rays, and shall have an adhesive backing. The breaking strength of the material shall be not less than 3.5 kN/m.

CA 04.09.05 Protection and maintenance

The Contractor shall protect the completed road signs against damage until they have been finally accepted by the Employer, and he shall maintain the road signs until the maintenance certificate has been issued. Damage or defects caused by negligence or faulty workmanship shall be rectified by the Contractor at his own cost to the satisfaction of the Engineer.

CA 04.09.06 Dismantling, storing and re-erecting existing road signs

Where instructed by the Engineer, the Contractor shall dismantle existing road signs, store them, and re-erect them at new positions indicated. This work shall be done taking care to cause as little damage as possible to the signs.

The method applied for dismantling the existing signs and transporting and storing the signs shall be subject to the Engineer's approval. No additional payment shall be made for any equipment or handling methods necessary to prevent damage to existing signs which are suitable for re-use, as instructed by the Engineer.

Where required by the Engineer, the signs shall be repainted or repaired and new materials shall be used for part or all of the supporting structure.

CA 04.10 **ROAD MARKINGS****CA 04.10.01** **General**

This section covers the permanent marking and maintenance of white, yellow or red painted lines or symbols on the road surface by specialist contractors.

CA 04.10.02 **Materials**(a) **Plant**

(i) Road-marking paint

Road-marking paint shall comply with the requirements of SABS 731 for type 1, type 2 or type 4 paint.

The paint shall be delivered at the site in sealed containers bearing the name of the manufacturer and the type of paint. Marking shall be in accordance with SABS 731.

The viscosity of the paint shall be such that it can be applied without being thinned down.

(ii) Retro-reflective road-marking paint

Retro-reflective road-marking paint shall comply with the requirements of CKS 192 and SABS 731.

(iii) Colour

The colours to be used shall be bright white, yellow or red.

The colour of the yellow and red paint shall be as specified in SABS 731.

(iv) Retro-reflective beads

The retro-reflective beads shall be glass beads that comply with the requirements for glass beads specified in CKS 192.

The beads shall be delivered at the site in sealed bags, marked with the name of the manufacturer, the batch number and an inspection seal of the South African Bureau of Standards (SABS), confirming that the beads form part of a lot that has been tested by the SABS and complies with the requirements of CKS 192. If not, the Contractor shall at all times have an SABS certificate on the site, with details of the batches that make up a lot that has been tested by the SABS, complies with CKS 192 and to which the inspection seal applies.

CA 04.10.03 Weather limitations

Road-marking paint shall not be applied to a damp surface or at temperatures lower than 10 °C, or when, in the opinion of the Engineer, the wind strength is such that it may adversely affect the painting operations.

No road-marking paint may be applied when visibility is dangerously impeded by mist, smoke or smog.

CA 04.10.04 Mechanical equipment for painting

The equipment shall consist of an apparatus for cleaning the surfaces, a mechanical road-painting machine and all additional hand-operated equipment necessary for completing the work. The mechanical road-marking machine shall be capable of painting at least two lines simultaneously and shall apply the paint to a uniform film thickness at the rates of application specified hereinafter. The machine shall be so designed that it will be capable of painting the road markings everywhere to a uniform width with sides within the tolerances specified hereinafter, without the paint running or splashing. The machine shall further be capable of painting lines of different widths by adjusting the spray jets on the machine or by means of additional equipment attached to the machine.

The machine shall be provided with clearly visible amber warning flashing lights which shall always be in operation when the machine is on the road.

CA 04.10.05 Surface preparation

Road markings shall be applied to bituminous surfaces only after sufficient time has elapsed to ensure that damage will not be caused to the painted surface by volatiles evaporating from the seal. After completion of the seal no less than two weeks or such longer period as may be directed by the Engineer shall elapse before any road markings shall be applied. However, the Engineer may, in certain cases, require road markings to be painted without waiting for the seal to harden, in which case it shall be done as soon as possible after the instruction has been given.

Before the paint is applied, the surface shall be clean and dry and completely free from any soil, grease, oil, acid or any other material that will be detrimental to the bond between the paint and the surface. The surface where the paint is to be applied shall be properly cleaned by means of watering, brooming or compressed air if required.

Particular care shall be taken to ensure that the surface shall be clean, where roadstuds are to be fixed.

The Contractor shall take note of conditions which he is unable to rectify by himself and may effect the durability of the paint, and he shall point out these conditions to the Engineer in writing. Disputes arising from such conditions shall be referred to the relevant Regional Engineer for arbitration before road marking commences.

The Contractor shall protect the retro-reflective surfaces of roadstuds when paint is applied and remove the protection immediately after the paint has been applied.

On concrete and bituminous surfaces where polished aggregate is exposed, a tack coat shall be used. On new concrete surfaces any laitance and/or curing compound shall be removed before the markings are applied.

The material shall not be laid over loose debris, mud or similar extraneous matter or over old flaking markings of paint or thermoplastic material. If the road surface is at a temperature of less than 5 °C, or if it is wet, it shall be warmed carefully by a road heater so that, when the material is laid, the surface temperature is above 5 °C and the surface dry.

CA 04.10.06 Setting out the road markings

The lines, symbols, figures or marks shall be premarked by means of paint spots of the same colour as that of the final lines and marks. These paint spots shall be at such intervals as will ensure that the traffic-markings can be accurately applied, and in no case shall they be more than 1,5 m apart. Normally spots of approximately 10 mm in diameter should be sufficient.

The dimensions and positions of road-markings shall be as indicated by the Engineer, specified in the appropriate statutory provisions and the South African Road Traffic Signs Manual.

The repainting of a roadway after the application of a fogspray shall only be done once it is possible to determine the beginning and positions of individual broken line segments. Premarking of such a roadway shall entail the searching for and marking of such broken line segments. Painting shall thereafter be done to the same tolerances as prescribed in CA 04.09.10.

After spotting, the positions of the proposed road markings such as broken lines and the starting and finishing points of barrier lines shall be indicated on the road. These premarkings shall be approved by the Engineer prior to commencement of any painting operations.

The position and outlines of special markings shall be produced on the finished road in chalk and shall be approved by the Engineer before the markings are painted. Approved templates may be used on condition that the positioning of the marking is approved by the Engineer before painting is commenced.

The positions for the beginning and end of all barrier-line road-markings must be suitably indicated by the Engineer before the marking of the road commences.

CA 04.10.07 Applying the paint

The figures, letters, signs, symbols, broken or unbroken lines or other marks shall be painted as shown on the drawings or as directed by the Engineer.

Where the paint is applied by machine, it shall be applied in one layer. Before the road-marking machine is used on the permanent works, the satisfactory operation of the machine shall be demonstrated on a suitable site which is not part of the permanent works. Adjustments to the machine shall be followed by further testing. Only when the machine has been correctly adjusted and its use has been approved by the Engineer after testing, may the machine be used on the permanent work. The operator shall be experienced in the use of the machine.

After the machine has been satisfactorily adjusted, the rate of application shall be checked and adjusted if necessary before application on a large scale is commenced.

Where two or three lines are required next to each other, the lines shall be applied simultaneously by the same machine. The paint shall be stirred before application in accordance with the manufacturer's instructions. Paint shall be applied without the addition of thinners.

Where, under special circumstances, painting is done by hand, it shall be applied in two layers, and the second layer shall not be applied before the first layer has dried out sufficiently. As most road-marking paint reacts with the bitumen surface of the road, the paint shall be applied with one stroke only of the brush or roller.

Ordinary road-marking paint shall be applied at a rate not less than 0,42 litre/m².

Unless otherwise instructed by the Engineer, the road-marking shall be completed before a particular section of the road is opened to traffic. Each layer of paint shall be continuous over the entire area being painted.

Control sheets with details of the order number, work dates, quantities of paint used and surface areas painted shall be completed by the Contractor for every section of road included in an order. One set of copies of these sheets shall be handed to the Engineer on completion of every individual order.

CA 04.10.09 Applying the retro-reflective beads

Where retro-reflective paint is required, the retro-reflective beads shall be applied by means of a suitable machine in one continuous operation, immediately after the paint has been applied. The rate of application of the beads shall be at least 0,8 kg/litre of paint or such other rate as may be directed by the Engineer. Machines that apply the beads by means of gravity only shall not be used. The beads shall be sprayed onto the paint layer by means of a pressure sprayer.

If specified or instructed by the Engineer, additional surface reflectorization of plastic road-markings shall be applied at a rate and according to the methods specified in BS 3262, 1987, part 3.

CA 04.10.10 Tolerances

Road-markings shall be constructed to an accuracy within the tolerances given below:

(a) Width

The width of lines and other markings shall not be less than the specified width, nor shall it exceed the specified width by more than 10 mm.

(b) Position

The position of lines, letters, figures, arrows, retro-reflective roadstuds and other markings shall not deviate from the true position by more than 100 mm in the longitudinal and 20 mm in the transverse direction.

When an unbroken line and a broken line are painted alongside each other, the beginning and/or the end of the adjacent lines shall coincide.

When existing lines are repainted, the new marking shall not deviate more than 100 mm in the longitudinal direction and 10 mm in the transverse direction from the existing marking.

(c) Alignment of markings

The alignment of the edges of longitudinal lines shall not deviate from the true alignment by more than 10 mm in 15 m.

(d) Broken lines

The length of segments of broken longitudinal lines shall not be shorter than the specified length or deviate by more than 150 mm from the specified length.

CA 04.10.11 General

In broken lines the length of segments and the gap between segments shall be as indicated on the drawings. If these lengths are altered by the Engineer, the ratio of the lengths of the painted section to the length of the gap between painted sections shall remain the same.

Lines on curves, whether broken or unbroken, shall not consist of chords but shall follow the correct radius.

The Contractor shall provide temporary traffic control facilities at his own cost in accordance with specifications to ensure traffic safety where work is being executed. Property and/or road signs damaged by the Contractor, his personnel or his agents shall be repaired or restored at his own cost to their condition as before the damage.

Only materials intended for use on this Contract may be stored on the site.

CA 04.10.12 Faulty workmanship or materials

If any material that does not comply with the requirements is delivered to the site, or is used in the works, or if any work of an unacceptable quality is carried out, such material or work shall be removed, replaced or repaired as required by the Engineer at the Contractor's own cost.

While work is in progress, tests shall be carried out on materials and/or the quality of work to ensure compliance with the specified requirements. The sampling methods are specified under the appropriate sampling and testing methods. The sampling methods described in TMH5 shall be followed where applicable. (TMH5 is published for the Committee of State Road Authorities by the National Institute for Transport and Road Research - presently the Division of Road and Transport Technology - as part of the series Technical Methods for Highways.)

CA 04.10.13 Protection

After the paint has been applied, the road markings shall be protected against damage by traffic or other causes. The Contractor shall be responsible for erecting, placing and removing all warning boards, flags, cones, barricades and other protective measures that may be necessary in terms of any statutory provisions and/or as may be recommended in the South African Road Traffic Signs Manual and specified in Road Note 13.

CA 04.11 CHEMICAL CONTROL OF VEGETATION AND ERADICATION OF UNDESIRABLE VEGETATION

CA 04.11.01 General

This section covers the eradication of declared and undesirable vegetation, as well as the chemical control of vegetation growth through the application of herbicide.

CA 04.11.02 Execution of work

The eradication of undesired vegetation and chemical control of vegetation growth shall be executed where directed by the written instruction of the Engineer.

Herbicide shall normally only be applied in the spring or summer during the period when the vegetation to be killed is growing strongly.

The Contractor's attention is drawn to the requirement that herbicides may only be applied by duly registered, competent contractors in possession of an AVCASA certificate. Proof of such registration shall be furnished on demand to the Engineer.

The Contractor shall ensure that no damage is caused to other plants inside or adjacent to the treated areas as a consequence of the application of herbicides.

Application shall not be carried out in high winds or wet weather.

The following herbicides may not be used:

- Agents of an explosive, flammable, volatile or corrosive nature
- Sodium chlorate
- Volatile low hormone type herbicides
- Agents which are not registered in the Republic of South Africa.

The Contractor shall state the brand name of the herbicide on which the tendered rate is based, which shall be subject to the approval of the Engineer, prior to the application thereof.

The agent shall be guaranteed to kill at least 90% of the unwanted growth with one application and shall have a residual effect which controls the growth of such vegetation effectively for one growing season.

The herbicide should be strictly applied at the rate recommended by the manufacturer.

(a) Chemical control of vegetation growth

Subject to written approval by the Engineer beforehand, spraying shall be executed in the following designated areas:

- (i) Shoulder weedspray shall comprise the spraying of a 300 mm wide strip of herbicide directly adjacent to the road shoulder. The spraying of shoulders may take place only after the shoulder strips have been cut.
- (ii) Where vegetation is encroaching onto the road shoulder an increased width of 500 mm shall be sprayed along the edge with 200 mm on the black top surface and 300 mm on the shoulder vegetation.
- (iii) Vegetation under guard-rails shall be controlled by spraying under the guard-rail to a width of 500 mm;
- (iv) Openings, cracks and joints between the road pavement and concrete, as well as between paving stones and concrete blocks;
- (v) Up to a maximum distance of 500 mm around the poles at kilometre markers, road signs and guard-rail posts;
- (vi) Between the road reserve fence and a neighbouring solid wall. Here the Contractor may use only contact herbicides which are absorbed by the leaves and which do not have a detrimental effect on the soil;
- (vii) Entire areas invaded by weeds;
- (viii) On block paved areas adjacent to concrete median barriers or steel guard-rails. These areas may have slopes to 1:1 grades.

The type of herbicide to be used, the correct spray rate, the method of application and when applied, shall be as specified in the Particular Specifications.

(b) The eradication of weeds

The eradication of declared and undesirable vegetation shall take place in the road reserve during the contract period over the whole length of the sections of road involved, and may include localised patches of noxious weeds, invader plants and other undesired vegetation.

Subject to the Engineer's approval, certain aspects, such as the treatment of the stumps of felled trees, may be carried out by the Contractor.

The Contractor shall ensure that no damage whatsoever is caused to any plants inside or adjacent to the areas treated as a consequence of the application of the herbicides, either during or after application. This also includes areas outside the road reserve.

The type of weedkiller to be used, the correct application rates and when applied, shall be as specified and according to the manufacturer's instructions.

CA 04.10.03 Quality standard

Eradication of undesired vegetation shall be carried out as specified and to the satisfaction of the Engineer. The herbicide shall be applied at the correct rate to prevent regrowth and the application confined to the undesired vegetation.

Areas shall be left neat and tidy and all vegetation cuttings removed where instructed.

CA 04.10.04 Plant and equipment

Vegetation shall be eradicated using knapsacks or portable weedspray machines.

It is important that the equipment be in good working condition. The equipment shall distribute the herbicide evenly without spilling. The nozzle shall be able to move close to the ground in order to prevent mist spray blowing away and killing plants which have to remain. The equipment shall also be safe for the workers, as well as for the travelling public.

CA 05 MAINTENANCE

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

All components of the roadway infrastructure, which includes the road surface, underlying layer works, kerbing, road markings, road signs and sidewalks, shall be maintained during the Contract.

The scope of the maintenance work for the road infrastructure consists of the following:

The scope of the maintenance work for the road infrastructure includes the following:

- (i) Maintenance approximately 270 m² of concrete surfacing to Port of Entry Entrance roads and parking areas.
- (ii) Maintenance and vegetation control of approximately 6200 m² of concrete block paving to areas affected by vehicular traffic.
- (iii) Maintenance of approximately 2 200 m² of concrete block paving to areas affected by pedestrian traffic, including vegetation control.

This description of the road and paved areas to be maintained is not necessarily complete and shall not limit the maintenance work to be carried out by the Contractor under this contract.

Maintenance shall include all repair work, replacing of components, fixing of defects, or any other actions or rectifying measures necessary for complete and safe functioning of the road infrastructure.

Maintenance of the road infrastructure shall also include all other actions related to maintenance, such as temporary accommodation of traffic through and around work areas, and provision of temporary accesses to properties.

Remuneration for maintenance of the complete roadway infrastructure shall be deemed included in the tendered monthly payment for maintenance thereof, and shall be paid as detailed in Additional Specification SA: General Maintenance.

CA 05.01 ROAD INFRASTRUCTURE

Routine maintenance on the road infrastructure shall be carried out as described in table CA 05.01/1.

TABLE CA 05.01/1

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation	Monthly
2	Check, inspect, repair all surface and kerbs failures	Two-monthly
3	Check, inspect, repair all pavement failures	Monthly
4	Blade all gravel roads and parking areas	Six-monthly
5	Check, inspect, repair, replace road signs	Six-monthly
6	Check, inspect, repair, repaint, replace road markings	Annually
8	Remove loose material from the surface of parking areas by means of mechanical brooming	Six-monthly
9	Remove loose material from the road surfaces of by means of mechanical brooming	Six-monthly

CA 06 MEASUREMENT AND PAYMENT

CA.01 REPAIR OF GRAVEL WEARING COURSE

CA.01.01 Reshaping the wearing course by:

- (a) Grading only Unit: square metre (m²)
- (b) Ripping, redistributing and compacting Unit: square metre (m²)
- (c) Importing, placing and compacting material from commercial sources Unit: cubic metre (m³)

The unit of measurement for CA.01.01 (a) and (b) shall be the square metre surface area graded or ripped and recompacted to a depth of 150 mm, as instructed by the Engineer.

The unit of measurement for CA.01.01 (c) shall be the cubic metre of compacted material imported from commercial sources as instructed by the Engineer and measured in place.

The tendered rates shall include full compensation for providing all plant, labour, equipment and materials required and for reshaping and/or constructing the wearing course as instructed by the Engineer. The tendered rates shall also include full compensation for the cost of testing to ensure the finished wearing course complies with the specified requirements, and for disposing of surplus material.

CA.01.02 Overhaul on surplus material Unit: cubic metre kilometer (m³-km)

The unit of measurement shall be the cubic metre of material hauled in excess of 1,0 km, the volume determined from the rated capacity of the truck multiplied by the overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

CA 02 SURFACE REPAIRS OF CONCRETE PAVEMENTS

CA.02.01 Preparation and sealing or resealing of old joints and cracks in existing concrete pavements:

(a) Expansion joints Unit: metre (m)

(b) Construction joints and weakened plane joints:

(i) (Width stated) Unit: metre (m)

(ii) Etc for other widths Unit: metre (m)

(c) Cracks:

(i) (Width stated) Unit: metre (m)

(ii) Etc for other widths Unit: metre (m)

The unit of measurement shall be the metre of each type of joint or crack prepared and sealed or resealed. No distinction will be made between joints or cracks through areas where the concrete has been repaired and other joints or cracks.

The tendered rates shall include full compensation for all labour plant, equipment, tools and materials, removing old sealant, backing material and any foreign material, refacing or enlarging the faces by sawing, routing of cracks to the specified dimensions, disposing of all debris, all cleaning work involved, installing back-up material where required, installing the bond breaker, applying the primer and mixing and applying the sealant, ensuring acceptable bond with existing work, and for any other operation needed to complete the work as specified and shown on the drawings.

CA.02.02 Patching of concrete:

(a) (Thickness stated) Unit: square metre (m²)

(b) Etc for other thicknesses Unit: square metre (m²)

The unit of measurement shall be the square metre of new concrete installed.

The tendered rates shall include full compensation for all the necessary labour, plant, equipment, tools and materials required for breaking out the existing concrete, disposing of the debris, compacting the exposed pavement layer, supplying, placing and finishing off the new concrete, and constructing isolation joints. The tendered rates shall also include full compensation for providing adequate accommodation of traffic where necessary.

CA.03 PAVEMENT LAYERS AND ASPHALT SURFACE REPAIR

CA.03.01 Excavation in existing pavements for patching Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated from the existing pavement irrespective of the type of material. The quantity shall be computed in accordance with the authorised dimensions of the excavation.

The tendered rate shall include full compensation for demarcating the excavation and excavating and disposing and/or stockpiling of the material, including haul over a free-haul distance of 1,0 km.

Payment will not distinguish between the different types of pavement material excavated.

CA.03.02 Backfilling of excavations for patching with:

- (a) Chemically stabilized gravel excavated from the existing pavement:
 - (i) Areas up to and including 10 m²..... Unit: cubic metre (m³)
 - (ii) Areas larger than 10 m² up to and including 50 m²..... Unit: cubic metre (m³)
 - (iii) Areas larger than 50 m²..... Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of chemically stabilized gravel or emulsion-treated crushed stone or the ton of asphalt placed in accordance with the specified requirements. The quantity will be computed in accordance with the authorised dimensions of the layer in the case of gravel or crushed stone and in accordance with the certified weighbridge tickets issued in the case of asphalt. Payment will not be made for wasted material.

The tendered rates shall include full compensation for providing all the material, irrespective of its origin, for all mixing, placing, compacting, including the floor, and finishing as specified in this section and other sections of the appropriate specifications, for all transport, work in restricted areas, and also for all machinery, equipment, labour, tack coat, supervision and other incidentals for executing the work as specified.

The tendered rates for chemically stabilized gravel shall also include full compensation for stabilizing and providing the stabilizing agent.

The tendered rates for emulsion-treated crushed stone shall also include full compensation for supplying and mixing with emulsion, stabilizing and providing the stabilizing agent.

Payment for hot-mixed asphalt base and surfacing will not distinguish between the various types of asphalt and will allow for priming.

CA.03.03 Alternative method of surfacing with cold mix asphalt from the following sources:

Patching of pavement layers:

- (a) Commercial sources (indicate thickness)..... Unit: square metre (m²)
- (b) Mixed on site as specified (indicate thickness)..... Unit: square metre (m²)

The unit of measurement for patching of asphalt pavement shall be the square metre of pavement patched, measured to the nearest square metre.

The tendered rate shall include full compensation for procuring, furnishing, and storing of all materials, providing and transporting all plant, labour and equipment necessary for cutting back the edges, excavation, removing excavated and loose material and disposal thereof, priming, surfacing with specified material, compaction and trimming as specified in this section.

CA.03.04 Additional backfilling up to the 500 mm below surface level and compaction to 90 % of modified AASHTO density Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material to be backfilled.

The tendered rate shall include full compensation for materials, labour, tools and equipment necessary for backfilling material up to the 500 mm below surface level as specified, irrespective of the size of area to be backfilled.

CA.03.05 Binder variations

(a) Penetration-grade bitumens Unit: ton (t)

(b) RTH/RTL road tars Unit: ton (t)

The unit of measurement in respect of increases or decreases in the bituminous binder from that specified in the nominal mix shall be the ton.

Payment for variations shall be made as specified in clause CA.04.06.

CA.03.06 Variation in active filler content

(a) Cement Unit: ton (t)

(b) Lime Unit: ton (t)

(c) Milled granulated blast-furnace slag Unit: ton (t)

(d) Fly-ash Unit: ton (t)

The unit of measurement in respect of increases or decreases in the active filler content for base and surfacing mixtures from that specified in the nominal mix shall be the ton. No payment shall be made for "inert" filler added by the Contractor.

Payment for variations shall be made as specified in Clause CA 04.04.

CA.04 SURFACE PATCHING OF SURFACED ROADS

CA.04.01 Trimming the edges and edge breaks of the existing surfacing Unit: metre (m)

The unit of measurement for trimming the edges shall be a metre of pavement edge cut back and trimmed as specified measured along the centre line of the road.

The tendered rate for trimming the edges shall include full compensation for cutting back the edges in accordance with instructions, excavating the material to the specified depth and removing all excavated and loose material. Payment for the backfilling of the edge breaks with hot-mix continuously graded asphalt will be made under item CA.04.04.

The tendered rates shall include full compensation for all transport, handling, labour, material and all incidentals necessary for completing all the work in accordance with the specifications, and also for work in restricted areas.

CA.04.02 Pothole repair using hot-mix continuously graded asphalt Unit: ton (t)

The unit of measurement for repairing surfacing shall be the ton of asphalt applied for the repair of the surfacing, irrespective of the thickness or number of layers.

The tendered rates shall include full compensation for procuring, furnishing, and storing of all materials, providing and transporting all plant, labour and equipment necessary for

cutting back the edges, excavation, removing excavated and loose material and disposal thereof, priming, backfilling with the approved product, compaction and trimming as specified in this section.

The quantity shall be calculated by measuring the volume of material used, multiplied by the density of the compacted material.

CA.04.03 Pothole repair using cold mix asphalt surfacing from the following sources:

(a) Commercial sourcesUnit: ton (t)

(b) Mixed on site as specifiedUnit: ton (t)

The unit of measurement for surfacing repair shall be the ton of cold mix asphalt applied for the repair of surfacing, irrespective of the thickness or number of layers.

The tendered rates shall include full compensation for procuring, furnishing, and storing of all materials, providing and transporting all plant, labour and equipment necessary for cutting back the edges, excavation, removing excavated and loose material and disposal thereof, priming, backfilling with the approved product, compaction and trimming as specified in this section.

The quantity shall be calculated by measuring the volume of material used, multiplied by the density of the compacted material.

CA.04.04 Repairing edge breaks using hot-mix continuously graded asphalt - medium gradeUnit: ton (t)

The unit of measurement for repairing edgebreaks shall be the ton of asphalt applied for the repair of edge breaks, irrespective of the thickness or number of layers.

The tendered rates shall include full compensation for compacting the surface on which the new edge is to be constructed, procuring, furnishing, and mixing all materials and compacting and trimming the asphalt to the required lines and levels. It shall also include full compensation for applying a tack coat of emulsion to the surface to be treated.

The tendered rates shall include full compensation for all transport, handling, labour, material and all incidentals necessary to complete all the work as specified.

The quantity shall be calculated by measuring the volume of material used, multiplied by the density of the compacted material. No extra payment will be made in regard to this item for producing small quantities of asphalt.

CA.04.05 Mechanical brooming of road surfaces..... Unit: square metre (m²)

The unit of measurement for the mechanical brooming of the road surface shall be the area of road swept, measured in square metres.

The tendered rate shall include full compensation for the provision of all equipment, use and maintenance thereof and all labour costs.

CA.05 CRACK SEALING

CA.05.01 Sealing cracks of width 3 mm to 15 mm:

- (a) Cleaning crack with hot compressed air, priming and sealing using hot applied SBS/SBR modified bitumen Unit: metre (m)
- (b) Cleaning crack with hot compressed air, and sealing using hot applied SBS/SBR modified bitumen Unit: metre (m)
- (c) Cleaning crack with cold compressed air, priming and sealing using..... Unit: metre (m)
- (d) Cleaning crack with compressed air, and sealing using a bandage Unit: metre (m)

Subitems CA.05.01 (a), (b) and (c) using hot applied sealant:

The unit of measurement shall be the metre of crack sealed measured after the crack has been sealed to the satisfaction of the engineer.

The tendered rates shall include full compensation for furnishing and procuring the materials and equipment and labour, for cleaning the crack with hot or cold compressed air as specified, priming if specified, applying the sealant, reapplications where necessary or applying the seal bandage, cleaning, curing, finishing and all other incidentals necessary for hot sealing the cracks as specified.

Subitem CA.05.01 (d) using seal bandage:

The unit of measurement shall be the metre of seal bandage applied measured after the crack has been covered to the satisfaction of the engineer. Over application of the bandage shall not be measured.

The tendered rate shall include full compensation for furnishing and procuring the materials and equipment and labour, for cleaning the crack with cold compressed air, applying the tack coat, the seal bandage and wearing coat if applicable, cleaning, curing, finishing and all other incidentals necessary for applying the seal bandage according to the manufacturer's specification and to the satisfaction of the Engineer.

CA.05.02 Sealing cracks of width more than 15 mm:

- (a) Cleaning crack with compressed air, filling using sand/lime mix followed by a rubber/aggregate slurry and overbanding using a Sealmac or similar approved geotextile bandage Unit: metre (m)

The unit of measurement shall be the metre of crack filled and covered measured after the crack has been sealed to the satisfaction of the Engineer.

The tendered rate shall include full compensation for furnishing and procuring the materials and equipment and labour, for cleaning the crack with compressed air as specified, filling the crack with a sand/lime mix, priming and filling to the surface with a rubber/aggregate slurry, applying the seal bandage, cleaning, curing, finishing and all other incidentals necessary for filling and covering the cracks as specified.

CA.05.03 Crack sealing per individual item
(items to be used on the instruction of the Engineer only)

- (a) Blowing out of cracks:
- (i) Treated per metre Unit: metre (m)
- (ii) Treated per area Unit: hour (h)
- (b) Priming of cracks (MSP/1 or similar):..... Unit: litre
- (c) Sealant (state type of hot-applied sealant) Unit: litre
- (d) Seal bandage (state type of hot-applied sealant and width) Unit: metre (m)
- (e) Treatment of raised cracks Unit: metre (m)

The unit of measurement for subitem CA.05.03(a)(i), the complete process of blowing out cracks, shall be the linear metre of crack blown out as specified.

The unit of measurement for subitem CA.05.03(a)(ii), the blowing out of the cracks over an area where subitem (i) is not applicable, shall be the number of hours the compressor was actually used.

The tendered rates shall include full compensation for furnishing all equipment, labour, blowing out cracks, cleaning up and reblowing if necessary, finishing and all other incidentals necessary for blowing out the cracks as specified. The tendered rates shall also include full compensation for furnishing and using the compressor, costs of fuel, operators, maintenance, transporting the machine to and from site and for all other incidentals.

The unit of measurement for subitem CA.05.03(b), supplying and jetting the bitumen emulsion prime shall be the litre of prime, jetted into the cracks.

The tendered rate shall include full compensation for furnishing and procuring the materials and equipment, for labour, jetting in the prime, cleaning, curing, finishing and all other incidentals necessary for priming the cracks as specified.

The unit of measurement for subitem CA.05.03(c), sealing the crack, shall be the litre of sealant inserted into the cracks. Payment shall distinguish between a hot bitumen-rubber seal or, alternatively, the proprietary brand seals.

The tendered rate shall include full compensation for furnishing and procuring the materials and equipment, for labour, applying the sealant, reapplications where necessary, cleaning, curing, finishing and all other incidentals necessary for cold sealing the cracks as specified.

The unit of measurement for subitem CA.05.03(d), covering the crack, shall be the metre of seal bandage applied over the crack.

The tendered rate shall include full compensation for furnishing and procuring the materials and equipment, for labour, applying the tack coat, the seal bandage and wearing coat if applicable, cleaning, curing, finishing and all other incidentals necessary for applying the seal bandage according to the manufacturer's specification and to the satisfaction of the Engineer.

The unit of measurement for subitem CA.05.03(e), treating the raised crack, shall be the metre of crack treated.

The tendered rate shall include full compensation for furnishing and procuring the materials and equipment, for labour, applying the softening agent, allowing for the time delays specified, rolling of the crack, cleaning, curing, finishing and all other incidentals necessary to complete the works to the satisfaction of the Engineer.

CA.07 ERECTION AND REPAIR OF PERMANENT ROAD TRAFFIC SIGNS

CA.07.01 Erection or reinstatement of road sign boards

- (a) Area not exceeding 2 m² Unit: square metre (m²)

The unit of measurement shall be the square metre of completed road sign erected as required in the Project Specification, instructions or drawings issued by the Engineer.

The tendered rates shall include full compensation for attaching the road signboard to a road sign support structure, or to an overhead road sign support structure or to an overbridge and for all equipment, labour, supervision, nuts, bolts, transport, handling, etc, necessary for the installation of the road sign board.

CA.07.02 Road sign supports (overhead road sign structures excluded)

- (a) Steel tubing of (76 mm diameter and 3 mm wall thickness) Unit: metre (m)

The unit of measurement for CA.07.02(a) for erecting supporting structures manufactured from steel tubing shall be the metre of steel tubing used. Bolts and other accessories shall not be measured.

The tendered rates shall include full compensation for erecting the road sign supports, including all bolts, screws, rivets, welding and accessories, together with the painting and galvanizing required and the provision and treatment of breakaway holes in timber supports.

The tendered rates shall also include full compensation for tying up, clearing, trimming, disposing of material at approved dumping sites provided by the Contractor, and finishing the area around each sign footing.

Overhead road sign supporting structures shall not be measured and paid for under this item, but shall be considered as specialised structural work.

CA.07.03 Excavation and backfilling for road sign supports Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of excavation measured in place according to the neat dimensions of the footings or excavations as shown on the drawings or directed by the Engineer. In the case of timber posts not in concrete, the plan area of the excavated hole shall be taken as 0,15 m², irrespective of the actual size of the excavated hole.

The tendered rate shall be in full compensation for excavating, backfilling and compacting the backfill material, for the disposal of all surplus excavated material, and for providing the backfill material.

CA.07.04 Extra over item CA.07.03 for cement-treated soil backfill Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre.

The tendered rate shall include full compensation for the additional cost of providing and mixing in cement.

CA.07.05 Extra over item CA.07.03 for rock excavationUnit: cubic metre (m³)

The unit of measurement shall be the cubic metre.

The tendered rate shall include full compensation for the additional cost of excavating in rock.

CA.07.06 Gravel drainage layer below road sign footingsUnit: cubic metre (m³)

The unit of measurement is the cubic metre of compacted gravel placed below road sign footings in accordance with the details on the drawings. The quantity will be calculated from the authorised dimensions, and gravel placed outside the authorised dimensions will not be measured for payment.

The tendered rate shall include full compensation for procuring, furnishing and placing the gravel.

CA.07.07 Hazard plates (600 x 150 mm).....Unit: number

The unit of measurement is the number of each size of hazard plate erected complete in accordance with the details on the drawings.

The tendered rate shall include full compensation for excavating, disposing of excavated material (including all haul), erecting and for placing and compacting the soilcrete backfilling.

CA.07.08 Repair of road sign faces.....Unit: square metre (m²)

The unit of measurement shall be the square metre of sign face repaired on the instruction of the Engineer. Only the portion of the sign face actually repaired shall be measured for payment.

The tendered rate shall include full compensation for procuring and furnishing all the necessary material, labour and equipment and for repairing as specified.

CA.08 ROAD MARKINGS**CA.08.01 Retro-reflective road-marking paint****(a) Longitudinal lines:**

(i) 100 mm wide broken or unbroken lines, white, yellow or red Unit: metre (m)

(ii) 150 mm wide broken or unbroken lines, white, yellow or red Unit: metre (m)

(iii) Broken or unbroken lines, white or yellow, other widths..... Unit: metre (m)

(b) Transverse lines and other markings:

(i) Broken or unbroken lines, white or yellow Unit: square metre (m²)

(ii) Lettering and symbols, white or yellow, repainting existing markings Unit: square metre (m²)

(iii) Lettering and symbols, white

- or yellow, new markings Unit: square metre (m²)
- (iv) Traffic island markings, white or yellow
repainting existing markings Unit: square metre (m²)
- (v) Traffic island markings, white or yellow
new markings Unit: square metre (m²)

The unit of measurement for subitem CA.08.01(a) shall be a metre of line of each specified width of line, for widths not exceeding 150 mm, and the quantity paid for shall be the actual length of line painted in terms of an official order, measured to the nearest metre. The length of gaps in broken lines shall not be measured for payment.

The unit of measurement for subitem CA.08.01(b) shall be a square metre and the quantity to be paid for shall be the actual surface area of the lettering, symbols, traffic island markings or lines completed in terms of an official order, measured to the nearest tenth of a square metre.

The tendered rate per metre or per square metre, as the case may be, shall include compensation for procuring and providing all the necessary labour, constructional plant, tools, equipment and materials, including the retro-reflective beads. The tendered rate shall also include full compensation for surface preparation, for painting the road markings and applying the retro-reflective beads, for protection and temporary traffic control facilities, maintenance, and for all incidentals necessary to complete and maintain the road markings in accordance with the provisions of the contract, including the setting-out of lettering, symbols and traffic island markings, but excluding setting out and premarking the lines.

**CA.08.02 Setting out and premarking of lines
(excluding traffic island markings, lettering
and symbols) Unit: kilometre (km)**

The unit of measurement for setting out and premarking lines shall be a kilometre of line set out and premarked. If two or more parallel lines lie in a strip with a maximum width of 1,0 m the setting out and premarking of the lines will be measured once only as if it is a single line.

The tendered rate shall include full compensation for setting out and premarking the lines in accordance with an official order, including all materials, and measured to the nearest tenth of a kilometre.

CA.08.03 Removal of road markings:

- (a) Removal of markings by means of
grit-blasting Unit: square metre (m²)
- (b) Removal of markings by other mechanical
methods (The tenderer shall state the method
he intends to use) Unit: square metre (m²)
- (c) Removal of markings by chemical methods
(The tenderer shall state the method he intends
to use) Unit: square metre (m²)

The unit of measurement for the removal of road markings shall be a square metre and the quantity paid for is the actual surface area of the markings removed in terms of an official order, measured to the nearest tenth of a square metre.

The tendered rate shall include full compensation for removing the markings, including all material.

CA.09 CHEMICAL CONTROL OF VEGETATION AND ERADICATION OF UNDESIRABLE VEGETATION**CA.09.01 Chemical control of vegetation:**

- (a) 300 mm wide strip Unit: kilometre (km)
- (b) 500 mm wide strip Unit: kilometre (km)
- (c) Cracks and joints between road pavement and concrete drains, paving stones or concrete blocks Unit: metre (m)
- (d) Around kilometre markers, road signs and guardrail posts Unit: square metre (m²)
- (e) Between road reserve fence and a solid wall Unit: square metre (m²)
- (f) Area covered by interlocking blocks Unit: square metre (m²)
- (g) Entire area invaded by weeds Unit: square metre (m²)
- (h) (Any other area as specified)

The unit of measurement for items CA.09.01(a) and (b) above shall be the kilometre of road treated as described in these specifications. The distance treated will be measured once for each strip so treated. The unit of measurement for item CA.09.01(c) above shall be the length of crack or joint treated as described in these specifications. The length treated will be measured once along the length of the crack. The unit of measurement for items CA.09.01(d), (e), (f) and (g) above shall be the square metre of road reserve treated as described in these specifications.

The Contractor is to assess the number of different types of places where application of chemicals will be required and to make provision accordingly for the fluctuating chemical demand per kilometre of road.

The tendered rate shall include full compensation for the supply of chemicals, plant, equipment and labour for the spraying of the chemical liquids in accord with the manufacturers specifications.

The tendered rates shall be fully inclusive of any costs arising from restricted working conditions due to the nature of the site or traffic flow.

Payment will be made as follows:

- (a) 60% will be payable after application
- (b) The remaining 40% will be payable once 90% of the vegetation has been controlled to the satisfaction of the Engineer.

CA.09.02 Eradication of weeds (chemical) Unit: square metre (m²)

The unit of measurement for the eradication of weeds by means of spraying will be the square metre treated in this way by a selected subcontractor.

The tendered rate shall include full compensation for the supply of all chemicals, machinery, labour and equipment to spray the herbicides according to the instructions of the manufacturers.

Payment of 60% of the value of the spraying done will be made when visible results are obtained (usually 14 days after application). The remaining 40% of the value of the work will be payable when at least 90% of unwanted growth has been destroyed.

CA.10 CONCRETE SPEED HUMPS

CA.10.01 Repair of concrete speed humpsUnit: number

The unit of measurement shall be the number of speed humps repaired.

The tendered rate shall include for the removal of the remainder of the existing speed hump and the replacement with a 150 mm high concrete speed hump to the Engineer's satisfaction. The width and length of the speed hump shall be the same as for the original, unless otherwise directed by the Engineer, and the concrete shall be of the same type and strength as used for concrete patching.

The tendered rate shall also be fully inclusive of all materials, machinery and labour costs.

TECHNICAL SPECIFICATION**CB STORMWATER DRAINAGE****CONTENTS**

CB 01	SCOPE
CB 02	STANDARD SPECIFICATIONS
CB 03	OPERATING AND MAINTENANCE MANUALS
CB 04	EXECUTION OF REPAIR WORK
CB 05	MAINTENANCE
CB 06	MEASUREMENT AND PAYMENT

CB 01 SCOPE

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of existing stormwater drainage systems. It covers both surface and underground drainage systems.

CB 02 STANDARD SPECIFICATIONS**CB 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

PW 371	-	Specification of Materials and Methods to be used (Fourth edition, October 1993)
SABS 1200 DB	-	Earthworks (pipe trenches)
SABS 1200 DK	-	Gabions and pitching
SABS 1200 G	-	Concrete (structural)
SABS 1200 LB	-	Bedding (pipes)
SABS 1200 LE	-	Stormwater drainage
SABS 1200 MK	-	Kerbing and channelling

CB 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CB 02.03 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CB 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CB 03 **OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be required for stormwater.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CB 04 **EXECUTION OF REPAIR WORK**

CB 04.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter indicate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems and installations shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the stormwater drainage systems shall be categorised under the following headings:

- (a) Prefabricated culvert installation and repair of existing culverts and structures;
- (b) Cleaning of prefabricated culverts;
- (c) Concrete channel construction and repair of existing channels;
- (d) Cleaning of concrete drains and channels;

- (e) Cleaning of earth channels;
- (f) Construction and repair of brickwork inlet structures;
- (g) Provision of lockable stormwater grid inlets;
- (h) Cleaning of pipelines.

CB 04.02 **PREFABRICATED CULVERT INSTALLATION AND REPAIR OF EXISTING CULVERTS AND STRUCTURES**

This section covers the work in connection with the construction of prefabricated pipe and portal culverts and stormwater structures such as manholes, grid inlets and the like.

It also covers the removal and replacement of damaged and broken prefabricated culverts, as well as repairs to existing culverts and stormwater structures.

CB 04.02.01 **Construction**

Prefabricated culverts shall be constructed or replaced in accordance with the specifications at the locations indicated by the Engineer.

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of culverts. The widths of the excavation for each type and size of culvert shall be as set out in SABS 1200 DB.

The depth of the excavation for each type and size of culvert shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the culvert and shall be sufficient to allow the type and thickness of bedding material instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Excavations shall commence from the outlet end of culverts to be installed.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

- (i) Hard material
Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers, and boulders exceeding 0,10 m³ shall be classified as hard material.

Where more than 40% of any material (by volume) consists of boulders each exceeding 0,10 m³ in size, the material shall be classified as hard material.

- (ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site and disposed of.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged culverts

Where indicated by the Engineer damaged sections of prefabricated culverts shall be completely removed and replaced with new units.

Excavation shall be carried out as described for new culvert installation and the excavated material shall be, if suitable, preserved for backfilling. The damaged culvert units shall be disposed of.

(e) Laying of concrete pipe culverts

Concrete pipe culverts shall be laid on class A or B bedding as directed by the Engineer. The inside of the culverts shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2% or as directed by the Engineer.

(i) Class A bedding - see SABS 1200 LB

(ii) Class B bedding - see SABS 1200 LB

(iii) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(iv) Concrete casing

Where ordered by the Engineer a pipe shall be encased in concrete according to the Engineer's instructions.

(f) Laying of concrete portal culverts

Portal culverts shall be laid on prefabricated floor slabs. A layer of fine-grained material of at least 75 mm thick shall be placed on the bottom of the excavation, levelled, compacted and trimmed to line and grade to form a bed to receive the precast slabs.

The portal portions of portal culverts shall be placed accurately and symmetrically on the floor slabs with a thin layer of mortar of one part of cement and six parts of sand between the contact surfaces to ensure a firm and uniform support.

(g) Extension of existing culverts

Where existing culverts require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where it joins the existing structure, at the same level as the existing structure.

Any sections of existing wing walls, approach slabs and head walls which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new inlet and outlet structures shall be paid for under the relevant sections in the specification.

(h) Construction of culverts in half widths in existing roads

To allow the free flow of traffic at all times the culverts shall be constructed in half widths. The downstream section shall be constructed first and the end of the excavation adjoining the traffic lane shall be properly supported to prevent displacement from occurring.

(i) Repairing of cracks and joints

Where instructed by the Engineer cracks in existing culverts and culvert joints which have opened shall be caulked with material specified in the Particular Specification.

(j) Backfilling of prefabricated culverts

The backfill material shall be material selected from the excavation mixed with 80 kg Portland cement with every cubic metre of excavated material.

Generally the backfill material shall be a sandy material, but may contain larger particles up to 38 mm and shall have a plasticity index not exceeding 12.

In the case of concrete pipe culverts on class B bedding the backfilling material shall be tamped in under the flanks of the culverts to provide a uniform bedding, all to the satisfaction of the Engineer.

Backfilling alongside and over the culverts to the underside of the pavement layers shall be placed at optimum moisture content and compacted to a minimum of 90% of modified AASHTO density in layers not exceeding 150 mm after compaction. Where approved by the Engineer, testing may be done with a dynamic cone penetrometer (DCP). The average penetration rate recorded after every 5 blows for each layer shall not exceed 50. The full depth of a layer shall be tested.

Backfilling shall be carried out simultaneously and equally on both sides of a culvert to prevent unequal lateral forces from occurring and the ends of culverts shall be protected to prevent the backfill material from spilling beyond the required levels.

(k) Reinstatement of pavement layers

Unless otherwise instructed by the Engineer the pavement layers shall be reinstated as follows:

- (i) Selected layers shall be of at least a G5 quality and shall be compacted to at least 93% of modified AASHTO density.
- (ii) Material for the subbase layers shall be stabilized with 3% cement and compacted to 95% of modified AASHTO density, and shall be at least a G5 quality.
- (iii) The material for the base layer shall be stabilized with 5% cement and compacted to at least 97% of modified AASHTO density, and shall be at least a G3 quality.
- (iv) The surfacing layer shall consist of a medium continuously graded asphalt compacted to 94% of Marshall density. The thickness of the surfacing layer shall be at least 25 mm. A 60% cationic emulsion shall be applied at 0,4 litre/m² to the top of the base layer before the surfacing layer is placed.

The soil cement shall be mixed on site with suitable concrete mixers and the water and cement contents shall be carefully controlled.

(l) Repair of stormwater manholes, grid inlets and the like

Repair work will be undertaken on the structures indicated on the drawings, or as directed by the Engineer. All repair work will comply with the construction and quality requirements of SABS 1200 LE.

CB 04.02.02 Quality standard

Culverts shall be constructed true to lines and levels with the inside smooth and without any displaced joints.

CB 04.02.03 Materials

The prefabricated culvert units shall be factory produced by a reputable manufacturer of these units and shall comply with the following requirements:

(a) Prefabricated concrete pipe culvert units

Prefabricated concrete pipe culvert units shall comply with the requirements of SABS 677. Pipes with ogee joints shall be provided, unless otherwise specified. Pipes subjected to traffic loadings shall be class 100 D; all other pipes shall be class 50 D.

(b) Portal prefabricated concrete culvert units

Portal prefabricated concrete culvert units shall comply with the requirements of SABS 986.

(c) Other types of prefabricated culverts

If required, other types of prefabricated culverts will be specified in the Particular Specification.

(d) Manhole covers, grid inlets, etc

Manholes, grid inlets, etc, shall have covers and frames complying with SABS 558.

CB 04.03 CLEANING OF PREFABRICATED CULVERTS

The work involved under this section is the removal of silt and debris from prefabricated culverts including the cleaning of inlet and outlet structures.

CB 04.03.01 Construction

Prior to cleaning any prefabricated culverts, the Contractor shall arrange with the Engineer for an inspection of the stormwater network. The Contractor shall provide adequate equipment, such as torches, lights, mirrors, etc, to enable a basic visual inspection of all the culverts. Based on this inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Material removed from the culverts shall be disposed of where instructed by the Engineer. Rubble and waste material shall be disposed of at the nearest appropriate solid waste disposal site, unless otherwise directed by the Engineer.

The Contractor must ensure that all material being removed is removed before or at the nearest accessible downstream structure. No additional payment will be made for the removal of material which, as a result of cleaning operations, find its way into a previously clean section of the culvert network.

CB 04.03.02 Quality standard

Prefabricated culverts shall be cleaned of all silt and debris such that all surfaces are clearly visible and accessible for inspection.

All spoil material shall be spread neatly and shall not wash back into drainage trenches.

The size of the culverts for the different categories will be determined as follows:

- (a) For pipe culverts - diameter
- (b) For portal culverts - width.

CB 04.04 CONCRETE CHANNEL CONSTRUCTION AND REPAIR OF EXISTING CHANNELS

This section covers the construction of new concrete lined drains where required and the maintenance of existing concrete drains. It includes the construction of kerb and channel combinations and repairs where required.

CB 04.04.01 Construction

The Engineer will indicate the locations where new drains are to be constructed to improve drainage and shall instruct where repairs to existing drains are to be carried out.

Construction of the following type of concrete drains may be required:

- (a) Concrete lining to open drains
- (b) Concrete pipes
- (c) Kerbing channeling combination.

Concrete drains shall be constructed in accordance with the details shown on the drawings or as directed by the Engineer.

(a) Excavation and preparation of bedding

The excavations shall be neatly trimmed to lines and levels so as to permit the accurate construction of the concrete linings. All loose material shall be well rammed at the optimum moisture content for the material used.

Where excavations are in hard material, overbreak shall be backfilled with concrete of the same class as specified for the lining.

In the case of kerbs and channels the trenches shall be excavated to the required depths and the bedding material shall be well rammed before placing the concrete.

Where wash-aways have occurred, any cavities or voids in the foundation material must be backfilled in layers not exceeding 150 mm in thickness and compacted to 90% of modified AASHTO density.

(b) Concrete linings

Concrete lining of open drains shall be cast in situ only and the exposed surfaces shall be given a class U2 (wood-floated) surface finish.

Sealed joints in concrete shall be in accordance with the details indicated on the drawings and joints shall be painted with a coat of approved bituminous emulsion containing 60% of pure bitumen by mass.

Expansion joints shall be made in accordance with the drawings.

(c) Half-round channels

Cast in situ half-round channels shall be constructed in accordance with the drawings, or to fit existing sections.

(d) Kerbing and channeling

Kerbing shall include barrier kerbs, mountable and semi-mountable types. All the elements shall be prefabricated units with cast in situ channeling unless otherwise specified by the Engineer.

Kerbing and channeling shall be laid on the approved bedding with close joints filled with 3:1 sand: cement mortar not exceeding 10 mm in thickness and neatly pointed with a pointing trowel. Kerbing shall be propped with class 15/19 in-situ concrete at each joint (size: 300 mm long x 200 mm wide x 80% of kerb height).

(e) Concrete cast against existing surfaced edges

Where concrete lining or concrete channeling in kerb and channel combinations is to be cast against existing surfacing the edge shall first be cut, before excavation, with approved sawing equipment to provide a neat straight edge. Care shall be taken during the placing of the concrete not to spill concrete onto the adjacent surfacing. Any concrete stains shall be removed by the Contractor at his own expense.

(f) Reinstatement of damaged existing structures

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris shall be spoiled.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

Provision shall be made for the reinstatement of existing damaged prefabricated concrete half round channels.

(g) Inlet and outlet structures

The structures shall be constructed in accordance with the requirements specified in the relevant section in this specification.

CB 04.04.02 Quality standard

The drains shall be constructed neatly to the dimensions shown on the drawings and within the specified dimensional and alignment tolerances.

Repairs to drains shall be in uniformity with existing structures.

CB 04.04.03 Materials

(a) Concrete

Concrete for the various structural components shall comply with the class detailed on the drawings. Concrete in channel linings shall be class 20/19.

(b) Steel reinforcement

(i) Steel bars

Steel reinforcing bars shall comply with the requirements of SABS 920.

(ii) Welded steel mesh

Welded steel mesh shall comply with the requirements of SABS 1024.

CB 04.05 **CLEARING OF CONCRETE DRAINS AND CHANNELS**

This section covers the work in connection with the removal of silt, debris and vegetation causing obstruction to flow in concrete drains and channels.

CB 04.05.01 **Construction**

Concrete channels shall be cleaned where instructed by the Engineer. Generally, channels shall be cleaned when depth of silt in invert exceeds 100 mm, or when other foreign matter is present.

Material removed from channels shall either be loaded and removed from the site or disposed of adjacent to channels where it cannot be washed back into the channel as directed by the Engineer.

Where material is spoiled adjacent to channels the Contractor shall ensure that the material is spread neatly and well clear of the top of the channels where it will not wash back. Material removed from kerb and channel combinations, side drains or from other channels where directed by the Engineer shall be transported to spoil.

Vegetation growing in channel joints and cracks shall be removed with roots to prevent regrowth.

Vegetation growing over channels from the edges shall be slashed at the concrete edges and disposed of. Undesirable vegetation shall be removed with roots and spoiled where directed by the Engineer.

CB 04.05.02 **Quality standard**

Concrete drainage channels shall be clear of any obstruction such that the concrete surfaces are clearly visible.

CB 04.06 **CLEANING OF EARTH CHANNELS**

This section covers the work involved in cleaning of all earth drains and channels, repairs to damaged earth drains and channels, as well as construction and repairs of banks and dykes.

CB 04.06.01 **Execution of work**

(a) Drains

Earth side drains and channels shall be cleaned of all debris, silt and vegetation when instructed by the Engineer.

Silt and debris excavated from the drains shall be deposited and spread neatly in close proximity of the drains where it will not wash back.

Scoured and eroded sections of drains shall be backfilled with suitable material obtained from the side of the road or from suitable sources indicated by the

Engineer. The backfill material shall be compacted at the optimum uniform moisture content in layers not exceeding 100 mm after compaction. The Contractor shall use suitable compaction equipment to produce repairs that will not erode or scour again.

If in the opinion of the Engineer drains require protective covering against scouring and erosion, such work shall be executed in accordance with the relevant section of this specification.

(b) Construction and repair of banks and dykes

Material for the construction and repair of banks and dykes shall be an approved soil or gravel obtained from sources approved by the Engineer. It shall be positioned in such a way that water will flow on the natural ground and against the bank.

Banks and dykes shall be properly compacted in layers not exceeding 150 mm in thickness. If approved by the Engineer, mitre banks may also be constructed of hand-packed stone, provided that the interstices are filled with an approved cohesive soil.

CB 04.06.02 Quality standard

Drainage channels shall be clear of any obstructions and no scouring, erosion or pooling shall be evident.

Existing fill and cut slopes and invert grades of drains shall be maintained.

CB 04.07 CONSTRUCTION AND REPAIR OF BRICKWORK INLET STRUCTURES

CB 04.07.01 Reinstatement of damaged existing structures

Damaged existing structures shall be demolished to the extent indicated by the Engineer on site and the resulting debris spoiled.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

CB 04.07.02 Lowering of inlet structures

Existing structures which are not functional due to the inlet being above the surrounding pavement level or ground level shall be demolished to the extent indicated by the Engineer and reinstated at the correct level to the same standard prescribed for new construction.

CB 04.08 PROVISION OF LOCKABLE STORMWATER GRID INLETS

Stormwater inlet structures within the prison walls shall be provided with lockable grids. These shall be in the form of a steel bar secured to the base of the catch pit and long enough to just protrude through the inlet grid. There shall be a hole in the end of the bar to allow a padlock to be positioned such that the grid will be immovable.

The steel bar shall be treated to avoid corrosion.

Padlocks shall be provided for all grid inlets. They shall be of a type suitable for outdoor use, or as specified in the Project Specifications.

CB 04.09 **CLEANING OF PIPELINES**

The work under this section involves the removal of silt and debris from pipelines, including the cleaning of inlet and outlet structures.

CB 04.09.01 **Construction**

Before cleaning any pipelines, the Contractor shall arrange with the Engineer for an inspection of the stormwater network. The Contractor shall provide adequate equipment such as torches, lights, mirrors and TV surveillance equipment, etc, to enable a basic visual inspection of all pipes. Based on this inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning and where detailed inspections are required.

Material removed from the pipes shall be disposed of where instructed by the Engineer. Rubble and waste material shall be disposed of at the nearest appropriate solid waste disposal site, unless directed otherwise by the Engineer.

The Contractor shall ensure that all material is removed at the nearest accessible structure. No additional payment will be made for the removal of material from previously cleaned sections of the network.

CB 04.09.02 **Quality standard**

Pipes shall be cleaned of all silt and debris.

All spoil material shall be spread neatly to ensure that it will not return to the drainage trenches.

The pipe sizes for the different categories will be determined by diameter.

CB 05 **MAINTENANCE**

This specification must be read in conjunction with Additional Specification: General Maintenance.

All components of the stormwater drainage infrastructure, including surface as well as underground components, shall be maintained during the maintenance phase of the Contract.

The scope of the maintenance work for the stormwater drainage infrastructure comprises the following:

- (i) Maintenance of approximately 26 m of pre-cast pipes, culverts and associated stormwater structures.
- (ii) Maintenance of all lined channels and earth side drains of varying sizes.

The above description of the stormwater drainage infrastructure to be maintained is not necessarily complete and shall not limit the maintenance work to be carried out by the Contractor under this contract.

Maintenance shall include all repair work, replacing of components, fixing of defects, cleaning, or any other actions or rectifying measures necessary for complete and safe functioning of the stormwater drainage infrastructure.

Maintenance on the stormwater drainage infrastructure shall also include all other actions related to maintenance, such as temporary drainage features and temporary accommodation of traffic.

Remuneration for maintenance of the stormwater drainage infrastructure shall be deemed included in the tendered monthly payment for maintenance thereof and shall be paid as detailed in Additional Specification SA: General Maintenance.

CB 05.01 STORMWATER DRAINAGE SYSTEM

Routine maintenance on the stormwater drainage system shall be done as described in table CB 05.01/1.

TABLE CB 05.01/1

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation.	Monthly
2	Check, inspect, repair or replace all manhole or inlet covers, grids and frames and builder's work to manholes.	Four-monthly
3	Check, inspect and repair manhole and inlet benching.	Four-monthly
4	Check, inspect, report and unblock any blockage that occurs.	Monthly

CB 06 MEASUREMENT AND PAYMENT

CB.01 PREFABRICATED CULVERT INSTALLATION AND REPAIR OF EXISTING CULVERTS AND STRUCTURES

CB.01.01 Excavation:

- (a) Excavation of soft material within the following depth ranges below the surface level:
 - (i) 0 m up to and including 1,5 mUnit: cubic metre (m³)
 - (ii) Exceeding 1,5 m up to and including 3,0 mUnit: cubic metre (m³)
 - (iii) Exceeding 3,0 m up to and including 4,5 mUnit: cubic metre (m³)
 - (iv) Etc in increments of 1,5 m
- (b) Excavating hard material irrespective of depthUnit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated within the specified dimensions, authorised by the Engineer in each case. Excavation in excess of widths specified or authorised shall not be measured for payment.

Irrespective of the total depth of the excavation, the quantity of material in each depth range shall be measured separately.

When measuring excavation for the removal of existing culverts, the volume occupied by the culvert shall not be subtracted from the calculated volume of excavation.

The tendered rates shall include full compensation for all excavation (including around structures), levelling, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the culvert beds, the disposal of unstable material unsuitable for backfilling, keeping the excavation safe, dealing with any surface or subsurface water and for any other operations necessary for completing the work as specified.

Payment shall distinguish between soft and hard material.

CB.01.02 Backfilling and reinstatement of pavement layers:

- (a) In-situ fill or cut material compacted to 90% of modified AASHTO density.....Unit: cubic metre (m³)
- (b) Selected layers compacted to 93% of modified AASHTO density.....Unit: cubic metre (m³)
- (c) Cement stabilized subbase layer compacted to 95% of modified AASHTO density.....Unit: cubic metre (m³)

The unit of measurement for CB.01.02(a) and (b) shall be the cubic metre of gravel material placed and compacted according to authorised dimensions on drawings.

The unit of measurement for CB.01.02(c) shall be the cubic metre of stabilized material placed and compacted according to authorised dimensions.

The tendered rates shall include full compensation for procuring and furnishing, placing, compaction and finishing of materials, labour, tools and equipment for executing the work to the satisfaction of the Engineer.

CB.01.03 Prefabricated culverts:

- (a) On class A bedding (type and diameter indicated) Unit: metre (m)
- (b) On class B bedding (type and diameter indicated) Unit: metre (m)
- (c) Portal culverts with prefabricated floor slabs (type and size indicated) Unit: metre (m)

The unit of measurement for prefabricated culverts shall be the metre of culvert laid. The length shall be measured along the soffit of the culvert.

The tendered rates shall include full compensation for providing, testing, loading, transporting and unloading the culverts, for providing and placing the bedding material where required, and for the installation, laying and jointing of the culverts as specified including cutting them on the site and removing any waste.

CB.01.04 Cast in-situ concrete and formwork in stormwater structures:

- (a) Class 20 concreteUnit: cubic metre (m³)
- (b) Class 25 concreteUnit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete in place. Quantities shall be calculated from the dimensions shown on the drawings or as authorised.

The tendered rates shall include full compensation for procuring and furnishing all the materials, storing the materials, providing all plant, mixing, transporting, placing and compacting the concrete, forming the inserts, construction joints and contraction joints, curing and protecting the concrete, repairing defective surfaces and finishing the concrete surface as specified.

CB.01.05 Replacement of manhole covers, grid inlets, etc

- (a) SABS 558 Type 4 - covers, grids, etc:
 - (i) Maximum dimension up to and including 300 mm Unit: number
 - (ii) Maximum dimension 301 mm to 600 mm Unit: number
 - (iii) Maximum dimension 601 mm to 900 mm Unit: number
 - (iv) Maximum dimension over 900 mm Unit: number
- (b) SABS 558 Type 4 - frames only for covers, grids, etc:
 - (i) Maximum dimension up to and including 300 mm Unit: number
 - (ii) Maximum dimension 301 mm to 600 mm Unit: number
 - (iii) Maximum dimension 601 mm to 900 mm Unit: number
 - (iv) Maximum dimension over 900 mm Unit: number
- (c) SABS 558 Type 2A - covers, grids, etc:
 - (i) Maximum dimension up to and including 300 mm Unit: number
 - (ii) Maximum dimension 301 mm to 600 mm Unit: number
 - (iii) Maximum dimension 601 mm to 900 mm Unit: number
 - (iv) Maximum dimension over 900 mm Unit: number
- (d) SABS 558 Type 2A - frames only for covers, grids, etc:
 - (i) Maximum dimension up to and including 300 mm Unit: number
 - (ii) Maximum dimension 301 mm to 600 mm Unit: number
 - (iii) Maximum dimension 601 mm to 900 mm Unit: number
 - (iv) Maximum dimension over 900 mm Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames.

CB.02 CLEANING OF PREFABRICATED CULVERTS

CB.02.01 Cleaning of prefabricated culverts and inlet structures (average depth of material removed not more than 100 mm):

- (a) Prefabricated concrete pipes and portal culverts:
 - (i) Up to and including 500 mm Unit: metre (m)
 - (ii) 501 mm to 750 mm Unit: metre (m)

- (iii) 751 mm to 950 mm Unit: metre (m)
- (iv) 951 mm to 1250 mm Unit: metre (m)
- (v) 1251 mm to 1500 mm Unit: metre (m)
- (vi) 1501 mm to 2100 mm Unit: metre (m)

(b) Prefabricated corrugated metal culverts:

- (i) Up to and including 500 mm..... Unit: metre (m)
- (ii) 501 mm to 750 mm Unit: metre (m)
- (iii) 751 mm to 950 mm Unit: metre (m)
- (iv) 951 mm to 1250 mm Unit: metre (m)
- (v) 1251 mm to 1500 mm Unit: metre (m)
- (vi) 1501 mm to 2100 mm Unit: metre (m)

The unit of measurement shall be the metre of culvert cleaned (depth of material removed is on average not more than 100 mm), measured once along the soffit of the culvert. For multiple culverts each individual culvert shall be measured separately.

The tendered rates shall include full compensation for removing the material, for disposing of the material in an appropriate manner and ensuring that the material will not wash into drainage trenches.

CB.02.02

Cleaning of prefabricated culvert and inlet and outlet structures (average depth of material removed is more than 100 mm):

(a) Prefabricated concrete pipes and portal culverts:

- (i) Up to and including 500 mm..... Unit: metre (m³)
- (ii) 501 mm to 750 mm Unit: metre (m³)
- (iii) 751 mm to 950 mm Unit: metre (m³)
- (iv) 951 mm to 1250 mm Unit: metre (m³)
- (v) 1251 mm to 1500 mm Unit: metre (m³)
- (vi) 1501 mm to 2100 mm Unit: metre (m³)

(b) Prefabricated corrugated metal culverts:

- (i) Up to and including 500 mm..... Unit: metre (m³)
- (ii) 501 mm to 750 mm Unit: metre (m³)
- (iii) 751 mm to 950 mm Unit: metre (m³)
- (iv) 951 mm to 1250 mm Unit: metre (m³)
- (v) 1251 mm to 1500 mm Unit: metre (m³)
- (vi) 1501 mm to 2100 mm Unit: metre (m³)

The unit of measurement shall be the cubic metre of material removed (depth of material removed is on average more than 100 mm). The quantity of material to be removed shall be measured in place for each individual culvert.

The tendered rates shall include full compensation for removing the material from the culvert, for loading the material onto trucks, for transporting the material within a free-haul distance of 1,0 km and for spoiling the material as specified.

CB.02.03 Provision of equipment for visual inspection of underground culvert network..... Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as torches, lights and mirrors, etc, to enable a basic visual inspection of the culvert network.

CB.02.04 Visual inspection of underground culvert network..... Unit: metre (m)

The tendered rate shall include full compensation for all processes necessary to complete a thorough check of the culvert network, including lifting and replacing manhole covers, using relevant equipment and any clearing necessary to allow the visual inspection to proceed.

CB.03 CONCRETE CONSTRUCTION AND REPAIR

CB.03.01 Excavation:

(a) For open drains:

- (i) Soft materialUnit: cubic metre (m³)
- (ii) Hard material.....Unit: cubic metre (m³)

(b) For half-round channels and kerbing and channeling:

- (i) Soft materialUnit: cubic metre (m³)
- (ii) Hard material.....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated in accordance with the authorised dimensions measured in place.

The tendered rates shall include full compensation for all plant, labour and tools necessary for excavating the material to the required dimensions, including trimming the excavation before placing concrete, disposing of the material from the site.

CB.03.02 Cast in-situ concrete:

- (a) Linings (class indicated)Unit: cubic metre (m³)
- (b) Half-round channels.....Unit: cubic metre (m³)
- (c) Channels for kerb and channel (class indicated).....Unit: cubic metre (m³)
- (d) Speed humps (class indicated)Unit: cubic metre (m³)
- (e) Inlet cover slabs (class indicated).....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete placed in situ. The quantity shall be calculated in accordance with the authorised dimensions.

The tendered rates shall include full compensation for procuring and furnishing all material and for all work necessary for mixing, placing and finishing the concrete to the authorised dimensions, including providing and erecting of formwork, for sawing of asphalt layers and for providing expansion and contraction joints as included on drawings or as instructed by the Engineer.

CB.03.03 Backfill below channelsUnit: cubic metre (m³)

The unit of measurement shall be the cubic metre of backfill as may be instructed by the Engineer to be placed below channels.

The tendered rate shall include full compensation for furnishing, procuring, placing and compacting concrete.

CB.03.04 Precast concrete kerbing:

(a) Supply and install (type indicated) Unit: metre (m)

(b) Install only (type indicated)..... Unit: metre (m)

The unit of measurement shall be the metre of precast kerbing complete as constructed, measured along the face of the kerb.

The tendered rate for CB.03.04(a) shall include full compensation for preparing of bedding, furnishing and installing all materials and supporting the kerb with in situ concrete, for backfilling behind kerbs, all complete as specified.

The tendered rate for CB.03.04(b) shall include full compensation for preparing of bedding, furnishing and installing all materials and reinstalling existing kerbing, all complete as specified.

CB.03.05 Steel reinforcement:

(a) Mild steel bars.....Unit: ton (t)

(b) High-tensile steel barsUnit: ton (t)

(c) Welded steel mesh Unit: kilogram (kg)

The unit of measurement for steel bars shall be the ton of reinforcing, and kilogram of welded steel in place in accordance with the drawings or as authorised. Ties, stools and other steel used for positioning the reinforcing steel shall be measured as steel reinforcement.

The tendered rate shall include full compensation for supplying, delivering, cutting, bending, welding, trial weld joints, placing and fixing the steel reinforcement including all tying wire, spacers and waste.

CB.03.06 Sealed joints in concrete lining open drains (type indicated) Unit: metre (m)

The unit of measurement shall be the metre of completed joint of each size and type.

The tendered rate shall include full compensation for supplying all material and for all labour, tools, formwork and incidentals necessary for sealing the joint as shown on the drawings or specified in the Project Specifications.

CB.03.07 Demolition and removal of damaged existing structures:

- (a) Plain concreteUnit: cubic metre (m³)
- (b) Reinforced concreteUnit: cubic metre (m³)
- (c) Kerbing and channeling Unit: metre (m)
- (d) Half-round channels..... Unit: metre (m)

The unit of measurement for CB.03.07(a) and (b) shall be the cubic metre of existing material demolished, determined from 70% of the rated cubic metre capacity of the truck used to remove the material.

The unit of measurement for CB.03.07 (c) and (d) shall be the metre length of kerbing and channeling or half-round channels removed.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material from the site.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

CB.03.08 Concrete side beams.....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of concrete in side beams constructed as instructed.

The tendered rate shall include full compensation for furnishing all material and labour including formwork as necessary, placing concrete and shaping all surfaces and all excavations required.

CB.03.09 Overhaul on material for haul in excess of 1,0 km:

- (a) Excavated material to spoil.....Unit: cubic metre kilometer (m³-km)
- (b) Existing structures demolished.....Unit: cubic metre kilometer (m³-km)

The unit of measurement shall be the cubic metre of loose material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

CB.04 CLEANING OF CONCRETE DRAINS AND CHANNELS

CB.04.01 Cleaning of concrete drainage channels:

- (a) Remove material and load for spoil:
 - (i) Channels in kerbing-channeling combinations and side drains Unit: metre (m)
 - (ii) Other drains and channels within the following invert width ranges:
 - (1) Less than 1,0 m Unit: metre (m)
 - (2) 1,0 m up to and including 2,0 m Unit: metre (m)

- (3) Exceeding 2,0 m up to and including 3,0 m Unit: metre (m)
- (4) Exceeding 3,0 m Unit: metre (m)

(b) Remove material and dispose of adjacent to channels:

- (i) Channels in kerbing-channeling combinations and side drains Unit: metre (m)
- (ii) Other drains and channels within the following invert width ranges:
 - (1) Less than 1,0 m..... Unit: metre (m)
 - (2) 1,0 m up to and including 2,0 m Unit: metre (m)
 - (3) Exceeding 2,0 m up to and including 3,0 m Unit: metre (m)
 - (4) Exceeding 3,0 m Unit: metre (m)

The unit of measurement shall be the metre of channel cleaned, measured once along the invert of the channel.

The tendered rates shall include full compensation for all labour and equipment required for removing the material from channels irrespective of the depth of silt and debris and for loading, off-loading and spreading when material removed is intended for spoiling at designated spoil sites. The tendered rates shall also include full compensation for the removal of vegetation in channels and growing over the edges of channels.

The tendered rates shall also include for transporting the excavated material to spoil sites.

Where material is disposed of adjacent to the channels, the tendered rate shall include full compensation for removing the material from the channels, irrespective of the depth of silt and debris, spoiling and spreading the material adjacent to the channel where it cannot be washed back in to the channel.

CB.04.02 **Overhaul of material hauled in excess of the free-haul distance of 1,0 km**.....Unit: cubic metre kilometer (m³-km)

The unit of measurement shall be the cubic metre of material hauled to spoil, the volume to be determined from the rated capacity of the truck multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material the average overhaul distance to the designated spoil site.

CB.05 **CLEANING AND MAINTENANCE OF EXISTING EARTH CHANNELS**

CB.05.01 **Cleaning earth drains and channels**Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material cleaned out of the drain.

The tendered rate shall include full compensation for all labour and equipment required for removing the obstruction from drains, irrespective of depth of silt and debris and disposal of the excavated material as described.

CB.05.02 Repairing of earth drains and channelsUnit: cubic metre (m³)

The unit of measurement shall be the cubic metre of compacted material calculated from the dimensions measured in place.

The tendered rate shall include full compensation for trimming the eroded area to firm surrounding material, for procuring, transporting placing and compacting the backfill material.

CB.05.03 Banks and dykes.....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of in place in banks or dykes, calculated in accordance with authorised dimensions.

The tendered rate shall include full compensation for procuring, transporting furnishing, placing, watering, compacting, shaping and trimming of material in the banks and dykes.

CB.05.04 Cleaning of vegetation at inlet and outlet structures (5 m x 5 m) Unit: square metre (m²)

The unit of measurement shall be the area measured in square metres, cleared of all vegetation blocking the inlet and outlet structures.

The tendered rate shall include for labour, clearing of vegetation, removing to spoil of vegetation and tools to complete the work to the approval of the Engineer.

CB.05.05 Overhaul of material in excess of the free-haul distance of 1,0 kmUnit: cubic metre kilometre (m³-km)

The unit of measurement shall be the cubic metre of imported material, nett volume of material compacted in place, multiplied by the average overhaul distance in excess of 1,0 km.

The tendered rate shall include full compensation for hauling the material the distance from the designated source in excess of 1,0 km.

CB 06 REPAIR AND CONSTRUCTION TO EXISTING BRICKWORK INLETS

CB.06.01 Demolition and removal of existing structuresUnit: cubic metre (m³)

The unit of measurement shall be the cubic metre of existing material demolished. The tendered rates shall include full compensation for all labour, equipment and slabs for the removal of the section, trimming the bedding and for loading, transporting and disposing of the material from the site.

CB 06.02 Repair of brickwork inlet structures Unit: number

The unit of measurement shall be the number of inlet structures repaired.

The tendered rate shall include full compensation for furnishing all material and labour necessary for restoring the inlet structure to an as new state.

CB.06.03 Reconstruction of brickwork inlet structures Unit: number

The unit of measurement shall be the number of inlet structures completely rebuilt.

The tendered rate shall include full compensation for furnishing all material and labour necessary for rebuilding the inlet structure to a complete state.

CB.07 LOCKABLE GRID INLETS

CB.07.01 Provision of lockable grid inlets.....Unit: number

The unit of measurement shall be the number of grid inlets fitted with a steel bar suitable for locking the inlet cover down.

The tendered rate shall include full compensation for all labour, equipment and tools, rust protection and any other function necessary for the secure installation of the bar.

CB.07.02 Provision of padlocks.....Unit: number

The unit of measurement shall be the number of padlocks provided for lockable grid inlets.

The tendered rate shall include purchasing and installation of all padlocks, as well as providing a full set of labelled keys to the User Client.

CB 08 CLEANING OF PIPELINES

CB.08.01 Cleaning of pipes and inlet structures (average depth of material removed not exceeding 100 mm):

- (a) Up to and including 300 mm Unit: metre (m)
- (b) Exceeding 300 mm up to and including 450 mm..... Unit: metre (m)
- (c) Exceeding 450 mm up to and including 600 mm..... Unit: metre (m)
- (d) Exceeding 600 mm up to and including 800 mm..... Unit: metre (m)
- (e) Exceeding 800 mm up to and including 1000 mm..... Unit: metre (m)

The unit of measurement shall be the metre of pipe cleaned, (depth of material removed is on average not more than 100 mm) measured once along the soffit of the pipe. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for removing the material, for disposing of the material in an appropriate manner and ensuring that the material will not wash into drainage trenches.

CB.08.02 Cleaning of pipes and inlet and outlet structures (average depth of material removed exceeding 100 mm):

- (a) Up to and including 300 mm Unit: metre (m³)
- (b) Exceeding 300 mm up to and including 450 mm..... Unit: metre (m³)
- (c) Exceeding 450 mm up to and including 600 mm..... Unit: metre (m³)
- (d) Exceeding 600 mm up to and including 800 mm..... Unit: metre (m³)
- (e) Exceeding 800 mm up to and including 1000 mm..... Unit: metre (m³)

The unit of measurement shall be the cubic metre of material removed (depth of material removed is on average more than 100 mm). The quantity of material to be removed shall be measured in place for each individual pipe.

The tendered rates shall include full compensation for removing the material from the pipe for loading the material onto trucks and for transporting the material from the site.

CB.08.03 **Overhaul of material hauled in excess of 1,0 km free-haul distance**Unit: cubic metre kilometre (m³-km)

The unit of measurement shall be the cubic metre of material hauled to spoil in excess of the free-haul distance of 1,0 km, the volume to be determined from the rated capacity of the truck, multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

CB.08.04 **Provision of equipment for visual inspection of underground pipe network** Unit: sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as torches, lights and TV surveillance equipment, etc, to enable a basic visual inspection of the pipe network.

CB.08.05 **Visual inspection of underground pipe network** Unit: metre (m)

The tendered rate shall include full compensation for all processes necessary to complete a thorough check of the stormwater network including lifting and replacing manhole covers and inlet covers, using relevant equipment and any clearing necessary to allow the visual inspection to proceed.

TECHNICAL SPECIFICATION

CC FENCING AND GATES

CONTENTS

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CC 06	MATERIALS
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CC 08	MEASUREMENT AND PAYMENT

CC 01 SCOPE

This specification covers the repair and maintenance of fencing and gates.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CC: Fencing and gates, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

CC 02 STANDARD SPECIFICATIONS

CC 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SABS 763 - Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire) (1988)
- SABS 675 - Zinc-coated fencing wires (plain and barbed) (1993)
- SABS 1373 - Chain-link fencing and its wire accessories (1983)

CC 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CC 02.03 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CC 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CC 03 **OPERATING AND MAINTENANCE MANUALS**

No operation and maintenance manuals will be required for fencing and gates.

The Contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CC 04 **EXECUTION OF WORK**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

Any fencing work identified either by the Contractor or during inspection by the Engineer shall be carried out on the instruction of the Engineer.

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to maintain the prison fence in a state of good repair.

The Engineer shall indicate where new fences are to be erected, or where repairs are necessary.

Wherever an opening has been made in the fence while repairing it, the area shall be guarded by a guard of the User Client. Under no circumstances shall a fence be left open or unattended at any time. Whenever a part of the fence is taken down to repair/replace it, it will be replaced within the same day it has been taken down.

Unless otherwise instructed by the Engineer, similar type fencing material to that in the existing fence line shall be used where fences are to be repaired.

CC 04.01 **SCOPE OF WORK**

The scope of work has been divided into the following sections:

- (a) Perimeter fences at the various sites;
- (b) Residential fences of the residential areas, and
- (c) Other internal fences at the various sites.

CC 04.02 **CLEARING THE FENCE ROUTE**

The fence route shall be cleared over a width of at least 0,5 m on each side of the centre line of the fence and surface irregularities shall be levelled so that the fence will follow the general contour of the ground.

The bottom of the fence shall be located at a uniform distance above the ground line, but no more than 50 mm.

CC 04.03 **INSTALLATION OF POSTS AND STANDARDS**

Posts shall be accurately set in holes and be provided with concrete bases to the dimensions specified.

Holes shall be dug to their full specified depth.

Posts shall be firmly planted into the ground at the same spacing as the existing posts or as instructed by the Engineer. The spacing of posts between any two straining posts shall be uniform.

CC 04.04 **ERECTING FENCE WIRES**

All fencing wire shall be wired to the sides of posts in order to prevent the wires from being displaced or becoming loose. The wire shall be carefully strained and hung without sag, and with true alignment, care being exercised not to strain the wire so tightly that it will break or that end, corner, straining or gate posts will be pulled up.

Each strand of fencing wire shall be securely fastened in the correct position to each post with soft galvanised binding wire.

Splices in the fencing wire shall be permitted if made in the following manner using a splice tool. The end of each wire at the splice shall be carried at least 75 mm past the splice tool and wrapped snugly around the other wire for not less than six complete turns, the two separate wire ends being turned in opposite directions. After the splice tool is removed the space left by it in the splice wire shall be closed by pulling the wire ends together. The unused ends of wire shall be cut close so as to leave a neat splice.

CC 04.05 **ERECTING DIAMOND MESH OR WIRE NETTING**

Wire netting or diamond mesh shall be stretched against the fence and properly secured to the fencing wire. The diamond mesh or wire netting shall be secured by means of soft binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires unless otherwise specified.

CC 04.06 **CLOSING OPENINGS UNDER FENCES**

At ditches, drainage channels or other hollows where it is not possible to erect the fence so that it follows the general contour of the ground, the Contractor shall cover the openings with wire netting or diamond mesh fixed to the fence.

CC 04.07 **EXISTING FENCES**

Where a new fence joins an existing fence, whether in line or at an angle, the new fence shall be erected with a new straining post positioned at the terminal of the existing fence.

CC 04.08 **GATES**

Gates shall be hung on gate fittings in accordance with the requirements specified. The gates shall be so erected that they swing in a horizontal plane at right angles to the gateposts, clear of the ground in all positions.

Double swing gates shall not leave a gap of more than 25 mm between them when closed and other gates shall not be further than 25 mm from the gate-post when closed. The clearance below the gates shall not exceed 75 mm with the gates closed.

CC 04.09 **REPAIRS TO FENCES**

In the case of fences that require repairing, the Contractor shall use new material as may be required to re-erect the fence to the standard specified.

CC 04.10 **ERECTING NEW FENCING MATERIAL**

All new material used to replace old material shall be similar to the old material replaced unless a new material is specified by the Engineer.

CC 05 **QUALITY STANDARD**

The completed fences shall be plumb, taut, true to line and ground contour, with all posts, standard and stays firmly set.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or netting so as not to create a hazard to grazing animals or a nuisance to the owners of the ground.

CC 06 **MATERIALS**

CC 06.01 **POSTS**

CC 06.01.01 **Steel posts**

New posts or posts that need to be replaced shall be of the same type and size as the existing posts. Tubular posts shall be galvanised in accordance with SABS 763 for Class B1 articles or shall be painted as specified and have a minimum wall thickness of 2,00 mm.

Tubular stays shall have a minimal bore of at least 60 mm and a wall thickness of at least 2,00 mm. These stays shall be galvanised as specified In SABS 763 or shall be painted as specified.

CC 06.01.02 **Wooden posts**

New posts or posts that need to be replaced shall be of the same type and size as the existing posts. Wooden posts shall be treated in accordance with SABS 457 (Hazard class H4 articles), or as specified and shall have a minimum diameter of 50 mm.

CC 06.02 **WIRE****CC 06.02.01** **Barbed wire**

Barbed wire shall comply with the requirements of SABS 675 and shall be one or more of the following types:

- (a) High-tensile grade, oval shaped, single-strand wire, 3,15 mm x 2,50 mm (2,81 mm equivalent diameter), and fully galvanised;
- (b) High-tensile grade, oval shaped, single-strand wire, 2,80 mm x 1,90 mm (2,31 mm equivalent diameter), fully galvanised (first class coating). This wire shall not be used less than 500 mm above ground where there is danger of grass fires;
- (c) Mild-steel grade, double strand, unidirectional twist wire, each strand 2,50 mm diameter, for use at any height above ground. The wire shall be fully galvanised;
- (d) Barbs shall be manufactured from 2,0 mm galvanised wire and shall be spaced at not more than 152 mm.

CC 06.02.02 **Barbed tape coil**

Barbed tape coil shall comply with the requirements for type A in CKS 592 and shall consist of close-coiled, high-tensile wire with a continuous strip of flat steel barbs (barbed tape) crimped to the wire along the entire length of the wire.

The high-tensile wire shall be Class B galvanized. The barbed tape shall be made of cold-roller carbon steel and galvanized to Class 2450.

CC 06.02.03 **Smooth wire**

Smooth wire shall comply with the requirements of SABS 675 and shall be of the types specified below:

- (a) Straining wire shall be 4,0 mm diameter and fully galvanised.
- (b) Fencing wire shall be high-tensile grade, 2,24 mm diameter wire fully galvanised.
- (c) Tying wire shall be 2,50 mm diameter, mild steel, galvanised wire for tying fencing wire to standards and droppers, and 1,60 mm diameter, mild steel, galvanised wire for typing netting and mesh wire to fencing wire.

CC 06.03 **DIAMOND MESH**

- (a) Diamond mesh (chain-link) fencing shall comply with the requirements of SABS 1373. The edge finish shall be both sides clinched or barbed.
- (b) The nominal diameter of the wire shall be 2,5 mm and the mesh size shall be 64 x 64 mm.
- (c) The wire shall be fully galvanised.

CC 06.04 **WELDED MESH**

Wire netting shall be fully galvanised with mild steel wire with a minimum diameter of 1,8 mm and 75 mm mesh.

CC 06.05 **MANUFACTURING TOLERANCES FOR WIRE**

The actual diameter of wire supplied shall nowhere be less than the specified diameter by more than the following tolerances:

Specified diameter	Tolerance
1,00 - 1,8 mm	0,05 mm
2,00 - 2,8 mm	0,08 mm
3,15 - 4,0 mm	0,10 mm

CC 06.06 **GATES**

New gates or gates that need to be replaced shall be the same type and size as existing gates. Gates shall be galvanised in accordance with SABS 763 for class B1 articles or shall be painted as specified.

CC 07 **MAINTENANCE**

This specification must be read in conjunction with Additional Specification: General Maintenance.

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the installation. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the *completed* installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

Maintenance implies and shall include monthly maintenance on all components of the specified installation. This shall include keeping the installation free of litter and any growth or any other element interfering with the function or integrity of the system, 0,5m wide on each side of the fence.

CC 08 **MEASUREMENT AND PAYMENT**

CC.01 **CLEARING FENCE ROUTE 1 m WIDE STRIP** Unit: metre (m)

The unit of measurement for the clearing of the fence route shall be the metre of fence line measured along each fence line.

The tendered rate shall include full compensation for the clearing of the fence line as specified, including the removal of stones and other obstructions and the disposal as directed of all material resulting from clearing operations.

CC.02 **SUPPLY AND ERECTION OF NEW FENCING MATERIAL TO REPLACE OLD MATERIAL:**

(a) Barbed wire Unit: metre (m)

- (b) Smooth wire Unit: metre (m)
- (c) Diamond mesh..... Unit: metre (m)
- (d) Wire netting..... Unit: metre (m)
- (e) Barbed tape coil..... Unit: metre (m)
- (f) Posts.....Unit: number
- (g) GatesUnit: number
- (h) Y-standards.....Unit: number

The quantity of material used shall be determined by measuring the quantities of individual items of material installed in the completed fence. Clearing of the fence line will be paid for under item CC.01. Removal and disposing of the existing fencing material shall be deemed included in the rate for new material.

The applicable units of measurement are as follows:

- (a) Fencing wire and basked tape coil

The unit of measurement shall be the metre of each type of fencing wire measured in place and between end posts. Binding wire and wire used for bracing and anchoring of posts shall not be measured for payment. Barbed tape coil shall not be measured along the coiled wire but also between end posts.

- (b) Diamond mesh and wire netting

The unit of measurement shall be the square metre of diamond mesh or wire netting and the quantity shall be calculated using the prescribed width and the length between straining posts or gate posts, or the length of strips for covering openings under fences, or the length used for the covering of gates.

- (c) Posts

The unit of measurement shall be the number of posts, as follows:

All straining posts erected in accordance with the maximum specified spacing or such lesser spacing as authorised by the Engineer, all corner and gateposts authorised by the Engineer and all end posts. Gate posts for new gates shall not be measured for payment.

- (d) Gates

The unit of measurement shall be the number of each type of gate repaired or replaced.

CC.03 REPAIR OF FENCES Unit: metre (m)

The unit of measurement shall be the metre of each type of existing fence repaired as instructed by the Engineer.

The tendered rate shall include full compensation for all overheads and transporting all labour, tools and materials from the Contractor's base to the point of repair.

Repair work shall imply minor repairs, tightening the fence and patching damaged areas. The tendered rate shall also include full compensation for all labour, tools, binding and tying wire and patching material for repairing the fence.

CC.04 REDRESS, TREAT AND PAINTING OF FENCE Unit: metre (m)

The unit of measurement for the redressing (tightening, repairing and patching), treating and painting the fence line shall be the metre of fence line measured along each fence line.

The tendered rate shall include full compensation for performing minor repairs, tightening the fence, patching damaged areas, treating the existing fence with an approved rust remover/inhibitor and then applying cold galvanising as specified by the Engineer.

CC.05 TREATING AND PAINTING OF POLES..... Unit: metre (m)

The unit of measurement for the treating and painting of poles shall be the metre of pole as instructed by the Engineer.

(a) For steel posts

The tendered rate shall include full compensation for treating the existing poles with an approved **rust remover/inhibitor** and the applying **cold galvanising** as specified by the Engineer.

(b) For timber posts

The tendered rate shall include full compensation for treating the existing poles with approved **timber treatment paint** in accordance with SABS 457 such as carbolineum treatment as specified by the Engineer

TECHNICAL SPECIFICATION**CE WATER DISTRIBUTION NETWORKS****CONTENTS**

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CE 06	QUALITY ASSURANCE SYSTEM
CE 07	MAINTENANCE TO INSTALLATION SYSTEMS AND REPAIR WORK
CE 08	MEASUREMENT AND PAYMENT

CE 01 SCOPE

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of existing water distribution networks. Such distribution networks may comprise:

- (a) Primary and secondary distribution pipelines
- (b) Valves
- (c) Bulk water meters
- (d) Domestic water meters
- (e) Chambers
- (f) Pumping stations
- (g) Borehole installations
- (h) Reservoirs.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CE: Water distribution networks, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

CE 02 STANDARD SPECIFICATIONS**CE 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- | | | |
|--------------|---|----------------------------|
| SABS 1200 D | - | Earthworks |
| SABS 1200 DB | - | Earthworks (pipe trenches) |
| SABS 1200 G | - | Concrete (structural) |
| SABS 1200 L | - | Medium-pressure pipelines |
| SABS 1200 LB | - | Bedding (pipes) |

CE 02.02 **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CE 02.03 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CE 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CE 03 **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance manuals.

CE 04 **EXECUTION OF REPAIR WORK**

CE 04.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance Contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over if the satisfaction of the Engineer has been obtained.

Repair work items for the water distribution systems shall be categorised under the following headings:

- (a) Repair of existing pipelines
- (b) Cleaning of existing pipelines
- (c) Repair of fittings
- (d) Repair of existing structures.

CE 04.02 REPAIR OF EXISTING PIPELINES

This section covers the requirements for the repair of the water distribution pipelines for defects such as pipe breaks and leakage for distribution pipelines.

CE 04.02.01 General

Repair work to the water distribution system is detailed in the Particular Specification and may include but not be limited to the following:

- (a) Replacement of damaged, broken, leaking, corroded surface and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing manhole covers and frames;
- (c) Repair work to damaged manholes;
- (d) Initial unblocking and clearing of all water distribution pipes and manholes;
- (e) Repair and upgrading of the water distribution system where necessary;
- (f) Introduction of additional connections to the water distribution system;
- (g) Removal of unauthorised connections;
- (h) Reinstatement and making good of walls, concrete, road surfaces, etc, to an approved acceptable level where any repair, upgrade and/or service work has been executed;
- (i) Video surveying of all underground drainage pipework to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (j) Test pipe system for leakage;
- (k) Repair, replace and service valves, which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (l) Where valves do not close properly, all these valves shall be refurbished, descaled and if necessary replaced;
- (m) Repair, clean and service all strainers, including the replacement of strainer elements where corroded and installation of new gaskets;

- (n) Repair, service, test and readjust pressure-reducing valves. Pressure gauges are to be recalibrated and checked. Up and downstream pressures are to be logged. Downstream pressure has to be adjusted to an acceptable level, taking into account the allowable working pressure of the system and its components;
- (o) Repair, service and check the proper functioning of all non-return valves;
- (p) Repair, service, readjust and calibrate all safety and expansion relief valves;
- (q) Repair, service and clean out all air release valves and vacuum breakers;
- (r) Repair, service and log readings of water meters including cleaning of integral strainers;
- (s) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float and/or filling valves to these tanks are to be serviced and repaired where required;
- (t) Water pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be followed if the outcome of this sampling requires attention;
- (u) Water supply has to be sampled and chemically analysed for the suitability to the systems and materials it serves;
- (v) Pressure test and sterilise repaired new installation and equipment;
- (w) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair, upgrade and/or service work have been executed.

CE 04.02.02 Construction

The Engineer will indicate the pipeline sections in need of repair and shall instruct the Contractor with regard to the repair work to be done.

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of the pipelines. The width of the excavation for each type and size of pipeline shall be as set out in SABS 1200 DB.

The depth of the excavation for each type and size of pipeline shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the pipeline and shall be sufficient to allow the type and thickness of bedding material instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Cutting, breaking out and replacing of concrete pavements will be paid under Subclause CA.02.

Excavations shall extend such that, where possible cut in may be reduced by lifting adjacent pipes.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting or with the use of pneumatic tools or mechanical breakers and boulders exceeding 0,10 m³ shall be classified as hard material.

Where more than 40% of any material (by volume) consists of boulders each exceeding 0,10 m³ in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged pipelines

Where indicated by the Engineer damaged sections of pipelines shall be completely removed and replaced.

(e) Pipe couplings

Repair sections will be joined, utilising existing pipe sockets and collars where possible.

Repair couplings shall be used with the approval of the Engineer.

(f) Laying of uPVC pipelines

New sections of uPVC pipelines shall be laid on a granular bed suitable for flexible pipelines as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2% or as directed by the Engineer.

Refer to SABS 1200 LB: Bedding (pipes), for the specification on bedding.

(g) Laying of asbestos cement, concrete or galvanised mild steel pipelines

New sections of the pipelines shall be laid on class A or B bedding as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2% or as directed by the Engineer.

Refer to SABS 1200 LB: Bedding (pipes), for the specification on bedding.

(h) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(i) Concrete encasement

Where instructed by the Engineer pipes shall be encased in concrete. All such encasing shall be done in accordance with the Engineer's instructions and sufficient allowance shall be made for movement joints.

(j) Extension of existing pipelines

Where existing pipelines require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where they join the existing service, at the same level as the existing pipeline.

Existing chambers or other structures which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new structures shall be paid for under the relevant sections in the specification.

(k) Construction in existing roads

Road crossings shall either be constructed utilising sufficient provision of bypass roads or utilising the half width of the road. At all times a through route shall be maintained for all traffic.

(l) Repairing of leaks

Where leaks occur at pipe sockets or collars the affected section shall be cut from the pipeline and repaired using repair couplings.

Where obvious leaks occur due to displaced sealing rubbers, the rubbers shall be replaced if the replacement can be done economically by lifting adjacent pipes.

(m) Replacement of pipes damaged by exposure to extensive ultraviolet light

Pipes damaged as a result of excessive exposure to sunlight shall be replaced where indicated by the Engineer.

CE 04.02.03 Quality standard

Pipelines shall be laid at even gradients within the points of correction, to the satisfaction of the Engineer and the applicable specifications.

CE 04.02.04 Materials

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Supercast cast-iron pipes and fittings

Supercast cast-iron pipes can be used for underground and above ground installations. Plain-ended cast-iron pipes and fittings shall be used, manufactured from 150, Grade A, grey iron in accordance with SABS 1034. Fittings and pipes shall be free of pinholes, blowholes, blemishes, flash and foundry sand and have a smooth bore. All pipes and fittings shall be sand

blasted and coated on the inside and outside by submersion in a corrosion inhibiting oxide primer or bitumen paint.

The pipes and fittings shall be joined by means of stainless steel neoprene couplings as supplied by the manufacturer's of the pipe system. The coupling shall be installed according to the manufacturer's specification and is to be tightened with a torque wrench to a torque of 6,8 Nm.

(b) uPVC pipe and fittings under ground

uPVC pipes and fittings can be used for above ground installations.

For pipe sizes larger than 160 mm diameter, uPVC class 6 pressure pipe to SABS 966 shall be used with prefabricated uPVC bends and junctions. Prefabrication shall be done by means of hot-air welding of fittings to be covered with three layers of fibreglass reinforced lining over welded sections. The resin to be used shall be as specified by the manufacturer for usage with PVC. Bends shall be manufactured out of 3 to 4 sections per bend. Pipe joints shall be done by means of couplings fixed with solvent cement for PVC piping. This joint shall be reinforced with a fibreglass lining of three layers.

Piping is to be supported and bracketed with properly sized and designed brackets consisting of two half sections clamped over the pipe and hung with two hanger rods.

Pipes are to be pressure tested in sections as specified in this specification.

(c) Prefabricated galvanised steel piping and fittings above ground

Prefabricated galvanised steel piping can be used for above ground rainwater drainage systems. The pipe to be used shall be plain-ended medium gauge uncoated pipe to SABS 62, galvanised to SABS 763. All fittings are to be manufactured out of the same material, welded with flanged ends or rolled ends to fit clambon fittings. Fittings are only to be galvanised after manufacturing. All joints are to be either flanged or equipped with clambon couplings. All fittings and junction to be 45° sections.

The pipe system must be properly secured and bracketed at regular intervals with correctly sized and designed galvanised brackets.

Pipes are to be pressure tested in sections as specified in this specification.

(d) Geberit HDPe pipe and fittings

Geberit HDPe pipes and fittings can be used for underground and above ground installations where specified. Pipes shall be plain ended and only Geberit HDPe bends and fittings shall be used. Jointing of pipes and fittings shall be done by butt welding, electro-sleeve couplings and/or flanged joints. Pipes and fittings shall only be installed by Geberit approved installers and the Contractor shall furnish a certificate to this effect. Pipes and fittings shall be installed strictly according to the Geberit application technique.

Pipes are to be pressure tested in sections as specified in this specification

(e) Galvanised steel pipe installations

- (i) All galvanised steel pipes shall be medium gauge mild steel screwed and socketed pipes to SABS 62 and shall be normalised and marked as such by the manufacturer. Pipes shall be hot-dipped galvanised to SABS 763.

- (ii) All fittings shall be malleable cast-iron fittings to SABS 509 and galvanised to SABS 763.
- (iii) All 80 diameter and larger pipes shall be joined with Class 16 flanged couplings to SABS 1123/1600. The bolts, nuts and spring washers to be used on these joints shall be cadmium plated.
- (iv) In pipe ducts and elsewhere pipes shall be fixed onto walls, soffits, etc, with approved type of supports, holderbats, clamps, etc. Brackets shall be designed to structurally support and fix the pipe system and shall have enough clearance from walls, soffits, etc, to insulate hot-water pipes and maintain equipment.
- (v) Pipes shall be supported according to the manufacturer's specifications with approved brackets at the following maximum intervals:

NORMAL SIZE (mm)	HORIZONTAL (metre)	VERTICAL (metre)
15 dia to 20 dia	1 200	1 830
32 dia to 40 dia	1 830	2 450
50 dia to 150 dia	2 450	3 050

- (vi) Pipes shall be installed in such a manner as to prevent airlocks. A minimum rise of 1:250 shall be maintained to high points, which shall be fitted with suitable air release valves.
 - (vii) All pipes shall be marked according to SABS 0140 or as specified by the Engineer. All surface pipes shall be painted.
 - (viii) Pipes shall be installed flush unless otherwise instructed by the Engineer.
 - (ix) Provision shall be made for thermal contraction and expansion.
 - (x) The type of pipe joint compound shall be approved by the Engineer and used sparingly with good quality hemp. For pipes larger than 80 mm diameter a jointing compound such as Epidermix 32 shall be used.
 - (xi) Any pipes buried shall have at least 900 mm cover and be coated and wrapped to SABS 11 17 and tested in the presence of the Engineer.
 - (xii) All exposed hot-water pipes shall be lagged as specified.
 - (xiii) All pipework and fittings shall be pressure tested and sterilised as specified.
 - (xiv) Valves shall be installed on all branch pipes and ball-o-stop valves on all connectors to basin pillar cocks, sink mixers, cistern type WCs and other fittings.
 - (xv) Approved type expansion bellows shall be installed where required for expansion and contraction to prevent excessive stain on fittings and pipe joints.
- (f) uPVC underground pipe installations
- (i) uPVC piping shall conform to SABS 966 with rubber ring type joints.
 - (ii) All bends shall be uPVC type fittings with rubber ring joints.

- (iii) All other fittings such as T-pieces, reducers, flanges, etc, shall be bitumen-dipped cast iron rubber ring jointed fittings to SABS 546.
- (iv) No solvent weld type fittings will be allowed.
- (v) All cast iron fittings shall be coated and wrapped to SABS 1117.
- (vi) All pipes shall be laid on a 100 mm sand-bedding cradle and covered with 300 mm sand before backfilling.
- (vii) All backfilling shall be to the Engineer's specification and approval.
- (viii) Pipe trenching and bedding shall be as follows:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SABS 1200 LB	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90% of modified AASHTO density

- (ix) All thrust blocks shall be cast between the pipe and the undisturbed trench material.
 - (x) No concrete shall come into direct contact with the uPVC pipe. At the thrust blocks the bend shall be wrapped with Densopol 80 HT Tape or approved equivalent.
 - (xi) DPE pipe connections to UPVC pipes up to 50 mm diameter can be done by means of SG iron manufactured saddles with the appropriate gaskets and cadmium-plated bolts and nuts.
 - (xii) All pipe crossings under traffic areas shall be backfilled with soilcrete and compacted as specified.
 - (xiii) All pipework shall be pressure tested with all joints uncovered, to the satisfaction of the Engineer.
 - (xiv) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.
- (g) HDPe underground pipe installations
- (i) HDPe piping shall be Type 4 HDPe pipe to SABS 533.
 - (ii) All fittings shall be of Plasson compression type, conforming to ISO/DIS 3458.
 - (iii) All pipes shall be laid on a 100 mm sand bedding cradle and covered with 300 mm of sand of selected material.
 - (iv) All backfilling shall be to the Engineer's specification and approval.

- (v) Pipe trenching and bedding shall be as follows:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100	Flexible pipe bedding as per SABS 1200 LB	Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90% of modified AASHTO density

- (vi) No concrete shall come into direct contact with the HDPE pipe. At these points the fittings shall be wrapped with a Densopol 80 HT tape or approved equivalent.
- (vii) All pipe crossings under traffic areas shall be backfilled with soilcrete and compacted as specified.
- (viii) All pipework shall be pressure tested with all joints uncovered to the satisfaction of the Engineer.
- (ix) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(h) Valves

- (i) Gate valves underground in valve chambers to connect to uPVC piping (65 mm NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SABS 936 Grade 42, cast-iron nitrile butadine rubber-covered gate, stainless steel spindle, nitrile butadine rubber O-rings and seals, cast iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SABS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valve shall be fitted with a square key spindle top to close the valve in a clockwise direction and socket ends to SABS 665 to fit into uPVC Class 12 pipe and installed to detail.

- (ii) Gate valves underground in valve chamber to connect to HDPE piping

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SABS 776 Class 125. The valve shall be able to withstand a working pressure of 1 600 kPa. The valve shall be fitted with a hand wheel on an extended spindle shaft of 700 mm to close in a clockwise direction and installed to detail.

- (iii) Gate valves above ground for temperatures up to 40 °C to connect to steel piping (65 mm NB and larger)

Gate valves to be equipped with non-rising spindle, spherical graphite iron body to SABS 936 Grade 42, cast-iron nitrile butadine rubber-covered gate, stainless steel spindle, nitrile butadine rubber O-rings and seals, cast iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SABS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with flanged ends to SABS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or side ways to a maximum 90° from upright.

- (iv) Gate valves above ground for temperatures above 40 °C to connect to steel piping (65 mm NB and larger)

Gate valve shall be equipped with non-rising spindle, spherical graphite iron body to SABS 963 Grade 42, cast-iron gate, gunmetal seat and gate rings, high-tensile bronze spindle, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SABS 665 and shall be capable of withstanding a working pressure of 1 600 kPa and a temperature of 90 °C.

The valve shall be fitted with flanged ends to SABS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

- (v) Gate valves above-ground to fit to copper pipes (65 mm NB and larger)

Gate valves shall be equipped with non-rising spindle, gunmetal bronze or dezincified brass body, gunmetal or dezincified brass gate, graphite asbestos packing in the gland.

The valve shall be fitted with a hand wheel to close in a clockwise direction and installed in an upright position or sideways to maximum 90° from upright.

The valve shall be equipped with flanges to SABS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

- (vi) Gate valves above-ground for temperatures up to 100 °C (up to 50 mm NB)

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SABS 776-1965 Class 125.

The valve shall be able to withstand a working pressure of 1 600 kPa.

The valve shall be equipped with a hand wheel to close in a clockwise direction.

The valve shall be installed in an upright position or sideways to a maximum 90° from upright and shall be so placed with other fittings to be removable without cutting the pipework.

- (vii) Ball-O-Stop valves (15 mm diameter - 25 mm diameter)

This valve shall be a full-way ballcock type with BSP threaded ends. This valve shall conform to SABS 1056 Part 3, 1985, shall be rated for a test pressure of 2 000 kPa, and shall be chrome-finished where exposed.

- (viii) Angle regulating valves

This valve shall be a 15 mm diameter chromium-plated angle regulating valve with a 350 mm chromium-plated copper tube and cap nuts where required.

(i) Strainers

(i) Strainers for connection to steel or uPVC pipes (65 mm NB and larger)

These strainers shall be of the Y-type with cast-iron body, stainless steel or bronze strainer element and shall be equipped with flanged ends to SABS 1123/1600. The whole size of the strainer element shall be maximum 1 mm diameter and be removable without dismantling of pipework. The strainer shall be suitable for a temperature of up to 90 °C at a 1 000 kPa pressure rating and installed with the element facing downwards or a maximum of 45° sideways.

(ii) Strainers for connection to steel and copper pipes (up to 50 mm NB)

The strainers shall be of the Y-type with bronze or dezincified brass body, stainless steel strainer element and must be equipped with BSP threaded socket ends. The whole size of the strainer element shall be maximum 0,8 mm diameter. The strainer shall be suitable for a temperature of up to 90 °C at a pressure rating of 1 000 kPa and installed with the element facing downwards or a maximum of 45° sideways.

(j) Non-return valves

(i) Non-return valves for cold water (65 mm NB and larger)

The non-return valve shall be of the spring-loaded dual flap plate type fitted between two flanges (wafer).

The non-return valve shall be equipped with a cast-iron body, aluminium bronze plates, stainless steel springs and neoprene seals on the plates. The valves shall be suitable for a working pressure of 1 000 kPa.

(ii) Non-return valves for hot water (up to 100 mm diameter) and cold water (up to 50 mm NB)

The non-return valve shall be of the spring-loaded piston type, with bronze or dezincified brass body, stainless steel spring and bronze disc with neoprene seal fitted with BSP threaded socket ends. The valve shall be suitable for a working pressure of 1 000 kPa and a temperature of up to 90 °C. All valves shall be installed as to be removable without extensive pipework removal.

(k) Air release valves and vacuum breakers

(i) Double orifice double-acting air release valves with sizes from 50 mm NB to 200 mm NB

The air release valve shall be fitted with small and large orifice. The air release valve shall be fitted with a cast-iron or stainless steel body, stainless steel or fibreglass balls, integral shut-off valve and flanged ends to SABS 1123/1600. The valve shall be equipped with an anti-shock facility.

The valve shall be suitable for maximum pressure of 1 600 kPa.

(ii) Single orifice air release valves for main water lines with sizes from 25 mm NB to 50 mm NB

The air release valve shall be fitted with a small orifice, cast-iron or stainless steel body, fibre glass or stainless steel ball float and BSP threaded inlet.

When the valve is installed a shut-off valve shall be installed on the inlet side. The valve shall be equipped with an anti-shock facility.

The valve shall be suitable for maximum pressure of 1 600 kPa.

- (iii) Single orifice double purpose air release valves for domestic water lines up to 15 mm NB

The air release valves shall be fitted with a stainless steel float, brass or cast steel body with an integral shut-off valve fitted.

The valve shall be capable to withstand a working pressure of 1 000 kPa at 110 °C.

- (iv) Vacuum breaker up to 40 mm diameter

The vacuum breakers shall be fitted with neoprene seal, spring-loaded disc in a dezincified brass or bronze body. The valve shall seal watertight and shall be designed to withstand a working pressure of 1 000 kPa and a temperature of 90 °C.

- (l) Pressure-reducing valves

- (i) Combination pressure reducing stations

Where a high peak flow can occur as well as a small flow and the small flow is out of the range of the large pressure-reducing valve, a small pressure-reducing valve shall be installed in parallel with the large pressure-reducing valve. The two pressure-reducing valves in parallel shall be set according to the manufacturer's specification.

- (ii) Large pressure-reducing valves (65 mm NB and larger)

The pressure reducing valve shall be equipped with a cast iron body, neoprene-nylon reinforced diaphragm, bronze seal disc washer, stainless steel shaft and flanged ends. The valve shall be pilot operated and shall be designed to handle high flows at a minimum head loss.

The valve must be adjustable to handle a wide range of incoming pressure at a constant downstream pressure.

The valve shall be equipped with flanged ends to SABS 1123/1600.

- (iii) Small pressure-reducing valves (15 mm NB - 50 mm NB)

The pressure-reducing valve shall be equipped with brass body, balanced single seat and integral strainer. The valve shall be able to handle a wide range of incoming pressure while the downstream pressure stays constant with maximum inlet pressure of 1 000 kPa and a maximum water temperature of 40 °C.

The valve shall be equipped with BSP male threaded brass union couplings.

- (m) Water meters

- (i) Combination water meters

Where high peak flow as well as a low flow can occur, and the low flow is out of the registration range of large water meter, a small diameter water meter shall be installed in parallel with the large water meter to cater for

the low flows with integral automatic change-over valves. These valves shall be designed to have a minimum pressure drop at the operating point.

(ii) Water meters (50 mm NB and larger)

These water meters shall be of the dry type with all gears and transmission and roller counters in a dry head, and shall be equipped with flanged ends to SABS 1123, cast-iron body with high quality corrosion proof coating. The meter must be protected from magnetic fields and sealed to prevent tampering with adjustments. The meter must be able to work up to a pressure of 1600 kPa under a maximum water temperature of 40 °C. The scale of meter must be in cubic metre (m³) and equipped with needle indicators reading in litres. The accuracy of the meter shall be not less than 98%.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturer's specification.

(iii) Water meters (up to 50 mm NB)

The meter shall be of the volumetric rotary piston type with brass body equipped with union couplers. The meter reading must be in kilolitres. The meter shall have an accuracy of not less than 98%. The meter must be able to operate up to a water pressure of 1000 kPa at a water temperature of 40 °C.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturers specification.

CE 04.03 FIRE WATER PIPED RETICULATION NETWORKS

CE 04.03.01 General

Repair work to the fire water piped reticulation networks is detailed in the Particular Specification and shall include but no be limited to the work described below. This specification only covers the water piped reticulation for the fire water protection system, whereas the equipment to this installation, such as fire hydrants, hose reels and extinguishers, are covered and detailed in Technical Specification JC: Conventional Fire Fighting Equipment. This specification must be read in conjunction with the afore-mentioned specification.

Repair work to the fire water piped reticulation networks may include the following:

- (a) Replacement of damaged, broken, leaking, corroded above-ground and underground pipe work, fittings and equipment;
- (b) Repair, replace and service valves which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (c) Where valves do not close properly, all these valves are to be refurbished, descaled and if necessary replaced;
- (d) Repair, service and check the proper functioning of all non-return valves and backflow preventers;
- (e) Repair, service, readjust and calibrate all pressure gauges;
- (f) Repair work to bracketing systems including fixing and repair of existing brackets and the introduction of additional brackets where required;

- (g) Report all related problems to fire fighting equipment to the Engineer;
- (h) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float or/and filling valves to these tanks are to be serviced and repaired where required;
- (i) Pressure test and sterilise repaired new installation and equipment;
- (j) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where any repair, upgrade and/or service work have been executed;
- (k) Record pressure readings on supply to installation.

CE 04.03.02 Material and equipment specification for fire water piped reticulation networks

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the relevant specification.

CE 04.04 CLEANING OF PIPELINES

The work under this section involves the removal of silt, debris and lime deposits from within the pipelines and the general cleaning in areas resulting from leakage.

CE 04.04.01 Construction

Prior to the cleaning of any pipeline sections, the Contractor shall arrange with the Engineer for an inspection of the pipe route. Based on the inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Visual inspections utilising check circuit TV cameras will not be required unless deemed essential on large diameter pipelines.

Sections of the pipeline may be removed for a more detailed inspection. Such sections will be repaired as specified in Subclause CE 04.02. Sections will only be cut from the pipeline where specifically instructed by the Engineer.

The method to be applied for the cleaning of the pipelines will be chemical or mechanical and shall be followed by disinfection of the related section. The method to be applied for each section of the pipeline will be instructed by the Engineer.

Material removed from the pipelines shall be disposed of as instructed by the Engineer.

The Contractor shall discuss the method proposed for the scouring of the pipelines where insufficient scour valves are present with the Engineer prior to implementation.

CE 04.04.02 Quality standard

Pipelines shall be cleaned such that head losses along the pipe route are negligible under simulated fire flow, when measured at convenient points along the route.

CE 04.05 REPAIR OF FITTINGS

CE 04.05.01 Construction

The Engineer will indicate the fittings that are to be repaired.

The repair of the following fittings may be required:

- (a) Gate valves
- (b) Fire hydrants
- (c) Viking Johnson couplings
- (d) Pressure-reducing valves
- (e) Ferrules
- (f) Domestic water meters
- (g) Bulk water meters
- (h) Stop-cocks
- (i) Tees
- (j) Bends
- (k) End caps
- (l) Saddles.

CE 04.06 REPAIR OF STRUCTURES

The Engineer will indicate the structures that are to be repaired.

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris spoiled at designated sites.

The reinstatement of damaged structures shall be carried out to the same standards prescribed for new construction.

CE 05 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

CE 06 **QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

CE 07 **MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT****CE 07.01** **GENERAL**

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance as described in Additional Specification SA: General Maintenance.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this technical specification and, where included in the documents, the Particular Specification for water distribution networks.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

The maintenance work and items are categorised for each maintenance activity under the following headings:

- (a) Repair of water distribution pipelines (see table CE 07.02/1)
- (b) Cleaning of existing pipelines (see table CE 07.02/2)
- (c) Repair of fittings (see table CE 07.02/3)
- (d) Repair of existing structures (see table CE 07.02/4)
- (e) Fire water piped reticulation structures (see table CE 07.02/5).

CE 07.02 **ROUTINE PREVENTATIVE MAINTENANCE**

This routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance, the Technical Specification related to this work and, where included in the document, the Particular Specification for water distribution networks.

The routine maintenance work to be performed and executed shall include, but not be limited to the following items listed in the tables below under each heading.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE CE 07.02/1 REPAIR OF WATER DISTRIBUTION PIPELINES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Log all water meter readings	Monthly
3	Log all pressure gauge readings	Monthly
4	Check, inspect, report and repair leaks/replace rotten pipes where required	Monthly
5	Sample water supply and chemical analyses to be provided by approved company	Annually
6	Water storage tanks to be emptied, cleaned out, inspected, repaired and resealed where necessary	Annually
8	Clean out all strainers	Monthly
9	Check, inspect, repair or replace all bracketing systems	Four-monthly
10	Paint repairs to piping, fittings and equipment	Annually

TABLE CE 07.02/2 CLEANING OF EXISTING PIPELINES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Remove silt, debris and loose lime deposits from within pipelines where required by scouring	Annually
3	Do general cleaning in areas where leakage has occurred	Six-monthly

TABLE CE 07.02/3 REPAIR OF FITTINGS

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Replace all valve gaskets, gland packings and seals	Annually
2	Check, inspect, service, repair and readjust all pressure reducing valves	Annually
3	Check, inspect and test operation of all valves on site	Four-monthly
4	Check, inspect, service, test and repair/replace all safety and expansion release valves	Six-monthly
5	Check, inspect, service, test and repair/replace all air release valves and vacuum breakers	Four-monthly
6	Check, service, repair or replace all ball float valves	Six-monthly
7	Check, inspect, test, service and repair/replace all non-return valves	Four-monthly

TABLE CE 07.02/4 REPAIR OF EXISTING STRUCTURES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on all water distribution related structures	Monthly
2	Clean out structures of debris	Annually

TABLE CE 07.02/5 FIRE WATER PIPED RETICULATION STRUCTURES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Report any failures/breakage of fire fighting equipment to the Engineer	Monthly
3	Log all pressure gauge readings	Monthly
4	Replace all valve gaskets, gland packings and seals	Annually
5	Clean out water storage tanks and reseal/repair if necessary	Annually
6	Check, inspect, service, repair/replace all non-return valves and backflow presenters	Four-monthly
7	Check, inspect, report and repair all leaks/replace rotten pipes where required	Monthly
8	Inspect, service, readjust and calibrate all pressure gauges	Four-monthly
9	Paint repairs to piping, fittings and equipment	Annually
10	Check, inspect, repair or replace all bracketing systems	Four-monthly

CE 07.03 CORRECTIVE MAINTENANCE

This corrective maintenance of the installations, systems and equipment to be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

CE 07.04 BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance specification.

All breakdown maintenance shall be done in accordance with the related specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

CE 08 MEASUREMENT AND PAYMENT

CE.01 WATER DISTRIBUTION PIPELINES

CE.01.01 Repair of existing pipelines..... Unit: metre (m)

The unit of measurement shall be per metre length of pipe replaced. In each case the Contractor shall agree on the length of pipe to be replaced and the method of coupling the pipes.

The tendered rate shall include full compensation for cleaning and grubbing, excavation, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, logging and backfilling of replacement pipeline, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench, disposal of surplus materials.

Separate items will be scheduled for house connections and distribution pipes.

The provision of the materials will be measured separately under CE 01.02.

CE.01.02 Provision of materials

(a) Pipelines..... Unit: metre (m)

The unit of measurement shall be the metre of pipe replaced.

(b) Fittings..... Unit: number

The unit of measurement shall be the number of fittings installed.

The tendered rates shall include full compensation for all transport to the place of installation, storage, labour costs.

Separate pay items shall be listed for the pipe materials and fittings per diameter and class.

CE.01.03 Replacement of manhole covers, grid inlets and the like

(a) SABS 558 Type 4 - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(b) SABS 558 Type 4 - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(c) SABS 558 Type 2A - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

(d) SABS 558 Type 2A - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames from the site.

CE.01.04 Repair of corrosion protection

Corrosion protection of pipes with diameters of:

- (a) Up to 100 mm dia..... Unit: metre (m)
- (b) 101 to 200 mm dia Unit: metre (m)
- (c) 201 to 300 mm dia Unit: metre (m)
- (d) 301 to 400 mm dia Unit: metre (m)

The unit rate of measurement shall be meter length of pipe painted with corrosion protection in accordance with Specification LB: Corrosion protection.

The tendered rate shall include full compensation for preparation of pipe fittings, application of corrosion protection and curing of corrosion protection.

Separate items shall be scheduled for different types of pipework.

CE.02 REPAIR OF FIRE WATER PIPE RETICULATION NETWORK

Measurement and payment items from CE 01, CE 03, CE 04 and CE 05 will be utilised for work done on the external fire water pipe reticulation. Additional payment items for specialist fittings shall be paid under Specification JC.

CE.03 CLEANING OF PIPELINE**CE.03.01 Cleaning of deposits in pipeline by mechanical means
for pipes of diameters of:**

- (a) Up to 100 mm dia..... Unit: metre (m)
 (b) 101 to 200 mm dia Unit: metre (m)
 (c) 201 to 300 mm dia Unit: metre (m)
 (d) 301 to 400 mm dia Unit: metre (m)

**CE.03.02 Scouring of pipeline to remove trapped debris for
pipes of diameters of:**

- (a) Up to 100 mm dia..... Unit: metre (m)
 (b) 101 to 200 mm dia Unit: metre (m)
 (c) 201 to 300 mm dia Unit: metre (m)
 (d) 301 to 400 mm dia Unit: metre (m)

The unit of measurement shall be metre length of pipe cleaned or scoured.

The unit rate of measurement for item CA.03.01 shall include full compensation for the emptying of the pipeline, cleaning, refilling and reporting on the condition of the pipe after cleaning. The rate shall also include the disposal of waste material in and appropriate manner.

The unit of measurement for item CA.03.02 shall include full compensation for the scouring of the pipeline and refurbishing of the pipeline. The unit of measurement shall be the total length of filled pipeline from which the water is scoured. The length shall be agreed with the Engineer prior to scouring.

The provision of additional scour points shall also be included in the rate.

CE.04 REPAIR OF FITTINGS**CE.04.01 Servicing of valves Unit: number**

The unit of measurement shall be the number of valves serviced.

The tendered rate shall include full compensation for cleaning, removing rust, scale or other solids from surfaces or moving parts, proper greasing of all moving parts, preparation for corrosion protection coating and painting of valves.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

CE.04.02 Recondition valves Unit: number

The unit of measurement shall be the number of valves reconditioned.

The tendered rate shall include full compensation for dismantling, cleaning, removing rust, removing scale or other solids from surfaces and moving parts, replacing components such as hinges, spindles, hard wheels or gates, swing axles, swing gates, replacing or repair of seals, skimming of seal surfaces, proper greasing of all moving parts, preparation for corrosion protection, painting or any other action or cost necessitated to recondition a valve to a perfect functional drop tight condition.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

CE.04.03 Decommission and remove valvesUnit: number

The unit of measurement shall be the number of valves decommissioned and removed.

The tendered rate shall include full compensation for all labour and equipment required to decommission and remove valves, such as installation of temporary isolating valves or blank flanges, removal of unserviceable valves, loosening and removal of bolts and nuts, or any other related action required. Excavation to exposed partially buried valves shall also be included in the rate.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of valves.

CE.04.04 Repair of house connections Unit: number

The unit of measurement shall be the number of house connections repaired.

The tendered rate shall exclude the provision of new fittings measured under CE. 01.02 but shall otherwise include full compensation for appurtenant fittings, excavation, backfilling and other necessary work to repair existing house connections.

All connections to the distribution pipelines, up to a diameter of 32 mm shall be measured as "house connections".

CE.05 REPAIR OF STRUCTURES

CE.05.01 Demolition and removal of damaged existing structures

- (a) Plain concreteUnit: cubic metre (m³)
- (b) Reinforced concreteUnit: cubic metre (m³)
- (c) Brickwork Unit: square metre (m²)
- (d) Precast concrete manhole sectionsUnit: number

The unit of measurement for CE.05.01(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

The unit of measurement for CE.05.01(c) and (d) shall be the square metre length of brickwork and the number of precast concrete manhole sections.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material. Excavation and backfill shall also be included for constructing the precast concrete manholes inclusive of all work required to complete the work as shown on the drawings.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

CE.05.02 Overhaul on material for haul in excess of 1,0 km

- (a) Excavated material to spoil Unit: cubic metre kilometre (m³-km)
- (b) Existing structures demolished Unit: cubic metre kilometre (m³-km)

The unit of measurement shall be the cubic metre of loose material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

CE.05.03 Repair of structures

- (a) Brickwork Unit: square metre (m²)
- (b) Concrete Unit: cubic metre (m³)
- (c) Precast concrete manhole sections Unit: number

The unit of measurement shall be the cubic metre of brickwork or concrete constructed.

The tendered rate shall include full compensation for the provision of materials, transport, preparation and placing of foundations, labour and all other associated work to complete the work required.

Separate items will be scheduled for specific installations.

CE.05.04 Marker posts Unit: number

The unit of measurement shall be the number of marker posts installed.

The tendered rate shall include full compensation for the manufacture and installation complete as shown on the drawings.

CE.05.05 Sample testing

- (a) Extract sample to determine lime deposition, corrosion and general condition for pipes of:
 - (i) Up to 100 mm dia Unit: number
 - (ii) 101 to 200 mm dia Unit: number
 - (iii) 201 to 300 mm dia Unit: number
 - (iv) 301 to 400 mm dia Unit: number

The unit rate of measurement shall be the number of sample tests carried out.

The tendered rate shall include full compensation for cutting into pipe and extraction of sample, visual inspection and reporting on condition of pipe. The tendered rate shall also include full compensation for the appropriate disposal of the sample and for the repair of the section pipeline.

Compensation for provision of new pipes and fittings, shall be measured under CE 01.

CE.06 TESTS AND INSPECTIONS OF REPAIR WORK

CE.06.01 Pressure testing

(a) Pressure test pipeline in sections of pipes with diameter of:

- (i) Up to 100 mm dia Unit: metre (m)
- (ii) 101 to 200 mm dia..... Unit: metre (m)
- (iii) 201 to 300 mm dia..... Unit: metre (m)
- (iv) 301 to 400 mm dia..... Unit: metre (m)

The unit of measurement shall be the metre length of pipe tested.

The tendered rate shall include full compensation for isolation of test section, filling of section with water, testing for required duration and reporting on performance of pipes, the provision of any additional water shall also be included in the rate. The rate shall also include the provision of all equipment, labour and supervision necessary for the completion of the pressure test.

CE.06.02 Provision of equipment for visual inspection of underground pipeline network Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as torches, lights and mirrors, etc, to enable a basic visual inspection of the pipeline network.

CE.06.03 CCTV inspection of underground pipework

(a) Pipes of diameter:

- (i) Up to 300 mm dia Unit: metre (m)
- (ii) 301 to 600 mm dia Unit: metre (m)

The unit of measurement shall be the metre length of pipe inspected.

The tendered rate shall include full compensation for all inter-pipe relocations required to conduct a thorough check of the pipework where indicated by the Engineer.

TECHNICAL SPECIFICATION**CF SEWERAGE NETWORKS****CONTENTS**

CF 01	SCOPE
CF 02	STANDARD SPECIFICATIONS
CF 03	OPERATING AND MAINTENANCE MANUALS
CF 04	EXECUTION OF REPAIR WORK
CF 05	TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK
CF 06	QUALITY ASSURANCE SYSTEM
CF 07	MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT
CF 08	MEASUREMENT AND PAYMENT

CF 01 SCOPE

This specification covers all aspects regarding the general repair and maintenance of sewerage networks which may include the following installations:

- (a) Sewer pipelines and manholes
- (b) Open sewerage channels
- (c) Conservancy tanks.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CF: Sewerage networks, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

CF 02 STANDARD SPECIFICATIONS**CF 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SABS 1200 D - Earthworks
- SABS 1200 DB - Earthworks (pipe trenches)
- SABS 1200 L - Medium-pressure pipelines
- SABS 1200 LB - Bedding (pipes)
- SABS 1200 LC - Cable ducts
- SABS 1200 LD - Sewers

CF 02.02 **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CF 02.03 **MANUFACTURER'S SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

CF 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CF 03 **OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be required for sewerage networks.

CF 04 **EXECUTION OF REPAIR WORK**

CF 04.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all Additional and Particular Specifications included in this document.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the sewerage network and wastewater treatment shall be categorised under the following headings:

- (a) Sewerage network within Medium A and Medium B perimeter fences
- (b) Sewerage components at farm
- (c) All other sewerage pipes and structures
- (d) Wastewater treatment.

CF 04.02

REPAIR OF EXISTING PIPELINES AND STRUCTURES

This section covers the work in connection with the construction of sewerage networks and associated sewerage structures such as manholes, cleaning eyes and the like. It also covers the removal and replacement of damaged and broken pipes and sewerage structures, as well as repairs to existing pipes and structures.

CF 04.02.01

General

Repair work to the soil and wastewater drainage system shall be detailed in the Particular Specification and may include the following:

- (a) Replacement of damaged, broken, leaking, corroded above-ground and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing gully gratings, manhole covers and frames, cleaning eye covers, screws and bolts, inspection of eye covers, screws and bolts, end caps and vent cowls;
- (c) Repair work to damaged manholes, gullies, cleaning eyes, etc, including builder's work and benching;
- (d) Initial unblocking and cleaning of all drainage pipework, traps and gullies;
- (e) Repair of sewerage system where necessary;
- (f) Provision of additional connections to the sewerage system;
- (g) Reinstatement and making good of walls, concrete, road surfaces, etc, to an approved acceptable level where any repair and/or service work have been executed;
- (h) Video surveying of all underground drainage pipework to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (i) Test pipe system and equipment for leakage;
- (j) Sewerage pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be followed if the outcome of this sampling requires attention;
- (k) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair and/or service work have been executed.

CF 04.02.02 **Construction**

The Engineer will indicate the location at which sections of pipeline are in need of repair after the appropriate surveys have been completed by the Contractor.

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of the pipelines. The width of the excavation for each type and size of pipeline shall be as specified in SABS 1200 DB.

The depth of the excavation for each type and size of pipeline shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the pipeline and shall be sufficient to allow for the type and thickness of bedding material as instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Excavations shall extend such that, where possible, cut in may be reduced by lifting adjacent pipes.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers and boulders exceeding 0,10 m³ shall be classified as hard material.

Where more than 40 % of any material (by volume) consists of boulders each exceeding 0,10 m³ in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged pipelines

Where indicated by the Engineer damaged sections of pipelines shall be completely removed and replaced.

Excavation shall be carried out as described for new pipeline installation and the excavated material shall be, if suitable, preserved for backfilling. The damaged pipe materials shall be disposed of where instructed by the Engineer.

(e) Pipe couplings

Repair sections shall be joined utilising existing pipe sockets and collars where possible.

Repair couplings shall be used with the approval of the Engineer.

(f) Laying of vitrified clay pipes and fittings

New sections of uPVC pipelines shall be laid on granular bed suitable for flexible pipelines as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2% or as directed by the Engineer.

(g) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(h) Concrete encasement

Where instructed by the Engineer pipes shall be encased in concrete. All such encasing shall be done in accordance with the Engineer's instructions and sufficient allowance shall be made for movement joints.

(i) Extension of existing pipelines

Where existing pipelines require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where they join the existing service, at the same level as the existing pipeline.

Existing chambers or other structures which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new structures shall be paid for under the relevant sections in the specification.

(j) Construction in existing roads

Road crossings will either be constructed utilising sufficient provision of bypass roads, or they will be done utilising the half width of the road. At all times a through route shall be maintained for all traffic.

(k) Repairing of leaks

Where leaks occur at pipe sockets or collars the effected section will be cut from the pipeline and repaired using repair couplings.

Where obvious leaks occur due to displaced sealing rubbers they will be replaced if the replacement can be done economically by lifting adjacent pipes.

(l) Sewer manholes

All manhole cover frames shall be cast into the concrete cover slabs.

Manholes in trafficable areas shall be provided with heavy duty covers and frames and surrounded by concrete slabs.

(m) Steep sewers

Sewer pipes in the ground with a slope steeper than 1:5 and under surface beds shall be encased in concrete.

(n) External sewers

The sewer outside the boundary of the building complex shall be constructed strictly in accordance with the details and specifications of the Local Authority.

(o) As-built services

Existing drainage invert levels and positions are to be checked against invert levels given on the drawings before work commences. The Engineer must be informed immediately of any discrepancy.

The Contractor shall be responsible for the compilation of as-built plans of sewerage network, showing all pipes, pipe diameters, invert levels and associated structures.

All existing services are to be located and opened before the proposed drainage work commences.

(p) Testing

The drainage system shall be tested according to the specifications laid down by the NBRI. This test shall be carried out in the presence and to the satisfaction and approval of the Engineer.

(q) Ingress of foreign material

During construction all pipe ends are to be suitably plugged to prevent any ingress of dirt, rubble, etc.

(r) CCV surveys

Modern technology video surveying equipment and detection equipment shall be utilised to establish blockage problems and positions of such problems.

(s) Proximity to buildings

Any drainage pipe within the 45° range below building foundations shall be encased in concrete or soilcrete as specified.

(t) Repair to existing structures

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris shall be spoiled at designated sites.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

Provision shall be made for the reinstatement of existing damaged prefabricated concrete half round channels.

(u) Repair to existing channels

Existing channels shall be cleaned. Broken sections of lined channels shall be repaired. Such repair work shall comprise patching of concrete and replacement of precast sections.

CF 04.02.03 Quality standard

Pipelines shall be laid at even gradients to the satisfaction of the Engineer and the applicable specifications.

CF 04.02.04 Materials

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Manhole covers

Manhole covers, etc, shall have covers and frames complying with SABS 558.

(b) Vitrified clay pipe and fittings

Vitrified clay pipe shall only be used for underground installations. The pipes and fitting shall strictly conform to SABS 559. The pipes and fittings shall have a minimum crushing strength of 45 kN/m.

The joining method to be used shall be polypropylene couplings with integral rubber seal similar or equal to Vitrosleeve in accordance with SABS EN 295: Vitrified clay pipes and fittings and pipe joints for drains and sewers, allowing up to 2,5° angular movement per joint and 5 mm line displacement per joint. The joint shall retain an affective water seal with respect to above conditions with a 6 m water head.

Pipes shall be cut using an approved pipe cutter and the end shall then be trimmed by means of a pipe trimmer to remove any sharp edges.

All fittings underground shall consist of vitrified clay and shall comply with SABS 559.

The piping system shall be tested according to the NBRI information sheet X/BOU 2-34.

CF 04.02.05 Air test for sewer and drains

The following air test as specified in the NBRI information sheet X/BOU 2-34 shall be applicable to all air tests on new sewers and drains installed under the repair Contract, and shall be executed by the Contractor and witnessed by the Engineer.

(a) Method of air testing

All openings in the pipeline are plugged by means of sewer testing plugs. The sewer plug at the lowest end of the pipeline is connected to an air supply hose, which is attached to a mechanically driven air blower, compressor or hand pump. Air is pumped into the pipeline at a pressure of approximately 375 mm water gauge. The pressure is held at this level for a period of two minutes to allow the air temperature to become constant. Subsequently the air supply is closed off and the time recorded for the air pressure to drop from 250 to 125 mm water gauge. If the recorded time is less than the value given in the table below, it means that the pipeline is leaking and does not comply with the required standards of tightness. The apparatus required for the air test is commercially available.

The following requirements have to be taken into account when performing the air test:

- (i) Air-permeable pipelines such as vitrified clay or asbestos cement should preferably be tested when moist or wet.
- (ii) The trench shall be partially backfilled before the test is carried out. This is required to stop possible temperature variations and to prevent damage to the pipeline during subsequent backfilling operations.
- (iii) The testing equipment shall be shielded from the direct rays of the sun.
- (iv) Flexible joints are recommended for sewer and drain pipelines. Good quality flexible joints are superior to cement caulked joints and they also provide the pipeline with flexibility to prevent cracking due to subsequent soil movement.
- (v) The test method is very sensitive to flaws in the pipeline, such as cracks or leaking joints. The actual positions of flaws along the pipeline can be determined by using the specialised equipment.
- (vi) If the pipeline is below the water table and subjected to external water pressure, the test method should be modified by the Engineer to ensure that the final pressure value is higher than that of the external water pressure acting on the lowest part of the installation.

The minimum times for pressure drop of 250 mm to 125 mm water gauge are given in table CF 04.02.05/1 below.

TABLE CF 04.02.05/1

PIPE DIAMETER (mm)	MINIMUM TIME (min - s)	CRITICAL LENGTH OF PIPELINE (m) (58 m ² internal surface area)	MINIMUM TIME(s) FOR LONGER LENGTH (L) OF PIPELINE
100	1 to 58	184,6	0,640 L
150	2 to 57	123,1	1,439 L
200	3 to 56	92,3	2,559 L
225	4 to 26	82,1	3,239 L
250	4 to 55	73,8	3,998 L
300	5 to 54	61,5	5,757 L
375	7 to 23	49,2	8,996 L
450	8 to 51	41,0	12,954 L
525	10 to 20	35,2	17,632 L
600	11 to 49	30,8	23,030 L

CF 04.03**CLEANING OF SEWERAGE NETWORK**

The work involved under this section is the removal of silt, debris and vegetation from within the pipelines and manholes and the general cleaning of areas where leakage has occurred. This can be done either mechanically or chemically according to the more appropriate method as specified by the Engineer.

CF 04.03.01**Construction**

The Contractor shall arrange with the Engineer for an inspection of the pipe route before the cleaning of any pipeline sections is carried out.. Based on the inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Visual inspections utilising closed-circuit TV cameras will not be required unless deemed essential and will be specifically requested by the Engineer.

Sections of the pipeline may be removed for a more detailed inspection. Such sections shall be repaired as specified in Subclause CF 04.02.02. Sections shall only be cut from the pipeline where specifically instructed by the Engineer.

The method to be applied for the cleaning of the pipelines shall be chemical or mechanical. The method to be used for each section of the pipeline will be instructed by the Engineer.

Material removed from the culverts shall be disposed of as instructed by the Engineer.

Where insufficient scour values are present, the method for scouring of the pipelines shall be discussed and agreed with the Engineer prior to implementation.

CF 04.04**REPAIR OF FITTINGS****CF 04.04.01****Construction**

The Engineer will indicate the fittings that are to be repaired, but these fittings shall not be limited to those specifically indicated by the Engineer.

Repair of the following fittings may be required:

- (a) Cleaning eyes
- (b) Permanent plug stoppers
- (c) Channel sections.

CF 05 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

CF 06 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

CF 07 MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT

CF 07.01 GENERAL

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance, as described in Additional Specification SA: General Maintenance, for the specified installations described under the Clause CF 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this Technical Specification and, where included in the documents, the particular specification for sewerage networks.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised for each maintenance activity under the following headings:

- (a) Sewerage network systems
- (b) Wastewater treatment systems.

CF 07.02

ROUTINE PREVENTATIVE MAINTENANCE

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Technical Specification related to this work and, where included in the documents, the particular specification for sewerage networks.

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed in table CF 07.02/1. The tendered rate shall include full compensation for all material, plant and labour required in order to perform such maintenance to the satisfaction of the engineer.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE CF 07.02/1 – SEWERAGE NETWORK SYSTEM

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation	Monthly
2	Check, inspect, repair or replace all manhole covers and frames and builder's work to manholes	Four-monthly
3	Check, inspect and repair manhole benching.	Four-monthly
4	Check, inspect, repair or replace all inspection eye, end caps and cleaning eye covers	Four-monthly
5	Check, inspect, report and unblock any blockage that occurs	Monthly
6	Check, inspect, repair/replace and clean out all equipment traps	Monthly
7	Paint repairs to surface piping and equipment	Annually
8	Survey and resultant repairs and unblocking of all main sewer lines	At start of Contract
9	Check, inspect, repair/replace sewer pipes where necessary to maintain good working condition at all times	Four-monthly

CF 07.03 CORRECTIVE MAINTENANCE

This corrective maintenance of the installations, systems and equipment to be done in accordance with Additional Specification SA: General Maintenance and the Technical Specification related to this work and, where included in the documents, the particular specification for sewerage networks.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

CF 07.04 BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance documents.

All breakdown maintenance shall be done in accordance with the related specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

CF 08 MEASUREMENT AND PAYMENT

CF.01 SEWERAGE NETWORKS

CF.01.01 Repair of existing pipelines Unit: metre (m)

The unit of measurement shall be per metre length of pipe replaced. In each case the Contractor shall agree on the length of pipe to be replaced and the method of coupling the pipes.

The tendered rate shall include full compensation for cleaning and grubbing, excavation, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, bedding and back filling of replacement pipeline, cutting to length, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench and disposal of surplus materials.

The tendered rate shall include full compensation for all material, plant and labour required to temporarily by-pass (if required) the pipe section being replaced.

The provision of the materials will be measured separately under CF. 01.02.

CF.01.02 Provision of materials

(a) Pipelines Unit: metre (m)

The unit of measurement shall be the metre of pipe replaced.

- (b) Fittings Unit: number

The unit of measurement shall be the number of fittings installed.

The tendered rates shall include full compensation for all transport to the place of installation, storage, labour costs.

Separate pay items shall be listed for the pipe materials and fittings per diameter and class and for the class of bedding to be used.

CF.01.03

Replacement of manhole covers, grid inlets and the like

- (a) SABS 558 Type 4 - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

- (b) SABS 558 Type 4 - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

- (c) SABS 558 Type 2A - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

- (d) SABS 558 Type 2A - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm Unit: number
- (ii) Maximum dimension 301 mm - 600 mm Unit: number
- (iii) Maximum dimension 601 mm - 900 mm Unit: number
- (iv) Maximum dimension over 900 mm Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the cover/unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames from the site.

CF.01.04 Manholes and inspection chambers**CF.01.04.01 Raising or lowering of existing manholes or inspection chambers of all types:**

- (a) Raise/lower 0 m up to and including 0,5 m Unit: number
 (b) Raise/lower exceeding 0,5 m up to and including 1 m Unit: number

The unit of measurement shall be the number of manholes/inspection chambers raised/lowered within the specified dimensions.

The tendered rates shall include full compensation for all excavation (including around structures), levelling, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the manhole beds, the disposal of material, dealing with subsurface or surface water, benching and for other operations necessary for completing the work as specified.

Payment shall distinguish between soft and hard material. The tendered rates shall include full compensation for transporting the excavated material from the site.

CF.01.04.02 Breaking into existing sewer and building a new manhole

- (a) Precast concrete manhole:
- (1) Depth exceeding 0,5 m up to and including 1,0 m Unit: number
 (2) Depth exceeding 1,0 m up to and including 1,5 m Unit: number
 (3) Depth exceeding 1,5 m up to 2,0 m Unit: number

The unit of measurement shall be the number of manholes constructed within the specified dimensions.

The tendered rate shall include full compensation for excavation, building a new manhole over the sewer, breaking into the existing sewer, building the channelization under wet conditions, ensuring the watertightness of the new connection, supplying all the necessary materials, removing surplus material, all labour and equipment required to make the connection, and liaison with the local authorities. Provision for manhole covers shall be made under CF 01.03 payment.

CF.01.04.03 Connecting to existing sewer..... Unit: sum

The tendered sum shall include full compensation for excavation, making an opening in the existing manhole, installing new pipes in the new opening, for breaking out and modifying the channelization inside the manhole to suit the new pipe layout, ensuring the watertightness of the new connection, supplying all the necessary materials, removing surplus material and debris all labour and equipment required to make the connection, and liaison with the local authorities.

CF.01.04.04 Repair of channels..... Unit: metre (m)

The unit of measurement shall be the length of channel section repaired.

The tendered rate shall include full compensation for cleaning, patching, repairing of existing channels, irrespective of diameter and position. The rate shall also include all necessary materials, equipment and labour required.

CF.02 CLEANING OF SEWERAGE NETWORK**CF.02.01 Mechanical cleaning of sewer pipes and structures:**

- (a) Up to 150 mm Unit: metre
 (b) 151 mm to 300 mm..... Unit: metre
 (c) 301 mm to 450 mm..... Unit: metre
 (d) More than 450 mm Unit: metre

The unit of measurement shall be the metre of pipe cleaned, measured once along the soffit of the culvert. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for removing the material, for disposing of the material in an approved manner and ensuring that the material will not wash into drainage trenches.

CF.02.02 Chemical cleaning of sewer pipes and structures:

- (a) Up to and including 150 mm..... Unit: metre
 (b) 151 mm to 300 mm..... Unit: metre
 (c) 301 mm to 450 mm..... Unit: metre
 (d) More than 450 mm Unit: metre

The unit of measurement shall be the metre of pipe cleaned, measured once along the soffit of the culvert. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for supply of chemical agents, equipment, labour and the effective application of the cleaning process.

CF.02.03 Provision of equipment for visual inspection of underground pipe networks Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as TV surveillance equipment, torches, lights and mirrors, etc, to enable a thorough visual inspection of the pipe network.

CF.02.04 Use of CCTV surveillance equipment..... Unit: metre (m)

The unit of measurement shall be the metre of pipe inspected.

The rate shall be fully inclusive of all associated equipment and interpipe moves and recording equipment.

CF.02.05 Visual inspection of underground pipe network..... Unit: sum

The tendered sum shall include full compensation for all processes necessary to complete a thorough check of the sewer network including lifting and replacing manhole covers, using relevant equipment and any clearing necessary to allow the visual inspection to proceed.

CF.02.06 Demolition and removal of damaged existing structures:

- (a) Plain concrete..... Unit: cubic metre (m³)
 (b) Reinforced concrete Unit: cubic metre (m³)

- (c) Kerbing and channelling..... Unit: metre (m)
- (d) Pipework..... Unit: metre (m)

The unit of measurement for CF.02.06(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rates cubic metre capacity of the truck used to remove the material.

The unit of measurement for CF.02.06(c) and (d) shall be the metre length of kerbing and channelling or pipework removed.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

CF.03

TESTS AND INSPECTIONS

- (a) Pressure testing of pipelines **Unit: metre**

The unit of measurement shall be the length of sewer pipeline tested.

- (b) Testing of manholes..... **Unit: number**

The unit of measurement shall be the number of manholes tested after repair.

The tendered rates shall include full compensation for all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out relevant tests as per SABS 1200. Submission of certificates from tests and equipment and any costs involved in obtaining such from relevant authorities shall also be included in the tendered sum.

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CG SOLID WASTE MANAGEMENT

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CG 01 SCOPE

This specification covers the requirements for repair and maintenance work related to solid waste site and solid waste management.

Monthly maintenance responsibilities for Solid Waste (which forms part of installation CR3, Fencing, Cleaning and Site Keeping) including all units and components as specified, shall commence with access to the site (site handover).

CG 02 STANDARD SPECIFICATIONS

CG.02.01 GUIDELINES

This specification shall be read in conjunction with the guidelines on solid waste and landfill sites as stipulated by DWAF which shall be deemed to form part of these specifications.

CG 03 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CG 04 DETAIL OF REPAIR WORK

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

CG . 2

Any work related to solid waste identified by the Contractor or during inspection by the Engineer shall be carried out on the instruction of the Engineer.

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to maintain the waste disposal site in a state of good repair.

The work shall include repair of existing solid waste disposal sites, removal of litter, etc, around the site and the provision of adequate drainage facilities.

Apart from informal dumps, the Contractor shall be responsible for removing all scattered waste in order to clean the entire site to a clean and healthy state.

Collection of solid waste shall be performed under the guidance of the Engineer.

The Contractor shall transport solid waste collected across the entire site to a central container for removal to a disposal site off site. Removal of solid waste from the central container to a disposal site off site shall be the responsibility of the Contractor.

CG 04.01 **LITTER COLLECTION**

All litter and rubble shall be collected within the perimeter fences of the Port of Entry and Border line bases (as reflected on the layout diagrams) and removed and disposed of as specified.

CG 04.02 **WASTE COLLECTION**

Waste bins shall be provided at each residential unit. Additional waste bins shall be provided at the offices and service buildings. The waste bins at all residential units shall be cleaned out on a weekly basis. Waste bins in public areas shall be cleaned out daily. The storage of the solid waste at the solid waste disposal area until such time as it is removed from site will be the responsibility of the Contractor in a skip at a central location within the site. The disposal area shall be prepared and managed by the Contractor. The site shall be fenced-off (1.8 m high diamond mesh) and the entrance gate shall be locked at all times.

CG 04.03 **REMOVAL OF WASTE**

Removal of solid waste from the central solid waste container (skip) to a formal solid waste facility shall be the responsibility of the Contractor. All waste collected at the Port of Entry shall be relocated to the nearest off site waste disposal site on a weekly basis.

CG 05 MAINTENANCE

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

The whole of the site within the perimeter fences of the Port of Entry (as reflected on the layout diagrams) shall be kept free of litter, rubble and other solid waste. Litter and rubble (solid waste) shall be collected, stored by the Contractor and removed from the site as frequently as necessary, but at least weekly by the Contractor.

Storage of the collected solid waste until such time as it is removed from site shall be the responsibility of the Contractor. Solid waste shall be removed from the residential units to the waste disposal site at least weekly. Solid waste shall be removed from the central solid waste container (skip) provided by the contractor as frequently as necessary, but at least weekly.

Removal of household solid waste to the municipal/approved dump site will still be carried out by the Contractor. The cleanliness of the site, excluding all areas included within residential fences, will be the responsibility of the Contractor.

Garden refuse are amongst the litter and rubble to be collected and disposed of by the Contractor.

Solid waste maintenance forms part of Installation CR3. The tendered monthly payment for maintenance of Installation CR3 as based on the point system and listed in the schedule of quantities, shall be deemed to include all labour, material, tools, equipment and transport required to continuously collect litter and rubble across the entire site, placing it in a central solid waste container (skip) provided by the contractor and removing it off-site to a formal solid waste facility at least weekly.

TABLE CG 05/1

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Cleaning out of all waste bins in public areas	Daily
2	Cleaning out of all waste bins at residential units	Weekly
3	Collect litter, rubble and other waste across the entire site within the perimeter fences of the Port of Entry and place in central solid waste container (skip)	Continuously
4	Remove waste from skip to external approved waste disposal site	Weekly

CG 06 MEASUREMENT AND PAYMENT**CG.01 COLLECTION OF LITTER..... Unit: sum**

The unit of measurement for the collection of litter shall be a sum for the total area over which the litter is distributed.

The tendered rate shall include full compensation for the clearing of all litter within a 450 meter radius of the existing disposal site and the burying of the litter at the disposal site.

CG.02 LEVELLING OF SITE Unit: m²

The unit of measurement shall be the surface area of the site to be graded.

The importation of additional material shall be paid under CG.03.

CG.03 IMPORTATION OF FILL MATERIAL Unit: m³

The unit of measurement shall be cubic metres of fill measured as the transported volume. The rate shall be inclusive of excavation, transport ,and the distribution of the material at the disposal site.

CG.04 COVERING OF DUMPING SITE**(a) Lime cover Unit: m²**

The unit of measurement shall be the square metre of area covered with lime.

The tendered rate shall include provision of lime, spreading and finishing of the lime to a minimum depth of 20 mm.

(b) Topsoil cover Unit: m²

The unit of measurement shall be the square metre of area of topsoil placed.

The tendered rate shall include provision of topsoil, spreading and finishing of the material to a depth of 300 mm.

G.05 WASTE COLLECTION SKIP Unit: sum

The unit of measurement shall be a sum for the provision of a single skip at a central location within the prison.

The tendered rate shall be fully inclusive of supply and installation of the skip to the site required.

CG.06 FENCING Unit: m

The unit of measurement shall be the metre for the provision of a security fence around the perimeter of the disposal site. The fence shall be provided with a lockable double bay gate. The security area shall have three strands of barbed wire at the top as per the standard security fence drawing.

CG.07 CUT-OFF TRENCH Unit: m

The unit of measurement shall be the metre of length of the trench.

The tendered rate shall cover a trench varying between 0,5 and 1,0 m deep with 45° sloped sides, and the disposal of excess material within the prison grounds.

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CG 01 SCOPE

This specification covers the requirements for repair and maintenance work related to solid waste site and solid waste management.

Monthly maintenance responsibilities for Solid Waste (which forms part of installation CR3, Fencing, Cleaning and Site Keeping) including all units and components as specified, shall commence with access to the site (site handover).

CG 02 STANDARD SPECIFICATIONS

CG.02.01 GUIDELINES

This specification shall be read in conjunction with the guidelines on solid waste and landfill sites as stipulated by DWAF which shall be deemed to form part of these specifications.

CG 03 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

CG 04 DETAIL OF REPAIR WORK

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

CG . 2

Any work related to solid waste identified by the Contractor or during inspection by the Engineer shall be carried out on the instruction of the Engineer.

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to maintain the waste disposal site in a state of good repair.

The work shall include repair of existing solid waste disposal sites, removal of litter, etc, around the site and the provision of adequate drainage facilities.

Apart from informal dumps, the Contractor shall be responsible for removing all scattered waste in order to clean the entire site to a clean and healthy state.

Collection of solid waste shall be performed under the guidance of the Engineer.

The Contractor shall transport solid waste collected across the entire site to a central container for removal to a disposal site off site. Removal of solid waste from the central container to a disposal site off site shall be the responsibility of the Contractor.

CG 04.01 **LITTER COLLECTION**

All litter and rubble shall be collected within the perimeter fences of the Port of Entry and Border line bases (as reflected on the layout diagrams) and removed and disposed of as specified.

CG 04.02 **WASTE COLLECTION**

Waste bins shall be provided at each residential unit. Additional waste bins shall be provided at the offices and service buildings. The waste bins at all residential units shall be cleaned out on a weekly basis. Waste bins in public areas shall be cleaned out daily. The storage of the solid waste at the solid waste disposal area until such time as it is removed from site will be the responsibility of the Contractor in a skip at a central location within the site. The disposal area shall be prepared and managed by the Contractor. The site shall be fenced-off (1.8 m high diamond mesh) and the entrance gate shall be locked at all times.

CG 04.03 **REMOVAL OF WASTE**

Removal of solid waste from the central solid waste container (skip) to a formal solid waste facility shall be the responsibility of the Contractor. All waste collected at the Port of Entry shall be relocated to the nearest off site waste disposal site on a weekly basis.

CG 05 **MAINTENANCE**

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

The whole of the site within the perimeter fences of the Port of Entry (as reflected on the layout diagrams) shall be kept free of litter, rubble and other solid waste. Litter and rubble (solid waste) shall be collected, stored by the Contractor and removed from the site as frequently as necessary, but at least weekly by the Contractor.

Storage of the collected solid waste until such time as it is removed from site shall be the responsibility of the Contractor. Solid waste shall be removed from the residential units to the waste disposal site at least weekly. Solid waste shall be removed from the central solid waste container (skip) provided by the contractor as frequently as necessary, but at least weekly.

Removal of household solid waste to the municipal/approved dump site will still be carried out by the Contractor. The cleanliness of the site, excluding all areas included within residential fences, will be the responsibility of the Contractor.

Garden refuse are amongst the litter and rubble to be collected and disposed of by the Contractor.

Solid waste maintenance forms part of Installation CR3. The tendered monthly payment for maintenance of Installation CR3 as based on the point system and listed in the schedule of quantities, shall be deemed to include all labour, material, tools, equipment and transport required to continuously collect litter and rubble across the entire site, placing it in a central solid waste container (skip) provided by the contractor and removing it off-site to a formal solid waste facility at least weekly.

TABLE CG 05/1

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Cleaning out of all waste bins in public areas	Daily
2	Cleaning out of all waste bins at residential units	Weekly
3	Collect litter, rubble and other waste across the entire site within the perimeter fences of the Port of Entry and place in central solid waste container (skip)	Continuously
4	Remove waste from skip to external approved waste disposal site	Weekly

CG 06 **MEASUREMENT AND PAYMENT****CG.01** **COLLECTION OF LITTER**..... Unit: sum

The unit of measurement for the collection of litter shall be a sum for the total area over which the litter is distributed.

The tendered rate shall include full compensation for the clearing of all litter within a 450 meter radius of the existing disposal site and the burying of the litter at the disposal site.

CG.02 LEVELLING OF SITE Unit: m²

The unit of measurement shall be the surface area of the site to be graded.

The importation of additional material shall be paid under CG.03.

CG.03 IMPORTATION OF FILL MATERIAL Unit: m³

The unit of measurement shall be cubic metres of fill measured as the transported volume. The rate shall be inclusive of excavation, transport ,and the distribution of the material at the disposal site.

CG.04 COVERING OF DUMPING SITE**(a) Lime cover Unit: m²**

The unit of measurement shall be the square metre of area covered with lime.

The tendered rate shall include provision of lime, spreading and finishing of the lime to a minimum depth of 20 mm.

(b) Topsoil cover Unit: m²

The unit of measurement shall be the square metre of area of topsoil placed.

The tendered rate shall include provision of topsoil, spreading and finishing of the material to a depth of 300 mm.

G.05 WASTE COLLECTION SKIP Unit: sum

The unit of measurement shall be a sum for the provision of a single skip at a central location within the prison.

The tendered rate shall be fully inclusive of supply and installation of the skip to the site required.

CG.06 FENCING Unit: m

The unit of measurement shall be the metre for the provision of a security fence around the perimeter of the disposal site. The fence shall be provided with a lockable double bay gate. The security area shall have three strands of barbed wire at the top as per the standard security fence drawing.

CG.07 CUT-OFF TRENCH Unit: m

The unit of measurement shall be the metre of length of the trench.

The tendered rate shall cover a trench varying between 0,5 and 1,0 m deep with 45° sloped sides, and the disposal of excess material within the prison grounds.

TECHNICAL SPECIFICATION

CI PRESSED STEEL TANKS

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CI 08	MEASUREMENT AND PAYMENT

CI 01 SCOPE

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of pressed steel tanks for the storage of potable water:

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CI: Pressed steel tanks, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

CI 02 STANDARD SPECIFICATIONS

CI 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

CKS 114 - Pressed steel sectional tanks

CI 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

CI 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

CI 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CI 03 OPERATING AND MAINTENANCE MANUALS

No operating and maintenance manuals will be required for pressed steel tanks.

CI 04 EXECUTION OF REPAIR WORK

CI 04.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance Contract all the systems, installations and equipment shall be repaired as specified in the Specification. This repair work shall include but not be limited to the specified Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

CI 04.02 PRESSED STEEL PANEL RESERVOIRS

Pressed steel panel water tanks shall be installed where specified. The tanks shall be erected on stands on reinforced concrete bases or strip-foundations (or on plinths/dwarf foundation walls where so specified in the Schedule of Quantities). All foundations shall be designed by an engineer based on design parameters defined by the manufacturer. The Contractor is to submit Engineering Certificates for the tanks, stands and foundation designs for approval to the Engineer. The following table indicates the volume of the tanks available on site:

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NAME OF PORT OF ENTRY	TYPE OF TANK	TANK VOLUME (kℓ)
Van Rooyenshek	Elevated steel storage tank	33
	Elevated steel storage tank	33
	On ground steel storage tank	58

The tanks shall comply with the requirements of CKS 114 (Pressed steel sectional tanks) and shall consist of 1 220 mm square sectional mild steel plates of 4,5 mm minimum plate thickness for the sides and bottom and 3 mm thickness sectional steel roof cover plates (not normal roof sheeting), complete with the necessary bracing, nuts, bolts and washers and jointing material.

- (a) Lockable access manhole cover;
- (b) Internal and external cat ladder, fitted with protection cages;
- (c) Ventilator;
- (d) Inlet and outlet connection points;
- (e) Overflow;
- (f) A Vortex inhibitor shall be installed and shall comply in all respects to the ASIB requirements;
- (g) Level indicator of solid, simple but reliable construction shall be used and located near manhole for easy maintenance;
- (h) Drain outlet in bottom of reservoir;
- (i) A COPON KSIR88 internal lining consisting of two coats with a total thickness of 275 micron (where so specified in the Schedule of Quantities);
- (j) The reservoir stand shall withstand a wind speed of 40 metres per second with reservoir full or empty;
- (k) Stand to be equipped with walkway all round the reservoir and a ladder from ground level to walkway. The ladder shall comply with relevant ISO specification or equivalent for that type of structure. A safety cage is to be fixed to the ladder above 2,5 metres from ground level. The walkway shall also be equipped with a 1 m high industrial tubular type handrail all round with stanchions at maximum 1,5 m centres;
- (l) Sealing strips or sealing compound of a type suitable for an extremely hot, arid climate to be applied between the plate flanges. Sealing to be non-toxic and approved for use with drinking water;
- (m) All external pipe connection points supplied with tank (as detailed above) shall be flanged to SABS 1123 table 1600/3. All pipework outside the tank, connecting to flanges as mentioned above, will be measured elsewhere.

All mild steel tank components, structural steel stand, walkway and ladders including bolts, nuts and washers shall be hot-dipped galvanized after manufacture to the requirements of SABS 763. This includes any pipe fittings, etc for connections.

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The tanks shall be tested for watertightness after completion to the satisfaction of the Engineer and shall also be sterilized by the contractor after completion.

For all details of the tank, internal and external bracing, COPON lining, stand, walkway and ladders, written approval of the Engineer shall be obtained before manufacture. Workshop drawings shall be submitted to the Engineer timeously for his final approval of the concrete footings and the bending schedules.

All external pipe connection points supplied with tank shall be flanged to SABS 1123 table 1600/3, unless otherwise specified.

CI 04.03 LIGHTNING PROTECTION

The reservoirs shall be protected from the effects of lightning by the installation of a lightning-protection system which complies with the requirements of SABS Code of Practice 03.

The Contractor shall obtain the services of a firm specialising in the supply and installation of such systems. The firm which shall be approved by the Engineer, shall timeously submit drawings of the system to the South African Bureau of Standards for approval, and work may commence only after the approved plan has been submitted to the Engineer.

CI 04.04 STERILIZATION OF RESERVOIR

Before the reservoir is sterilized, the pipelines serving the reservoir shall have been sterilized. The reservoir shall then be thoroughly cleaned out and washed down with clean water.

The roof and walls shall thereafter be thoroughly sprayed down, using pressurised equipment, and the floors shall be scrubbed with the solution specified in sub-clause 5.10 of SABS 1200 L.

On completion of the sterilization, the sterilizing solution shall be run to waste before the reservoir is filled for testing watertightness.

Should additional work be required to be done inside the reservoir after the watertightness tests has been completed, the reservoir shall be resterilized at the Contractor's expense.

CI 04.05 TESTING FOR WATERTIGHTNESS

Water for testing shall be provided by the contractor and he shall be responsible for providing all necessary equipment required for filling the reservoir.

The reservoir shall be filled with water at a uniform rate until the top water level has been reached. The water level will then be carefully noted and recorded by the Engineer in relation to a fixed bench-mark.

The level of the liquid surface shall be recorded at 24 hour intervals for a test period of 7 days. During this 7-day test period the total permissible drop in level, after allowing for evaporation, shall be determined by the Engineer.

In the event of appreciable leakage being evident at any stage of the filling or testing or in the event of the Engineer considering the final degree of water tightness to be unsatisfactory, the Contractor when ordered by the Engineer shall discontinue such filling or testing and shall, at his own expense, take approved steps immediately to rectify the leakage until a satisfactory test is obtained, which shall prove to the Engineer that water tightness has been obtained.

The costs of emptying the reservoir shall be borne by the Contractor. The water shall be discharged in a manner approved by the Engineer and shall be such that the Employer can utilise the water if he so desires.

The water shall not be used as a medium for additives to effect remedial work or to stop leaks.

The costs of retesting the structure for water tightness shall be borne by the Contractor.

CI 04.06 ENGINEER'S CERTIFICATE

The Contractor shall obtain a certificate from a registered professional engineer stating that the tank, stand, ladders, walkway and tank lining have all been designed and manufactured in accordance with accepted engineering standards. This certificate shall cover all the tanks installed under the contract, but shall also refer to each tank individually. No payment shall be made for any of the tanks until such time as when the certificate has been provided to the Engineer and the Engineer finds it to be legitimate and acceptable.

CI 05 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

CI 06 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

CI 07 MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT**CI 07.01 GENERAL**

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance, as described in Additional Specification SA: General Maintenance, for the specified installations described under the Clause CI 01 of this specification.

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The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

CI 07.02 ROUTINE PREVENTATIVE MAINTENANCE

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Specification related to this work.

CI 08 MEASUREMENT AND PAYMENT

CI.01 Manufacture, supply and erection of a (specify size) kilolitre storage tank complete with (specify height) m high galvanized steel stand Unit : sum

The tendered sum shall include full compensation for procuring and furnishing all materials, labour, equipment, transport, loading, off-loading, assembly and erection of the tank and stand, complete as scheduled with all pipework connections, level indicator, and accessories, stand, platform, walkway, hand railing ladders, holding down bolts, anchor bolts and grouting of base plates, as well as for all corrosion protection as specified, all in accordance with the specification, drawings and manufacturer's instructions.

Where the storage tank is erected on plinths or dwarf foundation walls and not on a steel stand, it shall be scheduled as such and the tendered rate shall include bearer beams as necessary and shown on the drawings.

Note: Excavations, footings, plinths, dwarf foundation walls, etc, will be measured and paid for elsewhere, as well as external GMS pipework, specials and valves connecting to flanges.

CI.02 Lightning protection for (specify size) kilolitre storage tank Unit : sum

The tendered sum shall include full compensation for obtaining SABS approval of the drawings, and for installing and testing the lightning-protection system on the structure as specified on the approved drawings.

CI.03 Sterilization of (specify size) kilolitre storage tank Unit : sum

The tendered sum shall include full compensation for sterilizing the structure as specified in Clause CI 04.04.

CI.04 Testing for water tightness (specify size) kilolitre storage tank Unit : sum

The tendered sum shall include full compensation for the provision of all labour, plant, materials and water for testing as necessary to carry out the test as specified. Only one test per tank shall be measured for payment, regardless of the number of tests carried out to determine water tightness as per Clause CI 04.05.

CI.05 Engineer's certificate Unit : sum

The tendered sum shall include full compensation for obtaining the certificate as specified in Clause CI 04.06 to the satisfaction of the Engineer. One certificate shall be obtained in respect of all the tanks supplied and installed under this contract."

TECHNICAL SPECIFICATION**CJ SITE KEEPING AND CLEANING****CONTENTS**

CJ 01	SCOPE
CJ 02	STANDARD SPECIFICATIONS
CJ 03	EXECUTION OF REPAIR WORK
CJ 04	MAINTENANCE
CJ 05	MEASUREMENT AND PAYMENT

CI 01 SCOPE

This specification covers the cleaning and site keeping of the facilities at the various installations. The scope of work has been divided into:

- Site keeping; and
- Cleaning of offices and support facilities.

CJ 01.01 SITE KEEPING

The area where site keeping is to be performed is the area included within the perimeter fence of the applicable installation and all areas falling within fenced-in residential properties (See Table CJ 01.01). Site keeping will include removal of rubble, removal of weeds, shrubs and other objects and cutting of the grass.

01.01.01 TABLE: OPEN AREAS

TABLE CJ 01.01.01: AREAS

NO	LOCATION	AREA	DESCRIPTION
<u>1</u>	Van Rooyenshek Port of Entry Open areas (Site Keeping)	61 372m ²	All areas included within the perimeter fence and all areas falling within fenced in residential properties. Waste and Rubble control 20 m around the outside perimeter of the Port of Entry.

CJ 02.01 CLEANING OF OFFICES AND SUPPORT FACILITIES

All offices, ablutions and support buildings are to be cleaned and maintained in a sanitary condition at all times.

CJ 02.02 ABLUTION EQUIPMENT AND CLEANING AGENTS

All offices, ablutions and support buildings are equipped with sanitizing and abluion equipment which must be maintained at all times. The following indicates the equipment that must be maintained in working order as well as providing of consumables such as toilet paper, hand-wash soap, air fresheners refills, sanitizer refills and plastic refuse bags for all waste bins and sanitary bins which will be the responsibility of the Contractor.

TABLE CJ 01.02: EQUIPMENT

INSTALLATION	QTY	TYPE
VAN ROOYENSHEK	97	Taps
	35	WC Pans and Cisterns
	6	Urinals including junior flush masters
	29	Wash hand basins
	19	Kitchen Sinks
	0	Wash troughs
	10	Baths
	9	Showers
	18	Geysers
	4	Hand dryer units
	6	Air fresheners
	24	Toilet roll holders
	6	She bins
	6	Soap dispensers
4	Urinal dispensers	

CI 02 STANDARD SPECIFICATIONS**CJ 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

CODE	DESCRIPTION
CKS 285-1971	Dispensers for paper towels
CKS 340-1979	Plastic Refuse Bags (Disposable)
SANS 1344:2009	Medium duty solvent detergent
SABS 1868	Gel detergent cleaner (non-abrasive)
SANS 1887-1:2008	Tissue paper Part 1: General requirements
SANS 1887-2:2008	Tissue paper Part 2: Toilet paper
SANS 1887-4:2008	Tissue paper Part 4: Paper towels
SANS 1924:2007	Toilet soaps intended for use in dispensers
SANS 60335-1:2007	Household and similar electrical appliances – Safety Part 1: General requirements
SANS 60335-2-67:2003	Household and similar electrical appliances – Safety Part 2-67: Particular requirements for floor treatment and floor cleaning machines, for industrial and commercial use

CJ 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

**CJ 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AN
INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

CJ 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

CI 03 EXECUTION OF WORK

CJ 03.01 GENERAL

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to accommodate the site keeping and cleaning of the facilities.

The Contractor shall be responsible for cleaning ablution facilities as frequently as necessary to maintain them in a clean and healthy condition. The actions outlined serve only as a benchmark for the cleaning and maintaining of the facilities.

The ablution facilities and operational buildings will be kept clean during the operational periods of the Port of Entry as indicated below:

(i) Van Rooyenhek Port of Entry is operational from 6am to 10pm, 7 days a week.

Cleaning activities will include providing all cleaning agents and equipment necessary for cleaning.

Providing of consumables such as toilet paper, hand-wash soap, air fresheners refills, sanitizer refills and plastic refuse bags for all waste bins and sanitary bins will be the responsibility of the Contractor.

CJ 03.02 ABLUTIONS

Each ablution facility shall be equipped with the following equipment:

- 1) Hand Dryer.
- 2) Stainless steel air freshener.
- 3) Stainless steel toilet paper dispenser units.
- 4) Stainless steel she bins.
- 5) Stainless steel hand soap dispensers.
- 6) Stainless steel sanitizer.
- 7) Stainless steel paper towel dispenser.
- 8) Stainless steel wall bin.

CJ 03.02.01 Hand Dryer

The hand dryer unit shall comply with at least the following specifications:

- Blower Output: 450 W @ 20 000 rpm;
- Air Heater Output: 900 W;
- Air Flow Rate: 81 meters per second @ 100 mm from the air outlet nozzle;
and
- Air Temperature: 55 °C @ 100 mm from the air outlet nozzle.

The hand dryers units shall be of the wall mounted kind and shall be installed in accordance with the manufacturer's specifications.

CJ 03.02.03 Toilet Paper Dispensing Unit

The stainless steel toilet paper dispensing units shall be able to accommodate two standard size 500 sheet single-ply toilet paper rolls and shall be lockable. The device shall be wall mounted.

CJ 03.02.04 She Bin

One stainless steel she bin shall be supplied for each of the female ablutions. The she bins shall possess a self-closing lid and shall accommodate for plastic bag liners which can be removed and replaced with a new liner.

CJ 03.02.05 Hand Soap Dispenser

There shall be at least one stainless steel liquid hand soap dispenser per abluion. The liquid soap dispenser shall be of the wall mounted kind. The dispenser shall dispense a metered amount of liquid soap.

CJ 03.02.06 Urinal Sanitizer Dispenser

There shall be one stainless steel, battery operated, wall mounted, urinal sanitizer dispenser per urinal.

CJ 03.02.07 Paper Towel Dispenser

The paper towel dispenser shall comply with CKS 285-1971. The unit shall be a Type 2, closed dispenser designed to dispense paper towels in sheets. There shall be at least one stainless steel wall mounted paper towel dispenser per abluion.

CJ 03.02.08 Wall Bin

There shall be one stainless steel wall bin per abluion. The wall bin shall possess a self-closing lid and shall accommodate for plastic bag liners which may be removed and replaced with a new liner. The device shall be wall mounted.

CJ 04 MAINTENANCE**CI 04.01 GENERAL**

The maintenance work to be performed under site keeping and cleaning shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this specification.

Maintenance implies and shall include routine cleaning (which is the equivalent of routine preventative maintenance), routine preventative maintenance of site keeping and cleaning equipment, corrective cleaning (which is the equivalent of corrective maintenance), corrective maintenance of site keeping and cleaning equipment as well as breakdown maintenance of all site keeping and cleaning equipment.

The maintenance scope in terms of site keeping is set out in Table CJ 01.01.01.

The maintenance scope in terms of cleaning is set out in Table CJ 01.02

The maintenance scope in terms of equipment is set out in Table CJ 01.03.

Monthly maintenance responsibilities for site keeping and cleaning of installations shall commence with access to the site. The maintenance schedules and

frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

Remuneration for maintenance of site keeping and cleaning will be deemed included in the tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance and in accordance with installation: CR3: Cleaning and Site Keeping.

CJ 04.02 ROUTINE PREVENTATIVE MAINTENANCE

The tasks related to routine preventative maintenance work shall include but not be limited to the general actions listed in Table CJ 04.02.01 and CJ 04.02.01 and CJ 04.02.03 below. Please note that the operational times for the Port of Entry is from as follows:

(i) Van rooyenshek Port of Entry is operational from 6am to 10pm, 7 days a week.

TABLE CJ 04.02.01: SITE KEEPING

No.	ROUTINE PREVENTATIVE MAINTENANCE TASKS	FREQUENCY
1.	Cleaning out of and supply of black refuse bags to all waste bins in public areas.	At least daily
2.	Watering of plants, shrubs, grass and trees	Weekly
3.	Removal of weeds	Weekly
4.	Clearing of weeds and grass along the edges of paved areas.	Weekly
5.	Cutting of grass. <i>No grass to exceed the length of 50 mm.</i>	Monthly
6.	Cutting of grass at residential units. <i>No grass to exceed the length of 30 mm.</i>	Weekly
7.	Restore lawns	Monthly
8.	Trimming of dense shrubs.	2 Monthly
9.	Fertilisation of lawns	Quarterly
10.	Fertilisation of flower beds and trees	Quarterly
11.	Removal of undesirable shrubs	Quarterly
12.	Trimming of trees where branches cause obstruction.	Quarterly
13.	Collecting of litter and foreign objects.	Continuous

TABLE CJ 04.02.02: CLEANING OF OFFICES AND SUPPORT FACILITIES

	ACTION	FREQUENCY
1.	Cleaning of floors in public areas and open plan offices	Daily (before opening of port of entry)
2.	Cleaning of counter tops and under counter shelves in public areas and open plan offices.	Daily (before opening of port of entry)
3.	Emptying of waste baskets in offices and service buildings	Daily
4.	Cleaning of office floors	Daily
5.	Vacuum carpets	Weekly

6.	Clean carpets	Six Monthly
7.	Washing of windows and dusting of window sills and ledges	Weekly
8.	Clean and polish all fittings	Weekly
9.	Washing of interior and exterior walls	Monthly
10.	Dusting of interior of the building to remove dust and spider webs	Weekly
11.	Clean and polish all vinyl floors	Monthly

TABLE CJ 04.02.03: CLEANING OF ABLUTION FACILITIES

	ACTION	FREQUENCY
1.	Cleaning and ensuring that the ablution facilities are in a sanitary condition	Continuous
2.	Washing and cleaning of floors	Daily
3.	Empty and clean all waste receptacles	Daily
4.	Clean all bowls, basins and urinals	Daily
5.	Clean and polish all fittings and mirrors	Daily
6.	Washing and cleaning out of she bins	Twice weekly
7.	Washing of windows and dusting of window sills, ledges, pipes and fittings	Weekly
8.	Washing of walls	Weekly
9.	Dusting of interior of the building to remove dust and spider webs	Weekly

CJ 04.03 SITE KEEPING AND CLEANING EQUIPMENT

All site keeping and cleaning equipment will be supplied by the Contractor and shall be maintained in a perfect working order for the duration of the Contract period. Remuneration for provision of cleaning equipment will be deemed included in the monthly tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance.

CJ 04.03.01 Grass, Shrub and Tree Cutting Equipment

Distinction will be made amongst 4 different types of grass, shrub and tree cutting equipment:

1. Light duty grass and shrub cutter (Weed Eater)

The light duty grass and shrub cutter shall be similar to a light duty Brush cutter and comply with the following:

Nylon or blade head;
Minimum displacement of 40.2 cm³;
Minimum power output of 1.6 kW; and
Length of 1.77 m.

2. Heavy duty shrub and tree cutter

The heavy duty shrub and tree cutter shall be similar to a heavy duty Brush cutter and comply with the following:

Blade head;
Minimum displacement of 51.7 c m³;
Minimum power output of 2.4 kW;
Length of 1.69 m.

3. Lawn mower for small lawns

The lawn mower for small lawns to be used at the residential areas shall comply with at least the following:

Walk behind 4 stroke petrol self propelled rotary mower;
Power output of 4 kW;
422 mm cutting width;
200 mm heavy duty sealed ball bearing wheels; and
54 litre polymer catcher with metal lining.

4. Lawn mower for large lawns

The lawn mower for large lawns shall comply with at least the following:
Walk behind 4 stroke petrol self propelled rotary mower;

Power output of 12 kW;
750 mm cutting width;
Rubber wheels.

CJ 04.03.02 Vacuum Cleaner

Vacuum cleaners shall be wet and dry and comply with at least the following:

Tank capacity: 25 litre
Cable length: 10 m
Airflow rate: 56 litre per second

CJ 04.03.03 Carpet Cleaner

Carpet cleaners shall comply with at least the following:

Tank capacity fresh water: 40 litre
Tank capacity dirty water: 25 litre
Cable length: 10 m
Suction motor: 2 x 1250 W;
Airflow rate: 2 x 60 litre per second
Pump delivery: 2.8 litre per minute @ 3 bar
Carpet cleaners shall be similar to Wetrok's Extravac 400.

CJ 04.03.04 Mop and bucket system

A two bucket mopping system shall be provided and be fitted with metal wringers. The mops provided shall be suitable for use with the buckets provided. Mop and bucket systems shall be similar to Wetroks Socar L40.

CJ 04.03.05 Window cleaning kit

Window cleaners shall have a telescopic handle with a length of 0.5 to 3 m. It shall be possible to fit squeegees and brushes to the telescopic handle as required in order to clean windows. A bucket with capacity of at least 10 litres shall be provided that is suitable for use with the window cleaning kit.

CJ 04.03.06 Sign boards

Sign boards shall be yellow in colour, free standing and printed on both sides. It shall clearly indicate the dangerous situation.

CJ 04.04 CONSUMABLES FOR SITE KEEPING AND CLEANING

Provision of consumables will be the responsibility of the Contractor. Remuneration for provision of consumables will be deemed included in the monthly tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance

CJ 04.04.01 Refuse Bags

Refuse bags shall comply with CKS 340-1979.

CJ 04.04.02 Toilet Paper

Toilet paper shall comply with SANS 1887 Part 1 & Part 2.

Toilet paper provided shall be single-ply, soft with a nominal number of 500 sheets per roll and a nominal outside diameter of 125 mm.

CJ 04.04.03 Toilet soap for hand soap dispensers

Toilet soap shall comply with SANS 1924:2007 – Toilet soaps intended for use in dispensers.

Toilet soap shall be Type 1, liquid toilet soap and shall be perfumed. The toilet soap shall be suitable for use in the hand soap dispensers provided.

CJ 04.04.04 Biological detergent for urinal dispenser

The urinal dispenser detergent may not contain any disinfectants. A biological detergent shall be used. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign).

The biological detergent shall be similar to Nu Flush from Innu-Science.

CJ 04.04.05 Air freshener

Air freshener shall be supplied that is suitable for use in the air freshener doser. Air fresheners shall be similar to Technical Concepts' Neutrale Metered Aerosols (available from Steiner Hygiene).

CJ 04.04.06 SHE bin liners

SHE bin liners shall be provided that is suitable for use in the she bins.

CJ 04.04.07 Paper towels

Paper towels shall comply with SANS 1887 Part 1 & Part 4. Paper towels provided shall be supplied in packets of folded towels that can be dispensed from the supplied paper towel dispenser without sticking or other undue difficulty.

CJ 04.04.08 Wall bin liners

Wall bin liners shall be provided that is suitable for use in the wall bins.

CJ 04.04.10 Biological detergents for cleaning of ablutions and public areas

Disinfectants and Detergent-disinfectants shall not be allowed to clean ablutions and public areas. A biological detergent shall be used. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign).

The biological detergent shall be similar to Nu Kleen Smell from Innu-Science.

CJ 04.04.11 Medium duty solvent detergent

Medium duty solvent detergents shall comply with SANS 1344:2009 medium duty solvent detergent. It shall be used in cases where surfaces, walls and floors are soiled with oil, grease or similar soils.

A biological detergent may be used as an alternative where surfaces are soiled with oil, grease or similar soils. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign).

CJ 04.04.12 Other

Brooms, dusters and muslin cloths shall be seen as consumables.

The Contractor shall furthermore be responsible for the supply of batteries for all battery operated equipment, e.g. the urinal sanitizer and the air freshener dozer.

CJ 04.05 SOLID WASTE MANAGEMENT

All solid waste that is generated as a result of site keeping and cleaning shall be managed in accordance with specification CG Solid Waste.

CJ 05 MEASUREMENT AND PAYMENT

CJ.05.01 HAND DRYERS

Unit
No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

CJ.05.02	<u>AIR FRESHENER DOSERS</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.03	<u>TOILET PAPER DISPENSING UNITS</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.04	<u>SHE BINS</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.05	<u>HAND SOAP DISPENSER</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.06	<u>URINAL SANITIZER</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour and installation and commissioning of the urinal sanitizer. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.07	<u>PAPER TOWEL DISPENSER</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
CJ.05.08	<u>WALL BIN</u>	Unit No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	

D

RAW WATER WORKS

TECHNICAL SPECIFICATION**DA BOREHOLE PUMP SYSTEMS****CONTENTS**

DA 01	SCOPE
DA 02	STANDARD SPECIFICATIONS
DA 03	OPERATING AND MAINTENANCE MANUALS
DA 04	EXECUTION OF REPAIR WORK
DA 05	GENERAL SPECIFICATION FOR ELECTRIC MOTORS
DA 06	TESTING AND COMMISSIONING
DA 07	MAINTENANCE
DA 08	MEASUREMENT AND PAYMENT

DA 01 SCOPE

This specification covers the decommissioning, removal, repair and reconditioning, installation, testing, commissioning and maintenance of borehole pumping equipment, motor control devices and low-voltage cables. It also includes the pump testing of all boreholes to determine the borehole yield and optimum use of each borehole. The function of borehole pump systems shall be delivery of raw water at a specified flow rate and head to the required location.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

DA 02 STANDARD SPECIFICATIONS**DA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS 5316, Part 1	- Acceptance tests for centrifugal, mixed flow and axial pumps
SABS 948	- Three-phase induction motors
SABS 1222	- Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
BS 4999	- General requirements for rotating electrical machines
ISO 281/1	- Rolling bearings – dynamic load ratings and rating life.

DA 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

DA 02.03 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

DA 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

DA 03 **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

DA 04 **EXECUTION OF REPAIR WORK**

DA 04.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The work required shall include, but not be limited to the following:

- (a) Removal of existing equipment;
- (b) Installation of temporary pumps;
- (c) Pump testing to determine safe yield;
- (d) Ground-water sampling;
- (e) Compilation of borehole recommendation report.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the borehole pump systems shall be categorised under the following headings:

- (a) Pump testing of boreholes
- (b) Repair of existing structures
- (c) Repair/replacement of electrical components.

DA 04.02 CLASSIFICATION OF BOREHOLES

The boreholes shall be inspected by the Contractor and the Engineer to confirm the classification of the boreholes in accordance with the guidelines below:

CLASS I	CLASS II	CLASS III	CLASS IV
Existing pump and motor in working order	Existing pump and motor require repair	Not equipped	Not equipped
Has connecting pipework	Has connecting pipework	Has connecting pipework	No connecting pipework
REPAIR WORK			
Routine maintenance	Repair pump and motor	Pump test Replace pump and motor	Abandon borehole

The above classification shall be used to determine the degree of repair work required.

DA 04.03 PUMP TESTING OF BOREHOLES

This section covers the requirements of the pump testing of the boreholes.

DA 04.03.01 Construction

It will be the responsibility of the Contractor to arrive on site with all equipment and materials required to complete the work without interruption.

The Contractor shall provide suitable plant to enable the installed pumping equipment to be removed and reinstalled. This includes the removal and reinstallation of motorised pumps and may also include the recovery of existing pumping equipment previously lowered into a borehole.

(a) Arrival-on-site actions

The Contractor shall firstly establish whether or not the borehole is equipped. If so, the Contractor will be required to:

- (1) Remove the equipment, taking care not to damage either the equipment or the installation,
- (2) inspect the equipment for defects, and
- (3) note down all particulars regarding the equipment and the installation.

The latter shall include but not be limited to the make and type of pump (and motor if motorised), the depth to which the pump was installed, the power rating of the motor and the diameter, length and quantity of pump column sections.

The Contractor shall next establish whether there are any other boreholes in the vicinity that need to be tested. Should this be the case, the following information shall be gathered and recorded for each borehole:

- (1) The straight-line distance (in metres) between each such borehole to be tested;
- (2) whether the borehole is equipped, open or sealed and, if equipped,
- (3) whether the installation is operational or not.

Depending on the degree of access available to such a borehole, the Contractor shall improve the access until it is adequate to reach the borehole and establish whether there is water in the borehole and if so, measure and record:

- (1) The depth to the ground-water rest level;
- (2) the height of the borehole collar above ground level, and
- (3) the depth of the borehole.

The final activities to be carried out prior to the actual installation of the test pump into the borehole to be tested shall comprise measuring and recording:

- (1) The diameter of the borehole;
- (2) the depth of the borehole as determined by means of a weighted line or plumb bob, and
- (3) the depth to the ground-water rest level in the borehole, with reference to a date level.

(b) Test pump installation

The conduit tube shall be attached and secured to the first section of pump column behind the pump element and the test pump installed to the required depth, attaching and securing the conduit tube to the riser main every 2 to 3 metre. If the pump installation depth has not been specified by the Engineer beforehand, then the depth must be determined on the basis of the guidelines provided in table DA 04.02.01/1.

The Contractor will be remunerated for the installation of a test pump per linear metre of depth installed at the rate tendered as set out in the Schedule of Quantities.

TABLE DA 04.02.01/1 GUIDELINES FOR TEST PUMP INSTALLATION DEPTH IF NOT SPECIFIED

DEPTH OF WATER IN BOREHOLE	TEST PUMP INSTALLATION DEPTH
Less than 5 m	Do not install the test pump
Between 5 m and 30 m	± 2 m above the bottom of the borehole
Between 30 m and 60 m	± 3 m above the bottom of the borehole
Between 60 m and 90 m	± 4 m above the bottom of the borehole
More than 90 m	± 5 m above the bottom of the borehole
<p>NOTE:</p> <ol style="list-style-type: none"> 1. Depth of water in borehole is calculated as the difference between the total depth of the borehole and the depth to the ground-water rest level as measured. 2. ± denotes a variation of not more than 0,5 m either way. 	

(c) Equipment set-up and pre-test actions

Where possible, the discharge pipe must be laid in a downhill direction from the borehole to be tested, provided this will take the pipe in the direction of or past another borehole located in the vicinity of the borehole to be tested. In such instances, lay the discharge pipe in a downhill direction that will take its furthest end as far as possible away from any other borehole in the vicinity.

In field situations where the terrain is extremely flat, the length of the discharge pipe shall be extended from 50 m to at least 300 m if any possibility exists that the discharged water may infiltrate to the ground-water resource within the radius of influence of the test. The dip meter should be inserted into the installed conduit tube and run down this tube to the bottom. Make sure that it passes freely down the full length of the tube. If the dip meter used is not graduated to an accuracy of 0,01 m, the position is to be marked on the dip meter cable indicating the depth to the ground-water rest level, and the end of the graduated tape attached at this position on the cable ensuring that the zero mark of the graduated tape corresponds exactly to this mark. Slowly lower the dip meter and graduated tape down the conduit tube, in the process securing the tape to the dip meter cable every 2 to 3 metre. Ensure that there is no slack between each point where the tape is secured to the dip meter cable. Also make sure that the dip meter cable and graduated tape combination passes freely along the full length of the conduit tube.

The Contractor will be remunerated for this work per set-up at the rate tendered for one such activity as set out in the Schedule of Quantities.

(d) Final pre-test measurements

The Contractor shall ensure that all the basic information required on the field data sheet is collected and recorded as completely as possible. The basic information data entry fields can be used as a checklist for information to be measured/collected and recorded. The Contractor shall not guess any information which has not been measured.

Payment for this work shall be incorporated into the payment for data recording as described below.

(e) Data recording

(i) Discharge measurements

The measurement of discharge (yield or pumping rate) must be consistently accurate and reliable and shall be appropriate to meet this requirement. Where volumetric calculation methods are applied, time will be measured using a stopwatch and the container volume must be accurately known. The volumetrically measured yields recorded on the field data sheets shall be based on the average obtained from a set of three sequential measurements. Guidelines for the number and periodicity of discharge rate measurements for each type of test are given in table DA 04.02.01/2.

TABLE DA 04.02.01/2 NUMBER OF PERIODICITY OF DISCHARGE RATE MEASUREMENTS

TYPE OF TEST	DISCHARGE RATE MEASUREMENTS	
	NUMBER	PERIODICITY
Calibration test	2 per step	At ± 5 and ± 10 minutes into each step
Stepped discharge test	5 per step	At ± 5 , ± 15 , ± 30 , ± 60 and ± 90 minutes into each step
Constant discharge test	See periodicity column	At ± 5 , ± 15 , ± 30 , ± 60 , ± 90 and ± 120 minutes into test and every 60 minutes thereafter for the full duration of pumping

(ii) Water-level measurements

Rigid guidelines for the periodicity of water-level measurements for each type of test are given in table DA 04.02.01/3. This information can be found duplicated on the field data sheets which must be filled in as a record of all data collection activities carried out for a pumping test. The type of water-level measurement values required to be recorded on the field data sheets are the actual (or true) draw down values. These values represent measurements which reflect the depth of the water level below the ground-water rest level depth, ie which already take into account the ground-water rest level depth below the reference measuring point. It shall be noted that the more basic type of measurement which reports the depth of the dynamic water level as a distance below the reference measuring point, ie which combines the depth of the water level below the ground-water rest level depth and the depth of the ground-water rest level below the reference measuring point, gives only an apparent (or false) draw down value. All water-level measurements must be measured to an accuracy of at

DA . 7

least 0,01 m (10 mm). The water-level data shall be plotted on the semi-logarithmic graph paper provided with each set of field data sheets. The plotting of the data shall be done as the test proceeds, ie each water-level measurement shall be plotted on the graph as soon as possible after measuring. The field data sheets and accompanying water-level graphs shall be shown to authorised supervisory personnel at request and shall be up-to-date at the time of such request.

(iii) Other information

The Contractor shall also record any extraordinary observations made during the test. These may include:

- (1) Changes in the colour of the discharged water;
- (2) changes in the turbidity of the discharged water;
- (3) the presence of air in the discharged water, and
- (4) rainfall events which occur during a test.

Remuneration for all data collection and recording activities by the Contractor in the course of a pumping test shall be incorporated into an hourly rate as set out in the Schedule of Quantities.

TABLE DA 04.02.01/3 PERIODICITY (IN MINUTES) OF WATER-LEVEL MEASUREMENTS DURING PUMPING TESTS

CALIBRATION TEST	STEPPED DISCHARGE TEST	CONSTANT DISCHARGE TEST	RECOVERY TEST
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
7	7	7	7
9	9	9	9
12	12	12	12
15	15	15	15
	20	20	20
The above periodicity (measured in minutes	25	25	25
after the start of each increased pumping	30	30	30
rate) must be followed for each step of the	40	40	40
calibration test	50	50	50
	60	60	60
	70	70	70
	80	80	80
	90	90	90
	100	120	120
		150	150
	The above periodicity (measured in minutes	180	180
	after the start of each increased pumping	210	210
	rate) must be followed for each step of the	240	240
	stepped		
	discharge test	Every 60 minutes to end of pumping	Every 60 minutes to end of recovery

(f) Test pumping of boreholes

The Contractor may be required to test existing "older" boreholes which may or may not already be equipped with pumping installations.

Test pumping serves two primary objectives. The first of these is an assessment of the productive capacity (yield potential) of the borehole. The second objective addresses the productivity of the ground-water resource. These objectives are met by various types of borehole tests performed separately and often sequentially. These tests are identified as:

- (i) The slug test
- (ii) the calibration test
- (iii) the stepped discharge test
- (iv) the constant discharge test
- (v) the recovery test.

Factors determining which of these tests shall be performed include:

- The potential yield of the borehole, and
- the amount of water which it will be required to supply.

(i) The slug test

The slug test provides a rapid means of assessing the potential yield of especially low yielding (less than 1 litre/s) boreholes (Vivier *et al*, 1995). The results may indicate whether it is feasible and warranted to perform other tests on the borehole. As with any of the other tests, a slug test can be executed in any borehole and not necessarily only newly drilled boreholes.

The test involves measuring the water-level response in a borehole to the rapid displacement of water therein. This displacement might cause either -

- (1) a rise in water level, as would result from the introduction of a slug below the rest water level, or
- (2) a drop in water level, as would be caused by the removal of a quantity of water from the borehole.

In instances where a slug is introduced, the water level will recede to its original level. The sudden removal of a quantity of water from the borehole will cause the water level to rise to its original level. The rate of recession or rise provides an indication of the yield of the borehole. In qualitative terms the more rapid this is, the higher the potential yield of the borehole.

(ii) The calibration test

A calibration test requires that water be pumped from the borehole at three or more different rates over short (15 minutes) sequential periods. The response of the water level to each known pumping rate is measured and recorded. The calibration test provides a means of assessing the yield potential of borehole according to the magnitude of the water-level decline associated with each pumping rate. This information is used to select appropriate pumping rates at which to perform a stepped discharge test or a pumping rate at which to perform a constant discharge test.

(iii) The stepped discharge test

Also known as a step draw down test, this test is performed to assess the productivity of a borehole. It also serves to more clearly define the optimum yield at which the borehole can be subjected to constant discharge testing if required. The test involves pumping the borehole at three or more sequentially higher pumping rates, each maintained for an equal length of time, generally not less than 60 minutes and seldom longer than 120 minutes. A step length of 100 minutes is recommended. The magnitude of the water-level draw down in the borehole in response to each of these pumping rates must be measured and recorded in accordance with a prescribed time schedule. The actual pumping rate maintained during each "step" must also be measured and recorded. As a rule, the rate of water-level recovery for a period of time immediately following the period of pumping should also be monitored according to the same time schedule as during pumping.

(iv) The constant discharge test

A constant discharge test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. This response can be analysed to provide information in regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. This test entails pumping the borehole at a single pumping rate which is kept constant for an extended period of time. The test duration shall not be less than 12 hours and, in some instances, might last up to 72 hours or more. The duration is generally determined by the importance which is attached to the borehole and ground-water resource not only in terms of its yield potential but also in terms of its intended application.

The pumping rate is set at a yield which it is considered the borehole and ground-water system will be able to maintain for the entire planned duration of the test and, in the process, utilising better than 70 per cent but not exhausting the available draw down. It is critical that the pumping rate during the entire duration of the test be kept as constant as possible. The draw down in water level in the borehole during the course of the test is again measured and recorded according to a prescribed time schedule. In the case of this type of test, it is imperative that water-level measurements be made during the recovery period following the end of pumping.

(v) The recovery test

This test provides an indication of the ability of a borehole and ground-water system to recover from the stress of abstraction. This ability can again be analysed to provide information with regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. Although referred to as a test, it rather represents a period of monitoring activity following a period of pumping. The rate at which the water level in the tested borehole (or any other borehole affected by the abstraction) recovers towards its starting level (the ground-water rest level before pumping started) is monitored in this period. The duration of this monitoring is generally equal to that of the preceding period of pumping unless the rate of recovery is sufficiently rapid so that the starting water level is reached in a shorter period of time.

(g) General approach and methodology

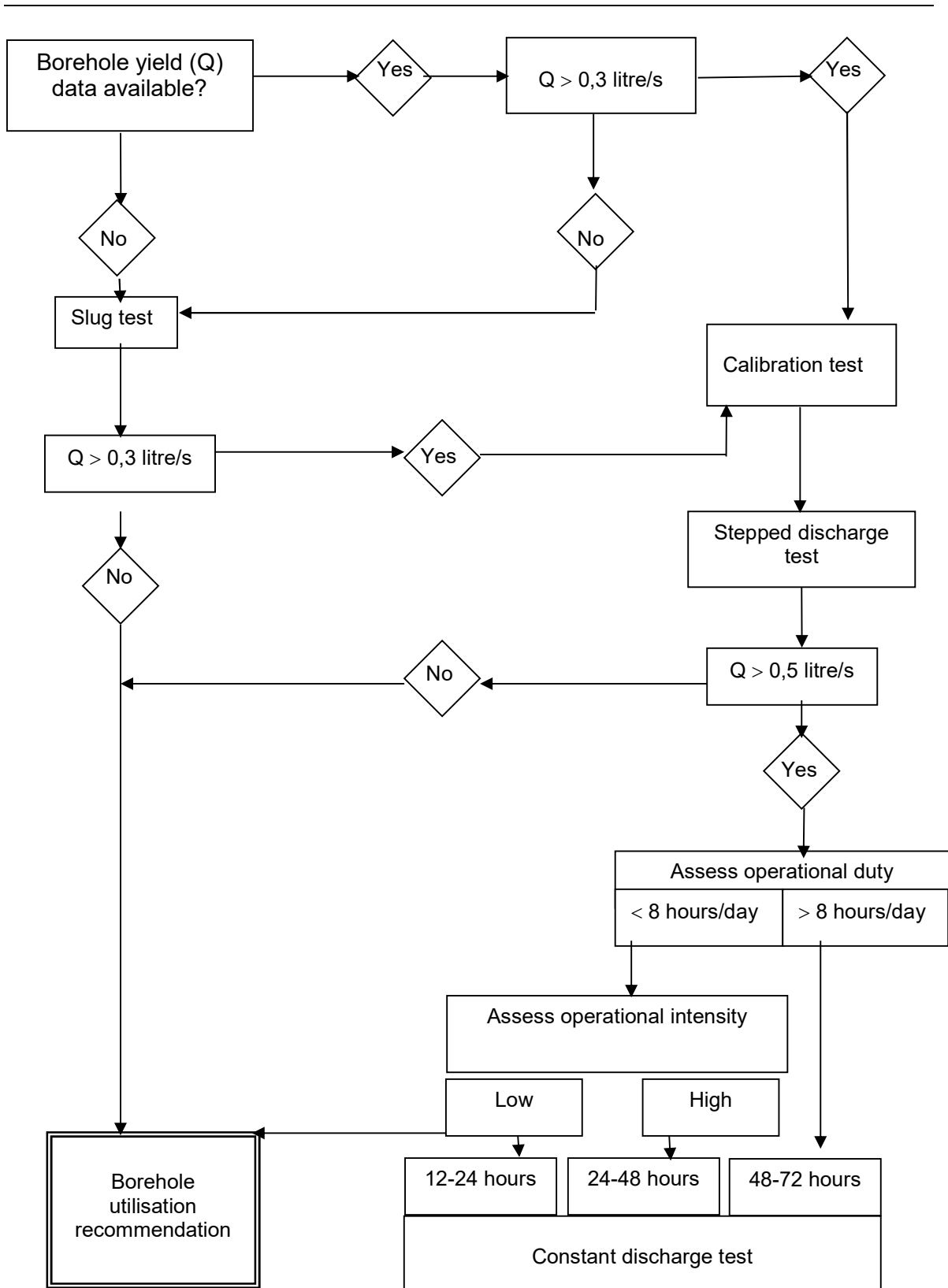
The Engineer will formulate a test pumping schedule for each borehole. The flow diagram presented overleaf provides an indication of the considerations which determine the scope of test pumping based on a logical decision-making process.

All project-related test pumping activities will also be carried out under the direct supervision of the Engineer. The execution of a pumping test in accordance with established scientific protocols must be undertaken by a suitably experienced and equipped testing contractor. The South African Bureau of Standards (SABS) is finalising a Standard Code of Practice titled *The test-pumping of water boreholes*. A draft of this Standard has been considered in the compilation of this document. It will be the task of the Engineer to evaluate and analyse the data, draw conclusions with regard to the productivity of the borehole and the aquifer, and make recommendations with regard to a suitable operating schedule for the borehole and the optimum exploitation of the ground-water resource.

Both the practical and analytical aspects of test pumping benefit greatly from prior information regarding the borehole and the aquifer which it taps into. This information is gleaned during the drilling and the construction of the borehole. It includes knowledge of:

- (1) The amount of water blown out of the borehole during drilling operations;
- (2) the depth(s) at which water was struck in the borehole;
- (3) the construction of the borehole in terms of the setting of especially perforated (slotted) casing, and
- (4) the nature of the rock formation at the depth(s) where water was struck.

This information will be communicated to the testing contractor by the Engineer prior to the testing of any borehole.



The Contractor shall keep a full record of the test pumping which is undertaken and submit the record on completion of the test. This record must include the following basic information:

- (1) The depth to water level before the start of testing;
- (2) the depth at which the test pump was installed;
- (3) the type, make and model of the test pump used;
- (4) the pumping rate as measured at regular intervals during the test, and
- (5) the water level in the borehole as measured according to a prescribed time schedule both during and after pumping.

The Contractor must be sufficiently well-equipped to gather this information with acceptable accuracy.

The rationale behind the flow diagram is explained as follows. A slug test should be performed on a borehole in instances where there is no prior indication of its possible yield. The result of the slug test will indicate whether additional test pumping is warranted. A slug test shall also be performed in instances where the possible yield of a borehole from prior information is indicated to be less than 0,3 litre/s. The result of the slug test will again indicate whether additional test pumping is warranted. In instances where the possible yield of a borehole from prior information is indicated to be equal to or greater than 0,3 litre/s, then a calibration test followed by a stepped discharge test shall be performed.

The result of the stepped discharge test will indicate whether further test pumping in the form of a constant discharge test is warranted or whether the borehole is judged to be sufficiently weak (potential production yield less than 0,5 litre/s) to make a utilisation recommendation without further testing. Should the result of the stepped discharge test indicate that a constant discharge is warranted, then the Engineer will need to make an assessment of the possible operational duty to which the borehole might be subjected.

The operational duty describes the number of hours per day for which the borehole must operate in order to meet the local water demand. By implication, the potential production yield of the borehole must be compared to the water demand. In qualitative terms, a lower yielding borehole would need to operate for a longer period per day to meet a given demand than a higher yielding borehole would need to. Further, the water demand is often too great for even a high yielding borehole pumping continuously to meet. The flow diagram indicates, however, that any borehole which reveals the potential to yield more than 0,5 litre/s and which will operate for a period in excess of 8 hours per day must be subjected to a constant discharge test of 48 to 72 hours duration. A borehole which does not fit this category requires an assessment of its possible operational intensity.

The operational intensity describes the yield at which a higher yielding borehole must operate in order to meet a water demand in a pumping period of eight hours or less per day. By implication, a high operational intensity requires the borehole to be pumped at a yield approaching its maximum, whereas a low operational intensity will place less stress on the borehole. These considerations will indicate whether a 24 to 48 hour or a 12 to 24 hour duration constant discharge test respectively will be performed.

The final step in the flow diagram requires the Engineer to make a borehole utilisation recommendation.

DA 04.02.02 Equipment and materials

This represents the test unit and all ancillary equipment and materials required to accurately and efficiently perform borehole testing. Details are provided below.

(a) Test unit

The test unit shall comprise a positive displacement (PD) type pump element and a pump head driven by a motor fitted with an accelerator, gearbox and clutch. The unit must be in good working order and capable of maintaining a minimum of 72 hours of continuous operation.

The unit must be capable of delivering water at a rate in excess of the expected maximum yield of the borehole to be tested. It may be acceptable under certain circumstances to employ a submersible pump for testing purposes. This must, however, be identified in the tender enquiry document. It is imperative that any submersible pump used for testing purposes be equipped with a non-return valve fitted at the bottom of the pump column (rising main).

(b) Discharge piping

Discharge piping comprises both the pipe (rising main or pump column) which brings the water to surface and the pipe (discharge hose) used to lead the pumped water away from the borehole being tested. The Contractor shall supply sufficient rising main to set the test pump at a depth of at least 100 m below the surface. It may, however, be required under certain circumstances to set the test pump at a greater depth in the borehole. Where necessary it shall be discussed with the Engineer prior to the installation of the test pump. The pump column must be of uniform diameter throughout. The Contractor shall also provide at least 50 m discharge piping. This must be free of leaks for its entire length. It may again, under certain circumstances, be required to discharge the pumped water at a point further away than 50 m (possibly in excess of 300 m) from the borehole being tested. In such instances, a similar procedure to that discussed above in regard to the rising main must be followed.

(c) Discharge measuring equipment/Instrumentation

This equipment/instrumentation must be adequate to accurately measure the pumping rate within the range of yields expected from successful project boreholes. If volumetric methods are used, a stopwatch for measuring time to an accuracy of at least one-tenth of a second is required. The full capacity of each container shall be determined accurately. The Contractor shall also ensure that a container stands level when used for discharge measurements. Guidelines regarding the use of different size containers for volumetric discharge rate measurements in specific yield ranges are given in table DA 04.02.02/1. Other acceptable instruments that may be used for discharge measuring are: (1) an orifice weir and (2) a flow meter. The use of these instruments is subject to various application criteria.

(i) Orifice weirs

These must be installed in a horizontal position at the end of the discharge pipe. The orifice plate opening must be sharp, clean, bevelled to 45 degrees and have a diameter less than 80 per cent of the diameter of the approach tube to which it is fixed. The

orifice plate must be vertical and centred on the end of the approach tube. There must be no leakage around the perimeter of the orifice plate mounting. The piezometer tube must not contain entrained air bubbles at the time of pressure head measurement. The latter measurement must be at least three times the diameter of the orifice.

TABLE DA 04.02.02/1 YIELD RANGE VERSUS CONTAINER SIZE FOR VOLUMETRIC MEASUREMENTS

YIELD RANGE	CONTAINER SIZE
Less than 2 litre/s	20 litre
2 litre/s to 5 litre/s	50 litre
5 litre/s to 20 litre/s	210 litre
20 litre/s to 30 litre/s	500 litre
30 litre/s to 50 litre/s	1000 litre
More than 50 litre/s	Other suitable methods

The orifice weir equipment must be calibrated for various combinations of approach tube and orifice diameters so that pressure head readings can be converted to accurate discharge measurements.

(ii) Flow meters

Flow meters must be calibrated and of similar diameter to that of the discharge pipe. The latter must be straight and of uniform diameter for a distance of four times the diameter of the pipe before the position of the meter. There must be no turbulent flow or entrained air in the discharge pipe before the meter. The discharged water must be free of solid material carried in suspension.

It is recognised that some water leakage will generally occur especially at the borehead during pumping. This is acceptable provided that: (1) such leakage does not interfere with any water-level monitoring and (2) the total amount of leakage to the end of the discharge pipeline does not exceed one per cent of the pumping rate as measured at the end of this pipeline.

(d) Water-level measuring equipment/instrumentation

The Contractor shall provide at least three water-level measuring devices which are each capable of providing an accuracy of at least 0,01 m (10 mm) and are of sufficient length to match the pump installation depth. If ungraduated electrical contact meters (dip meters) are used for this purpose, each such instrument must be equipped with a measuring tape of an acceptable length and approved standard and which is graduated to an accuracy of at least 0,01 m (10 mm). These instruments must be in good working order and number at least one spare for each two on site.

The Contractor shall further provide conduit tubing of sufficient length to match the pump installation depth. The diameter of this tube must be large enough (minimum 15 mm) to allow free movement of the dip meter probe and cable therein. The tubing must be made of material strong

enough to withstand reasonable pressure on its sidewall which might cause a constriction. The tube must be open at its lower end to allow the free entrance of water into the tube. This is facilitated by perforating the bottom section of the conduit tube sidewall. Precautions shall also be taken to prevent the dip meter probe from passing beyond the bottom end of the conduit tube and, as a result of entanglement, not able to be withdrawn.

(e) Other materials

No pumping test should commence without field data sheets on which to record all data and information relevant to the test pumping activities in an acceptable format. These can either be provided by the Contractor or the Engineer.

DA 04.02.03 **Ground-water sampling**

(a) Sampling for macro-element analysis

The Institute for Water Quality Studies of the DWAF, in conjunction with the Department of Health, commenced in May 1996 with the compilation of guidelines addressing all aspects of water sample collection aimed at routinely establishing the quality thereof for drinking purposes. Until such time as these guidelines become available, the following recommendations in this regard should be followed.

A water sample shall be collected from the end of the discharge pipeline no sooner than 15 minutes before the scheduled end of a pumping test, whether of a calibration, stepped discharge or constant discharge nature. This will ensure that a water sample is collected in case testing does not proceed to include either one or both of the latter two types of test. The standard amount of sample normally collected is in a clean, sterilised plastic bottle of capacity 240 millilitre or larger and equipped with a watertight screw-on cap. This is the standard issue sample bottle provided by the DWAF. Depending on the analysing laboratory's requirements, however, a sample of up to two litres in volume may have to be collected. The Engineer will advise on this matter in instances where the Contractor is required to collect samples, in which case the Engineer will provide ampoules containing preservative chemicals if required. All other materials such as sample bottles, tie-on labels and sample custody forms are to be provided by the Contractor. The mandatory sample custody form DW45 must be completed for each sample collected. Note that the code MACRO1 in Instruction 8 ("analyse for") of form DW45 defines the macro-element analysis.

(i) Sampling procedure

Wash hands thoroughly and rinse the sample bottle three times with the water to be sampled, ie the water being pumped from the borehole. Fill the bottle so that a space of five to ten millimetres is left at the top. Add the preservative as instructed in (ii).

(ii) Sample preservation

Gently tap the bottom of an ampoule of preservative on a firm surface so that all the chemical flows to below the constriction. Hold the ampoule firmly upright with thumbs placed either side of the constriction, flex off the neck, turn the ampoule upside down and place it in the bottle together with the broken-off neckpiece. Firmly screw on the cap of the sample bottle after rinsing it well with water from the borehole. Shake the capped sampled bottle

well. **Caution shall be exercised when handling the preservative, since this chemical is poisonous.**

(iii) Sample custody

Fill in the information requested on the tie-on label and attach this securely to the neck of the sample bottle. Place the sample bottle in a cooler or ice-box and keep it stored under chilled conditions. Complete the sample custody form (DWAf form DW45). The water sample and its custody form will be collected by the Engineer. The above procedures shall be adhered to and complied with to the satisfaction of the Engineer.

(b) Sampling for environmental isotope analysis

Use a new, clean, one-litre polyethylene bottle with watertight screw-on cap for routine stable (hydrogen and/or oxygen) isotope and tritium analysis. Take the same basic precautions as for macro-element analysis. Ensure that the water is as clean as possible, but do not filter or add anything. Turbidity does not matter. Rinse the bottle three times with the water to be sampled, fill till overflowing and tighten cap well. Turn bottle upside down and squeeze to test for tightness. Clearly label the bottle by waterproof marking pen on the bottle shoulder or tie-on label.

In special cases of confined to semi-confined (older) water, where tritium values < 0,5 TU are observed, or where it is specifically requested, samples for radiocarbon analysis may be required. Since this involves special procedures of field extraction of larger quantities of water, the Engineer shall contact experts in this field for the procedures and materials required.

This test shall only be conducted when requested by the Engineer.

The standards of isotopic measurement for hydrological applications are defined as follows:

(i) Minimum detectable values

Tritium: 0,3 TU (tritium units)

Radiocarbon: 2 pMC (per cent modern carbon)

(ii) Maximum analytical error

Tritium: $\pm 0,3$ TU (0 - 3 TU); otherwise ± 10 %

Radiocarbon: ± 2 pMC (> 40 pMC); ± 1 pMC (< 40 pMC)

Oxygen-18: $\delta^{18}O$; $\pm 0,15$ ‰

Deuterium: δ^2H ; $\pm 1,5$ ‰

DA 04.02.04 Aborted tests and breakdowns

The Engineer may at any stage during the execution of a pumping test request the testing contractor to abort a test if, in the opinion of the Engineer, continuation of the test is not in the interests of the project. Factors which may contribute to such a decision by the Engineer are:

- Sufficient data having been collected for an adequate scientific evaluation thereof;
- the execution of the test not meeting project criteria and requirements (such as for constancy of yield, accuracy of yield measurements or accuracy of water-level measurements, sufficiency of discharge line length, etc), or
- a mechanical breakdown occurring during pumping which causes a test to be interrupted or aborted.

(a) Tests aborted due to sufficiency of data

The Engineer will fully motivate his decision to abort the test in a written statement to the User Client. In such instances, the testing contractor will be remunerated for the actual duration of testing (including recovery testing) at the hourly rates set out in the Schedule of Quantities.

(b) Tests aborted due to incorrect execution

The testing contractor will be required to remedy the cause(s) for an abort decision by the Engineer. The test shall be restarted, as if it were the first attempt, after the water-level has recovered to within five per cent of the pre-test rest water-level or the contractor is instructed thereto by the Engineer. The testing contractor shall not be entitled to remuneration for any test which is aborted under these circumstances irrespective of the time elapsed up to receipt of the instruction to abort.

(c) Tests aborted due to breakdowns

The following procedures are recommended when a mechanical breakdown occurs during pumping which causes a test to be interrupted or aborted.

(i) Calibration test

Start immediately with the measurement and recording of the water-level recovery rate according to the periodicity given in table DA 04.02.04/1. Irrespective of how long after the start of pumping the breakdown occurs or how rapidly the breakdown can be fixed, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level or, at the discretion of the Engineer, may be discontinued. Restart the calibration test as if it is the first attempt. The Testing Contractor shall not be entitled to remuneration for a calibration test which is aborted under such circumstances.

(ii) Stepped discharge test

Record the time of the breakdown and start immediately with the measurement and recording of the water level recovery according to the periodicity given in Table 4-9. If the breakdown occurs during the first or second steps of the test, continue with water-level recovery measurements until the water-level is within five per cent of the start rest water level and then restart the stepped discharge test as if it is the first attempt. If the breakdown occurs during the third step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump. Only one such breakdown event is allowed.

If a second breakdown occurs, proceed as described for a first step breakdown. If the breakdown occurs during the fourth or later step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test and complete it at this yield after measuring and recording the water level immediately before restarting the pump. If a breakdown at this stage can not be fixed within five minutes, continue with water-level recovery measurements as if the test has been fully completed. The Contractor shall not be entitled to remuneration for a stepped discharge test which is aborted: (1) within the first or second step, or (2) within the third step and can not be restarted within the time allowed for repair.

(iii) Constant discharge test

Note the time of the breakdown and start immediately with the measurement and recording of the water-level recovery according to the periodicity given in table DA 04.02.04/1. If the breakdown occurs within the first two hours after the start of pumping, continue with water-level recovery measurements until the water-level is within five per cent of the pre-test (start) rest water level and then restart the test. If the breakdown occurs later than two hours into the test, can be fixed and the pump restarted to produce the same yield as before the breakdown within the time periods (after the breakdown occurring) given in table DA 04.02.04/1, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump.

If the breakdown can not be fixed and the pump started within one hour of the breakdown occurring, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level and then restart the constant discharge test as if it is the first attempt unless the following condition has been met. If the breakdown occurs after approximately 80 per cent of the planned duration of the constant discharge test has been successfully completed, continue with water-level recovery measurements as if the test has been fully completed. The allowable elapsed time (in hours) with regard to selected constant discharge test total durations in order for this specification to be acceptable is given in table DA 04.02.04/2.

TABLE DA 04.02.04/1 PERIOD ALLOWED FOR BREAKDOWN REPAIR AND CONTINUATION OF TESTING

TIME BREAKDOWN AFTER START OF TEST	PERIOD ALLOWED FOR REPAIR
2 hours to 4 hours	6 minutes
4 hours to 6 hours	12 minutes
6 hours to 8 hrs hours	18 minutes
8 hours to 10 hours	24 minutes
10 hours to 12 hours	30 minutes
12 hours to 14 hours	36 minutes
14 hours to 16 hours	42 minutes
16 hours to 18 hours	48 minutes
18 hours to 20 hours	54 minutes
Longer than 20 hrs	60 minutes

TABLE DA.04.02.04/2 PERIOD AFTER WHICH A CONSTANT DISCHARGE TEST MAY BE CONSIDERED COMPLETED IN THE EVENT OF A BREAKDOWN

CONSTANT DISCHARGE TEST DURATION	ALLOWABLE TIME ELAPSED TO BREAKDOWN
24 hours	20 hours (equivalent to 80 % of total time)
36 hours	30 hours (equivalent to 83 % of total time)
48 hours	38 hours (equivalent to 79 % of total time)
72 hours	60 hours (equivalent to 77 % of total time)

The Contractor shall not be entitled to remuneration for a constant discharge test which is aborted under circumstances which preclude its restart within the time allowable for repair and continuation. The contractor will, however, be entitled to remuneration for a constant discharge test which is aborted after approximately 80 per cent of the planned duration of the constant discharge test (refer to table DA.04.02.04/2) has been successfully completed, payment being made for the actual duration of the test (including the recovery test) at the hourly rates set out in the Schedule of Quantities.

DA 04.03 REPAIR OF EXISTING STRUCTURES

This section covers the requirements for the repair of the associated structures at the borehole installation.

DA 04.03.01 General

The work required shall include but not be limited to the following:

- (a) Repair existing concrete base slabs around boreholes;
- (b) Cast concrete base slabs at boreholes without base slabs;
- (c) Clear around the borehole an area 20 m x 20 m.

DA 04.03.02 Detail of work

(a) Brickwork structures

Where instructed by the Engineer, existing minor brickwork buildings shall be renovated.

(b) Concrete base slabs

Where instructed by the Engineer, existing concrete base slabs shall be broken up and removed from existing boreholes.

Concrete base slabs shall be constructed as instructed by the Engineer.

(c) Clear area

An area of 20 m x 20 m shall be cleared of bushes, building rubble and other foreign matter as instructed by the Engineer. The area shall in addition be levelled.

DA 04.04 **REPAIR/REPLACEMENT OF ELECTRICAL AND MECHANICAL EQUIPMENT**

This section covers the requirements for the repair of the mechanical equipment associated with the boreholes.

The requirements for the repair of the electrical equipment associate with the boreholes are specified in Technical Specification GB: Electrical installation for mechanical and pumping equipment.

DA 04.04.01 **General**

The work required shall include but not be limited to the following:

- (a) Reconditioning of MCC panel and housing
- (b) Testing of electrical mechanical equipment
- (c) Reconditioning of borehole pumping equipment
- (d) Borehole information register
- (e) Commissioning.

DA 04.04.02 **Detail of work**

- (a) Testing electrical and mechanical equipment

All electrical and mechanical equipment shall be inspected and tested at the start of the Contract to establish which items need to be repaired, reconditioned or replaced.

- (b) Borehole pumping equipment

The Contractor shall remove or extract the submersible pumps and inspect. Reconditioning or repair of pumps shall be carried out if necessary on the instruction of the Engineer. The difference between reconditioning and repair is defined in the payment items.

- (c) Borehole information register

A data register containing the following information shall be compiled during the repair contract and further developed during the maintenance contract:

- (i) Borehole pumping equipment and maintenance tasks, records, etc
- (ii) Borehole utilisation (rate of discharge and duration of discharge)
- (iii) Borehole water-level.
- (d) Commissioning

All components at each borehole will be fully commissioned after reconditioning or replacement as described in Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

DA 04.05 **SUBMERSIBLE CENTRIFUGAL PUMPS**

This Specification covers the supply, delivery and installation of submersible centrifugal pumps. Testing and commissioning is covered in Clause DA 05 and in Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

DA 04.05.01 **General**

Centrifugal pumps supplied under this Contract shall be suitable for vertical installation in submerged conditions, shall consist of a submersible motor coupled directly to a multistage centrifugal pump and shall be suitable for pumping water for domestic use.

The details of the existing installation were unknown at the time of tender. Allowance has been made for the servicing of pumping equipment.

Should it become apparent during the servicing that components need to be replaced such as bearings, shafts, etc., a payment item for the reconditioning of the pumping equipment has been allowed. The "reconditioning" payment item will replace the "servicing" payment item in this event.

No orders shall be placed for any pumping equipment until the boreholes have been tested and the report submitted to the Engineer. The Engineer shall then provide the pump requirements to the Contractor for ordering of equipment.

Preference will be given to pumps of the self-regulating type and where the power consumption characteristic is such that with an increase in delivery to beyond a certain limit, the power consumption decreases, thereby ensuring that the motor is not overloaded in the event of a large reduction in pumping head.

Preference will be given to locally manufactured pumps and motors, with a reliable and efficient after sales service and readily available spares.

DA 04.05.02 **Depth of installation**

The most suitable depth of installation and safe pumping rate shall be confirmed by an experienced borehole contractor by virtue of the supplied borehole record, test and calculated information. All costs involved in confirming the most suitable depth of installation and safe pumping rate shall be deemed included in payment item DA.01.

DA 04.05.03 Material

All parts of the pump shall be manufactured from material most capable of withstanding wear. Full specification in this respect shall accompany the Tender and the Tenderer's advice in this respect will be considered.

DA 04.05.04 Speed

The pump shall have a rotational speed not exceeding 1 450 rpm. If a higher rotational speed is required, this shall be motivated in a covering letter or in the technical data sheets.

DA 04.05.05 Design

All working parts of the pumps shall be removable and serviceable and shall under no circumstances be integrated into the body of the pumps.

DA 04.05.06 Turbine bowls

Turbine bowls shall be manufactured from high-grade cast steel and shall be finished off smoothly before a high-quality corrosion protection system is applied. Grey Iron No 30 turbine bowls may be approved by the Engineer, or if so stated in the Project Specifications. The bowls shall be selected for a minimum of 2 500 kPa or 1,5 times the maximum discharge pressure, whichever is the greater. The casing, suction strainer, cable shield and all fastenings, nuts and bolts shall be manufactured from stainless steel.

DA 04.05.07 Pump shaft

The shaft shall be manufactured of stainless steel. Where the shaft passes through stuffing boxes it shall be fitted with renewable sleeves of high-quality, wear-resistant alloy.

The shaft shall be so designed that the running speed is well below the first critical speed, and the complete rotor shall be accurately balanced after assembly.

The rotating elements shall be accurately balanced statically and dynamically to eliminate noise and vibration when running.

DA 04.05.08 Pump impellers

Impellers shall be manufactured of stainless steel or bronze and shall be carefully bored and keyed. All parts inaccessible to machining shall have a smooth finish. Balancing of impellers shall not be done by means of drilling balancing holes, but rather by accurate and careful machining of impellers.

DA 04.05.09 Seals and bearings

Pumps shall be fitted with mechanical seals with sand deflectors. Pump bearings and thrust collars shall be bronze and shall be lubricated by the fluid handled. The pump and motor shall not be adversely affected by suspended sand concentrations of up to 25 g/m³.

DA 04.05.10 Rising pipe

The rising pipe shall have threaded or approved bolted couplings at a spacing of approximately 6 m intervals. The rising pipe shall have a minimum internal diameter of 50 mm and shall internally and externally be protected against corrosion by a fusion-bonded powder epoxy coating to a minimum thickness of 250 micron. All bolts used shall be stainless steel. The couplings shall not totally obstruct the borehole, but shall allow for sufficient clearance between the coupling and borehole casing to prevent any damage to the drop cable set and earth wire.

The pump and rising pipe shall be centered in the borehole by means of approved centralisers at a preferred spacing of not more than 3 m. The centralisers shall be manufactured of an approved corrosion-resistant material and shall assist in eliminating any vibration that may occur in the borehole/rising pipe installation.

DA 04.05.11 Borehole vents

The borehole shall be adequately vented to prevent the build-up of pressure or vacuum. All borehole vent openings shall be piped watertight to the atmosphere outside of any enclosure and not less than 200 mm above any low ground level or the highest recorded flood level. Such vent openings shall be at least 12 mm in diameter. The terminal of the vent shall be suitably shielded and screened so as to prevent the entrance of foreign matter and insects.

DA 04.05.12 Pump motor

Unless otherwise specified, each pump shall be supplied complete with an electrical motor. Each electrical motor shall comply with the requirements as specified in Specification GB: Electrical installation for mechanical and pumping equipment and Clause DA 05 of this specification and Specification PF: Acceptance tests for pumps.

The depth setting shall be such that an up-flow of water past the motor is created. If insufficient up-flow of water past the motor is available, a suitable flow induced tube shall be fitted to the pump and motor to ensure sufficient cooling of the motor.

DA 04.05.13 Base plate

A suitable base plate shall be used to effectively close the top of the borehole to prevent any foreign matter from entering. The rising pipe shall be effectively bolted to the base plate. The base plate shall further be provided with the necessary openings for the drop cable site, earth wire and water-level monitoring device.

DA 04.05.14 Accessories

Over and above any reflux valves installed and specified above ground level, the pump shall be fitted with a non-slam type reflux valve situated at the pump outlet. The reflux valve shall be a matched component supplied and tested by the pump manufacturer for efficient and troublefree operation.

DA 04.05.15 Pump technical details

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.

The head at zero delivery of the curve for the impeller selected shall be at least 1,2 times the operating head.

The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected duty point. The efficiency of the pump at the selected duty point as stipulated in table DA 04.05.01/1 shall not be less than 75 %.

The possible percentage variation of data measured on Site by the supplied and/or installed instrumentation when compared with the catalogued performance data must be submitted.

All calculations for static and dynamic heads are to be based on an atmospheric pressure above mean sea level of approximately 1 410 m, which is the site elevation of the borehole site.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in "as new" condition at start up.

Details of the equipment shall include the following:

- (a) Operating, testing and commissioning instructions
- (b) Trouble analysis guide.

Full details of periodic and annual maintenance and service to be undertaken by the maintenance staff in accordance with a preventive maintenance programme shall be submitted.

The Contractor shall state in the technical data sheets the minimum selected service life for which the pump has been engineered and the components selected when operated under normal working conditions with optimum servicing and maintenance.

The minimum acceptable service life is 15 years with 8 500 operating hours per annum.

The Engineer reserves the right to call for -

- (a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or
- (b) site inspection, customer reports/references and user's interviews, and/or
- (c) full engineering, design and component selection details,

in order to check the correctness of the service life claimed.

DA 04.06 SUBMERSIBLE PROGRESSING CAVITY PUMPS

This Specification covers the supply, delivery and installation of belt-driven submersible progressing cavity pumps. Testing and commissioning is covered in Clause DA 05 and Additional Specification SC: General decommissioning, testing and commissioning procedures.

DA 04.06.01 General

The pumps supplied under this Contract shall be of the progressing cavity type with a stator and a rotor, similar to Mono, Orbit or approved equivalent pumps.

The pumps shall be belt-driven and suitable for vertical installation in submerged conditions and shall be suitable for pumping water for domestic use.

Preference will be given to locally manufactured pumps, with reliable and efficient after sales service and readily available spares.

DA 04.06.02 Depth of installation

The most suitable depth of installation and safe pumping rate if not required in the detail specification shall be confirmed by an experienced borehole contractor by virtue of the supplied borehole record, test and calculated information. All costs involved in confirming the most suitable depth of installation and safe pumping rate shall be deemed included in payment item DA.01.

DA 04.06.03 Material

The Contractor shall take cognisance of the operating environment and the properties of the pumped liquid when selecting the materials of manufacture for the pump components to ensure that the components are resistant to corrosion.

All parts of the pump shall be manufactured from material most capable of withstanding wear. Full specification in this respect shall accompany the Tender and the Tenderer's advice in this respect will be considered.

DA 04.06.04 Pump speed

The pump shall have a rotational speed not exceeding 1 500 rpm. If a higher rotational speed is required this shall be motivated in a covering letter or in the technical data sheets.

DA 04.06.05 Design

All working parts of the pumps shall be removable and serviceable and shall under no circumstances be integrated into the body of the pumps.

DA 04.06.06 Pump shaft and rotor

The pump shaft and rotor shall be manufactured from stainless steel.

The shaft shall be so designed that the running speed is well below the first critical speed.

The rising shaft shall be supported by a bobbin bearing every 1,5 metres.

The shaft supporting bearings shall be made of stainless steel with a vulcanised rubber outer sleeve and rubber linings with bushes of a synthetic material and shall be lubricated by the fluid handled.

DA 04.06.07 Pump stator

The stator of the pumps shall be manufactured from a suitable wear-resistant rubber and shall be formed by moulded-to-metal construction. The rubber shall be resistant to wear and heat caused by the occasional dry running of the pumps and the maximum permissible time span during which the pumps can run dry without any damage caused to the pumps, shall be indicated in the covering letter at tender stage.

DA 04.06.08 Rising pipe

The rising pipe shall withstand a 1 600 kPa working pressure.

The rising pipe shall have threaded or approved bolted couplings at a spacing of approximately 3 m intervals. The rising pipe shall have a minimum internal diameter of 50 mm and shall internally and externally be protected against corrosion by a fusion-bonded powder epoxy coating to a minimum thickness of 250 micron. All bolts used shall be stainless steel. The pump shaft shall run inside the rising pipe.

The pump and rising pipe shall be centred in the borehole by means of approved centralisers at a preferred spacing of not more than 6 m. The centralisers shall be manufactured of an approved corrosion-resistant material and shall assist in eliminating any vibration that may occur in the borehole/rising pipe installation.

DA 04.06.09 Borehole vents

The borehole shall be adequately vented to prevent the build-up of pressure or vacuum. All borehole vent openings shall be piped watertight to the atmosphere outside of any enclosure and not less than 200 mm above any low ground level or the highest recorded flood level. Such vent openings shall be at least 12 mm in diameter. The terminal of the vent shall be suitably shielded and screened so as to prevent the entrance of foreign matter and insects.

DA 04.06.10 Pulley head and base plate

A pulley head which includes the pulleys, shaft seals, bearings and pump delivery flange shall be mounted on a suitable base plate.

The pulley head and base plate shall effectively close the top of the borehole to prevent any foreign matter from entering.

The rising pipe shall be effectively bolted to the pulley head.

A double bearing configuration shall be installed where the shaft exits the pulley head frame. The bearing configuration shall consist of a lower thrust bearing and an upper sealed ball or roller locating bearing.

The pulley head shall be fitted with a stuffing box and shall have gland packings of adequate depths for sealing around the shaft, where the shaft exits the pump casing.

The gland packing shall be designed to permit high speed rotation without the possibility of seizing and charring the packing material or shaft. An automatic water seal shall be provided to prevent the entry of air into the pump.

DA 04.06.11 Belt drives

This clause only deals with V-belts, but full details of alternatives may be submitted to the Engineer for approval.

The Contractor shall install at least two belts per coupling.

The coupling (the belts, pulleys, shafts and keys) shall be selected such that it can safely transfer 200 % of the design starting torque and can operate up to a rotational speed of 150 % of the nominal duty speed.

The motor/engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60 % of the safe allowable limits specified by the supplier of the driving and/or driven equipment. Radial run-out on pulleys shall not be more than 1 % of the pulley diameter.

If the driving and driven pulleys are not in the same plane a maximum of a quarter twist turn between the driving and driven pulleys is allowed with a suitable belt length to prevent damage to the V-belts or pulleys.

Keys and keyways for load transfer to and from shafts shall comply with BS46 Part 1 and BS 4235 Part 2.

Suitable and accessible methods for adjusting the tension of the belts shall be provided.

The driving and driven pulleys and belts shall be enclosed in a single sturdy guard which allows visual inspection of the belt condition with the guard fitted. The guard shall be easily removable for belt maintenance.

Pulley sizes and ratios shall be selected such that operational belt speeds never exceed 25 m/s and are never less than 10 m/s.

The arc of contact on the small pulley shall be more than 120°. The pulley ratio shall not be less than 2,25:1, unless prior approval is obtained from the Engineer.

Belts shall be easily removed and installed for maintenance purposes and shall be to the approval of the Engineer.

The required belt tension to transfer the required load, including starting, shall not result in side thrusts in the prime mover and pump head pulley bearing which exceed 60 % of the manufacturer's specified maximum allowable side thrusts.

DA 04.06.12 Accessories

Each pump discharge line shall be fitted with the fittings and accessories as indicated by the Engineer.

Each pump shall be fitted with a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange.

Each pump shall be fitted with a non-slam type reflux valve situated at the pump outlet. The reflux valve shall be a matched component supplied and tested by the pump manufacturer for efficient and troublefree operation.

DA 04.06.13 Pump efficiency

The efficiency of the pumps shall not be less than 75 %. The normal operational efficiency of the pumps shall not be less than 3 % below the peak efficiency of the pumps.

DA 04.06.14 Pump technical details and installation

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The Contractor shall state in the technical data sheets, the minimum selected service life for which the pump has been engineered and the components selected when operated under normal working conditions with optimum servicing and maintenance.

The minimum acceptable service life is 15 years with 8500 operating hours per annum.

The pumps required shall be determined by the Engineer after the borehole yield testing to ensure the optimum use of each borehole.

The Engineer or his representative reserves the right to call for -

- (a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or
- (b) site inspection, customer reports/references and user's interviews, and/or

- (c) full engineering, design and component selection details,
in order to check the correctness of the service life claimed.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in "as new" condition at start up.

Details of the equipment shall include the following:

- (a) Operating, testing and commissioning instructions
- (b) Trouble analysis guide.

Full details of periodic and annual maintenance and service to be undertaken by the maintenance staff in accordance with a preventive maintenance programme shall be submitted.

DA 04.06.15 Prime mover

The pump shall be belt-driven by either an electric motor or diesel engine as specified in the schedule of quantities.

The prime mover and the pump pulley head shall be mounted on separate base frames.

DA 05 GENERAL SPECIFICATION FOR ELECTRIC MOTORS

DA 05.01 SCOPE, REFERENCE SPECIFICATIONS, STANDARDS AND CODES

This specification covers all aspects related to electric motors that may be incorporated in any of the items of equipment to be supplied under the contract.

DA 05.02 GENERAL REQUIREMENTS

- (a) Electric motors shall be manufactured in South Africa and shall comply with the requirements of SABS 948.
- (b) Where imported motors are offered they shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SABS 948 and the Engineer shall be provided with the appropriate certificate obtained from the South African Bureau of Standards stating that such motors do comply, prior to the installation of the motors. However, where tests reveal that motors do not comply, it shall be the responsibility of the Contractor to supply alternative motors which comply with the requirements of SABS 948 and which are acceptable to the Engineer. Where imported motors are not normally kept in stock in South Africa, written proof shall be provided of the availability of replacement parts as well as the delivery period of the parts after placing the orders.
- (c) All motors shall be standard catalogue models and shall be readily available.
- (d) All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to prevent stocking a variety of special spares.

DA 05.03 **WORKING VOLTAGE AND SUPPLY SYSTEMS**

- (a) The motors shall be capable of operating within $\pm 10\%$ of the nominal voltage supply without risk of damage. All motors shall be suitable for operating continuously at the specified 3-phase voltage under actual service conditions, including the $\pm 10\%$ system voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.
- (b) All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between plus and minus 5 per cent of the nominal supply voltage.
- (c) The slip-in speed of any motor at 80 per cent of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

DA 05.04 **TEMPERATURE RISE**

The temperature rise, as determined by resistance, of all motors, shall not exceed the following derated values:

Insulation class	E	B	F	H
Temperature rise (K)	50	60	80	100

DA 05.05 **EFFICIENCY AND POWER FACTOR**

- (a) The efficiency of all motors shall be guaranteed by the Contractor. Deviations from the guaranteed efficiency shall be within the limits specified in SABS 948.
- (b) The guaranteed efficiency of each size and rating of motor shall be as determined in accordance with BS 4999: Part 102. A basic test certificate of efficiency will be accepted for a motor of identical size and rating or a basic test of efficiency shall be conducted if no certificate is available.
- (c) The power factor of motors with a capacity of 20 kW or more shall not be less than 0,9 under all operating conditions.

DA 05.06 **VIBRATION**

- (a) Motors shall be statically and dynamically balanced.
- (b) All motors shall be checked for vibration without load, and at full rated voltage at the manufacturer's works, and the vibration amplitude as measured shall be in accordance with BS 4999: Part 142, quality grade 'Normal'.
- (c) The ratio of axial to radial vibration shall not exceed 0,5.

DA 05.07 **NOISE LEVEL**

Unless otherwise specified motors shall be of 'normal sound power', in compliance with BS 4999.

DA 05.08 **ENCLOSURE AND FRAME**

- (a) Each motor shall be protected to the degree required by its application, and its enclosure shall be designed for the system of cooling associated therewith.
- (b) Notwithstanding the requirements of DA 05.08 above, the minimum degree of protection shall be IP55 to SABS 1222 and, unless otherwise required, motors shall preferably be of the totally enclosed fan-cooled (TEFC) type.
- (c) All motors of the vertical-spindle type and exposed to the weather, shall be provided with a robust canopy of approved design.
- (d) Medium-length motors are preferred but short-length motors may be accepted where space is limited and written permission has been granted by the Engineer.

DA 05.09 **MOTOR TYPE**

Motors shall be of the squirrel-cage induction motor type. Slip-ring induction motors or other approved types will be considered if the Contractor is of the opinion that better results could be obtained by using such motors. Full electrical and mechanical details of each alternative shall be submitted with the tender documents.

DA 05.10 **RATING AND STARTING REQUIREMENTS**

- (a) Motors shall be adequately rated for the service for which they are intended, and due allowance shall be made for the temperature, altitude, climatic conditions and variations in the supply voltage. Motors shall, however, not exceed 120 % of the required capacity without prior approval having been obtained from the Engineer.
- (b) Not only shall motors be based on the full load requirements, but the motor capacity and starting characteristics shall be compatible with the requirements of the driven equipment.
- (c) Where motors are required to drive high inertia loads, the starting torque of the motor and the torque curve of the driven load shall be submitted to the Engineer for approval prior to manufacture. Such motors shall be capable of three starts per hour, with two consecutive starts from normal operating temperature, or more frequently if required by the Engineer.
- (d) Motors shall be of the continuously running duty class S1 unless otherwise specified in the detailed specification or if a more onerous duty is dictated by the drive requirement.
- (e) All squirrel-cage induction motors shall be suitable for direct-on-line starting at full voltage. Single-speed motors shall conform to BS 4999 part 41, Design B characteristics unless otherwise approved by or dictated by the drive requirements.
- (f) All motors shall be capable of starting its associated load with a minimum accelerating torque of not less than 5 per cent of full-load torque when the voltage at the motor terminals during starting is reduced to 80 per cent of the nominal value.
- (g) Unless otherwise approved, the -15 per cent tolerance on locked-rotor torque permitted by BS 4999: Part 69 will not be accepted and shall be limited to -10 per cent.

- (h) Documentation shall include performance curves to suit the expected working conditions.

DA 05.11 BEARINGS

- (a) All motors shall, wherever possible, be provided with prelubricated sealed bearings.
- (b) Regreasable bearings shall require only one lubrication per year. Grease lubrication of ball or roller bearings, where approved, shall be by means of hexagonal button-type grease nipples to BS 1486: Part 2, Nos. 21A or 21B (industrial type).
- (c) Grease-lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed, which holes shall be positioned so that the excess grease can be easily removed. Cups shall be fitted to contain excess grease.
- (d) Bearings shall be protected against eddy currents and shall be capable of withstanding vibrations caused by unbalanced loads.
- (e) All bearings shall be designed for a life of 100 000 hours at B10 rating.

DA 05.12 EARTHING

All motors shall be provided with a machined or spot-faced boss tapped to receive a bolt of not less than 10 mm in diameter for earthing purposes, which is located on one side between the mounting feet.

DA 05.13 HEATERS AND DRAINAGE

Non-submersible motors which will be located out of doors or in a damp location such as in a drainage sump, shall be provided with suitable means of drainage to prevent the accumulation of water due to condensation. They shall also be fitted with anti-condensation heaters suitable for a 220V AC supply if considered advisable by the manufacturer.

Where specified in the project specifications, motors shall be supplied with anti-condensation heaters to keep the motor temperature at 23 °C when the motor is not operational to prevent moisture from condensing in the motor.

Heater terminal boxes shall be fitted on the motor frame and shall be of robust design, liberally sized and complete with suitable terminal block and mechanical cable gland or conduit entry.

DA 05.14 TERMINAL ARRANGEMENTS

- (a) The line connections of each motor shall be brought out to a terminal box located in an approved position. In the case of two-speed motors, separate terminal boxes shall be provided for each speed.
- (b) Terminal boxes shall be of the totally enclosed type designed to exclude the ingress of dust and moisture and sealed from the internal circuit of the motor, and shall be manufactured from sand-cast metal. The wall thickness of the terminal boxes and the dimension of the cable inlet shall be as specified in SABS 948. The terminal box shall be so designed that the cable entry may be made in any one of four positions placed at right angles to one another.

- (c) Terminal boxes shall be of ample size to allow the cable to be terminated in the box. Under no circumstances will the cable be allowed to be in contact with the inside of the box or lid.
- (d) Terminals shall be of a substantial design and shall be suited to receive cable lugs. Pinch-screw connections will not be accepted.
- (e) The terminal arrangement shall permit the motor to be disconnected from its supply cable without damaging the cable tails and shall allow the supply cable and motor windings to be tested separately.
- (f) The electrical clearance and creepage distances, with the correct cable terminations in position, shall comply with the requirements of BS 4999.
- (g) Terminal markings shall be clear and permanent and shall comply with BS 4999. Irrespective of the direction of rotation required on the site, the connections shall be such that, when the supply leads L1-L2-L3 are connected to the motor terminals U-V-W respectively, the motor shall rotate in a clockwise direction when viewed from the driving end.
- (h) Motors suited for only one-directional rotation, shall be clearly marked as such by an arrow fixed to the motor frame at the driving end.

DA 05.15 **MOTOR/LOAD COUPLING**

- (a) Motors shall be coupled direct to the equipment to be driven, by means of approved couplings. Vee-belt and chain drives shall be considered only if direct coupling of the motor to the equipment is impossible or impracticable. Motors driving vee-belt or chain drives shall be fitted with heavy-duty bearings suited to the full side thrust at 120 % of full load torque and short-term overloads of up to 250 % of the full load torques during starting. The stiffness of the rotor shaft shall be checked to ensure that resonance and fatigue do not occur.
- (b) Where applicable, the flanges of the motors and equipment shall be identical.
- (c) The precision tolerance class shall apply to all flange-mounted motors with regard to concentricity, perpendicularity and shaft run-out.

DA 05.16 **SUBMERSIBLE MOTORS**

The following additional requirements apply specifically to all submersible motors:

- (a) All submersible motors shall be suited for submersion up to a depth of 1,5 times the depth of submersion shown on the drawings for each application, or as specified in the project specifications.
- (b) All submersible motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- (c) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (d) All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the motors.

- (e) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1,0 m above the maximum water level by means of a purpose-made, weatherproof, outdoor junction box. The submerged cable shall be supported to minimize any movement of the cable which results from turbulence caused by the operation of the equipment or the flow of the water.
- (f) Thermistor protection shall be provided for submersible motors.

DA 05.17 ADDITIONAL REQUIREMENTS

- (a) The rotation speed of motors shall not exceed 1 500 r/m unless approved otherwise by the Engineer.
- (b) Thermistor protection shall be provided for each winding of each motor.
- (c) The preferred class of insulation is Class F, derated in accordance with DA 05.16(d) above.

DA 05.18 TECHNICAL DATA SHEETS

Details of all individual electric machines and equipment requiring electrical energy shall be indicated on the 380 V motor and equipment schedule included in the technical data sheets.

DA 06 TESTING AND COMMISSIONING

DA 06.01 TESTS TO BE PERFORMED

- (a) All pumping equipment shall be subject to the commissioning tests as described in Additional Specification SC: General Decommissioning, Testing and Commissioning.
- (b) At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow rate or volumetric flow testing facilities will be supplied by others, unless otherwise specified in the detail specification.
- (c) The operating point of each pump shall be determined.
- (d) Efficiency tests will only be performed when specified in the detail specification.
- (e) NPSH tests will only be performed when specified in the detail specification.

DA 06.02 PUMP OPERATING POINT

During the day 1 commissioning tests the pump operating point shall be determined by observing the following:

- (a) Pump delivery and suction pressures, and
- (b) Electric motor power consumption.

If no efficiency tests are required in the detail specification then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

DA 06.03 FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS

- (a) Testing will be done in accordance with BS 5316 Part 1, class C tests.
- (b) Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.

DA 06.04 TEST CONDITIONS

- (a) All tests will be performed in situ.
- (b) The pumped medium or liquid specified as the process liquid in the detail specifications shall be utilised during the tests. The Contractor shall obtain from the pump manufacturer the test point for clean water corresponding to the specified duty point for the pumped liquid, in order to relate the measured performance to the pump supplier's curves which are based on water.

DA 06.05 ADDITIONAL TESTS

Additional tests may be specified in the detail specification.

DA 07 MAINTENANCE

All borehole pumping equipment and systems shall be serviced and repaired, following practical completion of the installation of which it forms part, to maintain it in perfect functional condition.

Maintenance to be carried out shall include routine preventative maintenance in accordance with the manufacturer's specification to be set out in the operating and maintenance manual, as well as unforeseen repair work or replacement.

The remuneration for monthly maintenance of borehole pumping equipment and systems shall be deemed included in the tendered rate for ten points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance.

The routine maintenance of the installations, systems and equipment shall include, but not be limited to the items listed in table DA 07/1 below:

TABLE DA 07/1 ROUTINE MAINTENANCE OF INSTALLATIONS, SYSTEMS AND EQUIPMENT

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Service submersible pumps	Four-monthly
2	Clean filters/strainers	Monthly
3	Check V-belts	Monthly
4	Measure rest water-level	Monthly
5	Check MCC panel	Monthly
6	Check electric motors	Monthly
7	Log and record water meter reading and water usage	Daily
8	Log and record amps, volts and hour meter readings	Daily

DA 08 MEASUREMENT AND PAYMENT**DA.01 PUMP TESTING OF BOREHOLES** Unit: number

The unit of measurement shall be the number of boreholes tested on the written instructions of the Engineer.

The tendered rate shall include full compensation for all labour, equipment and material required for the complete testing of the boreholes in accordance with the specification.

DA.01.01 Extra over DA.01 for:(a) The removal of existing equipment Unit: number

The unit of measurement shall be the number of boreholes from which all the equipment is removed. The tendered rate shall include full compensation for the removal of existing operational pumps and motors and all associated pipework.

(b) Recovery of lost equipment Unit: number

The unit of measurement shall be the number of boreholes from which all the lost equipment is retrieved. The tendered rate shall cover the recovery of lost pumps and pipework for boreholes.

(c) Installation of temporary pumps Unit: number

The unit of measurement shall be the number of temporary pumps installed and later retrieved. The tendered rate shall be fully inclusive of the pump and pipes required to effectively test the boreholes in accordance with the specifications.

(d) Ground-water sampling Unit: number

The unit of measurement shall be the number of boreholes of which the water is sampled. The tendered rate shall be fully inclusive of the requirements of the specification irrespective of the number of samples taken from a borehole.

- (e) Compilation of borehole report.....Unit: number

The unit of measurement shall be the number of boreholes regarding which approved reports is compiled. The tendered rate shall be fully inclusive of the work required to compile and produce six copies of each borehole recommendation report.

- (f) Standing time Unit: day

The unit of measurement shall be the number of days no work could be carried out. This will cover periods when the test pumping rig and crew or, if more than one rig and crew are fielded, when all rigs and crews are idle, waiting for decisions by the Engineer where those decisions or whose presence is required before the commencement or continuation of the work instructed. Under no circumstances will standing time be payable for any delays other than those incurred by the Engineer's decisions. Except only for abnormal weather conditions as provided for in PS14 of Portion 1 of the Project Specifications, no standing time will be payable due to inclement weather or prevention of access to a site by the Contractor due to inclement weather.

- (g) Interhole moves.....Unit: number

The unit of measurement shall be the number of interhole moves made. The tendered rate shall include all labour and equipment costs incurred in moving plant, equipment and labour from one hole to another hole.

- (h) Removal of existing pumping equipment.....Unit: number

The unit of measurement shall be the number of boreholes from which equipment is removed prior to testing the borehole. The tendered rate shall cover the removal of existing pumping equipment from a borehole to be tested. Payment for removal up to an installed depth of 50 m shall be made at the unit rate tendered for in the Schedule of Quantities. Installed depths in excess of 50 m shall be remunerated for the first 50 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

- (i) Reinstallation of existing pumping equipmentUnit: number

The unit of measurement shall be the number of boreholes in which removed equipment is re-installed. The tendered rate shall cover the reinstallation of existing pumping equipment in a borehole following test pumping of the borehole. Payment for installation up to a depth of 50 m shall be made at the unit rate tendered for in the Schedule of Quantities. Reinstallation depths in excess of 50 m shall be remunerated for the first 50 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

The existing pumping equipment shall be reinstalled and left in working condition as it was found before removal unless the Contractor is instructed otherwise by the Engineer.

DA.02 REPAIR OF EXISTING STRUCTURES

- DA.02.01 BrickworkUnit: m²**

The unit of measurement shall be the area of brickwork repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair of brickwork.

DA.02.02 Concrete base slabs Unit: m³

The unit of measurement shall be the cubic metre of concrete used in the repair of base slab.

The tendered rate shall include full compensation for all labour, materials, and equipment required to carry out the work as well as fro all work carried out.

DA.02.03 Clean around borehole..... Unit: number

The unit of measurement shall be the number of boreholes around which the area is cleaned and levelled.

The tendered rate shall cover full compensation for the cleaning of an area 20 m x 20 m around each borehole.

DA.02.04 Removal of concrete base slab.....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre volume of concrete broken out of the existing base slab.

The tendered rate shall include full compensation for the removal of the concrete inclusive of all tools, labour, removal of surplus material to a damp site and all other work required to satisfactorily complete the task.

DA.03 REPAIR/REPLACEMENT OF ELECTRICAL EQUIPMENT

DA.03.01 Detailed inspection and testing of components Unit: number

The unit of measurement shall be the number of boreholes for which a detailed inspection has been performed and all electrical and mechanical components tested.

The tendered rate shall include full compensation for testing all electrical and mechanical components for carrying out inspections and for all labour and equipment needed to carry out the work.

DA.03.02 Commissioning..... Unit: number

The unit of measurement shall be the number of borehole installations commissioned.

The tendered rate shall include full compensation for all labour and equipment supplied and for the commissioning of each borehole installation.

DA.03.03 Reconditioning of pumping equipment..... Unit: number

The unit of measurement shall be the number of pumps and motors reconditioned.

The tendered rates shall include full compensation for replacement of components and materials and for, tools, transport, site handling and labour necessary for the complete reconditioning of pumping equipment to conform to all the specifications in Subclause DA 04.06.14: Pump technical details and installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

DA.03.04 **Repair of pumping equipment**.....Unit: number

The unit of measurement shall be the number of submersible pumps and motors repaired.

The tendered rate shall include full compensation for supply of an identification label, resetting the spacer between impeller and back plate and ensuring that impeller rotates freely, as well as cleaning and corrosion protection and installing a new hoisting chain.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

DA.04 **SUBMERSIBLE CENTRIFUGAL PUMPS**

DA.04.01 **Supply and delivery of submersible borehole pumps:**

(a) (Pump description)Unit: number

(b) Etc for other pumps

The unit of measurement shall be the number of units supplied and delivered where each unit shall include one pump, one motor, one base plate, drop cable set, earth wire, flow inducer if required and all other accessories as specified.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery to site, storage, patent rights, etc, of all the equipment complete as specified in the Specifications.

DA.04.02 **Installation of submersible borehole pumps:**

(a) (Pump description)Unit: number

(b) Etc for other pumps

The unit of measurement shall be the number of units installed. Each unit shall include one pump with motor or engine, base plate and all other accessories as specified.

The tendered rates shall include full compensation for the installation of the units, the making good of all damaged corrosion protection areas, maintenance and for all other costs and actions that are necessary to provide a complete and efficiently working system.

Payment under this item may only be claimed after the relevant operating manuals have been handed over to the Engineer.

DA.04.03 **Supply, deliver and install rising pipe (diameter and pressure class indicated)**Unit: number

The unit of measurement shall be the metre of rising pipe installed.

The tendered rate shall include full compensation for all labour, plant, transport and materials required to manufacture, supply and install the rising pipe, corrosion protection, fixing to the pump and base plate, including couplings, gaskets, nuts and bolts.

DA.04.04 Remove existing equipment from borehole and store on site as directed by the Engineer:

(a) (Equipment description).....Unit: number

(b) Etc for other descriptions

The unit of measurement shall be the number of installations from which the equipment is removed.

The tendered rate shall include full compensation for the removal of the existing borehole equipment, providing a suitable storage facility, transporting the equipment to the storage facility and store the equipment for the period required.

DA.05 SUBMERSIBLE PROGRESSING CAVITY PUMPS

DA.05.01 Supply and delivery of submersible progressing cavity pumping equipment:

(a) Pump unit.....Unit: number

(b) Pulley head and base frame..... Unit: number

(c) Rising pipe..... Unit: m

(d) Rising pump shaft..... Unit: m

The unit of measurement for subitem DA.05.01(a) shall be the number of submersible progressing cavity pump units supplied and delivered.

The unit of measurement for subitem DA.05.01(b) shall be the number of pulley heads including two complete sets of drive belts and their protective safety cages (sized to enclose the drive pulley heads of the motor or engine, suited to the particular installation) and a base frame for each pulley head supplied and delivered.

The unit of measurement for subitem DA 05.01(c) shall be the linear metre length of rising pipe supplied and delivered.

The unit of measurement for subitem DA.05.01(d) shall be the linear metre length of shaft supplied and delivered.

The tendered rates shall include full compensation for the manufacture, corrosion protection, predelivery testing, transport to site, off-loading and all handling of equipment which shall include the following:

- the pump unit
- pulley head and base frame
- rising pipework and centralisers
- rising shaft and locating bearings
- all accessories including valves, fittings, V-belts, fasteners and auxiliary materials to render a complete pump unit.

DA.05.02 Installation of submersible progressing cavity pumping equipment:

(a) Pump unit.....Unit : number

(b) Pulley head and base frame.....Unit : number

(c) Rising pipe Unit : m

(d) Rising pump shaft..... Unit : m

The unit of measurement for subitem DA.05.02(a) shall be the number of submersible progressing cavity pump units installed.

The unit of measurement for subitem DA.05.02(b) shall be the number of pulley heads including two complete sets of drive belts and a base frame for each pulley head installed.

The unit of measurement for subitem DA.05.02(c) shall be the linear metre length of rising pipe installed.

The unit of measurement for subitem DA.05.02(d) shall be the linear metre length of shaft installed.

The tendered rate shall include full compensation for the site handling and positioning and installation of the equipment including all labour and consumables required for a fully installed submersible progressing cavity pump.

Payment under this item may only be claimed after the relevant operating manuals have been handed over to the Engineer.

DA.05 BOREHOLE STRUCTURES

DA.06.01 Clear area around borehole Unit: square metre (m²)
The unit of measurement shall be the square meter of area cleaned and levelled around the borehole.

DA.06.02 Removal of concrete base slab Unit: cubic metre (m³)
The unit of measurement shall be the cubic metre volume of concrete broken out of the existing base slab.

The tendered rate shall include full compensation for the removal of the concrete inclusive of all equipment, labour, removal of surplus material to a dump site and all other work required to satisfactorily complete the task.

DA.06.03 Laying of Concrete base slabs Unit: m³
The unit of measurement shall be the cubic metre of concrete used for a new base slab or for the repair of a base slab.

The tendered rate shall include full compensation for all labour, materials, and equipment required to carry out the work, as well as cleaning of the construction area.

DA.06.04 Brickwork Unit: m²
The unit of measurement shall be the area of brickwork repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair of brickwork. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

DA.06.05 Repair of existing steel cover Unit: number
The unit of measurement shall be the number of steel covers repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair required and repainting of the existing borehole steel cover. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

DA.06.06 **Supply, Deliver and Install new borehole enclosure** Unit: number
The unit of measurement shall be the number of borehole enclosures installed.

The tendered rate shall include full compensation for all labour, materials and equipment required for the supply, delivery and installation of the new borehole enclosure complete as per the tender drawings. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

DA.06.07 **Painting of exposed pipe work** Unit: m
The unit of measurement shall be the metre of pipe work painted. The approximate diameter of the pipe work is 100 mm.

The tendered rate shall include full compensation for the tools, labour, material, supply and delivery. The paintwork shall be conducted in accordance with Particular Specification PBJ.

TECHNICAL SPECIFICATION

DC BOREHOLE SITING & DRILLING

CONTENTS

DC 01	SCOPE
DC 02	STANDARD SPECIFICATION
DC 03	CONTRACTOR'S RESPONSIBILITY AND APPROACH
DC 04	DRILLING PROCEDURE
DC 05	MEASUREMENT AND PAYMENT

DC 01 SCOPE

This specification covers borehole drilling procedures, casing, backfilling, stabilising, protection and recording and reporting of related activities with the drilling of a borehole. The function of drilling of a borehole shall be supply of raw water to the facility at hand.

DC 02 STANDARD SPECIFICATIONS

DC 02.01 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

DC 02.02 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.:

DC 02.03 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

DC 02.04 DWAF GUIDELINES

Minimum Standards and Guidelines for Groundwater Resource Development for the Community Water Supply and Sanitation Programme issued by the Department of Water Affairs and Forestry shall be adhered to unless otherwise specified.

DC 03 CONTRACTOR'S RESPONSIBILITY AND APPROACH

It is required that the drilling of any borehole be approached with due diligence and care on the part of the appointed drilling contractor. Specifically, it is required that the drilling of each borehole be approached on the premise that it will be successful and, as such, will serve the function of a raw water supply to the facility at hand. Under normal circumstances, the pre-drilling of a small diameter pilot borehole will not be allowed. Such an approach may only be considered with the approval of the Hydrogeological Consultant who shall be

required to fully motivate such an approach to the Implementing Authority.

The Drilling Contractor shall function under the direct supervision of the Hydrogeological Consultant. This by no means implies that the Drilling Contractor is absolved from any responsibility. All drilling activities shall, therefore, be approached through communication and discussion between the Hydrogeological Consultant and the contractor with a view to developing the most suitable and mutually acceptable finished product serving the best interests of the project.

Failure by the contractor to timeously render advice and input where required shall be regarded as a dereliction of duty. This responsibility extends to informing the Hydrogeological Consultant of serious reservations regarding any aspect of the work. The contractor shall also be required to maintain the aesthetic appearance of the site during drilling operations, including keeping the site neat, tidy and free of litter. The contractor shall ensure that safety standards are met and that the work site is kept free, as far as is possible, from vehicular and pedestrian traffic and from interested bystanders and onlookers not involved with the project.

The appointed Drilling Contractor shall carry the final responsibility for the finished water supply borehole and all actions and activities leading up thereto.

DC 04 DRILLING PROCEDURE

DC 04.01 WORKMANSHIP & PERFORMANCE

The standard of workmanship of the Drilling Contractor shall be subject to close scrutiny by the Hydrogeological Consultant. Although it cannot be expected of the contractor to complete a specified number of boreholes in a given time period, it is reasonable to expect that "favourable progress" be made under normal circumstances and drilling conditions. An indication of what might be regarded as "favourable progress" is considered to fall in the range of 50 to 100m of drilling advancement per day taking into consideration interhole moves and setup time.

Although work-in-progress may be completed, the contractor shall under no circumstances vacate a site before the Hydrogeological Consultant has inspected the completed works and provided written approval that the work executed conforms to the requirements of this specification.

DC 04.02 DRILLING TECHNIQUE

The drilling technique to be employed for the project at hand is that of rotary air percussion drilling employing a down-the-hole (DTH) hammer.

Depending on site-specific circumstances other techniques might be employed including: (1) mud rotary drilling, (2) Odex drilling, (3) dual-tube reverse circulation and (4) cable tool percussion drilling. Instances where another drilling technique might be considered more appropriate and efficient shall be identified by the Hydrogeological Consultant during the project and the Contractor informed accordingly.

DC 04.03 EQUIPMENT AND MATERIAL

The equipment made available by the Drilling Contractor shall be in good working order. Equipment shall be maintained in good condition for the duration of the project. Routine servicing and preventative maintenance of all equipment required for the drilling procedure and other ancillary equipment shall form the responsibility of Contractor and shall be deemed as included in the tendered rates.

The drilling equipment shall include a full air/foam pumping system. At the start of the project, the gauge diameter of the button drill bits to be employed with the rotary air percussion drilling technique shall conform closely to their manufactured gauge and shall also possess all of their tungsten carbide buttons.

The Hydrogeological Consultant shall discuss with the Drilling Contractor the retirement of a bit due to excessive wear or damage incurred during the course of the project. Further, it is imperative that the equipment be of a suitable size and capacity to deal, on occasion, with: (1) deep boreholes (up to 200 m), (2) larger than average borehole diameters (up to 254 mm), (3) large quantities of groundwater and (4) potentially onerous drilling conditions. Since this capability is provided in large measure by the air compressor, it is considered that a compressor having a capacity of at least 2400 kPa (24 bar) and a volume of at least 750 cfm is appropriate for most water borehole drilling applications and conditions using the rotary air percussion technique. In order to maintain the straightness of a borehole, the Hydrogeological Consultant may insist that the drilling contractor employ at least an overshot sleeve (drill collar) fitted to the pneumatic DTH hammer. Further precautions to ensure this aspect might include the use of a stabiliser rod immediately behind the bit/hammer/overshot combination. All materials to be used on the project should be new and meet project specifications.

Steel casing shall be: (1) of the seam-welded type, (2) round, (3) straight, (4) of uniform wall thickness and (5) have bevelled edges. Second-hand material such as steel casing recovered from an earlier borehole can be used provided that it has been refurbished to an acceptable condition. The Hydrogeological Consultant shall have the right to reject, with motivation, any material (including casing) that is deemed inappropriate, substandard or otherwise unsuitable for the project.

DC 04.03 BOREHOLE CONSTRUCTION

This sections addressed certain basic borehole construction practices which will contribute to final acceptance of the successfully finished product.

DC 04.03.01 DRILLING DIAMETER

Drilling of the water supply borehole shall commence at a diameter, which shall allow for the trouble free insertion of casing. Under normal circumstances, this entails drilling a 203 mm (8") or 216 mm (8½") diameter bore through the weathered overburden and any other potentially unstable near surface material. The bore shall penetrate at least three meters into fresh, more competent material before this horizon can be secured from potential collapse or wash-out by casing it off with nominal 165 mm (6½") or 152 mm (6") diameter steel casing. Thereafter, the bore is continued at 165 mm (or 152 mm) drilling diameter to its completion depth.

The presence of unstable rock formations (which are often also associated with groundwater-bearing horizons) at greater depths in the bore generally account for complications, which shall impact, on the abovementioned approach. The Drilling Contractor shall firstly attempt to penetrate through such horizons in order establish their vertical thickness. Such horizons often possess only a temporary instability and become "cleaned out" as drilling advances. In instances where such horizons remain unstable and severely hamper drilling progress, it will become necessary for the contractor to remove the surface casing and ream (widen) the borehole to a diameter of at least 203 mm (or 216 mm) to the depth of such unstable horizon. It will then be required to re-insert 165 mm (or 152 mm) nominal diameter casing to this depth and attempt to advance this casing through the unstable horizon.

In exceptional circumstances it may even be necessary to re-drill or ream the borehole to a diameter of 254 mm through unstable overburden material, insert nominal 203 mm (or 216 mm) diameter casing through this horizon and widen the borehole to 203 mm (or 216 mm) diameter below this depth to the unstable

zone. Extremely onerous drilling conditions at depth might even warrant the commencement of drilling at a diameter of 305 mm or greater. This approach is often taken when aiming to maximise the exploitation of groundwater from a productive karst aquifer.

Information regarding the dimensions of the more commonly used button drill bits for rotary air percussion drilling is given in Table DC.1 together with casing diameters generally associated with each bit gauge.

Table DC.1. Dimensions of commonly used button drillbit gauge diameters for use with the rotary air percussion drilling method

BIT GAUGE DIMAMETER	CASING INSIDE DIAMETER FOR DRILLTHROUGH PURPOSES
127 mm (5 in.)	143 to 146 mm
152 mm (6 in.)	156 to 159 mm
165 mm (6½ in.)	168 to 171 mm
203 mm (8 in.)	207 to 212 mm
216 mm (8½ in.)	
254 mm (10 in.)	257 to 264 mm
305 mm (12 in.)	
NOTE:	
1. The bit gauge diameter is also given in the Imperial unit of inches (in.) since this unit is still in common use when referring to this parameter.	
2. Casing inside diameter varies according to wall thickness (refer Table DC.2).	

The information provided in Table DC.1 shows that each bit gauge passes comfortably through casing with a similar nominal diameter. For example, a 203 mm gauge bit can be used to extend the depth of a borehole already equipped with 207 to 212 mm inside diameter casing without having to reduce to the next smallest drilling diameter. Note also that a borehole drilled to a given diameter is able to accept casing having the next smallest diameter. For example, a 203 mm diameter borehole can be fitted with either 152 mm nominal inside diameter or preferably 165 mm nominal inside diameter steel casing.

In view of the foregoing, it is clear that the minimum final cased diameter of a successful raw water supply (for the extent of the facility at hand) borehole shall seldom be less than 152 mm nominal.

DC 04.03.02 STEEL CASING

Steel casing may either be used in a temporary manner or form a permanent part of the borehole infrastructure. Its temporary use is indicated in instances where, for example, the borehole is unsuccessful or the need for it to remain in place becomes redundant. Under these circumstances it is also referred to as a pre-collar, surface casing, starter casing, outer casing or soil casing generally to be removed (recovered) on completion of drilling. It shall be left in place where the Hydrogeological Consultant is of the opinion that the unsuccessful borehole should be secured to serve a long-term groundwater monitoring purpose. In such instances, additional provision shall be made to protect the borehole against actions, which may compromise this function. Steel casing shall be: (1) of the seam-welded type, (2) round, (3) straight, (4) of uniform wall thickness and (5) have bevelled edges. Second-hand material such as steel casing recovered from an earlier borehole can

be used provided that it has been refurbished to an acceptable condition. The Hydrogeological Consultant shall have the right to reject, with motivation, any material (including casing) that is deemed inappropriate, substandard or otherwise unsuitable for the project.

More commonly, however, this casing constitutes the final casing with which a successful borehole is equipped. Its proper installation, therefore, is mandatory. It is installed from surface through unstable, unconsolidated or fractured materials usually occurring in the near surface. Under these circumstances, the function of steel casing includes one or more of: (1) supporting unstable materials against collapse into the borehole during drilling, (2) facilitating the installation or removal of other casing, (3) minimising the erosion and widening of the unstable upper portions of the borehole sidewall caused by the return flow established during drilling and/or the passage of drilling equipment/tools and (4) facilitating the placement of a sanitary seal and/or gravel pack or formation stabiliser.

In order to ensure as far as is possible that the annular space between this casing and the borehole sidewall remains open for the later emplacement of a sanitary seal, the circumferential entrance to this space shall be temporarily plugged. Hessian sacking packed around and lightly tamped into the surface entrance to this annular space can be used for this purpose. In instances where steel casing needs to be driven through unstable horizons (generally at greater depths in a borehole), it will be also be required that such casing be fitted with a casing shoe to protect the "mouth" of the casing from damage. Irrespective of the casing used to facilitate the drilling of the borehole, the final cased diameter of the finished product shall be sufficient for the borehole to easily accept a borehole pump. Since the outside diameter of the latter are generally in the order of 100 mm, it is required that the final cased diameter of the borehole not be less than 152 mm (6 in.) nominal where steel casing is used. Information on the dimensions of the more commonly used steel casing available locally is given in Table DC.2.

Table DC.2. Dimensions of commonly used and locally available steel borehole casing

OUTSIDE DIAMETER	WALL THICKNESS	INSIDE DIAMETER
165 mm (6 in. nominal)	3.0 mm	159 mm
	4.0 mm	157 mm
	4.5 mm	156 mm
177 mm (6½ in. nominal)	3.0 mm	171 mm
	4.0 mm	169 mm
	4.5 mm	168 mm
219 mm (8 in. nominal)	3.5 mm	212 mm
	4.5 mm	210 mm
	6.0 mm	207 mm
273 mm (10 in. nominal)	4.5 mm	264 mm
	6.0 mm	261 mm
	8.0 mm	257 mm

NOTES:

1. The casing outside diameter dimensions are also given in the Imperial unit of inches (in.) since this unit is still in common use when referring to this parameter.
2. Use of the term "nominal" when referring to casing diameter provides a direct association with the gauge of the bit (Table DC.1) which most closely passes through it.

DC 04.03.03 CASING SHOE

This item is fitted (welded) to the bottom end (foot) of a casing string in order to protect the "mouth" of the casing from damage due to forcing the casing through unstable horizons. Its use is therefore only warranted (indeed mandatory) in instances where such conditions reveal themselves to require securement through the emplacement of casing.

DC 04.03.04 uPVC CASING

Also referred to as thermoplastic casing, the material generally comprises PVC (polyvinyl chloride) which, when treated to withstand ultraviolet radiation, is known as uPVC casing. Its application in the construction of water supply boreholes is specific, being used mainly in instances where security against the collapse of a borehole sidewall is required and where steel casing does not already offer such security. In such instances, the casing is inserted the entire length of the borehole and will certainly be perforated for some portion of its length.

The diameter of this casing will also necessarily be smaller than that of the steel casing used which, in most instances, will have a nominal diameter of 165 mm. In order not to compromise too severely on the minimum nominal diameter requirement of 152 mm for successfully completed water supply boreholes, the inside diameter of the uPVC casing shall not be less than 128 mm with a wall thickness of 6 mm. It is also common practice to leave the steel casing in place in order to provide protection for the uPVC casing. The decision to use uPVC casing in the final construction of a borehole shall be made by the Hydrogeological Consultant.

DC 04.03.05 PERFORATED CASING

For the purposes of this project, perforated casing used shall be of a prefabricated type. As a general guideline, slots should be: (1) 300 mm in length, (2) 3 to 4 mm wide, (3) positioned in bands around the circumference of the casing, (4) spaced equally in each band, (5) each circumferential band of slots separated by 100 mm of plain pipe, (6) every second band of slots aligned with one another and (7) a 300 mm section of plain pipe left at both ends of the casing.

Bearing in mind that the number of slots forming each circumferential band depends not only on the casing diameter but also impact on the strength of the casing, it is suggested that the guidelines presented in Table DC.3 be adhered to in this regard.

Table DC.3. Recommended number of slots per circumferential band for various steel casing diameters and associated percentage open area provided

NOMINAL CASING DIAMETER	NUMBER OF SLOTS PER CIRCUMFERENTIAL BAND	PERCENTAGE OPEN AREA
152 mm	6	3.0%
165 mm	8	3.7%
219 mm (8 in. nominal)	10	3.7%

Also presented in this table (Table DC.3) is the approximate open area provided by the above slot pattern applied to each of the given casing diameters. In certain instances, however, it may be required to use more sophisticated and expensive slotted casing. Also known as screens, these include: (1) continuously wound wedge wire screens, (2) louvered screens or bridge-slotted screens and (3) screens pre-

coated with gravel. The decision to use such screens shall again be made by the Hydrogeological Consultant after providing motivation to and gaining acceptance from the Implementing Authority.

DC 04.03.06 RECOVERY OF STEEL CASING

The contractor shall make every effort to recover, only on instruction from the Hydrogeological Consultant, steel casing from unsuccessful or abandoned boreholes. This casing can also be refurbished to an acceptable condition for re-use.

DC 04.03.07 BOREHOLE STRAIGHTNESS

The Drilling Contractor in the presence of the Hydrogeological Consultant shall perform the straightness test and its success (or failure) recorded by this party.

A borehole, which fails a straightness test, shall be deemed lost and it shall be required of the Drilling Contractor to drill a replacement borehole at own expense. In the event that a straightness test is made before completion of the borehole, then the contractor shall be required to cease operations and facilitate access to the borehole for the duration of such activity.

DC 04.03.08 BOREHOLE VERTICALITY

The Hydrogeological Consultant in the presence of the Drilling Contractor shall perform the verticality test. The consultant shall therefore be required to provide the necessary equipment for conducting a verticality test. A borehole, which fails a verticality test, shall be deemed lost and it shall be required of the contractor to drill a replacement borehole at own expense. In the event that a verticality test is made before completion of the borehole, then the Drilling Contractor shall be required to cease operations and facilitate access to the borehole for the duration of such activity.

DC 04.03.09 BACKFILLING

This entails filling the annular space between the borehole sidewall and the outside of the casing with suitable material. The purpose of annular backfilling includes: (1) the provision of a base on which to found a sanitary seal and (2) the provision of support for the sidewalls of the borehole and the casing. In instances where casing has been seated at a comparatively shallow depth in fresh material below a weathered near-surface horizon, all of the drill cuttings removed from the borehole whilst drilling represents suitable material for this purpose. Annular backfilling with this material is not advisable in instances where this is not the case, such as for example where the casing extends to a substantial depth and comprises slotted/perforated sections or where the waterbearing horizon is shallow and open to the borehole via slotted/perforated casing. In these instances, it shall be required to insert a formation stabiliser into the annulus. The backfilling shall extend to within approximately 5 m of the ground surface.

The Contractor shall allow for the cost of backfilling in the tendered rates.

DC 04.03.10 FORMATION STABILISER

This comprises material, which is placed in the annulus between the borehole sidewall and perforated/slotted sections of casing to stabilise the formation against collapse and ingress into the borehole. The drill cuttings and spoils removed from the borehole is not suitable material for this purpose. The stabiliser shall comprise material which is: (1) well sorted, (2) well rounded, (3) low in calcareous content and (4) graded such that the smallest grain size is larger than the casing perforations/slots. The stabiliser material can either be placed by hand or through a

tremie pipe. Excessive bridging of stabiliser material in the annulus can be prevented: (1) through the use of centralisers on the casing or (2) by washing it in with clean water. The formation stabiliser should extend some 10 m above the top of the uppermost perforated/slotted section of casing before the borehole is developed.

The Contractor shall allow for the cost of formation stabilising in the tendered rates.

DC 04.03.11 CONCRETE COLLAR

The Drilling Contractor shall construct a shallow circular concrete collar around each successfully completed borehole. This collar shall have dimensions and volume as specified by the Hydrogeological Consultant. The concrete mixture shall required strength of some 30 MPa after 28 days. A similar collar may need to be constructed, on request of the Hydrogeological Consultant, over unsuccessful or abandoned boreholes.

The Contractor shall allow for the cost of the concrete collar in the tendered rates.

DC 04.03.12 UNSUCCESSFUL AND ABANDONED BOREHOLES

A borehole shall be declared unsuccessful at the discretion of the Hydrogeological Consultant. The latter may also, at any time during the course of the work, order the abandonment of a borehole in progress.

In such instances, the Hydrogeological Consultant shall instruct the Drilling Contractor on further actions to be taken. These may include either: (1) the salvage of any casing from the borehole and (2) the plugging of the borehole or (3) the securing of the borehole for long term monitoring purposes, in which case it shall be provided with a sanitary seal concrete collar protection and marking.

Plugging (or finishing) of an unsuccessful or abandoned borehole is aimed at removing any danger or hazard such boreholes may present to the environment, e.g. as a conduit for the inflow of surface water into the groundwater regime or as a danger to traffic (whether human, stock or vehicular) in the immediate vicinity thereof. It shall also be required to cast a concrete collar over the infilled borehole.

The Drilling Contractor shall be remunerated for an unsuccessful or abandoned borehole on the basis of tendered rates in the Schedule of Rates for such of the following items as are relevant: (1) drilling per linear metre of depth for each relevant drilling diameter employed, (2) steel casing per linear metre thereof recovered, (3) backfilling, (4) a sanitary seal, (5) borehole protection and (6) borehole marking. Payment for any casing left behind in an unsuccessful or abandoned borehole will only be made, on the same basis as described in (2) above, on written certification by the Hydrogeological Consultant that the contractor has made every reasonable attempt in this regard.

DC 04.03.13 LOST BOREHOLES

A borehole shall be declared lost by the Hydrogeological Consultant in the event that it can not be completed satisfactorily due to factors such as: (1) the irrecoverable loss of drilling equipment, materials or tools therein, (2) accident to plant or heavy machinery, (3) failure to pass a straightness test and (4) failure to pass a verticality test. A decision in this regard shall be made after consultation with the Drilling Contractor, who shall have the considered option to either attempt remediation of the situation to the satisfaction of the Hydrogeological Consultant or, alternatively, declare the situation irretrievable. No payment shall be made for any work done, materials used or time spent by the Drilling Contractor on a lost borehole. The cost of any materials recovered in a damaged state from a lost borehole shall be borne

by the contractor. A borehole, which is declared lost, shall be replaced with a new borehole to be constructed by the Drilling Contractor in the vicinity of the lost borehole and at a position indicated by the Hydrogeological Consultant. Payment for a new borehole constructed under these circumstances shall be made on the same basis as for any other successfully completed borehole. Materials recovered in good condition may, however, be re-used by the contractor.

DC 04.03.14 SANITARY SEAL

Every successful water supply borehole shall be provided with a sanitary seal. The seal shall consist of Portland Cement mixed to slurry with bentonite and water, which is free of oil and other organic matter. The bentonite and water should be thoroughly mixed in the ratio of 2 kg bentonite to 25 ℓ water prior to adding and mixing in 50 kg (one bag) cement. The final grout seal shall extend to a depth of at least 5 m below ground surface, i.e. founded on the backfilling. In such shallow applications, the slurry can be gravity-fed into the annulus through a small diameter tube (tremie pipe) extending to the depth of emplacement. The tremie pipe should be withdrawn slowly as the slurry fills up the annulus. There shall be no voids in the sanitary seal.

The Contractor shall allow for the cost of the sanitary seal in the tendered rates.

DC 04.03.15 BOREHOLE DEVELOPMENT

The Geohydrologist shall submit proof of sufficient borehole development procedures. This activity shall be concluded with the collection of a 1 ℓ representative water sample obtained from the return flow during development.

The Contractor shall allow for the cost of borehole development in the tendered rates.

DC 04.03.16 BOREHOLE DISINFECTION

The Geohydrologist shall submit proof of sufficient borehole disinfection procedures.

Guideline volumes/weights of common compounds to be used for disinfection purposes under most normal circumstances can be derived from the information provided in Table DC.4

The Contractor shall allow for the cost of borehole disinfection in the tendered rates.

Table DC.4. Guideline volumes/weights of common sterilants to be used per unit volume of water for various borehole diameters

	VOLUME OF WATER PER METRE OF BOREHOLE	VOLUME/WEIGHT OF STERILANT TO BE USED FOR DISINFECTION PER UNIT VOLUME OF WATER BELOW GROUNDWATER REST LEVEL		
		Sodium hypochlorite	Calcium hypochlorite	Chlorinated lime
	18 ℓ	500 ml (2 cups)	26 g (¼ cup)	90 g (1 cup)
	21 ℓ	600 ml (2½ cups)	30 g (½ cup)	105 g (1 cup)
	33 ℓ	940 ml (4)	47 g (½ cup)	165 g (1½)

		cups)		cups)
	51 ℓ	1500 ml (6 cups)	73 g (¾ cup)	255 g (2½ cups)
<p>NOTES:</p> <ol style="list-style-type: none"> 1. No distinction is drawn between open and cased portions of a borehole since these differences are considered to have a negligible impact on calculated unit volumes. 2. The trade percentage of chlorine in the listed sterilants is taken to be: <ul style="list-style-type: none"> • 3.5 percent by volume (35 m ℓ /ℓ) for sodium hypochlorite; • 70 percent by weight (700 g/kg) for calcium hypochlorite; and • 20 percent by weight (200 g/kg) for chlorinated lime. <p>EXAMPLE:</p> <p>A 100-metre deep borehole with a nominal diameter of 165 mm and with a rest water level standing at a depth of 25 m below surface will require 75 x 30 g = 2,250 g (2.25 kg), alternatively 75 x _ cup = 25 cups, of calcium hypochlorite to achieve adequate disinfection. The same situation would require 75 x 600 mℓ = 45,000 mℓ (45 ℓ) of sodium hypochlorite to achieve adequate disinfection.</p>				

DC 04.03.17 BOREHOLE PROTECTION

This entails sealing the borehole from the introduction of foreign material directly through the casing.

In order to provide the Hydrogeological Consultant with ready access to the borehole for water level measuring purposes, it is required that a small hole be drilled in the lid. This hole shall be furnished with a tamper-proof plug such as a "dead-end" threaded into a water pipe connector welded on the hole. The final diameter of the hole providing access to the borehole shall be sufficient to allow a "normal" dipmeter probe to pass through it. It is considered that a diameter of at least 10 mm and not more than 20 mm is suitable for this purpose.

The Contractor shall allow for the cost of borehole protection in the tendered rates.

DC 04.03.18 BOREHOLE MARKING (IN THE FIELD)

The activity itself represents marking the borehole by: (1) script-welding its assigned and unique identifying number onto the lid of the borehole and (2) planting a concrete block with dimensions of 200 mm x 200 mm x 200 mm (also bearing the number of the borehole) in the ground a distance of five metres to the north of the borehole. It is the responsibility of the Hydrogeological Consultant to ensure that a borehole number is provided to the contractor for this purpose.

The Contractor shall allow for the cost of borehole marking in the tendered rates.

DC 04.03.19 SITE FINISHING

The activities associated with this task shall include the repair of construction scars on the work site resulting from drilling activities as well as the general cleanup of the site of waste materials, debris and oil spills. The latter shall be shovelled over and worked into the ground wherever possible.

Site finishing shall be deemed as included in the tendered rates.

DC 04.04 DATA RECORDING AND REPORTING

A detailed and accurate record of all information arising from the borehole drilling activity shall be recorded with care and diligence. The Drilling Contractor can collect much of this information. The Hydrogeological Consultant shall keep this current and available for inspection on request.

The contractor shall include the cost of data recording and reporting in the tendered rates.

It shall be the responsibility of the Hydrogeological Consultant to verify receipt of this information prior to certifying a claim by the Drilling Contractor in this regard. The following items of information represent the minimum number of parameters, which shall be monitored and recorded by the contractor:

- Penetration Rate;
- Formation Sampling and Description;
- Water Strike Depth;
- Blow Yield; and
- Groundwater Rest Level.

DC 04.05 DOWN-THE-HOLE LOSS OF EQUIPMENT

The Hydrogeological Consultant shall afford the contractor every opportunity and reasonable time to fish for lost equipment. The Drilling Contractor shall, in turn, keep the Hydrogeological Consultant informed of progress and the likelihood of success in this regard. The contractor shall have no claim against any other party for any losses incurred in this regard. The Hydrogeological Consultant shall finally decide on the fate of the borehole. It may either be declared successful or lost.

DC 04.05.01 BOREHOLE DECLARED SUCCESSFUL

Circumstances under which a borehole may be declared successful include: (1) the borehole has encountered significant water, (2) pumping equipment can be installed to an acceptable depth in the borehole and (3) the lost equipment does not pose a threat to the present and future quality of the groundwater. In the event that a borehole is declared successful despite the irrecoverable loss of drilling equipment, materials or tools therein, then the exact nature and position of the equipment lost in the borehole shall be recorded and appear in relevant project documentation. The Drilling Contractor shall be remunerated for a borehole declared successful under these circumstances on the same basis as for any other successfully completed borehole.

DC 04.05.02 BOREHOLE DECLARED LOST

Refer to paragraph DC 04.03.13.

DC 04.06 BOREHOLE INFORMATION REQUIRED

A detailed and accurate record of all information arising from the following activities shall be submitted by the Hydrogeological Consultant.

- Down-the-hole borehole measurement;
- Borehole Construction Information;
- Geological Information;
- Hydrogeological Information; and
- Hydrochemical Information.
-

The Contractor shall allow for the cost of the information in the tendered rates.

DC 04.07 REHABILITATION OF EXISTING BOREHOLES

The scope of this work may vary from the basic cleaning out and redevelopment of an existing borehole to the recovery of casing, the reaming and subsequent re-

installation of casing. The nature of the rehabilitation required in each individual instance shall be identified prior to undertaking this activity since this shall indicate which equipment will most suitably complete the task.

The rehabilitation of an existing borehole shall be carried out under the supervision of the Hydrogeological Consultant. In any event, the execution of such work shall be subject to the same degree of data collection and record keeping as is required of a new borehole.

The Drilling Contractor shall be remunerated for this service on the basis of the rates tendered as per section DC 05. It shall be expected of the contractor to have assessed the potential technical risks involved with such work and, as a consequence, the contractor shall have no claim against any other party for the loss of equipment, materials or tools incurred in the course of such work.

DC 04.08 FINAL ACCEPTANCE

The Hydrogeological Consultant shall accept a successfully finished water supply borehole by issuing of a certificate of completion. At this stage, the Hydrogeological Consultant shall have established that all aspects pertaining to the work and the final product meet, at least, those of the various criteria and requirements set out above which have been imposed.

DC 04.09 APPOINTMENT OF HYDROGEOLOGICAL CONSULTANT

The Contractor shall be responsible for appointing a Hydrogeological Consultant for the purposes of this contract. The Hydrogeological Consultant shall be registered with the Department of Water Affairs and Forestry and shall be approved by the Engineer.

The Hydrogeological Consultant shall be responsible for the hydrogeological survey to site the borehole, oversee the drilling of the borehole and pump testing the borehole as well classification of the drinking water for domestic purposes.

DC 05 MEASUREMENT AND PAYMENT

DC.01 DRILLING OF BOREHOLE Unit: m

The contractor shall be remunerated for drilling per linear metre of depth at the rate tendered for each relevant drilling diameter employed.

The tendered rate shall include full compensation for all labour, equipment and material required, recording and reporting for the complete drilling of the boreholes in accordance with the specification.

DC.02 BOREHOLE CASING

DC.02.01 Steel Casing Unit: m

The unit of measurement for steel casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

DC.02.02 Casing Shoe Unit: item

Remuneration shall be for each casing shoe supplied and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing shoe.

DC.02.03 uPVC Casing Unit: m

The unit of measurement for uPVC casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

DC.02.04 Perforated Casing Unit: m

The unit of measurement for perforated casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

DC.03 RECOVERY OF STEEL CASING Unit: m

Remuneration for the recovery of steel casing shall be per linear metre thereof salvaged from a borehole.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the recovery of steel casing.

DC.04 APPOINTMENT OF HYDROGEOLOGICAL CONSULTANT

(a) Appointment of Hydrogeological ConsultantUnit: PC Sum

(b) Charge required by Contractor on subitem (a) aboveUnit: %

Remuneration for the appointment of a Hydrogeological Consultant shall be based on a Prime Cost Sum. The Prime Cost Sum provided under subitem (a) in the Schedule of Quantities will be expended in accordance with Subclause 48(2) of the General Conditions of Contract.

The tendered percentage under subitem (b) will be paid to the Contractor on the value of each payment made to the Hydrogeological Consultant.

DC.05 REHABILITATION OF EXISTING BOREHOLES Unit: m

The contractor shall be remunerated for rehabilitation of an existing borehole by means of drilling per linear metre of depth at the rate tendered for each relevant drilling diameter employed.

The contractor shall also be remunerated for the basic cleaning out and development of an existing borehole to the recovery of casing, the reaming and subsequent re-installation of casing. The nature of the rehabilitation required in each individual instance shall be identified prior to undertaking this activity since this shall indicate which equipment will most suitably complete the task.

The tendered rate shall include full compensation for all labour, equipment and material required recording and reporting for the complete drilling of the boreholes in order to rehabilitate an existing borehole in accordance with the specification.

The rehabilitation of an existing borehole shall be carried out under the supervision of the Hydrogeological Consultant. In any event, the execution of such work shall be subject to the same degree of data collection and record keeping as is required of a new borehole.

It shall be expected of the contractor to have assessed the potential technical risks involved with such work and, as a consequence, the contractor shall have no claim against any other party for the loss of equipment, materials or tools incurred in the course of such work.

TECHNICAL SPECIFICATION

DH OPERATION OF POTABLE WATER WORKS

CONTENTS

DH 01	SCOPE
DH 02	STANDARD SPECIFICATION AND REGULATIONS
DH 03	LEGAL AND GENERAL REQUIREMENTS
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DH 01 SCOPE

Potable water works shall mean all units, components, equipment and materials, and their relation to each other, employed to enable reliable and effective water treatment.

This specification covers the operation of a water works and equipment related to effective water treatment.

The Contractor shall manage and operate the water works in accordance with the prescriptions in this specification, the relevant operation and maintenance manuals and **Additional Specification SF**. Operation duties shall generally refer to all tasks and actions required for operating the process units and components of the water works typically found at remote DPW sites such as police stations, border posts, etc. These works shall include (among others):

1. Local authority connection with on-site storage:

- Water meter and isolating valves at connection.
- Feed to ground level and/or elevated tank(s).
- Ground level tank/reservoir.
- Pump and rising main from ground level tank to elevated tank.
- Chlorination unit.
- Elevated tank(s): Plastic up to 5 kl capacity; pressed steel > 5 kl.
- Feed from elevated tank to first user connection.

2. Borehole(s):

- Fully equipped production borehole(s): Duty (at least) and stand-by (where available).
- Monitoring borehole (where applicable).
- Water meter and isolating valves at each production borehole.
- Feed to ground level and/or elevated tank(s).
- Ground level tank/reservoir.
- Pump and rising main from ground level tank to elevated tank.
- Chlorination unit.
- Elevated tank(s): Plastic up to 5 kl capacity; pressed steel > 5 kl.
- Feed from elevated tank to first user connection.

3. Desalination of brackish groundwater:

- Reverse osmosis (RO) unit in full- or side-stream configuration, including high-pressure pumps, pressure vessel array and cleaning (CIP) system.
- Water meter in RO system pipework.

- Pre-treatment for RO process (where applicable), including anti-scalant addition and cartridge filtration.
- Post treatment (stabilisation) where applicable.
- On-site brine disposal.

This specification covers requirements for potable water quality, as well as testing procedures and equipment to verify these requirements.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with Portion 3: Additional Specifications included in this document.

DH 02 STANDARD SPECIFICATIONS AND REGULATIONS

DH 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

SABS 1200	-	Standardised specification for civil engineering construction
SABS ISO 5667-2	-	Water quality sampling, part 2: Guidance on sampling techniques
SABS 241	-	South African Standard Specification for drinking water

DH 02.02 OTHER SPECIFICATIONS

The following Technical Specifications for repair and maintenance of water process units shall be read in conjunction with this specification and shall be deemed to form part thereof:

CI	Pressed steel tanks
CE	Water Distribution Networks
DA	Borehole pump systems
DB	Potable Water Filtration Systems
DF	Potable Water Disinfection and Filtration Units
SF	General Operation

DH 02.03 ACTS, REGULATIONS AND STATUTORY REQUIREMENTS

All relevant regulations and statutory requirements as laid down in the latest edition of the following acts shall be adhered to:

- Occupational Health and Safety Act, 1993 (No. 85 of 1993)
- National Water Act (No. 36 of 1998)
- Water Services Act (No. 108 of 1997)
- Environment Conservation Act (No. 73 of 1989)
- National Environmental Management Act (No. 107 of 1998)

DH 02.04 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

DH 02.05 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

DH 03 LEGAL AND GENERAL REQUIREMENTS

DH 03.01 DEFINITION OF WATER USE

This specification covers the legal requirements for water use as regulated by the National Water Act (No. 36 of 1998). A large fraction of the activities performed by the Department of Public Works is covered by the general authorisations in terms of Section 39 of the Water Act. The following categories of water use are scheduled:

- Taking of water and storage of water (Section 2 (a) and (b)) of the Water Act.
- Engaging in a controlled activity, identified as such in Section 37 (1) of the Water Act. Irrigation of any land with waste or water containing waste generated through any industrial activity or by a water works (Section 21 (e) of the Water Act).
- Discharging of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit, and disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generating process.
- Disposing of waste in a manner which may detrimentally impact a water resource (Section 28 of the Water Act).

DH 03.02 REGISTRATION OF WATER USE

According to the Water Act a water use must be registered with the Department of Water Affairs and Forestry (DWAF). The prescribed forms are available on DWAF's internet web site:

<http://www.dwaf.gov.za>

The application forms for registration or licensing of a water use are available on the above website. Forms DW 771 / DW 758 R1c.doc (updated version) – Licensing Part 1: Company, Business or Partnership, National or Provincial Government are applicable.

Parts 1, 3, 4 and 8 of these forms will be completed by the Department of Public Works. All other forms shall be completed and submitted by the Contractor.

These registration forms shall be completed by the Contractor and must be submitted to:

**The Director-General
Department of Public Works
Private Bag X65
PRETORIA
2001**

For attention of: **Deputy Director, Water Management**

Based on the information so provided, the Department of Water Affairs and Forestry may require the applicant to apply for a license for the relevant water or wastewater use.

DH 03.03 **LICENSING OF A WATER USE**

In general a water use must be licensed unless it is:

- Listed in Schedule 1 (See page 152 of Government Gazette No. 19182 dated 26 August 1998)
- An existing lawful use.
- Permissible under a general authorisation (See Government Gazette No. 20526 dated 8 October 1999)

The responsible authority can waive the need for a license.

If licensing is required, the Department of Public Works will appoint an independent consultant for the duty.

DH 03.04 **OPERATOR REGISTRATION AND CLASSIFICATION OF WATER CARE WORKS**

In the terms of Section 26 (f) of the Water Act (No. 36 of 1988) operators shall be registered with the Department of Water Affairs and Forestry. The Contractor shall be responsible for the registration of workers/operators in terms of this requirement (See Regulation R2834 dated 27 December 1985). The Engineer will classify the water care works for tendering purposes.

DH 03.05 **ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

In terms of Government Notices R1182 and R1183 of 5 September 1997, new water care works as well as upgrading of water care works are generally subject to Environmental Impact Assessment. The relevant procedures are described in a guideline document: EIA Regulations, Implementation of Sections 21, 22 and 26 of the Environment Conservation Act (No. 73 of 1989).

An independent consultant will generally be appointed to conduct such assessment. An EIA must be submitted to the Department of Environmental Affairs and Tourism for approval by means of a Record of Decision.

Under normal conditions, an EIA will not be required for repair of water care works.

DH 03.06 **ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

An Environmental Management Plan (EMP) is required for all repair work that may generate waste (such as water treatment sludge) or that may detrimentally impact the environment during repair and operation of the water care works.

The Contractor shall prepare and submit an EMP to the Department of Public Works' project manager. His approval is not required, but the EMP should guide repair work so as to safeguard the environment from detrimental impact. The Contractor shall make provision in his tendered rates for all costs implied by the EMP.

DH 04 GENERAL DESCRIPTION OF THE WATER SUPPLY SYSTEM

DH 04.01 VAN ROOYENSHEK PORT OF ENTRY WATER PURIFICATION WORKS

Water is abstracted from the 4 boreholes located +/- 200m away from the site and stored in steel water storage tanks located next to the purification plant.

Water is fed into the water treatment section of the filtration plant via the water pumps to the required pressure (150 kPa) on the pump delivery gauges.

Chemicals added are used to de-stabilize the colloidal particles in the water body. The chemicals are fed through dosing pumps. Chemical mixing is done with a mechanical stirrer. A flocculation chamber allows time for floc growth. The water then flows to the clarifier tank.

Chlorine is injected to the clean water storage tank after the filter process using one duty and one standby dosing pump running alternately.

The complete bulk water system requires daily monitoring and operation in order to ensure effective reporting and supply of water to the operational and residential areas.

DH 05 TECHNICAL DETAILS OF THE INSTALLATION

DH 05.01 VAN ROOYENSHEK PORT OF ENTRY: BOREHOLE PUMPS AND WATER PURIFICATION WORKS

The borehole pump specifications are to be determined at the commencement of the contract

The water purification plant must always be maintained and operated according to the manufacturer's specification. Improper maintenance and operation will result in failure.

QTY	Position	Pump Description	Pump and Motor Description	Pumping Medium
4	Borehole submersible pump	Submersible Pump	To be determined at the start of the contract	Clear borehole water
2	Dosing pump	Alldos	M220-4 380V	chemicals

DH 06 DETAILS OF THE REPAIR WORK

All borehole pumps to be serviced.

DH 07 **OPERATION****DH 07.01** **GENERAL**

Operation shall include all activities and all other actions or rectifying measures necessary for optimal operation of water care works.

Remuneration for operation of the complete water works shall be deemed included in at the tendered rate for monthly payment of operation of the works.

DH 07.02 **PREPARATORY OPERATIONAL TASKS**

The preparatory tasks to be executed shall include, but shall not be limited to the items listed in the table below:

DH 04.02	PREPARATORY OPERATIONAL TASKS
01	Satisfy legal and general requirements.
02	Draft inventories of process units, components, materials, etc.
03	Draft process flow diagrams.
04	Derive from available information the design capacity and current load of the works.
05	Assess compliance with relevant design parameters to enable optimal operation of the plant according to its original functionality.
06	Draft plant-specific Operation and Maintenance manuals.
07	Institute required safety measures.
08	Draft template logbook.
09	Draft water balance of water and wastewater system.

DH 07.03 **GENERAL OPERATION WORK**

General operation of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations, and with the Particular Specification related to this work.

The general operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

DH 04.03	GENERAL OPERATION WORK	FREQUENCY
01	General housekeeping: Keep site and treatment facilities in neat and acceptable condition.	Daily
02	Control access to the site.	Daily
03	Maintain safety conditions on site.	Daily
04	Log and report pollution events, power failures, extraordinary process phenomena, etc. Check auto-reset of power to mechanical equipment.	Event
05	Calibrate water meters to ensure accurate flow data.	6 Months
06	Record operating hours (and kW-hours where applicable) of all mechanical equipment.	Daily
07	Check operation of all valves and sluices.	Monthly

DH 07.04 OPERATION OF SPECIFIC PROCESSES AND UNITS

Operation of specific processes, units and components of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations, and with the Particular Specification related to this work.

The specific operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

DH 04.04.--	OPERATION OF SPECIFIC PROCESSES AND UNITS	FREQUENCY
01	Boreholes and equipment	
	01 Check whether pump is operating.	Daily
	02 Record operating hours.	Daily
	03 Record pressure at borehole collar during operation.	Daily
	04 Record borehole water levels at start and stop of pump.	Monthly
	05 Check operation of emergency stop switch.	Monthly
	06 Record meter reading.	Monthly
	07 Record rainfall: Date, precipitation and duration per event.	Event
	08 Monitor pollution risk (e.g. septic tank or fuel depot close to borehole).	3 Months
02	Treated water tanks and reservoirs	
	01 Record water level in tank/reservoir.	Daily
	02 Empty and clean tank/reservoir.	6 Months
03	Chlorination	
	01 Check operation of chlorination facility.	Daily
	02 Ensure chlorine-dosing proportional to flow rate.	Weekly
	03 Measure residual chlorine concentration at outlet of contact tanks (generally the elevated storage tank).	Weekly
	04 Ensure dosage concentration and dosing rates compatible with specification requirements.	Weekly
04	On-site pipework	
	01 Flush pipework, tanks and geysers.	6 Months
	02 Measure residual pressure in pipelines.	3 Months
05	Submersible pumps	
	01 Check operation and correct switching of pumps.	Daily
	02 Clean pump suction sumps/chambers.	Weekly
	03 Check integrity of power supply and MCC	Monthly
	07 Operate the control system on a daily basis according to supplier's prescriptions, including: Chemical solution preparation, membrane cleaning, sampling, measurement and logging of data.	Daily
	08 Check accuracy of chemical dosing rates.	Weekly
	09 Manage provision, storage and control of chemicals.	Daily
06	Power supply	
	01 Check operation of stand-by generator where applicable	Monthly

DH 08 MONITORING AND REPORTING

The contractor shall keep a written record of all measurements taken and analyses done for process control and for reporting to relevant authorities in terms of legal or project management requirements.

A logbook shall be kept for daily recording of failures, malfunctions, spills, pollution events, power failures and detail of corrective measures implemented.

The monitoring programme for the above measurements and analyses shall include, but shall not be limited to the items listed in the attached table.

DH 09 MEASUREMENT AND PAYMENT

DH 09.01 REGISTRATION OF A WATER USE Unit : Number

The unit of measurement shall be the number of potable water and sewage treatment plants to be registered. Boreholes are registered as single units. Separate forms are necessary for individual properties, as it is registered at the Surveyor General under its own title dead number. Multiple boreholes on the same property can be registered on the same form by using a summary of the location of each borehole.

The tendered rates shall include full compensation to obtain all relevant information from different authorities (Surveyor General, for instance) to complete the forms. It shall also include full compensation to complete and dispatch the application forms.

**DH 09.02 ENVIRONMENTAL IMPACT ASSESSMENT (EIA):
PRE-APPLICATION CONSULTATION, SUBMIT
APPLICATION AND PLAN OF STUDY FOR
SCOPING AND THE SCOPING REPORT Unit : Number**

The unit of measurement shall be to perform the necessary tasks required by the relevant authorities to obtain authorisation for the proposed activity (or activities which may form any entity) up to the acceptance of and the issuing of Records of Decision. This can be performed by the contractor or if required, by the relevant authority, an independent consultant shall be appointed.

The unit of measurement shall be the number of scoping reports compiled by the contractor. The tendered rate shall include full compensation for performing the necessary tasks required by the relevant authorities to obtain authorisation for the proposed activity (or activities which may form an entity) up to the issuing of Record of Decision. Should it be required by the relevant authority that an independent consultant perform this duty such a consultant will be appointed for that purpose by the Department of Public Works.

**DH 09.03 ENVIRONMENTAL IMPACT ASSESSMENT:
PLAN OF STUDY FOR ENVIRONMENTAL IMPACT
REPORT Unit : Number**

The unite of measurement shall be to do a full Environmental Assessment if it is required by the relevant authority for the proposed activity (or activities which may form an activity), after the scoping report has been reviewed and accepted.

The Environmental Impact Assessment shall be conducted by an independent consultant.

The tendered rates shall include full compensation for all the necessary tasks required by the relevant authority to authorise the activity (activities).

**DH 09.04 ENVIRONMENTAL MANAGEMENT PLAN (EMP)
DURING REPAIR AND OPERATION Unit : Number**

The unit of measurement shall be number of EMP's compiled by the contractor. One EMP per site will be acceptable.

The tendered rates shall include full compensation for the compilation of an Environmental Management Plan, which will be executed during the repair, maintenance, and operation of a potable water installation and sewerage purification works.

DH 09.05 REMUNERATION FOR OPERATIONAL RESPONSIBILITIES

Remuneration for the monthly operation of an installation is determined by a ten point per month scoring system (refer to score card in Technical Specification SF: General Operation of an Installation). The scoring system includes but is not limited to the following operational parameters:

- Potable water quality control analysis by an approved authority;
- quality monitoring programme;
- operation of a site laboratory;
- tests performed on site to evaluate component performance;
- record keeping and reporting system;
- supply of chemicals necessary for the operation of the plant;
- operators and supervisors;
- tools and equipment for operational needs;
- compliance with the required standard (SANS 241 Class 0 or Class 1);
- daily operation of the entire plant to its optimum capacity; and
- Keep site clean, cut/mow weeds and natural grass to a length not longer than 50mm, remove shrubs and small trees from pond walls.

TECHNICAL SPECIFICATION

DL OPERATION OF POTABLE WATER WORKS

CONTENTS

DL 01	SCOPE
DL 02	STANDARD SPECIFICATION
DL 03	OPERATING AND MAINTENANCE MANUALS
DL 04	PROCUREMENT AND INSTALLATION OF CHLORINATION SYSTEMS
DL 05	TESTING AND COMMISSIONING
DL 06	DESCRIPTION OF INSTALLATION
DL 07	OPERATION AND MAINTENANCE
DL 08	MEASUREMENT AND PAYMENT

DL 01 SCOPE

This specification states the requirements for all work related to the procurement, installation, testing, commissioning, operation and maintenance of chlorination equipment for the disinfection of drinking water at remote borehole installations. Chlorination equipment shall be provided as one of the following three technological systems, according to site-conditions and the relevant stipulations in this document:

- 1) Calcium hypochlorite dosing systems.
- 2) Sodium hypochlorite dosing systems.
- 3) Vacuum systems for gas chlorination.

Any on-site sodium hypochlorite generators, chlorine dioxide preparation systems or pressure systems for gas chlorination (direct chlorination) shall be deemed UNACCEPTABLE and are all excluded from the scope of this work.

DL 02 STANDARD SPECIFICATIONS AND REGULATIONS

DL 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 10298 - Indirect small to medium-sized gas chlorination systems for the disinfection of water
- SANS 241 - Drinking water
- SANS 10306 - The management of potable water in distribution systems
- SANS 6052 - Residual chlorine content of water

DL 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

DL 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

DL 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

DL 03 OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation and production of operating and maintenance manuals including an inventory of all chlorination equipment.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals. The completion of operating and maintenance manuals shall be a requirement for practical completion.

DL 04 PROCUREMENT AND INSTALLATION OF CHLORINATION SYSTEMS

DL 04.01 GENERAL

Chlorine and hypochlorite are strong bleaching and oxidizing agents and pose a SUBSTANTIAL SAFETY RISK.

The Contractor shall submit proof to the Engineer to demonstrate his (or his subcontractor's) understanding, skill and experience in the assembly of chlorination systems.

All chlorine dosing equipment shall be manually adjustable to set accurate dosing rates within the range of average daily flow rates specified. The concentration of chlorine at the point of dosing shall be between 1 - 5 mg/ l, so that the free residual chlorine concentration shall be between 0.2 - 1.0 mg/ l at the furthest point of use in the water distribution system.

The chlorination system shall be installed in such a way as to dose upstream of overhead tanks/ reservoirs to provide for contact time. Where more than one borehole is used for water supply, the dosing point shall be installed in a common rising main, upstream of the overhead tanks/ reservoirs.

DL 04.02 CALCIUM HYPOCHLORITE DOSING SYSTEM

Calcium hypochlorite dosing shall be the system of choice for disinfection at small remote bore-hole water supply installations.

Calcium hypochlorite can be supplied as briquettes, chips or pellets. Chlorinators shall be designed to provide a consistently accurate dose of available chlorine to small water systems. Corrosion resistant plastics (polyethylene) shall be used in the product's construction.

All Ca(ClO)₂ supplied shall have a chlorine content of between 65 and 70% and an average moisture content of less than 4%. Calcium hypochlorite shall be properly packaged prevent contact with moisture and to ensure safety of handling. A shelf life of at least 3 months shall be maintained for supplied calcium hypochlorite.

The dosing plant uses a dry chemical product that is dissolved in water to make-up the required chlorine containing solution. When the chemical make-up tank is empty a specified mass of the chemical is added to the tank as it is filled with water to make up the required concentrate of chemicals in the solution. The chemical solution used on this systems is 1.7% of Calcium Hypochlorite (*1.13% Cl)

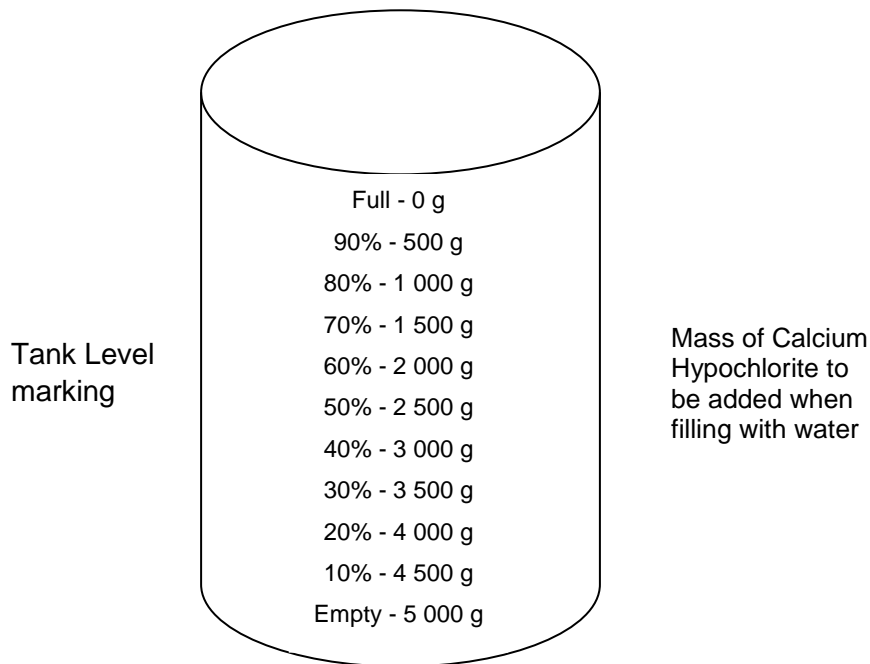
Note*: Calcium Hypochlorite contains 68% chlorine

The principal of making up the chemical is to top up the tank once per week so that the tank is operating of the top half of the tank. This is done at the time of performing the weekly operational tasks. The level of the solution in the tank is used, as the indicator of how much chemical has to be added when performing the topping up task. If this is done, the concentrate of the chemical solution will stay constant.

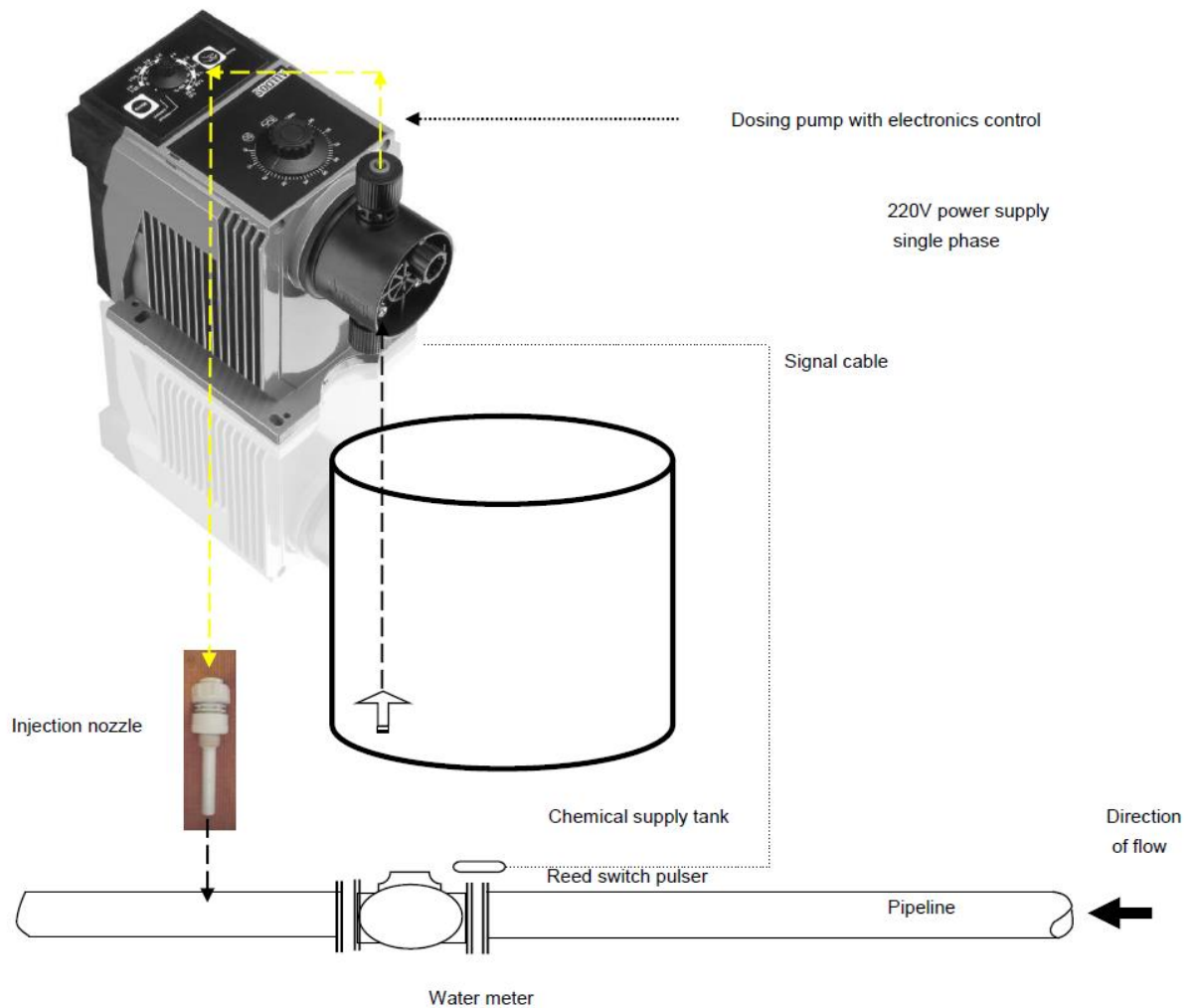
The calcium component of the Calcium Hypochlorite will precipitate and cause a white settlement in the dosing tank. This settled white substance that accumulates at the bottom of the tank is not chlorine and needs to be cleaned out on a regular cycle as described in the three monthly procedures. The tank is used to its lowest operating level (15%) before executing the three monthly cleaning procedures.

The make-up tanks are marked in 10% increments. The mass of chemical that has to be added at each increment is indicated in gram at each increment as in the following illustration as example using the main plaza markings.

Illustration of the markings on the tank



Dosing proportionate to flow shall be done with displacement pulse dosing pump with electronic control, interlinked with flow meter, read switch pulses.



DL 04.03 SODIUM HYPOCHLORITE DOSING SYSTEM

Sodium hypochlorite is a colourless, transparent liquid, which shall be dissolved in cold water to a concentration of between 8 - 10% for liquid dosing.

Sodium hypochlorite shall be safely stored, located it in a cool, dark place, maintaining pH 11 or more and avoiding contact with copper or nickel.

The size of dosing tank shall be dimensioned such and kept at a maximum level to ensure that sodium hypochlorite (NaOCl) does not break down to NaCl and NaOH.

A UV-stabilized polyethylene (PE) off-white or semitransparent dose tank is required, with a sintered drain-off connection and 4 lateral mounting places at the

bottom on the tank shell. The dose tanks shall be optimized for stability and functionality.

The dosing apparatus shall be robust and shall not cause blockages. The dosing apparatus shall ensure absolutely precise dosing through a dosing process that is always strictly proportional to the quantity of water flowing through the main delivery pipe. This could be achieved through a flow meter in the dosing apparatus. The following special features shall be required:

- (i) Adjustable dosing capacity that avoids over- or under-dosing
- (ii) Automatic stop of an overload-proof synchronous motor under conditions of short-term pressure shocks, with automatic re-start when pressure drops to normal again.
- (iii) A control LED that indicates pump strokes, with a second LED that flashes the liquid level becomes too low causing the dose pump to switch off automatically: the empty indication is directly combined with the suction line for this purpose.

DL 04.04 VACUUM GAS CHLORINATION SYSTEM

Vacuum gas chlorination systems shall only be considered where average daily flow rates are more than 8 l/s (i.e. around 700 m³/d). The mean residence time of gas cylinders shall never be more than two months. Gas cylinders shall be mounted on mechanical balances.

Pressure systems feeding pressurized gaseous chlorine directly into the water supply system shall not be acceptable.

A dual system with two cylinders is required, including an automatic changeover device to switch between cylinders that shall be installed with a wall mounted manifold.

All chlorination equipment and ancillaries, the layout and installation, materials, operational safety measures and maintenance shall be strictly in accordance with SANS 10298.

DL 04.05 SAFETY SIGNS AT CHLORINATION INSTALLATION

Regardless of the type of chlorination system installed, warning signs shall be installed at the chlorination systems to be clearly visible. Warning signs shall also include all safety precautions for the operation and maintenance of chlorination systems, in accordance with the manufacturer's specifications and other relevant safety specifications and acts. A warning sign with first aid instructions shall also be installed at the chlorination system, specifying instructions for instances of skin exposure, eye exposure, inhalation exposure and swallowing, according to the manufacturer's specifications and SANS 10298.

DL 05 TESTING AND COMMISSIONING

After installation, the contractor shall evaluate the functioning of chlorination systems to ensure that there are no leaks and that the rate of dosing is set correctly.

DL 06 DESCRIPTION OF INSTALLATION

DL 06.01 BULK WATER

Water is pumped from multiple boreholes with borehole pumps and delivered into the elevated bulk storage tanks.

The boreholes are switched on and off to maintain a "full tank status". This manual does not cover details regarding the control of the boreholes.

An analysis of the borehole water indicated that the physical properties of the water were suitable for human consumption. The only treatment that the water requires is to dose it with a small quantity of chlorine so that any harmful bacteria and microorganisms that may enter the water can be destroyed.

A system was designed to dose chlorine at a rate of 0.5 to 2 mg/l. The object is to have a residual of chlorine left in the water so that by the time it reaches the user. The traceable presence of free chlorine should be between 0.2 to 0.5 mg/l. the dosing pump can be adjusted up or down to achieve the required residual.

The flow rate from the boreholes could vary depending on which of the boreholes are active and in which combination the boreholes are used. To maintain a constant dosing ratio (mg/l) the dosing facility has to be able to keep pace with possible fluctuations of flow from the boreholes.

"Proportionate to flow" takes place as follows:

- A water meter is used to measure the volume of water that is delivered from the boreholes to the storage tanks. This water meter is equipped with a sensor that gives one pulse for every 100L of water that has passed through the meter to the storage facility.
- A chemical dosing pump is used to dose a chlorine containing solution from the chemical make-up tank into the pipeline, before the water enters the storage tanks.
- The pulses from the water meter is received by an Alldos dosing pump with Etron electronics.
- Each pulse, as received from the water meter, is used to start the dosing pump and introduce a set volume of the chlorine containing solution into the pipeline to maintain the required chlorine-dosing ratio

The dosing pump can be set to manual mode in case of failure of the signal from the water meter.

DL 06.01 WASTEWATER TREATMENT WORKS

The wastewater treatment works is situated within the boundaries of the Van Rooyenshek port of entry (29°45'16.15"S & 27° 6'27.66"E) which consists of ± 2170 m² of land. The collector system consists of nearly ± 756 m of sewer network. The sewer network services 13 residential and 41 operational buildings with a total floor surface area of 3 166 m². The buildings consist out of a total of 97 taps, 35 w/c pans, 35 w/c cisterns, 29 wash hand basins, 19 sinks, 10 baths and 9 showers.

The wastewater treatment process consists out of a three Oxidation ponds for solids settling and treated effluent is discharged to the open veld..

DL 07 OPERATION AND MAINTENANCE

DL 07.01 GENERAL

Maintenance shall be carried out according to an approved maintenance plan and operation and maintenance manual, which shall specify actions including routine preventative maintenance according to the manufacturer's specifications, as well as unforeseen repair work, corrective maintenance and/or replacement of parts of the system.

DL 07.02 OPERATION AND ROUTINE PREVENTATIVE MAINTENANCE

The tasks related to the operation and routine preventative maintenance work shall include but not be limited to the GENERAL actions listed in Table DL 06.02/1 below. SANS 241 shall be adhered to in the routine preventative maintenance of vacuum systems for gas chlorination.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE DL 07.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF CHLORINATION SYSTEMS AND ANCILLARIES	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system.	Daily
2	Clean complete installation thoroughly so that leaks would be obvious and clear when they occur.	Weekly
3	Check, service, repair and clean dosing apparatus from blockages	Monthly
4	Corrosion protect all equipment and ancillaries.	Whenever necessary
5	Check for and repair all leaks. Report leaks.	Monthly
6	Check dosing rate and reset regulators if necessary.	Monthly
7	Measure residual chlorine in the drinking water system (DPD 4 or similar).	Weekly

DL 07.03 OPERATION

Operation of all chlorination systems shall include the supply of chemicals, including chlorine gas or sodium hypochlorite or calcium hypochlorite. The contractor shall supply chemicals to ensure that there is always enough supplied for a full month' s requirement.

DL 07.04 SAFETY PROCEDURES AND PRE-CAUTIONS

SANS 10298 specifies operational safety in terms of general safety requirements, emergency action plans, personal protective equipment and handling of containers, which shall at all times be adhered to. Only personnel who are adequately trained shall be allowed to operate and maintain the chlorination systems.

DL 07.05 REMUNERATION

Remuneration for the monthly operation of chlorination systems, the supply of chlorine or hypochlorite as well as ALL maintenance activities related to chlorination systems shall be deemed included in the tendered rate for ten points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance.

DL 08 MEASUREMENT AND PAYMENT**DL 08.01 SUPPLY AND DELIVERY OF CHLORINATION SYSTEMSUnit: number**

The unit of measurement shall be the number of chlorination systems supplied and delivered, including all equipment and ancillaries deemed part of a functional system.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates. Different systems as specified in this document shall be listed in the Schedule of Quantities, according to:

- (i) Calcium hypochlorite dosing systems.
- (ii) Sodium hypochlorite dosing systems.
- (iii) Vacuum systems for gas chlorination.

Tendered rates shall include full compensation for all transport cost, including all handling of the equipment, loading and off-loading of chlorination systems

Different systems shall be based on the daily average flow rate of the main water supply.

DL 08.02 INSTALLATION, TESTING AND COMMISSIONING OF CHLORINATION SYSTEMS.....Unit: number

The unit of measurement shall be the number of chlorination systems installed, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the chlorination equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- a) Installation of all equipment, ancillaries and all other necessary appurtenances required to render a fully functional chlorination system.
- b) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers.
- c) Routing and fastening of all power cables, connecting of all electrical material and switchgear.
- d) All required installation materials, labour and consumables to render a complete and working installation.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests to ensure a leak free system and the correct settings of regulators to ensure accurate dosing.

Separate items will be listed in the Schedule of Quantities for different types and sizes of systems, as specified under payment item DL.01.

PARTICULAR SPECIFICATION

DW SUPPLY OF WATER

CONTENTS

PWS 01	SCOPE
PWS 02	STANDARD SPECIFICATIONS, REGULATIONS AND CODES OF PRACTICE
PWS 03	DETAIL OF WORK
PWS 04	PLANT: TRANSPORT
PWS 05	TESTING
PWS 06	PAYMENT ITEMS

DW 01 SCOPE

Procure, deliver and discharge, into the storage container(s) at each facility, potable water complying with the specified quality standards.

DW 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES OF PRACTICE

The supply of water is to be undertaken in compliance with the relevant specifications, regulations and/or codes of practice included in the following publications.

- SANS 241 of 2006 - South African Standard Specification for Drinking Water*
- SANS 10252-2: 1993 – Code of Practice “Water Supply and Drainage for Buildings, Part 2: Drainage Installations for Buildings” – Annexure B – Septic Tank Systems*
- National Water Act, Act No 36 of 1998**
- Occupational Health and Safety Act, No 85 of 1993*

DW 03 DETAIL OF WORK

DW 03.01 PROCUREMENT OF WATER

DW 03.01.01 Procurement of potable water

Water of quality in compliance with the South African Standard Specification for Drinking Water, SANS 241: 2006 and volume to meet the facility requirements is to be procured on a legal basis from a source(s) identified by the Contractor. Written proof of purchase, quantity, quality and date(s) is to be provided with the Contractors application for payment for services provided under the Contract.

DW 03.01.02 Procurement of raw water

Raw water is to be procured on a legal basis from a source(s) identified by the Contractor. Written proof of purchase, quantity, quality and date(s) is to be provided with the Contractors application for payment for services provided under the Contract.

DW 03.02 DELIVERY OF WATER TO FACILITIES

DW 03.02.01 General

The Contractor shall deliver the water to facilities on instruction from the Engineer within 24 hours.

DW 03.02.02 Delivery of potable water

The Contractor shall ensure that the water is not contaminated during delivery and upon discharge into the facility storage container(s) and must comply with the following macro and micro-determinants and bacteriological limits:

MACRO- AND MICRO-DETERMINANTS	
1	2
Determined Mg/l	Class 1
Turbidity	1
Magnesium (as Mg)	70 max.
Sodium (as Na)	200 max.
Chloride (as Cl)	200 max.
Sulphate (as So4)	400 max.
Nitrate + nitrite (as N)	10 max.
Fluoride (as F)	1.0 max.
Zinc (as Zn)	1.0 max.
Aluminium (as Al)	0.3 max
pH	6.0 - 9.0
Conductivity	150 mS/m
Iron	0.2
Manganese	0.1

MICROBIOLOGICAL REQUIREMENTS				
1	2	3	4	5
Determinants	Units	Allowable compliance contribution		
		95% of samples, min	4% of samples max	1% of samples max
		Upper limits		
Heterotrophic plate count	Count/ml	100	1000	10000
Total coliform bacteria	Count/100 ml	Not detected	10	100
Faecal coliform bacteria	Count/100 ml	Not detected	1	10

DW 04 PLANT: TRANSPORT

The Contractor shall ensure that the type, condition and capacity of the vehicle(s), including standby vehicles, to be used is sufficient to fulfil the obligations of the Contract. The transport operation shall be undertaken in compliance with relevant transport ordinances.

DW 05 TESTING

The Contractor is responsible to ensure that tests required ensuring compliancy with the specifications and ordinaries relating to the quality of water, are undertaken at the frequency and in terms of procedures prescribed.

DW 06 PAYMENT ITEMS

DW 06.01 Supply units of 1000 litres (m³) of potable water from commercial sources on The instruction of the Engineer/Department's representatives..... Unit: m³

The unit of measurement shall be the number of cubic metres of potable water delivered to site within 24 hours from the time that the Engineer has logged an emergency breakdown call with the Call Centre.

The tendered rate shall include full compensation for the labour, materials and equipment needed to supply potable water into the elevated storage tank as directed by the engineer.

The tendered rate shall include, initial testing of water quality, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers. Separate items will be listed in the schedule of quantities for different rates of delivery.

DW 06.02 Supply and delivery units of 1000 litres (m³) of potable water from existing Sources within a 3km radius on the instruction of the Engineer/Department's representatives Unit: m³

The unit of measurement shall be the number of cubic metres of potable water delivered to site within 24 hours from the time that the Engineer has logged an emergency breakdown call with the Call Centre.

The tendered rate shall include full compensation for the labour, materials and equipment needed to supply and deliver potable water into the elevated storage tank as directed by the engineer.

The tendered rate shall include, initial testing of water quality, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers.

DW 06.03 Supply units of 1000 litres (m³) of raw water on the instruction of the Engineer/Department's representatives Unit: m³

The unit of measurement shall be the number of cubic metres of raw water delivered to site.

The tendered rate shall include full compensation for the labour, materials and equipment needed to supply and deliver raw water into the raw storage tank or raw storage dams as directed by the engineer. It shall be possible to treat the raw water with the existing water treatment works on site to a standard that is in compliance with the South African Standard Specification for Drinking Water, SANS 241: 2006.

The tendered rate shall include, initial testing of water quality, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers. Separate items will be listed in the schedule of quantities for different rates of delivery.

**DW 06.04 Delivery of potable water from commercial sources on the instruction of
The Engineer/Department's representatives Unit: km**

The unit of measurement shall be the number of kilometres travelled from the commercial source approved by the Engineer delivered to the storage tank.

The tendered rate shall include full compensation for the labour, materials and equipment needed to transport potable water into the elevated storage tank as directed by the engineer.

The tendered rate shall include, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers.

E

WASTEWATER WORKS

TECHNICAL SPECIFICATION**EA WASTEWATER INLET WORKS****CONTENTS**

EA 01	SCOPE
EA 02	STANDARD SPECIFICATIONS
EA 03	ADDITIONAL REQUIREMENTS FOR REPAIR AND INSTALLATION OF WASTEWATER INLET WORKS EQUIPMENT
EA 04	OPERATION AND MAINTENANCE MANUALS
EA 05	DETAIL OF REPAIR WORK
EA 06	MAINTENANCE
EA 07	MEASUREMENT AND PAYMENT

EA 01 SCOPE

Wastewater inlet works shall mean all materials, units, components and equipment, and their relation to each other, employed to enable reliable screening, grit deposition and flow measurement of water at a variety of flow rates.

This specification covers the supply, delivery, repair, installation, testing and commissioning, as well as the maintenance of wastewater inlet works and equipment such as hand raked screens, hand stops and open channel sluices, grit channels, as well as flow measurement sensors and converter devices.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

The Contractor shall also be responsible to manage and maintain the wastewater inlet works in accordance with the prescriptions in this specification. The repair work and maintenance of the particular wastewater inlet works is specified in the relevant clauses on detail of repair work and maintenance in this specification.

EA 02 STANDARD SPECIFICATIONS**EA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SABS 1200 - Standardized specification for civil engineering construction

EA 02.02 OTHER SPECIFICATIONS

Not applicable

EA 02.03 **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

EA 02.04 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

EA 02.05 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

EA 03 **ADDITIONAL REQUIREMENTS FOR REPAIR AND INSTALLATION OF WASTEWATER INLET WORKS EQUIPMENT**

The specifications in EA 03 are of a general nature and if not referred to in Clause EA 05: Detail of Repair Work, are not considered part of this Contract.

EA 03.01 **FLOW MEASUREMENT REQUIREMENTS**

In an open channel the flow rate shall be measured via the head caused by an obstruction such as a Parshall or long-throated flume, for which the relevant standardised head/flow rate conversion formulae, shall be applied.

In a closed pipe the closed pipe the flow shall be measured by the Doppler effect on the ultrasonic pulses passing through the liquid in the pipe.

Ultrasonic sensors shall be used to measure the Doppler effect, and an electronic converter device shall be employed to calculate the flow rate.

Apart from electronic flow measurement, a metal level indicator shall be installed in the channel at the correct position for measuring the depth (head). The level indicator shall be a ruler that shows both depth and flow rate on separate scales. The ruler shall have a black background and figures shall be yellow and clearly visible for people with normal eyesight from a standing position. The units of the ruler shall be millimetre for depth and m³/h for flow rate. The scales shall be such that at least ten figures for each scale can be shown on the ruler.

EA 03.02 **ULTRASONIC FLOW METERS AND LEVEL METERS**

EA 03.02.01 **General**

All ultrasonic flow meters shall be microprocessor-based, non-contact meters and be able to be programmed to read flow accurately passing through any pipe or type of flume or over any type of weir, or to read level/volume accurately in an irregularly shaped container.

EA 03.02.02 Operating principle in Open Channels and Closed Pipes

In open channels a burst of ultrasonic pulses is transmitted from a transducer, which is not in contact with the medium. These pulses are reflected off the top surface of the medium and received by the same transducer. The time delay between the transmitted and received signal is proportional to the level between the transmitter/receiver, which is fixed, and the medium, which is variable. To compensate for the temperature dependence of the ultrasonic signal, the ambient temperature shall be measured at the transducer and shall be taken into consideration when the level difference is calculated between transmitter and medium.

In a closed pipe pulses pass through the wall of the pipe and through the liquid. The movement of liquid changes the characteristics of the pulses which are detected and calibrated to indicate a flow rate.

EA 03.02.03 Constructional requirements

The ultrasonic transducer shall include a built-in temperature sensor and shall have a minimum enclosure rating of IP 65. The transducer shall be corrosion protected, as well as immune to ultra-violet radiation.

The flow calculation shall be temperature compensated.

For flow application, the instrument shall provide for the following standard primary flow elements:

- (a) Venturi flumes
- (b) V-notched weirs
- (c) Parshall flumes
- (d) Broad crested weirs, or
- (e) Any special obstruction with a known relationship between height of medium and flow rate.
- (f) Closed, full flow pipes.

For this open channel applications a ten point look-up table with linear interpolation is deemed satisfactory.

For flow applications the instrument shall be equipped with a local flow rate indicator and an 8-digit totaliser. If the totaliser is fed from the microprocessor, it shall be supplied with a minimum of 24-hour battery backup to prevent data loss in the event of power failure.

In addition to the above, for flow meter applications a galvanically isolated pulsed output shall be provided for remote totalising.

A galvanically isolated 4-20 mA output, linear to flow or level shall be provided for remote indication and processing.

In open channel conditions where no stilling well is provided as part of the measuring structure, a suitably dimensioned stilling well shall be supplied as part of the instrument.

The control unit shall be supplied complete with battery backup to prevent loss of set-up data in the event of a power failure.

The control unit and associated power supplies and surge protection shall be housed in the previously detailed instrument enclosure.

For level measurement and/or multiple pump sump level control, the instrument shall be equipped and configured as follows:

(a) Control relays

A minimum of three single pole changeover (SPCO) relays shall be provided for pump control or level alarms. The on and off points for each relay shall be separately programmable.

Each relay shall have a battery backed four-digit (min) hours run time counter.

Time delay between individual relay on signals shall be possible to prevent electric or hydraulic shock loads.

The above relays shall be programmable as rate of rise or fall alarms.

(b) Alarm relay

A single-pole change-over relay shall be provided to signal mains failure, echo loss or any other instrument fault or high or low alarm as required.

(c) Current output

A galvanically isolated 4-20 mA signal linear to the tank/sump level shall be provided. The apron shall be selectable to be rising or falling with level and shall be selectable as part of or the full range of the instrument.

(d) Pumped volume indicator

By means of a minimum 8-digit totaliser, the instrument shall record the approximate pumped volume through a sump. An isolated pulsed output shall be provided for remote indication of this information.

(e) Auto test routine

An auto test routine shall be provided for level instruments used for pump sump control whereby a rising from zero level to transducer face and back again, can be simulated to check the operation of the level control system.

EA 03.02.04 Installation requirements

The ultrasonic transducer shall be supplied complete with mounting bracket and frame. The mounting frame shall be rigid and made from stainless steel. The transducer shall be mounted in such a way that it is free from all handrails, walkways, etc. Passing traffic and the operation of other machines in the vicinity of the transducer shall have no influence on the transducer.

The installation shall include all required interconnections and sundries between the sensor and control unit.

All equipment shall be installed according to the manufacturers requirements.

EA 03.02.05 Accuracy

The accuracy of the measurement shall be better than 0,25 % of full scale.

EA 03.03 **REQUIREMENTS FOR HAND RAKED SCREENS**

Hand raked screens to be supplied under this Contract shall be manufactured from stainless steel. Screens shall be installed with stainless steel Rawl bolts in the channel floor and against the wall. The screen shall be installed at an inclination of 70° with the horizontal. The screen shall be manufactured and installed as illustrated on the drawings.

EA 03.04 **REQUIREMENTS FOR GRIT CHANNELS**

Grit channels shall be repaired where the concrete surfaces of the channel floor and walls have corroded. All corroded surfaces shall be repaired by applying a layer of quick setting epoxy grouting to the surfaces.

Grit channel sluice gates to be supplied under this Contract shall be manufactured from stainless steel to fit the channel dimensions. Sluices shall have a stainless steel cable, which connects them to the channel.

EA 04 **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

EA 05 **DETAIL OF REPAIR WORK**

EA 05.01 **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

EA 05.02 **INLET WORKS**

Repair work to the inlet sump, screen chambers and grit channels shall include the following:

- (a) *Clean and corrosion protect strainer basket and lubricate guide rails and strainer guides;*
- (b) *Clean and corrosion protect pulley assembly and lubricate crank handles;*
- (c) *Remove, recondition and recommission self-priming pumps;*
- (d) *Remove, recondition and recommission float switches.*
- (e) *Corrosion protection for valves and pipework;*

- (f) *Clean MCC panels, etc, for domestic electricity and instrumentation of the raw-water sewerage pump station. Replacement and reconditioning of MCC panels will be measured under Specification EB: Wastewater pump systems.*
- (g) *Flush all gravity pipelines.*

EA 06 **MAINTENANCE**

EA 06.01 **GENERAL**

Maintenance shall include all repair work, replacing of components, routine setting, fixing of leaks, general corrosion protection or any other actions or rectifying measures necessary for complete operation of wastewater works. Routine preventative maintenance according to the manufacturer's specification as set out in the operating and maintenance manual, as well as unforeseen repair work or replacement, shall be carried out.

Remuneration for maintenance of the complete wastewater inlet works shall be deemed included in ten points for the tendered rate for monthly payment of maintenance of the installation of which it forms part.

EA 06.02 **ROUTINE PREVENTATIVE MAINTENANCE**

This routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed in table EA 06.02/1 below.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE EA 06.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF INLET WORKS	MAINTENANCE FREQUENCY
1	Check and lubricate strainer basket guide rails and cable and pulley assembly	Monthly
2	Check, repair or service self priming pumps, float switches and hour metres.	Four-monthly
4	Clean and calibrate flow rate measurement device	Monthly

EA 06.03 **FLOW RATE MEASUREMENT**

The Contractor shall be responsible for the proper performance of flow measurement devices. To ensure a perfect functional condition, the flow measuring devices shall be cleaned and calibrated monthly. The measuring devices shall be calibrated regularly by a manufacturer's representative according to his specification. Apart from regular calibration, the Contractor shall keep records of flow measurements to establish base line data that will be used for future monitoring and periodic maintenance calibration.

EA 07 MEASUREMENT AND PAYMENT

EA.07.01 SUPPLY AND DELIVERY OF SCREENING EQUIPMENT.....Unit : number

The unit of measurement shall be the number of specified units of screening equipment supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading, including all handling of the equipment. The equipment shall include the following:

- (a) The wastewater screen
- (b) Two hand rakes
- (c) Stainless steel cable to lock hand rake to screen.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EA.07.02 SUPPLY AND DELIVERY OF FLOW MEASURING EQUIPMENTUnit : number

The unit of measurement shall be the number of specified units of flow measuring equipment supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading, including all handling of the equipment. The equipment shall include the following:

- (a) The flow sensor
- (b) The converter device and transducer.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EA.07.03 INSTALLATION, TESTING AND COMMISSIONING OF FLOW MEASURING EQUIPMENTUnit : number

The unit of measurement shall be the number of flow measuring devices installed, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- (a) Installation of the flow measuring sensor;
- (b) Installation of the converter device;
- (c) All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EA.07.04 **INSTALLATION, TESTING AND COMMISSIONING OF SCREENING EQUIPMENT** Unit : number

The unit of measurement shall be the number of screens tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- (a) Installation of the screen;
- (b) All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EA.07.05 **DECOMMISSIONING AND REMOVAL OF WASTEWATER INLET WORK EQUIPMENT** Unit : number

The unit of measurement shall be the number of specified units of wastewater inlet works equipment decommissioned and removed.

The tendered rates shall include full compensation for all labour, machinery, tools, transport and site handling necessary for the decommissioning and removal equipment.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EA.07.06 **RECONDITIONING OF WASTEWATER INLET WORKS UNITS AND EQUIPMENT** Unit : number

The unit of measurement shall be the number of specified units of equipment reconditioned.

The tendered rates shall include full compensation for all components, materials, tools, transport, site handling and labour necessary for the complete reconditioning of wastewater inlet works units and equipment in conformance with the specifications in Clause EA 05, Detail of repair work.

TECHNICAL SPECIFICATION**EB WASTEWATER PUMP SYSTEMS****CONTENTS**

EB 01	SCOPE
EB 02	STANDARD SPECIFICATIONS
EB 03	OPERATING AND MAINTENANCE MANUALS
EB 04	PUMP DESIGN AND REQUIREMENTS
EB 05	MOTOR DESIGN AND REQUIREMENTS
EB 06	WORKING VOLTAGE AND SUPPLY SYSTEMS
EB 07	PROTECTION AND CONTROL DEVICES
EB 08	DETAIL OF WORK
EB 09	TESTING AND COMMISSIONING
EB 10	MAINTENANCE
EB 11	MEASUREMENT AND PAYMENT

EB 01 SCOPE

This section covers the decommissioning, removal, repair and reconditioning, installation, testing, commissioning and maintenance of pumping equipment, aerators, motor control devices and low voltage cables..

EB 02 STANDARD SPECIFICATIONS**EB 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- | | | |
|-----------------|---|--|
| BS 5316, Part 1 | - | Acceptance tests for centrifugal, mixed flow and axial pumps |
| SABS 948 | - | Three-phase induction motors |
| SABS 1222 | - | Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides) |
| BS 4999 | - | General requirements for rotating electrical machines |
| BS 1486, Part 2 | - | Heavy-duty lubrication nipples |
| ISO 281/1 | - | Rolling bearings – dynamic load ratings and rating life. |

EB 02.02 **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

EB 02.03 **MANUFACTURER'S SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

EB 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

EB 03 **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

EB 04 **PUMP DESIGN AND REQUIREMENTS**

- (a) Submersible pumps shall be designed to be suitable for submersion in sewage up to a depth of 5 m.
- (b) The pump shaft shall be manufactured from stainless steel and shall be sealed with double mechanical face seals where it enters the casing.
- (c) The impeller shall be suitable for pumping a type of wastewater as specified in Clause EB 08: Detail of work. All impellers shall be of the non-clogging type. The spacer between the impeller and back plate shall be reset every six months to the minimum distance to prevent clogging of rags between impeller and back plate.
- (d) The impeller shall be manufactured from stainless steel or, in the case of other materials, shall be coated with an approved material resistant to abrasion and corrosion due to the environment specified. For pumps rated below 2 kW, non-metallic impellers may be utilised.
- (e) The impeller shall be statically, dynamically and hydraulically balanced. No holes may be drilled in the impeller to balance it with regard to mass distribution.
- (f) Only permanently sealed ball or roller bearings shall be installed.
- (g) Bearings shall have a B-10 life rating of 100 000 hours.
- (h) The pump shall be a currently catalogued product.

- (i) Performance curves shall be based on a reproducible and certified test carried out in an approved testing facility, such as the SABS.
- (j) The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.
- (k) The head at zero delivery of the curve from the impeller selected shall be at least 1,2 times the maximum head in the pump's operational range.
- (l) Each submersible pump shall be clearly labelled. The label shall be a 0,5 mm thick stainless steel plate of dimensions 100 mm x 50 mm. The label shall be fixed to the pump exterior with an approved adhesive or other method over its full back surface after the completion of corrosion protection on the pump. It may follow the shape of the pump exterior over areas suited for the bending of flat surfaces excluding sharp folds. Under no circumstances shall the label plate influence, damage or otherwise have other detrimental effects on the corrosion protection system. The label shall include the following information:
 - pump rates
 - pump head
 - power required
 - NPSH(r) rotational speed
 - impeller detail.
- (m) All new submersible pumps shall be supplied with a length of power cable to suit the installation shown on the drawings.
- (n) All new pumps utilised for the pumping of biological sludges shall be fitted with double flushed mechanical seals, which shall be included in the cost of the pumps. The pump shafts shall be hardened and accurately ground where the seal bears on the shaft. The rotating seal face shall be mounted on a flexible member sealing on the shaft as well. The flexible member shall be manufactured from rubber, PTFE or equivalent material suitable for the operating environment.
- (o) Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:
 - (i) Preference shall be given to pumps of the self-regulating type, and where the power consumption characteristic is such that the power consumption decreases with an increase in delivery to beyond a certain limit, thus ensuring that the motor is not overloaded in the event of a large reduction in pumping head.
 - (ii) The casing for centrifugal pumps shall be horizontally or vertically split to allow removal of parts.
 - (iii) The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.

EB 05 MOTOR DESIGN AND REQUIREMENTS

- (a) Electric motors shall comply with the requirements of SABS 948.
- (b) Imported motors forming an integral part of the pump shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SABS 948.
- (c) All motors shall be standard catalogue models and shall be readily available.
- (d) All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to prevent stocking a variety of special spares.
- (e) All motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- (f) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (g) All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the pumps.
- (h) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1,0 m above the maximum water level by means of a purpose-made, weatherproof, outdoor junction box. The submerged cable shall be supported to minimise any movement of the cable, which results from turbulence caused by the operation of the equipment or the flow of the water.
- (i) Thermistor protection or Klaxon type temperature switches shall be provided for submersible motors.
- (j) Seal monitors shall be provided for submersible motors, together with the required seal monitor relays. The cost for the seal monitor relays shall be deemed to be included in the rates tendered for the equipment.

EB 06 WORKING VOLTAGE AND SUPPLY SYSTEMS

The motors shall be capable of operating within ± 10 % of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified three-phase voltage system under actual service conditions, including the ± 10 % voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.

All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between ± 5 % of the nominal supply voltage.

The slip-in speed of any motor at 80 % of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

EB 07 PROTECTION AND CONTROL DEVICES

Submersible pumping equipment shall have float switches to switch the pump motor on and off, according to the level of the liquid. Switches shall operate freely and not be hindered by cables or other switches and shall switch off at a level where no damage to the pump or motor will occur.

Three level switches shall operate a pump control system:

- (a) Level switch one shall switch off pumps at low level;
- (b) Level switch two shall switch on one pump at an intermediate level, to draw the liquid down to level 1. When the level again rises to where level switch two is switched on, the pump duty shall rotate to start the motor parallel to the one which ran the first time;
- (c) Level switch three shall switch on both pumps to run in parallel at a high level;

In the event of a pump failing to start, the other pump must automatically restart.

Pumps shall be operated in both manual and automatic modes.

EB 08 DETAIL OF WORK

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

EB 08.01 RAW SEWERAGE SYSTEM

All raw sewer is discharge to a septic tank/sump then pumped out by means of the existing raw sewer pumps. ***(The sump will be cleaned by means of high pressure washing and sludge will be removed, dried out and disposed of at an approved and authorised dumping site).***

The raw sewage is pumped from the septic tank pump station to wastewater treatment works is situated within the boundaries of the Van Rooyenshek port of entry (29°45'16.15"S & 27° 6'27.66"E) which consists of ± 2170 m² of land.

The collector system consists of nearly ± 756 m of sewer network. The sewer network services 13 residential and 41 operational buildings with a total floor surface area of 3 166 m². The buildings consist out of a total of 97 taps, 35 w/c pans, 35 w/c cisterns, 29 wash hand basins, 19 sinks, 10 baths and 9 showers.

The wastewater treatment process consists out of a three Oxidation ponds for solids settling and treated effluent is discharged to the open veld.

The existing installation will have to be restored to a fully functioning state at the commencement of the contract.

EB 08.02 TESTING EQUIPMENT

All electrical and mechanical equipment shall be checked at the start of the Contract to establish which items need to be repaired, reconditioned or replaced.

EB 08.03 **PUMPING EQUIPMENT**

If no detail of the various sewage pumps is available, such detail shall be determined by removing the pumps.

Reconditioning or repair of pumps shall be carried out where necessary.

EB 08.04 **MOTOR CONTROL CENTRE**

- (a) The inside and outside of all surfaces of the motor control centre must be thoroughly cleaned and metal surfaces treated for rust and corrosion and repainted to specification.
- (b) Float switches for level sensing shall be checked. Missing, damaged or faulty switches shall be replaced with new switches of similar and equal type. The switches must be installed and supported on suitable brackets to prevent the cables and switches from tangling due to the inflow of the sewage water.
- (c) Check and tighten all terminations of all equipment.
- (d) Clean out all switchgear and equipment properly to remove dust and spider-webs.
- (e) Dismantle and clean all moving parts and contacts of magnetic contactors and starters, reassemble, check overload trip units and adjust correctly. Test for correct functioning on completion of repair work.
- (f) Replace any damaged ammeters, switches and lamps on the control board with parts similar and equal to the existing types on the panel.

EB 09 **TESTING AND COMMISSIONING****EB 09.01** **TESTS TO BE PERFORMED**

- (a) All pumping equipment shall be subject to the commissioning tests as described in the standard specification.
- (b) At least one of each type or size of pump supplied, repaired or reconditioned, shall be subject to a delivery flow rate test. The Contractor shall supply flow rate or volumetric flow testing facilities.
- (c) The operating point of each pump shall be determined.
- (d) Efficiency tests shall be performed.
- (e) NPSH tests shall be performed.

EB 09.02 **PUMP OPERATING POINT**

During the day 1 commissioning tests the pump operating point shall be determined by observing the following:

- (a) pump delivery and suction pressures, and
- (b) electric motor power consumption.

If no efficiency tests are required, then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side of a submersible pump, then the suction pressure conditions shall be calculated from the system properties.

EB 09.03 **FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS**

- (a) Testing shall be done in accordance with BS 5316 Part 1, class C tests.
- (b) Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.

EB 09.04 **TEST CONDITIONS**

- (a) All tests shall be performed in situ.
- (b) The pumped medium or liquid specified as the process liquid in the detail specifications shall be utilised during the tests. The Contractor shall obtain from the pump manufacturer the test point for clean water corresponding to the specified duty point for the pumped liquid, in order to relate the measured performance to the pump supplier's curves which are based on water.

EB 09.05 **ADDITIONAL TESTS**

Additional tests may be specified in the detail of the work.

EB 10 **TRAINING OF OPERATING PERSONNEL**

The contractor shall be responsible for training of operating personnel who are employed by the Department of Public Works in accordance with additional specification SC: Training. The training course will be based on the Operating and Maintenance Manuals. A programme shall be submitted to the Engineer, and training shall be scheduled upon approval of the Operating and Maintenance Manuals and Training Programme.

The training shall be presented during a minimum of two sessions with a minimum duration of three hours each.

EB 11 **MAINTENANCE**

EB 11.01 **GENERAL**

All wastewater pumping equipment and systems shall be serviced and repaired, following practical completion of the installation of which it forms part, to maintain it in perfect functional condition.

Maintenance shall be carried out and shall include routine preventative maintenance according to the manufacturer's specification to be set out in the operating and maintenance manual, as well as unforeseen repair work or replacement on the following items.

- (i) Two raw sewer pumps
- (ii) Motor Control Centre (Raw sewer pumps)

The remuneration for monthly maintenance of wastewater pumping equipment and systems shall be deemed included in the tendered rate for ten points of the installation

of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance, and illustrated in detail on the mechanical flow diagram.

EB 11.02 ROUTINE PREVENTATIVE MAINTENANCE

The routine preventative maintenance work to be carried out shall include but not be limited to the items listed in table EB 10.2/1 below.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE EB 10.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF WASTEWATER PUMP SYSTEMS	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Check, service, repair and clean all pumps	Six-monthly
3	Corrosion protect pumps, motors and surface piping	Six-monthly
4	Check, inspect, report and repair all leaks	Monthly
5	Check and lubricate moving parts	Four-monthly

EB 12 MEASUREMENT AND PAYMENT

EB 01 SUPPLY AND DELIVERY OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of pumping equipment units supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading including all handling of the equipment. The equipment shall include the following:

- (a) The pump and motor as an integrated unit
- (b) Electrical power cable.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EB 02 INSTALLATION, TESTING AND COMMISSIONING OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of pumping equipment units tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the pumping equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- (a) Installation of the guide rails and sealing frame;
- (b) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers;
- (c) Routing and fastening of the power cable up to the isolator box;
- (d) All required installation materials, labour and consumables to render a complete and working installation.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EB.03 DECOMMISSIONING AND REMOVAL OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of pumping equipment units tested and commissioned.

The tendered rates shall include full compensation for all labour, machinery, tools, transport and site handling necessary for the decommissioning and removal of pumping equipment.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EB.04 RECONDITIONING OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of pumps and motors reconditioned.

The tendered rates shall include full compensation for replacement of components and materials, and for tools, transport, site handling and labour necessary for the complete reconditioning of pumping equipment to conform to all the specifications in Clauses EB.04: Pump design and requirements, and EB.05: Motor design and requirements.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EB.05 REPAIR OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of submersible pumps and motors repaired.

The tendered rate shall include full compensation for supply of an identification label, resetting the spacer between impeller and back plate and ensuring that impeller rotates freely, as well as cleaning and corrosion protection and installing a new hoisting chain.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EB.06 SERVICING OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of pumps or aerators serviced. The tendered rate shall include full compensation for servicing (including all consumables), cleaning, corrosion protection (including pump and motor base), adjusting, aligning, including disassembling and re-assembling. The tendered rate shall include all labour, tools, equipment and spare parts that form part of servicing as set out in the operating and maintenance manuals or as specified by the supplier.

EB.07

**PUMPING OUT, CLEANING AND RECONDITIONING OF WASTE WATER
PUMP SUMPS AND RELATED INFRASTRUCTURE..... Unit: number**

The unit of measurement shall be the number of waste water pump sumps and related infra structure cleaned and reconditioned as described in. The tendered rates shall include full compensation for all components, materials, tools, transport, site handling and labour necessary for the complete cleaning and reconditioning of wastewater pump sumps and related infrastructure.

TECHNICAL SPECIFICATION

EH MATURATION PONDS

CONTENTS

EH 01	SCOPE
EH 02	STANDARD SPECIFICATIONS AND ADDITIONAL SPECIFICATIONS AND REQUIREMENTS
EH 03	OPERATING AND MAINTENANCE MANUALS
EH 04	DETAIL OF REPAIR WORK
EH 05	MAINTENANCE
EH 06	MEASUREMENT AND PAYMENT

EH 01 SCOPE

This specification covers the requirements for repair work and maintenance responsibilities for maturation ponds.

The function of maturation ponds as part of a wastewater works is polishing of secondary sedimentation tank effluent as part of the whole process of chemical oxygen demand reduction.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

EH 02 STANDARD SPECIFICATIONS AND ADDITIONAL SPECIFICATIONS AND REQUIREMENTS

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

EH 02.01 GENERAL STANDARD SPECIFICATION

Ponds are usually earth dams with concrete linings, to which the following specification shall apply:

SABS 1200 Standardized Specification for civil engineering construction.

EH 02.02 ADDITIONAL REQUIREMENTS

Ponds shall have positive overflow weirs. The overflow structure of all ponds shall be such that water is free to fall into the next pond's inflow structure. Where outflows between ponds are submerged, aquatic growths are not allowed to exit the system naturally and tend to accumulate.

EH 02.03 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

EH 02.04 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

EH 02.05 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

EH 03 OPERATING AND MAINTENANCE MANUALS

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

EH 04 DETAIL OF REPAIR WORK

EH 04.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

EH 04.02 ACCOMMODATION OF EXISTING FLOW

Incoming existing flow shall be accommodated by means of temporary submersible pumps or mobile self-priming pumps and pipework. The Contractor shall supply temporary pumping equipment to discharge a maximum of 12 litre/second to various positions on site, as specified below.

EH 04.03 MATURATION PONDS

The maturation ponds shall be emptied completely while existing flow is accommodated at the same time, either by pumping incoming flow into the pump sump of the other maturation pond, or by pumping into the maturation pond directly. No water shall be let out through the emergency overflow line as part of this action.

After emptying each maturation pond, it shall be left to allow sediment to dry completely, after which all residue and organic mass that may have settled to the bottom will be removed and buried with dried sludge.

EH 05 **MAINTENANCE**

Maintenance of maturation ponds shall include all work necessary to maintain water quality with regard to aquatic growths. Aquatic growths shall be removed manually and disposed of with dried sludge.

Maturation pond outlet structures, weirs and emergency outlets, as well as all pipework and channels interconnecting ponds and other units (such as sedimentation tank inlet pipes or effluent recycle outlet channels) shall be maintained clean, neat and in a perfect functional condition.

The regular cleaning of the surface of the ponds and removal of artificial solids shall form part of the maintenance work.

Remuneration for the maintenance of maturation ponds shall be included in the tendered rate for ten points for maintenance of the installation of which maturation ponds form part.

Installations shall be as defined in Additional Specification SA: General Maintenance, and on the mechanical flow diagram.

EH 06 **MEASUREMENT AND PAYMENT**

EH.01 **EMPTY MATURATION PONDS AND REMOVE SLUDGE**.....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre determined by the surface area of the pond times the average depth of excavation.

The tendered rate shall include full compensation for the excavation and for removal to and dumping the excavated material at a solid waste disposal site.

TECHNICAL SPECIFICATION**EJ WASTEWATER QUALITY MEASUREMENT AND TESTING****CONTENTS**

EJ 01	SCOPE
EJ 02	STANDARD SPECIFICATIONS
EJ 03	TEST METHODS
EJ 04	DETAIL OF WORK
EJ 05	MAINTENANCE

EJ 01 SCOPE

This specification covers requirements for effluent standards, as well as testing procedures and equipment to verify these standards.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

EJ 02 STANDARD SPECIFICATIONS**EJ 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- | | | |
|-----------------|---|--|
| SABS ISO 5667-2 | - | Water quality sampling, part 2: Guidance on sampling techniques |
| SABS ISO 5667-2 | - | Water quality sampling, part 10: Guidance on sampling of wastewater (when available) |
| SABS SM 11 | - | Water - pH value |
| SABS SM 217 | - | Water - free and saline ammonia content |
| SABS SM 1048 | - | Water - chemical oxygen demand |
| SABS SM 1049 | - | Water - suspended solids content |
| SABS SM 1057 | - | Electrical conductivity of water |
| SABS ISO 4831 | - | Microbiology: General guidance for the enumeration of coliforms: Most probable number technique |
| SABS ISO 4833 | - | Microbiology: General guidance for the enumeration of coliforms: Colony count technique at 30 °C |

EJ 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

EJ 02.03 **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

EJ 02.04 **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

EJ 03 **TEST METHODS****EJ 03.01** **SETTLABLE SOLIDS CONTENT**

Imhoff tests shall be carried out on the water flowing out of primary settling tanks. The sample for purposes of testing shall be taken from the stream flowing into the settled sewage pump sump.

EJ 03.02 **FLOW MEASUREMENT**

Flow rate shall be measured and recorded daily to populate a database of the following parameters:

- (a) Total flow
- (b) Maximum flow (peak flow)
- (c) Minimum flow (night flow).

EJ 04 **DETAIL OF WORK****EJ 04.01** **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

EJ 04.02 **TEST LABORATORY**

The Contractor shall make use of existing fixtures to store his equipment. Should the Contractor require more storerooms or store space, it shall be provided at his cost.

The building can be locked in a floor-to-roof security gate and fence.

EJ 04.03 **TEST EQUIPMENT**

The following equipment shall be supplied as part of this Contract:

- (a) Bench top potentiometer, accurate and precise to at least 0,1 pH unit, including reference electrode and glass sensor or combination electrode;
- (b) Electrical conducting meter, with error not exceeding 1 % or 0,1 m S/m;
- (c) Thermometer covering the range $23\text{ }^{\circ}\text{C} < T < 27\text{ }^{\circ}\text{C}$ accurate and capable of being read to the nearest 0,1 $^{\circ}\text{C}$;

- (d) Magnetic stirrer with PTFE (Teflon) stirring bars;
- (e) 3 x 1 000 millilitre Imhoff cones with wooden rack;
- (f) 5 x 1 000 millilitre glass bottles with ground stopper;
- (g) 2 x 500 millilitre volumetric flasks;
- (h) 1 x 1 000 millilitre volumetric flasks;
- (i) 3 x pipettes (glass);
- (j) 3 x burettes (glass).

EJ 05 **MAINTENANCE**

EJ 05.01 **GENERAL**

As part of the maintenance responsibilities on this project the Contractor shall regularly test wastewater and effluent quality as specified in the following clauses.

Maintenance shall include maintaining all testing equipment, including equipment not supplied as part of the Contract, in a clean and perfect functional condition.

EJ 05.02 **CHEMICALS**

The Contractor shall be required to supply all chemicals used in treatment of wastewater as instructed by the Engineer. A sum is provided in the Schedule of Quantities for the supply of any chemicals. The Contractor shall tender a percentage on the actual value to cover his handling cost and costs related to mixing and dosing of the correct amount of chemicals.

A chemicals logbook shall be supplied by the Contractor to record the use of chemicals. The logbook shall be completed with every test and shall include the following information:

- (a) Date
- (b) Name of testing official
- (c) Test performed
- (d) Chemical used
- (e) Amount used (weight).

The Contractor shall be liable to replace any unaccounted for chemicals at his own cost.

EJ 05.03 **pH VALUE OF WATER**

pH shall be tested on site. The Contractor shall be responsible for maintaining the apparatus for measuring pH and shall take measurements as often as necessary. The pH in the effluent shall be in the range 5,5 - 7,5.

EJ 05.04 **FREE AND SALINE AMMONIA CONTENT OF WATER**

An approved testing authority, such as the SABS, shall measure ammonia content of water. The effluent sample shall be submitted to the testing authority according to prescription.

The value of ammonia in the final effluent shall not be more than 2 mg/litre.

EJ 05.05 **CHEMICAL OXYGEN DEMAND OF WATER**

An approved testing authority, such as the SABS, shall measure the chemical oxygen demand of final effluent. The effluent sample shall be submitted to the testing authority according to prescription.

The value of chemical oxygen demand in the effluent shall not exceed 30 mg/litre.

EJ 05.06 **SUSPENDED SOLIDS CONTENT OF WATER**

An approved testing authority, such as the SABS, shall measure the suspended solids content of final effluent. The effluent sample shall be submitted to the testing authority according to prescription.

The value of suspended solids in the effluent shall not exceed 10 mg/litre.

EJ 05.07 **ELECTRICAL CONDUCTIVITY OF WATER**

The value of electrical conductivity shall be tested on site. The Contractor shall be responsible for maintaining the apparatus for measuring the value of electrical conductivity and shall take measurements as often as necessary. The limit value of electrical conductivity in the effluent shall not exceed 50 mS/m above background receiving water, to a maximum of 100 mS/m.

EJ 05.08 **SETTLABLE SOLIDS**

The Contractor shall measure the value of settleable solids daily. A spot sample of the water flowing into the settled sewage sump shall be taken. The sample shall be left to settle for 45 minutes and then stirred with a glass stirrer.

The sample shall be left to settle for exactly 15 minutes and the value of settleable solids determined. The value of settleable solids shall not exceed 0,4 millilitre/litre. The Contractor shall make use of this test to adjust the sludge withdrawal rate from primary sedimentation tanks.

EJ 05.09 **ADDITION OF LIME**

The addition of lime to neutralise water may be reverted in the event of continued low pH values. The origin of low pH values must be investigated on occurrence.

EJ 05.10 **FAECAL COLIFORM COUNT**

No provision is made under this Contract for disinfection of water, and the value of faecal coliform counts will not be considered as a performance indicator. However, the value of faecal coliforms shall be determined and recorded monthly.

EJ 05.11 MONITORING PROGRAMME

Regular measurement of the quantity and quality of wastewater final effluent shall be recorded according to the requirements of Government Notice no 1191: General Authorisations in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998), 8 October 1999.

The Contractor shall keep a written record of all values for the duration of the Contract, of the following wastewater discharge and relative activities:

- (a) Quantity of wastewater final effluent discharged;
- (b) Quality of the wastewater final effluent discharged;
- (c) Detail of the monitoring programme;
- (d) Detail of failures and malfunctions in the discharge system and detail of measures taken.

EJ 05.12 REMUNERATION FOR MAINTENANCE RESPONSIBILITIES

Remuneration for the monthly maintenance of the wastewater quality monitoring programme, maintenance of a site laboratory, laboratory equipment, testing to be performed on site as specified and record keeping system shall be deemed included in ten points for the maintenance of the installation of which wastewater quality control, measurement and testing form part.

Remuneration for all work and expenses related to quality tests to be performed by approved testing authorities in terms of SABS 0259 shall be paid to the Contractor as the sum of the actual cost per test (based on invoice submitted by the testing authority) and the percentage as tendered on the actual cost of testing.

The Contractor shall be responsible for payment of testing authorities for any tests performed by them.

TECHNICAL SPECIFICATION**EK VALVES AND SLUICE GATES FOR WASTEWATER****CONTENTS**

EK 01	SCOPE
EK 02	STANDARD SPECIFICATIONS
EK 03	ADDITIONAL REQUIREMENTS
EK 04	OPERATING AND MAINTENANCE MANUALS
EK 05	DETAIL OF WORK
EK 06	MAINTENANCE
EK 07	MEASUREMENT AND PAYMENT

EK 01 SCOPE

This specification covers the repair and maintenance, as well as the supply, delivery, installation, testing and commissioning of manual valves and sluice gates.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

EK 02 STANDARD SPECIFICATIONS**EK 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SABS 1123 - Steel pipe flanges
- SABS 664 - Cast-iron gate valves for water works.

EK 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

EK 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

EK 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

EK 03 ADDITIONAL REQUIREMENTS

EK 03.01 INSTALLATION AND HAND WHEELS

Valves shall be installed in positions as shown on the relevant drawings, process flow diagrams and as specified in Clause EK 05 (Detail of work) of this specification.

Where applicable, the spindles or wheels of valves shall clearly indicate the direction of closure, which shall be clockwise when viewing the valve from and along the valve spindle axis.

EK 03.02 GATE VALVES

Gate valves shall have non-rising spindles, or rising spindles, as specified in Clause EK 05 (Detail of work).

Each gate valve shall comply with the following specifications:

- (a) Each valve shall be a resilient seal gate valve in accordance with SABS 664.
- (b) Each valve shall be designed to facilitate maintenance without the body of the valve having to be removed from the line.
- (c) Each valve shall be double flanged, with the flange drilling being in accordance with SABS 1123.
- (d) Each valve shall be resistant to the corrosive environment in which it has to operate.

The materials to be used in the manufacture of each valve in pipelines (with diameters exceeding 100 mm) for the conveyance of water and sewage are the following:

<u>Component</u>	<u>Material</u>
Body	Cast iron
Bonnet	Cast iron
Gate	Cast iron
Bridge	Carbon steel
Gland	Carbon steel
Spindle	Stainless steel 304
Gate seals	Neoprene
Gate studs	Stainless steel 304
Gate nuts	Stainless steel 304
Gland packing	Graphited asbestos
Gaskets	Rubber

EK 03.03 **SLUICE GATES**

The frames, spindles, spindle braces and gates of all sluice gates shall be manufactured from stainless steel 304, unless otherwise specified.

All gates shall be guided by rigid guide rails. The gates shall be held uniformly against the side facings of the frames by the action of adjustable wedges and shall provide drop-tight closure under the specified conditions.

All channel sluice gates shall be of the level invert type fitted with renewable seals of a non-biodegradable material on the invert.

All sluice gates to be supplied shall be hand-operated and shall be supplied with clockwise closing hand wheels. If rising spindles are to be used, the rising spindles shall be protected by suitable sleeves which provide convenient visual inspection and greasing facilities.

Hand wheels shall be of cast iron with diameters to suit operating either directly on the head frame or on a stainless steel (grade 304) tubular pedestal to suit the installation depth. Where necessitated by the mass of the gate and/or the pressure against the gate, suitable gearing shall be provided so as to facilitate the operation.

All parts shall be designed with a minimum factor of safety against structural failure of not less than 3,0 based on the working stresses of the material. In the design due consideration shall be given to the thickness of materials with regard to corrosion and operating conditions.

The sluice gates shall be designed with suitable stiffeners to prevent the gates from deforming or buckling on account of unbalanced pressures acting on the sluice gates.

All channel sluice gates shall be designed for an unbalanced water pressure caused by a water column of twice the height of the gate.

The maximum force required at a hand wheel or crank to raise a gate or open a valve shall not exceed 100 N.

The Contractor shall supply the Engineer with all information regarding cavities to be left in the channel floors and walls and all the details concerning holding-down bolts or any other information relating to details of installation in civil structures to be constructed.

The Contractor shall be responsible for all handling, installation and grouting of the sluice gates and shall carry out all necessary adjustments to ensure proper and smooth operation.

EK 03.04 **NON-RETURN VALVES**

- (a) Non-return valves shall be full bore valves with swing gates.
- (b) Non-return valves shall be flanged into a pipeline.
- (c) Non-return valves shall be manufactured from materials suitable for use in corrosive environments. Bodies shall be manufactured from cast iron. Swing gates shall be manufactured from stainless steel.
- (d) Swing gates shall rotate freely, but shall close drip-tight under return pressure.

EK 03.05 CORROSION PROTECTION

Corrosion protection shall be in accordance with Technical Specification LB: General corrosion protection, and the Contractor shall ensure that all new, serviced or reconditioned units are fit for operation in the relevant environment.

EK 04 OPERATING AND MAINTENANCE MANUALS

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

EK 05 DETAIL OF WORK

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

The work to be done regarding valves and sluice gates is shown below.

Decommission and remove valves and sluice gates.

Recondition/servicing gate valves or sluice gates. Paint valves with high gloss enamel paint. For preparation work see BJ 03.01.03, prepare according to condition of the metal.

Installation, testing and commissioning of valves or sluice gates

EK 06 MAINTENANCE

All valves and sluice gates forming part of wastewater treatment installations shall be maintained from the date of practical completion of the installation of which they form part, until the end of the Contract.

Maintenance shall include all repair work, replacing of components, fixing leaks, routine settings (of flow rates, etc), corrosion protection and all other actions necessary to maintain valves and sluice gates in a perfect functional condition.

Remuneration for maintenance of valves and sluice gates shall be deemed included in the tendered rate for ten points for the monthly maintenance of the installation of which valves and sluice gates form part.

EK 07 MEASUREMENT AND PAYMENT

EK.01 SUPPLY AND DELIVERY OF VALVES AND SLUICE GATES Unit: number

The unit of measurement shall be the number of manually or electrically actuated valves or sluice gates supplied.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery into storage or on the site, etc, as well as all

royalties, patent rights, etc, for the valves or sluice gates complete with headstock, seals, guide rails, frame, etc, as specified.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EK.02 **INSTALLATION, TESTING AND COMMISSIONING OF VALVES OR SLUICE GATES** Unit: number

The unit of measurement shall be the number of valves or sluice gates installed.

The tendered rates shall include full compensation for the installation, making good all the damaged corrosion-protected areas, testing, calibration, commissioning and maintenance of the valves or sluice gates and for all other costs and actions necessitated to obtain a complete and efficiently working system.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EK.03 **SERVICE GATE VALVES OR SLUICE GATES** Unit: number

The unit of measurement shall be the number of gate valves or sluice gates serviced.

The tendered rate shall include full compensation for cleaning, removing rust, removing dried sludge or other solids from surfaces and moving parts, proper greasing of all moving parts, preparation for corrosion protection coating and painting of gate valves or sluice gates.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EK.04 **RECONDITION GATE VALVES OR SLUICE GATES** Unit: number

The unit of measurement shall be the number of gate valves or sluice gates reconditioned.

The tendered rate shall include full compensation for cleaning, removing rust, removing dried sludge or other solids from surfaces and moving parts, replacing components such as spindles, hand wheels or gates, replacing or repair of seals, proper greasing of all moving parts, preparation for corrosion protection, painting or any other action or cost necessitated to recondition a gate valve or sluice gate to a perfect functional condition.

Items will be listed in the Schedule of Quantities for different types and sizes of equipment.

EK.05 **RECONDITION NON-RETURN VALVES** Unit: number

The unit of measurement shall be the number of non-return valves reconditioned.

The tendered rate shall include full compensation for dismantling, cleaning, replacing components such as hinges, swing axle, swing gate, replacing seals, skimming seal surfaces, corrosion protection or any other action or cost necessitated to recondition a non-return valve to a perfect drip tight functional condition.

Separate items will be listed in the Schedule of Quantities for different sizes of equipment.

EK.06

DECOMMISSION AND REMOVE VALVES AND SLUICE GATESUnit: number

The unit of measurement shall be the number of valves or sluice gates decommissioned and removed.

The tendered rate shall include full compensation for all labour and equipment required to decommission and remove valves or sluice gates, such as installation of temporary spades or blank flanges, maintaining existing liquid volumes, loosening and removal of bolts and nuts, or any other action required.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of valves or sluice gates.

TECHNICAL SPECIFICATION

EM OPERATION OF WASTEWATER WORKS

CONTENTS

EM 01	SCOPE
EM 02	STANDARD SPECIFICATION AND REGULATIONS
EM 03	LEGAL AND GENERAL REQUIREMENTS
EM 04	OPERATION
EM 05	MONITORING AND REPORTING
EM 06	MEASUREMENT AND PAYMENT

EM 01 SCOPE

Wastewater works shall mean all units, components, equipment and materials, and their relation to each other, employed to enable reliable and effective wastewater treatment.

This specification covers the operation of a wastewater works and equipment related to effective wastewater treatment.

The Contractor shall manage and operate the wastewater works in accordance with the prescriptions in this specification, the relevant operation and maintenance manuals and **Additional Specification SF**. Operation duties shall generally refer to all tasks and actions required to operate the process units and components of the following wastewater works and shall include (among others):

TABLE 1 : PROCESS UNITS FOR TYPICAL DPW SYSTEM TYPES					
Septic Tanks System	Oxidation Pond system	Rotating Bio-contactor (RBC) System	Biological System	Filtration	Activated Sludge System
Septic tank(s)	Inlet works: Screening & degritting	Inlet works: Screening & degritting	Inlet works: Screening, degritting, flow measuring		Inlet works: Screening, degritting, flow measuring
French drain(s)	Floating solids trap	Sceptic tank(s)	Peak flow cut-off & storage/balancing tank		Peak flow cut-off & storage/balancing tank
	Oxidation ponds: primary & secondary	Biological reactor(s): rotating discs	Pump station(s)		Biological reactor(s): completely mixed, oxidation ditch, sequencing batch, multiple tanks.
	Surface aerator(s)	Humus tank(s)	Flow regulating facilities		Aerator(s): Vertical axis surface, horizontal axis surface, course/fine bubble
	Re-circulation facilities	Flow regulating facilities	Primary settling tank(s)		Waste activated sludge (RAS) facilities
	Flow measuring facilities	Flow measuring facilities	Bio filter(s)		Flow regulating facilities
	On site burial facility: grit & screenings	Maturation pond(s)	Humus tank(s) (Secondary settling tank SST)		Return activated sludge (RAS) facilities
		Reed bed(s)	Chemical phosphate removal facilities		Clarifier(s) (Secondary settling tank – SST)
		Sludge drying beds	Chlorine dosing & contact facilities		Chemical phosphate removal facilities
		On site burial facility: Grit & screenings	Flow measuring facilities		Biological nutrient removal facilities
		Sludge disposal facilities: Burial, lagoon storage, composting, co-disposal export	Maturation pond(s)		Chlorine dosing & contact facilities
			Anaerobic digester(s)		Flow measuring facilities
			Sludge drying beds		Maturation pond(s)
			On site burial facility: Grit & screenings		Sludge drying beds
			Sludge disposal facilities: Burial, lagoon storage, composting, co-disposal, export		On site burial facility: Grit & screenings
					Sludge disposal facilities: Burial, lagoon storage, composting, co-disposal, export

This specification covers requirements for effluent standards, as well as testing procedures and equipment to verify these standards.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with Portion 3: Additional Specifications included in this document.

Assessment of the following design parameters is a prerequisite for proper operation of the wastewater works:

TABLE 2 : KEY DESIGN PARAMETERS FOR PROCESSES AND UNITS					
NOTE: Acknowledged guidelines must be used for design & construction, e.g. WISA, 1988: Manual on the Design of Small Sewage Works					
Septic System	Tanks	Oxidation Pond system	Rotating Bio-contactor (RBC) System	Biological Filtration System	Activated Sludge System
Population served		Population served & per capita organic loads	Population served & per capita organic loads	Population served & per capita organic loads	Population served & per capita organic loads
Hydraulic retention time (combined building drainage system)		Average & peak dry & wet weather flow rates	Average & peak dry & wet weather flow rates	Average & peak dry & wet weather flow rates	Average & peak dry & wet weather flow rates
Sludge retention time		Hydraulic & organic loading rates	Hydraulic & organic loading rates	Hydraulic, organic & nutrient loading rates per surface area & bed volume	Hydraulic, organic & nutrient loading rates
Desludging frequency		Hydraulic retention time	Septic tank capacity & desludging frequency	Type, size, volume, void ratio & depth of filter media	Sludge age (20 – 30 days) & solids loading rate
Type & permeability of subsoil		Availability of land for ponds & for effluent disposal by irrigation	Wetted surface area: Number, size, spacing & submersion depth of discs	Aeration rate of filter media	Active sludge mass & density
		Suitability of climatic conditions	Hydraulic retention time	Dosing rate of flow distribution assembly	Hydraulic control of sludge mass (by wasting of sludge from reactor): WAS rate – volume of reactor/sludge age
		Proximity to residential areas (Odours)	Rotational speed of discs	Rotational speed of flow distribution assembly	Sludge age required for nitrification
			Geometry & surface loading rates of humus tanks & appurtenances	Geometry & surface loading rates of TSTs, humus tanks & appurtenances	Return flow rate of activated sludge (1.5 – 2.5 x influent flow rate)
			Sludge & effluent return flow rates	Effluent return flow rates	Oxygen requirements, type & capacity if aeration equipment, control of aeration rate
				Geometry & hydraulic retention time of anaerobic digester & appurtenances	Surface and solids flux loading rates of clarifier (sludge volume index)
					Additional reactor volume & anaerobic/anoxic zones required for biological nutrient removal

EM 02 STANDARD SPECIFICATIONS AND REGULATIONS

EM 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

- | | | |
|-----------------|---|--|
| SABS 1200 | - | Standardised specification for civil engineering construction |
| SABS ISO 5667-2 | - | Water quality sampling, part 2: Guidance on sampling techniques |
| SABS ISO 5667-2 | - | Water quality sampling, part 10: Guidance on sampling of wastewater (when available) |
| SABS SM 11 | - | Water – PH value |
| SABS SM 217 | - | Water – free and saline ammonia content |

SABS SM 1048	-	Water – chemical oxygen demand
SABS SM 1049	-	Water – suspended solids content
SABS SM 1057	-	Electrical conductivity of water
SABS ISO 4831	-	Microbiology: General guidance for the enumeration of coliforms: Most probable number technique
SABS ISO 4833	-	Microbiology: General guidance for the enumeration of coliforms: Colony count technique at 30°C

EM 02.02 OTHER SPECIFICATIONS

The following Technical Specifications for repair and maintenance of wastewater process units shall be read in conjunction with this specification and shall be deemed to form part thereof:

EA	Wastewater inlet works
EB	Wastewater pump systems
EC	Sedimentation tanks
ED	Biological trickling filters
EE	Activated sludge works
EF	Sludge treatment and disposal
EG	Septic tank and conservancy tanks and disposal fields
EH	Oxidation and maturation ponds
EI	Disinfection of wastewater
EJ	Wastewater quality measurement and testing
EK	Valves and sluice gates for wastewater
EL	Rotating biological contractors

EM 02.03 ACTS, REGULATIONS AND STATUTORY REQUIREMENTS

All relevant regulations and statutory requirements as laid down in the latest edition of the following acts shall be adhered to:

- Occupational Health and Safety Act, 1993 (No. 85 of 1993)
- National Water Act (No. 36 of 1998)
- Water Services Act (No. 108 of 1997)
- Environment Conservation Act (No. 73 of 1989)
- National Environmental Management Act (No. 107 of 1998)

EM 02.04 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

EM 02.05 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

EM 03 LEGAL AND GENERAL REQUIREMENTS

EM 03.01 DEFINITION OF WATER USE

This specification covers the legal requirements for water use as regulated by the National Water Act (No. 36 of 1998). A large fraction of the activities performed by the Department of Public Works is covered by the general authorisation in terms of Section 39 of the Water Act. The following categories of water use are scheduled:

- Taking of water and storage of water (Section 2 (a) and (b)) of the Water Act.
- Engaging in a controlled activity, identified as such in Section 37 (1) of the Water Act. Irrigation of any land with waste or water containing waste generated through any industrial activity or by a water works (Section 21 (e) of the Water Act).
- Discharging of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit, and disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generating process.
- Disposing of waste in a manner which may detrimentally impact a water resource (Section 28 of the Water Act).

EM 03.02 REGISTRATION OF WATER USE

According to the Water Act a water use must be registered with the Department of Water Affairs and Forestry (DWAF). The prescribed forms are available DWAF's internet web site.

<http://www.dwaf.gov.za>

The application forms for registration or licensing of a water use are available on the above website. Forms DW 771 / DW 758 R1c.doc (updated version) – Licensing Part 1: Company, Business or Partnership, National or Provincial Government are applicable.

Parts 1, 3, 4 and 8 of these forms will be completed by the Department of Public Works. All other forms shall be completed and submitted by the Contractor.

These registration forms shall be completed by the Contractor and must be submitted to:

**The Director-General
Department of Public Works
Private Bag X65
PRETORIA
2001**

For attention of: **Deputy Director, Water Management**

Based on the information so provided, the Department of Water Affairs and Forestry may require the applicant to apply for a license for the relevant water or wastewater works.

EM 03.03 LICENSING OF A WATER USE

In general a water use must be licensed unless it is:

Listed in Schedule 1 (See page 152 of Government Gazette No. 19182 dated 26 August 1998)

An existing lawful use.

Permissible under a general authorisation (See Government Gazette No. 20526 dated 8 October 1999)

The responsible authority can waive the need for a license.

If licensing is required, the Department of Public Works will appoint an independent consultant for the duty.

EM 03.04 OPERATOR REGISTRATION AND CLASSIFICATION OF WATER CARE WORKS

In the terms of Section 26 (f) of the Water Act (No. 36 of 1988) operators shall be registered with the Department of Water Affairs and Forestry. The Contractor shall be responsible for the registration of workers/operators in terms of this requirement (See Regulation R2834 dated 27 December 1985). The water care works will be classified by the Engineer for tendering purposes.

Draft regulations regarding the registration of waterworks and process controllers in terms of section 116 of the National Water Act, 1998 was published in Regulation Gazette No. 8411 dated 24 February 2006 and tenderers shall familiarize themselves with the progress regarding the promulgation of the new regulations.

The preliminary classification of the Wastewater Treatment Works is Class D.

EM 03.05 **ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

In terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) a Basic Assessment process must be conducted as part of a waste management license application for the treatment of effluent, wastewater or sewage with an annual through put capacity of more than 2 000 m³ but less than 15 000 m³. The expansion of such facilities which requires an amendment of the existing license will also require that a Basic Assessment must be conducted.

The activities involved are published in Government Notice No 718 dated 3 July 2009 under Category A of the Notice.

EM 03.06 **ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

An Environmental Management Plan (EMP) is required for all repair work that may generate waste (such as sewage sludge) or that may detrimentally impact the environment during repair and operation of the water care works.

The Contractor shall prepare and submit an EMP to the Department of Public Works' project manager. His approval is not required, but the EMP should guide repair work so as to safeguard the environment from detrimental impact. The Contractor shall make provision in his tendered rates for all costs implied by the EMP.

EM 04 **OPERATION****EM 04.01** **GENERAL**

Operation shall include all activities and all other actions or rectifying measures necessary for optimal operation of water care works.

Remuneration for operation of the complete water works shall be deemed included in ten points for the tendered rate of monthly payment of operation of the works.

EM 04.02 **PREPARATORY OPERATIONAL TASKS**

The preparatory tasks to be executed shall include, but shall not be limited to the items listed in the table below:

EM 04.02	PREPARATORY OPERATIONAL TASKS
01	Satisfy legal and general requirements.
02	Draft inventories of process units, components, materials, etc.
03	Draft process flow diagrams.
04	Derive from available information the design capacity and current load of the works.
05	Assess compliance with relevant design parameters to enable optimal operation of the plant according to its original functionality.
06	Draft plant-specific Operation and Maintenance manuals.
07	Institute required safety measures.

08	Draft template logbook.
09	Draft water balance of water and wastewater system.

EM 04.03 **GENERAL OPERATION WORK**

General operation of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations and with the Particular Specification related to this work.

The general operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

EM 04.03	GENERAL OPERATION WORK	FREQUENCY
01	General housekeeping: Keep site in neat and acceptable condition.	Daily
02	Control access to the site.	Daily
03	Maintain safety conditions on site.	Daily
04	Log and report spills, pollution events, power failures, extraordinary process phenomena, etc. Check auto-reset of power to mechanical equipment.	Event
05	Calibrate and set flow measuring to ensure equalised hydraulic loading rates on downstream process units.	Yearly
06	Calibrate and set flow measuring equipment to ensure accurate flow data.	6 Months
07	Calibrate and set peak wet weather flow cut-off weirs at inlet works.	Yearly
08	Synchronise, by means of mathematical modelling and measurement, process units in integrated systems with recycling (such as activated sludge systems) and make adjustments where necessary.	6 Months
09	Develop a feel for effective treatment by means of visual indicators of good/bad plant performance: Colour, odour, foam, algae growth, aerator spray patterns, effluent clarity, bubbles, floating material, solids accumulation, flow patterns, turbulence, touch.	Daily
10	Record operating hours and kW-hours of all mechanical equipment.	Daily
11	Check operation of all valves and sluices.	Monthly

EM 04.04 **OPERATION OF SPECIFIC PROCESSES AND UNITS**

Operation of specific processes, units and components of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations and with the Particular Specification related to this work.

The specific operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

EM 04.04.--		OPERATION OF SPECIFIC PROCESSES AND UNITS	FREQUENCY
01		Septic tanks and French drains	
	01	Check and log scum, water and sludge depths in tank.	6 Months
	02	Empty tank at specified frequencies (max. 3 years) or when full.	3 Years
	03	Inspect French drain for accumulation of water or for seepage to surface. If positive, repair drain.	3 Months
	04	Clean connecting pipes and accessories and remove tree and grass roots from pipes.	3 Months
02		Inlet works	
	01	Hand-raked screens: Remove screenings (rags, plastics, etc), ensuring that only degradable material is passed on to subsequent process units. (Last removal after evening peak flow)	2 hours during day
	02	Mechanical screens: Inspect for proper operation and ensure automatic functioning overnight.	2 hours during day
	03	Alternate flow through degritting channels and remove grit from isolated channel.	Daily
	04	Wash screenings and grit, and return degradable material to treatment train.	Hourly
	05	Dispose of screenings and grit by on-site burial.	Daily
03		Oxidation/maturation ponds	
	01	Remove floating material from trap at inlet to pond and dispose of by on-site burial.	Daily
	02	Remove tree and grass roots from verges of ponds.	Monthly
	03	Check leak detection facilities (if provided) for signs of leakage.	Monthly
	04	Check presence of sluice gates to by-pass channels and whether they are set correctly.	Monthly
	05	Ensure that surface growths are not accumulated in ponds.	Monthly
04		Re-circulation facilities	
	01	Check whether pumps are operating.	Daily
	02	Check return flow rates.	Monthly
05		Flow measuring facilities	
	01	Check whether measuring facilities are operating: Level sensor, integrating flow meter, data logger.	Daily
	02	Keep flume/weir and stilling chamber free of floating/settling material.	Daily
	03	At flumes/weirs where continuous recording equipment is not available, measure and record flow depth and time daily at visually observed peak flows, and at least once per month at minimum night flow.	Daily
06		On-site burial of solids	
	01	Ensure daily covering with soil of disposed material.	Daily

	02	Attend to nuisance conditions at disposal site.	Event
07	Sludge drying beds		
	01	Apply sludge to drying beds in depths to suit climatic conditions, and remove when adequately dried.	Daily
	02	Keep sludge beds free of weed growth.	Daily
	03	Replenish filter media when required.	Event
08	Sludge disposal facilities		
	01	Remove tree and grass roots from verges of sludge lagoon.	Monthly
	02	Check leak detection facilities (if provided) for signs of leakage from lagoon.	Monthly
	03	Maintain hygienic conditions at sludge handling facilities.	Daily
09	Peak-flow cut-off and storage/balancing tanks		
	01	Check operation of return-flow pumps.	Weekly
	02	Maintain hygienic conditions in storage/balancing tank.	Event
10	Pump stations		
	01	Check operation and correct switching of pumps.	Daily
	02	Clean pump sumps.	Weekly
11	Effluent disposal facilities		
	01	Oxidation ponds: Manage irrigation of effluent as means of disposal.	Daily
	02	Ensure erosion free discharge to receiving water body.	Monthly
12	Power supply		
	01	Check operation of stand-by generator where applicable.	Monthly

EM 05 MONITORING AND REPORTING

The contractor shall keep a written record of all measurements taken and analyses done for process control and for reporting to relevant authorities in terms of legal or project management requirements.

A logbook shall be kept for daily recording of failures, malfunctions, spills, pollution events, power failures and detail of measures taken.

The monitoring programme for the above measurements and analyses shall include, but shall not be limited to the items listed in the table below

EM 05 PAYMENT ITEMS

EM.05.01 Pump out of sludge into a suitable waste containment vehicle for transportation.....Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of sludge pumped, multiplied by the distance (one-way) in kilometre.

The tendered rates shall include full compensation for all components, materials, tools, transport, site handling and labour necessary for the complete pumping, removal and disposal of the sludge.

The Contractor shall be required to provide a certificate of the disposed sludge as proof from the registered treatment plant indicated by the Engineer.

The waste containment vehicle shall be a commercially registered waste containment vehicle capable of handling no less than 10m³ at a time.

EM.05.02 Disposing of sludge at a registered commercial source on the instruction of the Engineer/Department's representatives Unit: m³-km

The unit of measurement shall be the cubic meter load of sludge multiplied with the number of kilometres travelled (one way trip) to the commercial source approved by the Engineer.

The tendered rate shall include full compensation for the labour, materials and equipment needed to transport sludge to a registered wastewater treatment works indicated by the Engineer.

The tendered rate shall include, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the suitable commercial waste containment vehicle and the remuneration costs of the driver and workers.

The Contractor shall be required to provide a certificate of the disposed sludge as proof from the registered treatment plant indicated by the Engineer.

F

**MECH & ELEC EQUIP (CLEAR WATER
PUMPS)**

TECHNICAL SPECIFICATION**FN CLEAR-WATER PUMP SYSTEMS****CONTENTS**

FN 01	SCOPE
FN 02	STANDARD SPECIFICATIONS
FN 03	AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS
FN 04	PUMP DESIGN AND REQUIREMENTS
FN 05	MOTOR DESIGN AND REQUIREMENTS
FN 06	WORKING VOLTAGE AND SUPPLY SYSTEMS
FN 07	PROTECTION AND CONTROL DEVICES
FN 08	DETAIL OF WORK
FN 09	TESTING AND COMMISSIONING
FN 10	MAINTENANCE
FN 11	MEASUREMENT AND PAYMENT

FN 01 SCOPE

This specification covers the decommissioning, removal, repair and reconditioning, installation, testing, commissioning and maintenance of pumping equipment, motor control devices and low-voltage cables. The function of clear-water pump systems shall be the delivery of water at a specified flow rate and head to the required location.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

FN 02 STANDARD SPECIFICATIONS**FN 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS 5316, Part 1	-	Acceptance tests for centrifugal, mixed flow and axial pumps
SABS 948	-	Three-phase induction motors
SABS 1222	-	Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
BS 4999	-	General requirements for rotating electrical machines
BS 1486, Part 2	-	Heavy duty lubrication nipples
ISO 281/1	-	Rolling bearings – dynamic load ratings and rating life

FN 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

FN 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

FN 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

FN 03 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

FN 04 PUMP DESIGN AND REQUIREMENTS

- (a) The pump shaft shall be manufactured from stainless steel and shall be sealed where it enters the casing with double mechanical face seals.
- (b) The impeller shall be suitable for pumping the type of clear water as specified in Clause FN 08 (Detail of work) of this specification.
- (c) The impeller shall be manufactured from stainless steel or, in the case of other materials, it shall be coated with an approved material resistant to abrasion and corrosion prevalent to the conditions under which the impeller shall operate. For pumps rated below 2 kW non-metallic impellers may be utilised.
- (d) The impeller shall be statically, dynamically and hydraulically balanced. No holes may be drilled in the impeller to balance it with regard to mass distribution.
- (e) Only permanently sealed ball or roller bearings shall be installed.
- (f) Bearings shall have a B-10 life rating of 100 000 hours.
- (g) The pump shall be a currently catalogued product.
- (h) Performance curves shall be based on a reproducible and certified test carried out in an approved testing facility, such as the SABS.
- (i) The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.

- (j) The head at zero delivery of the curve of the impeller selected shall be at least 1,2 times the maximum head in the pump's operational range.
- (k) Each pump shall be clearly labelled. The label shall be a 0,5 mm thick stainless steel plate of dimensions 100 mm x 50 mm. The label shall be fixed to the pump exterior with an approved adhesive or other method after the completion of corrosion protection on the pump. It may be bent to follow the shape of the pump exterior but shall not be bent to accommodate sharp folds. Under no circumstances shall the stainless steel plate of the label influence, damage or otherwise have a detrimental effect on the corrosion protection system. The label shall include the following information:
 - pump rates
 - pump head
 - power required
 - NPSH (r) rotational speed
 - impeller detail.
- (l) All new submersible pumps shall be supplied with a length of power cable to suit the installation shown on the drawings.
- (m) All new pumps shall be fitted with double flush mechanical seals, which shall be included in the cost of the pumps. The pump shafts shall be hardened and accurately ground where the seal bears on the shaft. The rotating seal face shall be mounted on a flexible member, sealing on the shaft as well. The flexible member shall be manufactured from rubber, PTFE or equivalent material suitable for the operating environment.
- (n) Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:
 - (i) Preference shall be given to pumps of the self-regulating type and where the power consumption characteristic is such that the power consumption decreases with an increase in delivery to beyond a certain limit, thus ensuring that the motor is not overloaded in the event of a large reduction in pumping head.
 - (ii) The casing for centrifugal pumps shall be horizontally or vertically split to allow removal of parts.
 - (iii) The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.

FN 05 MOTOR DESIGN AND REQUIREMENTS

- (a) Electric motors shall comply with the requirements of SABS 948
- (b) Imported motors forming an integral part of the pump shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SABS 948.
- (c) All motors shall be standard catalogue models and shall be readily available.
- (d) All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to make stocking a variety of special spares unnecessary.
- (e) All motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.

- (f) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (g) All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the pumps.
- (h) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1,0 m above the maximum water level by means of a purpose-made, weatherproof, outdoor junction box. The submerged cable shall be supported to minimise any movement of the cable, which result from turbulence caused by the operation of the equipment or the flow of the water.
- (i) Thermistor protection or Klixon type temperature switches shall be provided for submersible motors.
- (j) Seal monitors shall be provided for submersible motors, together with the required seal monitor relays. The cost for the seal monitor relays shall be deemed to be included in the rates tendered for the equipment.

FN 06 **WORKING VOLTAGE AND SUPPLY SYSTEMS**

The motors shall be capable of operating within $\pm 10\%$ of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified three-phase voltage system under actual service conditions, including the $\pm 10\%$ voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.

All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between $\pm 5\%$ of the nominal supply voltage.

The slip-in speed of any motor at 80 % of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

FN 07 **PROTECTION AND CONTROL DEVICES**

Submersible pumping equipment shall have float switches to switch the pump motor on and off, according to the level of the liquid. Switches shall operate freely and not be hindered by cables or other switches and shall switch off at a level where no damage to the pump or motor will occur.

Three level switches shall operate a pump control system:

- (a) Level switch one shall switch off pumps at low level;
- (b) Level switch two shall switch on one pump at an intermediate level, to draw the liquid down to level 1. When the level again rises to where level switch two was switched on, the pump duty shall rotate and start the motor parallel to the one which ran the first time;
- (c) Level switch three shall switch on both pumps to run in parallel at a high level.

In the event of a pump failing to start, the other pump must automatically be restarted.

Pumps shall be operated in both manual and automatic modes.

FN 08 **DETAIL OF WORK****FN 08.01** **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

FN 08.02 **TESTING EQUIPMENT**

All electrical and mechanical equipment shall be checked at the start of the Contract to establish which items need to be repaired, reconditioned or replaced.

FN 08.03 **PUMPING EQUIPMENT**

If no detail of the existing pumps is available, such detail shall be determined by removing the pumps.

Reconditioning or repair of pumping equipment shall be carried out if necessary.

FN 08.04 **MOTOR CONTROL CENTRE**

- (a) The inside and outside of all surfaces of the motor control centre must be thoroughly cleaned and metal surfaces treated for rust and corrosion and repainted to specification.
- (b) Float switches for level sensing shall be checked. Missing, damaged or faulty switches shall be replaced with new switches of similar and equal type. The switches must be installed and supported on suitable brackets to prevent the cables and switches from tangling, due to the inflow of the sewage water.
- (c) Check and tighten all terminations of all equipment.
- (d) Clean out all switchgear and equipment properly to remove dust and spider webs.
- (e) Dismantle and clean all moving parts and contacts of magnetic contactors and starters, reassemble, check overload trip units and adjust correctly. Test for correct functioning on completion of repair work.
- (f) Replace any damaged ammeters, switches and lamps on the control with parts similar and equal to the existing types on the panel.
- (g) Wiring diagrams of all electrical panels and MCC panels shall be compiled.

FN 09 **TESTING AND COMMISSIONING****FN 09.01** **TEST TO BE PERFORMED**

- (a) All pumping equipment shall be subject to the commissioning tests as described in the applicable specification.
- (b) At least one of each type or size of pump supplied, repaired or reconditioned, shall be subject to a delivery flow rate test. The Contractor shall supply flow rate or volumetric flow testing facilities.

- (c) The operating point of each pump shall be determined.
- (d) Efficiency tests shall be performed.
- (e) NPSH tests shall be performed.

FN 09.02 **PUMP OPERATING POINT**

During the day 1 commissioning tests the pump operating point shall be determined by observing the following:

- (a) pump delivery and suction pressures, and
- (b) electric motor power consumption.

If no efficiency tests are required, then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressures gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

FN 09.03 **FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS**

- (a) Testing shall be done in accordance with BS 5316 Part 1, class C tests.
- (b) Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.

FN 09.04 **TEST CONDITIONS**

- (a) All tests shall be performed in situ.
- (b) The pumped medium or liquid shall be water.

FN 09.05 **ADDITIONAL TESTS**

Additional tests may be specified in the detail of work.

FN 10 **MAINTENANCE**

FN 10.01 **GENERAL**

All pumping equipment and systems shall be serviced and repaired, following practical completion of the installation of which it forms part, to maintain it in perfect functional condition.

Maintenance shall be carried out and shall include routine preventative maintenance according to the manufacturer's specification to be set out in the operating and maintenance manual, as well as unforeseen repairwork or replacement.

The remuneration for monthly maintenance of pumping equipment and systems shall be deemed included in the tendered rate for 10 points of the installation of which the

system forms part. Installations are specified in Additional Specification SA: General Maintenance, and illustrated in detail on the mechanical flow diagram.

FN 10.02 ROUTINE PREVENTATIVE MAINTENANCE

The routine preventative maintenance work to be carried out shall include but not be limited to the items listed in table FN 10.2/1 below.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE FN 10.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF CLEAR-WATER PUMP SYSTEMS	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Check, service, repair and clean all pumps	Six-monthly
3	Check, service, repair and clean all motor control centres and level sensing devices.	Six-monthly
4	Corrosion protect pumps, motors and surface piping	As required
5	Check, inspect, report and repair all leaks	Monthly
6	Check and lubricate moving parts	Six-monthly

FN 11 MEASUREMENT AND PAYMENT

FN.01 SUPPLY AND DELIVERY OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of submersible pumping equipment units supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading, including all handling of the equipment. The equipment shall include the following:

- (a) The pump and motor as an integrated unit
- (b) Electrical power cable.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

FN.02 INSTALLATION, TESTING AND COMMISSIONING OF PUMPING EQUIPMENT Unit: number

The unit of measurement shall be the number of pumping equipment units tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the pumping equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- (a) Installation of the guide rails and sealing frame;
- (b) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers;
- (c) Routing and fastening of the power cable up to the isolator box;

- (d) All required installation materials, labour and consumables to render a complete and working installation.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

FN.03 DECOMMISSIONING AND REMOVAL OF PUMPING EQUIPMENT.....Unit: number

The unit of measurement shall be the number of pumping equipment units tested and commissioned.

The tendered rates shall include full compensation for all labour, machinery, tools, transport and site handling necessary for the decommissioning and removal of pumping equipment.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

FN.04 RECONDITIONING OF PUMPING EQUIPMENT.....Unit: number

The unit of measurement shall be the number of pumps and motors reconditioned.

The tendered rates shall include full compensation for replacement of components and materials, and for tools, transport, site handling and labour necessary for the complete reconditioning of pumping equipment to conform to all the specifications in Clauses FN 04: Pump design and requirements, and FN 05: Motor design and requirements.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

FN.05 REPAIR OF PUMPING EQUIPMENT.....Unit: number

The unit of measurement shall be the number of pumps and motors repaired.

The tendered rate shall include full compensation for supply of an identification label, resetting the spacer between impeller and back plate and ensuring that impeller rotates freely, as well as cleaning and corrosion protection and installing a new hoisting chain.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

FN.06 RECONDITIONING OF MCC BOARDS OR OTHER ELECTRICITY BOARDS.....Unit: number

The unit of measurement shall be the number of MCC boards or other electricity boards reconditioned.

The tendered rates shall include full compensation for replacement of components and materials and for tools, transport, site handling and labour necessary for the complete reconditioning of all components of the board.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

FN.07 **COMPILATION OF WIRING DIAGRAMS**Unit: number

The unit of measurement shall be the number of wiring diagrams compiled.

The tendered rates shall include full compensation for drawing, printing, computer time and any other associated costs necessary for the compilation of a wiring diagram.

K

WATER CONTROL PLAN

TECHNICAL SPECIFICATION

KA WATER AUDIT

CONTENTS

KA 01	SCOPE
KA 02	STANDARD SPECIFICATIONS
KA 03	EXECUTION OF REPAIR WORK
KA 04	MAINTENANCE
KA 05	MEASUREMENT AND PAYMENT

KA 01 SCOPE

This specification covers the material, equipment, testing and work required for the implementation of a water audit. It covers only the external water services comprising the water supply from the point of delivery and the associated distribution system.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

KA 02 STANDARD SPECIFICATIONS

KA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition including all amendments up to the date of tender, of the following specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SABS 1200 DB - Earth works (pipe trenches)
- SABS 1200 LB - Bedding and pipes
- SABS 0306 - Management of potable water in distribution systems
- BS 1780 - Specification for Bourdon tube pressure and vacuum gauges

KA 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

KA 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

KA 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

KA 02.05 MECHANICAL PRESSURE GAUGES

- (a) Analogue mechanical or Bourdon tube pressure gauges shall be of the bottom entry type and shall have faces at least 60 mm in diameter with clear, readable markings and indicators. The screw-in fitting shall be compatible with the pipe fitting, which shall be the metric equivalent of a ½ inch BSP internal thread unless otherwise specified. Threads shall be in accordance with BS 21 for jointing threads or BS 1387 for long screw threads. The Contractor shall provide the relevant details in the operation and maintenance manuals.
- (b) The indicated range on the gauge shall span 120 % of the operational pressure range specified for the relevant equipment. Accuracy shall be within 3 % of the full-scale deflection value. An adjustable indicator shall be set to indicate the maximum operational system pressure clearly.
- (c) It shall be possible to isolate the pressure gauge from the pressure pipe by means of a valve or a gauge cock, which shall be supplied and installed by the Contractor and shall be included in the tendered rate for the equipment.
- (d) A gauge protector shall be fitted where a gauge has to indicate pressures in corrosive media or liquids that could easily clog the pressure ports. It is a requirement that gauge protectors be fitted where sludge is the working medium.
- (e) Pressure gauges fitted to hydraulic pipelines shall be glycerine-filled for damping purposes, and gauges fitted to pneumatic or gas pipelines shall be vacuum-damped.
- (f) The circumferential positioning of pressure gauges on water and sewerage pipes shall be in accordance with BS 5316: Part 1 class C, and the static head tapping shall also comply with these standards.
- (g) Bourdon type pressure gauges shall comply with BS 1780.

KA 02.06 DATA LOGGER SPECIFICATION

The data logger shall be a Meinecke Cosmos data logger or similar approved.

KA 02.06.01 Special features required

The following special features are required of the data logger:

- Recording of analogue values (pressure) and flow simultaneously;
- Inputs may be used for either digital or analogue sensing devices;
- Three independent memories (day, hour and events);
- Positive and negative data logging;
- LC-display;
- Alarm contact;
- Battery-powered (independent of the mains power supply);
- Appropriate software included.

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KA 02.06.02 Technical data

Protection	IP68
Casing	Cast aluminium
Operating temperature	0 to 50 °C
Storage temperature	-10 to + 70 °C
System clock	Read time
Output	V.24/RS 232-compatible data interface to connect to the PC. All socket connectors are waterproof.
Alarm contact	FET open drain - 1 max 100 mA; U max 50 V

KA 02.06.03 Pressure sensor

The sensor may be either:

- direct-connected to a 3/8" NPT thread nipple, or
- connected by an adapter to a 3/8" Whitworth female connection.

Material:

All parts which are in contact with the media and the housing must be manufactured from stainless steel.

Storage temperature	-55 to +100 °C
Operating temperature	-40 to +100 °C
Operating temperature interface	0 to +70 °C
Compensated range	0 to +70 °C
Media temperature	-40 to +125 °C
Humidity	0 to 100 % (RH)
Shock	50 g
Accuracy	± 1,0 % FS at constant temperature
Non-linearity	± 0,2 % FS
Repeatability	± 0,5 % FS
Thermal effects	0 °C to 70 °C
Response time	1,0 ms

Pressure ratings (bar):	<u>Operating pressure</u>	<u>Proof pressure²</u>	<u>Burst³</u>
	0 - 20,70	31,0	345

- (a) Sensor including interface;
- (b) Maximum pressure without causing damage to the sensing elements;
- (c) The media will be contained until this extreme pressure limit is exceeded.

Measuring range: 0,0 to 20,7 bar

KA 03 EXECUTION OF REPAIR WORK

KA 03.01 GENERAL

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

KA 03.02 INSTALLATION OF WATER METERS

This section covers the installation and repair of all water meters that will be used as part of the water audit process.

KA 03.02.01 Bulk water meters

Bulk water meters at reservoirs shall be repaired or replaced depending on the condition of the meter. Meters not installed in accordance with the manufacturer's instructions shall also be rectified.

All reservoir outlets shall be metered.

All boreholes will be metered.

KA 03.02.02 Zone meters

Zone meters shall be installed within the network where significant benefit can be obtained from dividing the area into zones so that the consumption pattern can be monitored and discrepancies between the supply and consumption within the area compared.

Zone meters will also be used for the measurement of night flows where required.

KA 03.02.03 Individual connections

All individual connections within the reticulation shall be metered. Such connections shall include meters for individual buildings.

KA 03.02.04 Domestic water meters

Meters for domestic water consumption shall be provided in above ground installations, but underground in secure areas.

KA 03.02.05 Combination water meters

The installation of combination water meters shall be considered for all installations where connections larger than 80 mm are used for institutions that have peak flows exceeding 400 times the minimum anticipated flow.

KA 03.02.06 Fire flow connections

Where fire flow connections are provided, measures shall be taken to ensure that the fire flow and domestic water consumption are metered separately. The Engineer will indicate where the meters are to be installed.

KA 03.03 ROUTINE INSPECTIONS OF PIPELINE ROUTES

KA 03.03.01 Water pipelines

The routes of all water supply pipelines shall be inspected for visible leaks. All leaks shall be properly logged and reported for repair.

KA 03.03.02 Sewer manholes

Sewer manholes shall be inspected for excessive night flows. The households in areas with high night flow rates shall be inspected for leakages resulting from leaking cisterns, etc, which occur on the consumers' side of the meters.

KA 03.04 COMPILATION OF DATABASE

The Contractor shall compile a database to assist in effective management of the system. The database shall contain the following information:

- (a) Meter serial number
- (b) Meter size
- (c) Meter make
- (d) Installation position
- (e) Meter reading on installation
- (f) Date of installation
- (g) Date last calibrated
- (h) Consumer name
- (i) Postal and residential address
- (j) Length and diameter of pipeline.

The above-mentioned data may also be provided as part of the User Client's billing system.

In the compilation of the database the Contractor shall ensure that the information required for the "water audit" software is also collected.

KA 03.05 LEAK DETECTION AND REPAIR

This clause covers the providing of additional equipment for implementing a water loss management programme in identified areas. Areas with significantly high unaccounted for water flows will be identified for measuring night flows.

KA 03.05.01 Provision of data loggers

Data loggers shall be provided in accordance with Particular Specification PA: Measuring instruments. The data loggers will enable the monitoring of flow patterns and detailed inspection of the minimum night flow in a particular area.

KA 03.05.02 Measurement of night flows

Measurement of the night flow shall be done as instructed by the Engineer.

KA 03.05.03 Meter management

All metered consumers must be incorporated into a billing system for the accurate compilation of monthly accounts for water consumed.

The billing system shall be user-friendly and cover at least the following aspects:

- (a) Meter serial number;
- (b) Consumer name;
- (c) Postal and residential address;
- (d) Meter reading at start and end of period;
- (e) Dates of meter reading;
- (f) Volume of water consumed;
- (g) Tariff applicable for payment;
- (h) Estimated interim accounts;
- (i) Accounts in arrears;
- (j) Unreadable accounts with associated reasons;
- (k) Incorporation of prepayment meters and associated consumption.

KA 03.05.04 Provision of software

Software packages shall be provided to enable the following:

- (a) Establishment of a meter database;
- (b) Establishment of a user-friendly database;
- (c) Water audit (WAR);
- (d) Night-flow evaluation (SANFLOW).

KA 03.05.05 Training and capacity building

This clause covers the training of representative staff of the User Client to acquire a level of competency so that they will be able to manage the water control plan.

The training programme shall include the following aspects:

- (a) Software application for water balance, water audit and billing system;
- (b) Meter reading;
- (c) Use of data loggers.

SABS 0306 will be used as a basis for the training.

KA 04 MAINTENANCE

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

All components of the water control plan including the associated water meters, as well as software and hardware for the computers, shall be maintained during the maintenance phase of the Contract. Maintenance of the system shall ensure reliable

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functioning and optimum service life thereof. Commencement of maintenance of the system shall mean that the system has been repaired to its original level of serviceability and shall leave the Contractor with an as-new system to maintain for the remaining period of the 36 month contract.

Remuneration for maintaining the system, services and parts of the infrastructure in perfect functional condition is provided for in the Schedule of Quantities by means of monthly payment items.

Maintenance implies and shall include monthly routine preventative maintenance and corrective maintenance, as well as breakdown maintenance on all components of the specified installation. Maintenance shall include all repair work, replacing of components, fixing defects or any other actions or rectifying measures necessary for complete operation of the water control plan.

KA 04.01 **SCOPE OF MAINTENANCE**

Maintenance work for the water control plan shall comprise the following:

KA 04.01.01 **Monthly maintenance**

- (a) Check operation of water meters;
- (b) Read all water meters;
- (c) Verify sample meter readings;
- (d) Update database;
- (e) Issue consumer accounts;
- (f) Repair visible leaks;
- (g) Compile monthly water balance on volume and costs.

KA 04.01.02 **Regular maintenance**

- (a) Check sewer night flows three-monthly;
- (b) Install data loggers to measure night flows at bulk and zone meters three-monthly;
- (c) Analyse data from data loggers;
- (d) Implement leak detection in areas indicated as problematic through data logger analysis.

KA 04.01.03 **Annual maintenance**

- (a) Clean strainer units at water meters;
- (b) Confirm settings and operation of pressure-reducing valves.

KA 05 MEASUREMENT AND PAYMENT

KA.01 COMPILATION OF DATABASE Unit: sum

The tendered sum shall include for the provision of the software and the input of all the initial data.

KA.02 MEASUREMENT OF NIGHT FLOWS Unit: number

The unit of measurement shall be the number of periods during which a night flow is measured per water meter installation, irrespective of the duration of the measuring period.

The tendered rate shall include for the installation of data loggers, downloading of data, presentation and analysis of results and all associated incidental charges.

KA.03 METER MANAGEMENT SYSTEM Unit: sum

The unit of measurement shall be a sum for the complete compilation of a meter management system sufficient for management of the installation.

The tendered rate shall include for the input of all related data.

KA.04 PROVISION OF SOFTWARE Unit: number

The unit of measurement shall be the number of software packages provided.

The tendered rate shall include for the supply, delivery and installation of the relevant software. All associated labour costs shall be included but, the associated computer hardware costs are to be excluded.

Separate pay items will be listed in the Schedule of Quantities for different software packages.

KA.05 TRAINING AND CAPACITY BUILDING Unit: sum

The unit of measurement shall be a sum to cover the respective training and capacity building offered.

The tendered rate shall include for the labour, transport, materials and all other related costs.

Separate items will be listed in the Schedule of Quantities for different courses required.

KA.06 SUPPLY AND INSTALLATION OF PRESSURE GAUGES Unit: number

The unit of measurement shall be the number of pressure gauges supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the pressure gauges, including site handling, correct positioning, testing and all material and labour required to obtain a fully functional pressure gauge.

KA.07 **SUPPLY AND DELIVERY OF DATA LOGGERS** Unit: number

The unit of measurement shall be the number of data loggers supplied and delivered. There will be different items for different data loggers.

The tendered rate shall include full compensation for the corrosion protection, patent rights, royalties, transport and all other costs and actions required for the supply and delivery of data loggers as specified.

KA.08 **INSTALLATION, TESTING AND COMMISSIONING OF DATA LOGGERS AS SPECIFIED** Unit: number

The unit of measurement shall be the number of data loggers installed, tested and commissioned as specified.

The tendered rates shall include full compensation for the site handling, positioning, installation, testing and commissioning of the data loggers as specified, including all other costs and actions required to obtain a fully functional system for flow measurement.

All actions required as part of the software installation shall be included.



**REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF PUBLIC WORKS**

SPECIFICATION

FOR

THE ELECTRICAL INSTALLATION

AT

VAN ROOYENSHEK: APPOINTMENT OF A SERVICE

**PROVIDER FOR THE MAINTENANCE AND REPAIRS OF BUILDING, CIVIL,
MECHANICAL, ELECTRICAL INFRASTRUCTURE AND INSTALLATIONS FOR
A PERIOD OF 36 MONTH (APPOINTMENT OF CONTRACTOR):**

CONSISTING OF:	ELECTRICAL WORK	PG
1:	Electrical Installation	1 to 40

See separate documents for:

**Technical & Particular
specification. BOOK 2 OF 2**

ELECTRICAL ENGINEER

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FEB 2021

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PART B: ELECTRICAL WORK

NOTICE TO TENDERERS

1. The tenderer for the principal contract shall submit additional information regarding the installer of the Electrical Installation together with the returnables enclosed with the tender enquiry documents
2. The Contractor, on acceptance of his tender for the principal contract shall submit within the period stated, the information indicated on the forms following immediately after the Summary of the Bills of Quantities for this installation.

SPECIFICATION FOR ELECTRICAL WORK

PART 1 - GENERAL

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PART 1 - GENERAL

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.

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 develops 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.

3 REGULATIONS

The installation shall be erected and tested in accordance with the Acts and Regulations as indicated in the scope of works

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.

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 and **Technical & Particular specification. BOOK 2 OF 2.**

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 and Technical & Particular specification BOOK 2 OF 2..

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.

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 and Technical & Particular specification BOOK 2 OF 2.

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.

- a) Screwed metallic conduit and accessories: SANS 61386-1 and 21.
- b) Plain-end metallic conduit and accessories: SANS 61386-1 and 21.
- c) 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 and Technical & Particular specification BOOK 2 OF 2 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 in regard to the supply authority's requirements.

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.

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 and Technical & Particular specification BOOK 2 OF 2, 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.

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.

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.

12 WIRING:

Except where otherwise specified in Part 2 of this specification and Technical & Particular specification BOOK 2 OF 2, 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 and Technical & Particular specification BOOK 2 OF 2 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 2,5mm² conductors and a 2.5mm²-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 and Technical & Particular specification BOOK 2 OF 2, 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 and Technical & Particular specification BOOK 2 OF 2 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.

13 SWITCHES AND SOCKET OUTLETS

All switches and switch-socket outlet combination units shall conform to the Department Quality Specification and Technical & Particular specification BOOK 2 OF 2s, which form part of this specification and Technical & Particular specification BOOK 2 OF 2.

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 and Technical & Particular specification BOOK 2 OF 2 or alternatively the height of socket outlets may be indicated on the drawings.

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 Specification and Technical & Particular specification BOOK 2 OF 2s which form part of this specification and Technical & Particular specification BOOK 2 OF 2 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 Specification and Technical & Particular specification BOOK 2 OF 2s shall be used throughout the installations.

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 board 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.

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.

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.

18 EARTHING OF INSTALLATION

18.1 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.

18.2 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.

18.3 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.

18.4 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.

18.5 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 be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

18.6 NON-METALLIC CONDUIT

Where non-metallic conduit is specified or allowed, the installation shall comply with the Department's standard quality specification and Technical & Particular specification BOOK 2 OF 2 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.

18.7 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.

18.8 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 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.

LED 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 $\frac{3}{4}$ of the length of the luminaires apart.

LED 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 $\frac{3}{4}$ 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 LED luminaires as well as other luminaires exposed to the weather in accordance with the "Wiring Code".

LED luminaires are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings the luminaires shall be secured to the bracing or joists by means of two 40mm x No. 8 round head screws.

PART 2: INSTALLATION DETAILS

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PART 2: INSTALLATION DETAILS

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.

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.

3 ELECTRICAL EQUIPMENT

All equipment and fittings supplied must be in accordance with the attached quality specification and Technical & Particular specification BOOK 2 OF 2 (Part 3 of this document), suitable for the relevant supply voltage, and frequency and must be approved by the Employers Electrical Engineer.

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.

5 BALANCING OF LOAD

The Contractor is required to balance the load as equally as possible over the multiphase supply.

6 SERVICE CONDITIONS

All plant shall be designed for the climatic conditions appertaining to the service.

7 SWITCHES AND SOCKET OUTLETS

The installation of switches and socket outlets must conform to clause 13 of Part 1 of this specification and Technical & Particular specification BOOK 2 OF 2.

8 LIGHT FITTINGS AND LAMPS

The installation and mounting of luminaires must conform to of this specification and Technical & Particular specification BOOK 2 OF 2. All fittings to be supplied by the Contractor shall have the approval of the Employer.

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 Technical & Particular specification BOOK 2 OF 2 and to the satisfaction of the Employer/s Electrical Engineer.

10 MAINTENANCE OF ELECTRICAL SUPPLY

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.

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 and Technical & Particular specification BOOK 2 OF 2, including the supply and installation of all fittings and also the installation of such equipment supplied by the Employer.

12 SUPPLY AND CONNECTION

The supply will be 400/230 Volt, 50 Hz.

The Contractor will be responsible for the supply and installation of all cables. The size and length of the cable is listed in the Schedule of Cables and measured in the Bills of Quantities.

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 and Technical & Particular specification BOOK 2 OF 2. Wiring of the installation shall be carried out as directed in clause 9 part 1 of this specification and Technical & Particular specification BOOK 2 OF 2.

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.

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.

13.2 Intercom Installation

(NOT APPLICABLE)

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.

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 Water Heaters

The supply, installation and plumbing work shall be the responsibility of the Mechanical Contractor.

The Electrical Contractor must electrically connect all water heaters as specified and listed in the Schedule of Power Points.

The Electrical Contractor must liaise with the Plumbing Contractor with regard to the method of mounting the water heater, water inlet and outlet, drainage valve as well as the electrical connection.

30Amp. 2-pole isolators, as indicated on drawings and Schedule of Power Points, to be used. The isolator shall be suitable for voltages of up to 250V. Isolators to conform fully to SANS 152 as amended. Microgap switches shall be capable of carrying rated current continuously and making and breaking of rated current. Connection will be by means of 2 x 6mm sq insulated conductors and 4mm sq BCEW from the indicated circuit to a 30Amp 2P Isolator.

30Amp. 3-pole isolators, as indicated on drawings and Schedule of Power Points, to be used. The isolator shall be suitable for voltages of up to 250V. Isolators to conform fully to SANS 152 as amended. Microgap switches shall be capable of carrying rated current continuously and making and breaking of rated current. Connection will be by means of 4 x 6mm sq insulated conductors and 4mm sq BCEW from the indicated circuit to a 30Amp 3P Isolator

60Amp. 3-pole isolators, as indicated on drawings and Schedule of Power Points, to be used. The isolator shall be suitable for voltages of up to 250V. Isolators to conform fully to SANS 152 as amended. Microgap switches shall be capable of carrying rated current continuously and making and breaking of rated current. Connection will be by means of 4 x 10mm sq insulated conductors and 6mm sq BCEW from the indicated circuit to a 60Amp 3P Isolator

14.2 Extractor Fans (Bathrooms)

The fans will be supplied and installed by the Mechanical Contractor. All fans will be connected by the Electrical Contractor. Extraction fan connections will be by means of 20mm conduit from the indicated extractor fan circuit to a 100 x 100mm flush mounted outlet box 300mm under the ceiling or at 2400mm where there is no ceiling.

30Amp. 2-pole isolators, as indicated on drawings and Schedule of Power Points, to be used. The isolator shall be suitable for voltages of up to 250V. Isolators to conform fully to SANS 152 as amended. Microgap switches shall be capable of carrying rated current continuously and making and breaking of rated current

Connection will 3 x 4mm sq insulated conductors to end in a 30Amp, 2-P isolator with red indication light on the switched cover plate. Install a 20mm \varnothing conduit from the isolator to the fan and connect with same wiring as being fed.

14.3 Extractor Fans (Canopy)

The fans will be supplied and installed by the Mechanical Contractor. All fans will be connected by the Electrical Contractor. Extraction fan connections will be by means of 25mm conduit from the indicated extractor fan circuit to a 100 x 100mm flush mounted outlet box at the extractor fan motor.

Extraction fans will be by means of new 25mm conduit from the indicated circuit to a 30Amp 3P Isolator mounted inside a weatherproof 100 x 100mm outlet box within arm's reach of fan and to be connected to a 30A 3P DOL starter at 1400mm AFFL specified and indicated on the drawings.

Extraction fans connection will be by means of new 4 x 6mm sq insulated conductors and 4mm sq BCEW from the indicated circuit to a 30Amp 3P Isolator and to the 30A 3P DOL starter.

14.4 Air Conditioners

The supply, installation and plumbing work shall be the responsibility of the a/c contractor.

The electrical contractor must electrically connect all air conditioners as specified and listed

A 30Amp two-pole isolators, as indicated on the drawings and Schedule of Power Points, to be used. Triple pole isolator shall be rated 660V while two pole shall be suitable for voltages up to 250V. All isolators shall

conform fully to SANS 152 as amended. Microgap switches shall be capable of carrying rated current continuously, making, and breaking of rated current.

Connection will be by means of 2 x 4mm sq insulated conductors and 2.5mm sq BCEW from the indicated circuit to a 30Amp 2P Isolator.

A 30Amp three pole isolators, as indicated on the drawings and Schedule of Power Points, to be used. Triple pole isolator shall be rated 660V while two pole shall be suitable for voltages up to 250V. All isolators shall conform fully to SANS 152 as amended. Microgap switches shall be capable of carrying rated current continuously, making, and breaking of rated current.

Connection will be by means of 4 x 6mm sq insulated conductors and 4mm sq BCEW from the indicated circuit to a 30Amp 3P Isolator.

14.4 Compressor (Comp)

Compressor will be by means of new 25mm conduit from the indicated circuit to a 20Amp 3P Isolator mounted inside a weatherproof 100 x 100mm outlet box within arm's reach of compressor as indicated on the drawings.

Compressor connection will be by means of new 4 x 6mm sq insulated conductors and 4mm sq BCEW from the indicated circuit to a 20Amp 3P Weatherproof Isolator

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-resin 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 than 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.

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 unnecessarily 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 $130 \pm 5^{\circ}\text{C}$.

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 joiner 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.

16. DISTRIBUTION BOARDS

In addition to clause 14 and clause 15 of Part 1 of this specification and Technical & Particular specification BOOK 2 OF 2 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 and Technical & Particular specification BOOK 2 OF 2 in Part 3 of this specification and Technical & Particular specification BOOK 2 OF 2, and be approved by the Employer's Electrical Engineer.

THE ELECTRICAL CONTRACTOR MUST ALSO REFER TO THE PHOTO'S OF EACH BUILDINGS

The latest Departmental Quality Specification and Technical & Particular specification BOOK 2 OF 2 Section for Distribution Boards must be adhere to by Part 3 of the specification and Technical & Particular specification BOOK 2 OF 2.

17. SUBSTATION

(NOT APPLICABLE)

18. SCHEDULE OF LIGHT FITTINGS

As per Technical & Particular specification BOOK 2 OF 2 of the project

19. SCHEDULE OF POWER POINTS

As per Technical & Particular specification BOOK 2 OF 2 of the project

20. SCHEDULE OF CABLES, CONDUIT AND WIRING

As per Technical & Particular specification BOOK 2 OF 2 of the project

21. SCHEDULE OF DISTRIBUTION BOARDS

As per Technical & Particular specification BOOK 2 OF 2 of the project.

THE ELECTRICAL CONTRACTOR MUST ALSO REFER TO THE PHOTO'S OF EACH BUILDINGS

22. SWITCHGEAR AND CIRCUITS

As per Technical & Particular specification BOOK 2 OF 2 of the project

23. SCHEDULE OF LIGHTS, SOCKET OUTLETS AND SPECIAL POWER POINTS

As per Technical & Particular specification BOOK 2 OF 2 of the project

24. LIGHTNING PROTECTION

24.1.1 The Electrical Contractor must allow for a qualified and accredited subcontractor, which is a member of the Earthing and Lightning Protection Association (ELPA) to conduct a ground survey test and install a lightning protection system for the building in accordance with the latest revision to the *SANS Code of Practice 03 and 03A* and must comply with performance requirements laid down therein.

24.1.2 The lightning protection system shall consist of earth rods around the building as indicated on the drawings.

24.2 Earth Electrode Rods

24.2.1 Earth electrode rods shall be of the stainless steel type with copper coating (minimum thickness of 0.25mm) with a 16mm diameter. The tops of the rods shall be no less than 600mm below final ground level with the rod installed vertically.

24.3 Inter Connections

24.3.1 The earth electrode rods shall be bonded to the down conductors by means of exothermic welding.

24.4 Down Conductors

24.4.1 Down conductors shall be installed in 20mm surface mounted galvanised conduits at the cable ends of the buildings as shown. Down conductors shall consist of 50mm sq Green PVC insulated copper conductors and 8mm diameter aluminium conductor.

25.4.2 Down conductors shall terminate at test points 1400mm above final ground or paving level at a bolted connection. Conduits shall be fixed to the walls by means of raised galvanised saddles.

24.5 Roof Conductors

24.5.1 A 50mm sq aluminium conductor shall be installed along all ridges of roofs terminating at ends with conductors running downwards over surface of roof and the eaves. Lift shaft to have a conductor installed

in the form of a closed loop upon their upper surface. In all cases where metallic gutters have been installed along eaves of a pitched roof, these must be bonded to the air terminal system.

The roof conductor shall be mounted on raised aluminium saddles. The down conductors shall be bonded to the roof conductor by means of bolted connection.

24.6 Appointment of Specialist Earthing and Lightning Protection Association (ELPA)

24.6.1 The Contractor shall make allowance for earth resistance tests to be carried out by a Specialist Contractor in lightning and earthing protection. The recommended earthing and lightning protection design shall be submitted to the Engineer, complete with all calculations and supportive documentation.

24.6.2 The procedure to be adopted shall be strictly as follows:

24.6.2.1 Carry out on site earth relativity tests as many are required to obtain a representative reading.

24.6.2.2 Present the results of tests together with detailed recommendations on the required system in accordance to SANS 03 to **BVi Electrical Department** for approval. This documentation shall include for detailed drawings, graphs, calculations, system description, lengths of conductors and earth spikes.

24.6.2.3 On approval by **BVi Electrical Department**, installation is to proceed as recommended.

24.6.2.4 All exothermic welds, conductors, etc. shall be inspected by the Engineer prior to any backfilling taking place.

24.6.2.5 The system shall be tested in order to verify that the recommendation and installation are satisfactory.

24.6.2.6 Submission of *SANS Certificate of Completion* on the completion of the installation.

24.6.2.7 PARTICULARS OF EARTHING AND LIGHTNING PROTECTION ASSOCIATION (ELPA) CONTRACTOR

(To be completed by tenderers and submitted together with the tender form).

TENDER NO: _____ REFERENCE: _____

SERVICE: _____

NAME OF ELPA CONTRACTOR: _____

ADDRESS _____

EARTHING AND LIGHTNING PROTECTION ASSOCIATION REGISTRATION NUMBER:

DATE

SIGNATURE OF ELPA TENDERER

**PART 3: QUALITY SPECIFICATION AND TECHNICAL & PARTICULAR SPECIFICATION BOOK 2 OF 2
FOR MATERIALS AND EQUIPMENT OF ELECTRICAL INSTALLATIONS**

THIS ENTIRE SPECIFICATION AND TECHNICAL & PARTICULAR SPECIFICATION BOOK 2 OF 2 AND BILLS OF QUANTITIES SHALL BE READ IN CONJUNCTION WITH THE ELECTRICAL GENERAL TECHNICAL SPECIFICATION AND TECHNICAL & PARTICULAR SPECIFICATION BOOK 2 OF 2 AND QUALITY SPECIFICATION AND TECHNICAL & PARTICULAR SPECIFICATION BOOK 2 OF 2 OF THE DEPARTMENT OF PUBLIC WORKS.

ADDITIONAL REQUIREMENTS OR SPECIFICATION AND TECHNICAL & PARTICULAR SPECIFICATION BOOK 2 OF 2S NOT COVERED IN QUALITY SPECIFICATION AND TECHNICAL & PARTICULAR SPECIFICATION BOOK 2 OF 2S ABOVE

LED LIGHTS

All Light fittings installed for this project is to be of the LED type, unless otherwise stated.

The following international standard specification and Technical & Particular specification BOOK 2 OF 2s and South-African Bureau of Standards shall apply to the LED luminaire specification and Technical & Particular specification BOOK 2 OF 2:

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 specification and
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 and
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 or 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 $-40^{\circ}\text{C} < T < 60^{\circ}\text{C}$.

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.

PART 4: BILLS OF QUANTITIES

Refer to Main Bill of Quantities

PART 5: 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 and Technical & Particular specification BOOK 2 OF 2, 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.	Daylight sensitive switch		
7.	Time switch		
8.	Conduit		
9.	Conduit boxes		
10.	Power skirting		
11.	Surface switches		
12.	Watertight switches		
13.	16A flush socket outlets		
14.	16A surface socket outlets		
15.	Luminaries		
16.	Type		
17.	Type		
18.	Type		
19.	Type		
20.	Type		
21.	Type		
22.	Type		
23.	Type		
24.	Type		
25.	Type		
26.	Type		
27.	Type		
28.	Type		
29.	Type		
30.	Type		
31.	Type		
32.	Type		
33.	Type		
34.	Type		
35.	Type		
36.	Type		
37.	Type		
38.	Type		
39.	Type		
40.	Type		
41.	Type		
42.	Type		
43.	Type		
44.	Type		
45.	Type		

PARTICULARS OF ELECTRICAL CONTRACTOR

The electrical contractor to complete the info below and attach the certified documentation (ECB & ECA & DOL) to the electrical tender document. If the info is not complete and certified documentation not attach to the electrical tender, the tenderer to be disqualified and marked as non-responsive to the tender.

TENDER NO: _____ REFERENCE: _____

SERVICE: _____

NAME OF THE ELECTRICAL CONTRACTOR THREE PHASE REGISTER: _____

ADDRESS _____

CONTACT NUMBER: _____

ELECTRICAL CONTRACTOR'S REGISTRATION NUMBER AT THE ELECTRICAL CONTRACTING BOARD OF SOUTH AFRICA.

ECB NUMBER: _____

ELECTRICAL CONTRACTOR'S REGISTRATION NUMBER AT THE ELECTRICAL CONTRACTORS ASSOCIATION OF SOUTH AFRICA

ECA NUMBER: _____

ELECTRICAL CONTRACTOR'S REGISTRATION NUMBER AT THE DEPARTMENT OF LABOUR:

DOL NUMBER _____

THE QUALIFIED THREE PHASE ELECTRICIAN IS REQUIRED TO SUBMIT THE FOLLOWING COMPREHENSIVE INFO:

- Original tax clearance certificate
- VAT registration certificate
- Workmen's Compensation registration certificate (or proof of payment of contribution in terms of the COID Act no. 130 of 1993)
- Company / cc / Trust / Partnership registration certificate
- Certified copy of identity document staff on the project
- Previous project completion certificates.
- CV's of the staff on the project
- Consultants reference letters
- Certified academic and certified electrical certificate of the staff on the project.

Please ensure that DPW -22(EC) Particulars of electrical contractor is inserted and completed in main tender document

DATE

SIGNATURE OF TENDERER

TECHNICAL SPECIFICATION

AB BUILDING ELECTRICAL INSTALLATIONS

CONTENTS

AB 01	SCOPE
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AB 01 SCOPE

AB 01.01 This specification comprises all aspects regarding the repair and maintenance of building electrical systems of Maseru Border Post. Building electrical systems comprise:

- (i) Distribution boards and low voltage cable
- (ii) Interior and exterior lighting of buildings
- (iii) Small power and fixed appliances
- (iv) Earthing and lightning protection system

AB 01.02 This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3, the Additional Specifications included with this document.

AB 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

AB 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

AB 02.02 SABS Specifications

General	Distribution and meter boards	LV cables and conductors	Lighting system	Earthing and lightning protection system	Small power installation	
					Power outlets	Conduits, powerskirting, cable trays and ducting
SABS 0142	SABS 152	SABS 0150	SABS 0114	SABS 03	SABS 152	SABS 763
SABS 0160	SABS 156	SABS 0198	SABS 163	SABS 0199	SABS 163	SABS 764
SABS 0400	SABS 171	SABS 1411	SABS 1012		SABS 164	SABS 950
SABS 1222	SABS 172	SABS 1507	SABS 1084		SABS 1084	SABS 1065
	SABS 173		SABS 1250		SABS 1239	SABS 1085
	SABS 763		SABS 1279			SABS 1197
	SABS 1092		SABS 1777			
	SABS 1180					

- AB 02.03 Department of Public Works Specifications PW 774 and PW 343.
- AB 02.04 Occupational Health and Safety Act of 1993
- AB 02.05 Manufacturer's specifications and installation instructions.
- AB 02.06 Additional requirements

Equipment and material installed shall be new and unused. Luminaires, lamps, control gear, isolators and power outlets shall bear the SABS stamp. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on cabling, wiring, distribution boards, luminaires, power points and fixed appliances.

AB 03 OPERATING AND MAINTENANCE MANUALS

AB 03.01 The Contractor shall be responsible for the compilation of a complete set of as-built drawings, inventory list and Operating-and-Maintenance manuals.

This shall be done in accordance with the Additional Specification SB – Operating and Maintenance manuals.

AB 03.02 Over and above what is specified in the Additional Specification – SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall be structured and shall at least include the following:

AB 03.02.01 Description of installation

(a) Distribution boards and cabling

The complete system description of the distribution boards and cabling shall be done for each installation individually. The system description shall be presented in a tabular format and shall contain, but not be limited to the following:

Item	Distribution board description and location	Feed source	Type (Surface / Recessed)	No of ways	Size and kA rating of main circuit breaker	Description of sub-distribution boards	Size and type of supply cable	Minimum kA rating of circuit breaker

(b) Lighting system

The complete system description of the lighting system shall be done for each installation individually. The system description shall be represented in a tabular format and shall contain, but not be limited to the following:

Item	Circuit description	Switching arrangement	Luminaire detail	Lamp detail

(c) Small power and fixed appliances

The complete system description of the small power and fixed appliances shall be done for each installation individually. The system description shall be represented in tabular format and shall contain, but not be limited to the following:

Item	Circuit description	Source type and of supply	Switching arrangement	Description of appliance	Location of appliance	Rating of appliance	Type and of rating of isolating switch

(d) Earthing and lightning protection

The complete system description of the earthing and lightning protection system shall be done for each installation individually. The system description shall be presented in tabular format and shall contain, but not be limited to the following:

Item	Type of installation	Quantity and positions of earth electrodes	Type and size of earth electrode	Size and type of conductors	Type of joint

AB 03.02.02 Commissioning data

Complete commissioning, test and inspection data of all systems shall be provided for each building installation individually and shall comprise, but not be limited to the following:

(a) Distribution boards and cabling

Item	DB descr.	Maximum load			Phase voltage			Earth leakage unit trip test				Earth resistance		Insulation resistance				
		Value (A)			Meas-instr	Value (V)			Meas-instr	Value (mA)		Meas-instr	Value	Meas-instr	Cable Descr.	Value	Meas-instr	
		R	W	B		R	W	B		Unit 1	Unit 2							

(b) Lighting system

Item	Description installation	Illumination levels		Luminaire type	Lamp				
		Value (Lux)	Measuring instrument		Type	Installation date	Starting current (A)	Running current (A)	Measuring instrument

(c) Small power and appliances

Item	Description of installation	Circuit description	Earthing provided (Yes/No)

(d) Earthing, bonding and lightning protection system

Item	Installation description	Earth electrode			Fixed appliances					
		Size and type	Resistance value (Ω)	Meas. instr.	Description	Local isolator provided (Yes/No)	Type and rating of local isolator	Appliance earthed (Yes/No)	Earth continuity	Meas. instr.

AB 03.02.03 Operating data

The complete operating data for each installation system shall be provided and shall include, but not be limited to the following:

- (i) safety precautions to be implemented
- (ii) system operation
- (iii) system running check list and frequency of servicing required

AB 03.02.04 Maintenance instructions

The complete maintenance instructions for each installation system, shall comprise, but not be limited to the following:

- (i) schedule of maintenance particulars
- (ii) projected frequency of services and replacements
- (iii) schedule of serviceable components per system
- (iv) trouble shooting diagrams
- (v) details of all replacement items and spares, including manufacturer's brochures / pamphlets, order number, etc.
- (vi) complete as-built circuit diagrams

AB 04 TESTS AND INSPECTIONS PRIOR TO PRACTICAL COMPLETION

AB 04.01 All systems are to be re-checked by the Contractor prior to re-commissioning. Copies of all checks for each installation shall be presented to the Engineer for approval before re-commissioning takes place.

AB 04.02 It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters:

- AB 04.02.01 continuity of ring final circuit conductors
- AB 04.02.02 continuity of protective conductors, including main and supplementary equipotential bonding
- AB 04.02.03 earth electrode resistance
- AB 04.02.04 insulation resistance
- AB 04.02.05 polarity
- AB 04.02.06 earth fault loop impedance
- AB 04.02.07 operation of residual current devices
- AB 04.02.08 phase voltage
- AB 04.02.09 current per phase
- AB 04.02.10 illumination levels in lux

AB 04.03 The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

AB 05 LOGGING AND RECORDING PROCEDURES

AB 05.01 The Contractor shall as part of this Contract institute a Recording system as part of his Maintenance Control Plan as defined in the Additional Specification SA – General Maintenance. This shall consist of a Record book which shall be utilised to log and record all faults, system checks, breakdowns, maintenance visits, inspections etc.

AB 05.02 The logbook shall be stored in a safe place inside the prison maintenance supervisor's office and shall only be utilised by the Contractor and Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

This logbook shall be structured to at least include the following:

- AB 05.02.01 Bi-annual inspection and testing of all systems.
- AB 05.02.02 Monthly lamp inspection and maintenance actions.
- AB 05.02.03 Annual earthing test report.
- AB 05.02.04 Bi-annual inspection and testing of distribution boards.

AB 06 MAINTENANCE TOOLS AND SPARES

AB 06.01 On commencement of the Repair and Maintenance Contract, the Contractor shall supply and deliver certain tools and spares to the User Client. These tools and spares will be the property of the Department of Public Works. Any deficiencies or shortfall or damaged tools and spares during the contract shall be replaced with new equipment / material.

AB 06.02 The tools and spares shall be kept safe in a lockable store room on site. The Contractor shall provide his own lock for the designated store room. The inventory of the tools and spares shall be verified on a monthly basis. Any short fall shall be replaced by the Contractor as part of his responsibility under this contract.

AB 06.03 The tools and spares shall at least include the following:

- 01: 58W Flourescent lamps
- 02: 36W Flourescent lamps
- 03: 18W Flourescent lamps
- 05: 1000W MH lamps
- 06: 400W HPS lamps
- 07: 400W MV lamps
- 08: 400W MH lamps
- 09: 250W HPS lamps
- 10: 250W MV lamps
- 11: 250W MH lamps
- 12: 150W HPS lamps
- 13: 125W MV lamps
- 14: 150W MH lamps
- 15: 70W HPS lamps
- 16: 80W MV lamps
- 17: 100W MH lamps
- 18: PL9 Watt lamps
- 19: PL18 Watt lamps
- 20: PL26 Watt lamps
- 21: 11W Energy Saver lamps
- 22: 15W Energy Saver lamps
- 23: 20W Energy Saver lamps
- 24: 50W 12V lamps
- 25: 50W 220V lamps
- 26: 16W 2D lamps
- 27: Distribution kiosks key
- 28: DB face plate - square key
- 29: DB face plate - triagular
- 30: Special spanner for cell tamper proof luminaires made from hardened steel.

AB 06.04 Tools and Spares: Measurement and payment

<u>Item</u>	<u>Unit</u>
(a) Supply of tools and spares	No

The unit of measurement shall be the number of tools and spares supplied.

The tendered rate shall include full compensation for the supply and delivery of the tools and spares as specified.

AB 07 QUALITY ASSURANCE SYSTEM

AB 07.01 Following formal approval of his Quality Assurance system by Engineer, the Contractor shall implement the approved QA system.

AB 07.02 Records of this QA system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required by the Department.

AB 08 RE-COMMISSIONING OF INSTALLATION

AB 08.01 On practical completion of the repair work, the contractor shall re-check and put all systems into operation.

AB 08.02 All commissioning shall be performed by the Contractor, to the satisfaction of the Engineer. The Contractor shall confirm in writing that all systems have been repaired according to specification and are fully operational.

AB 08.03 All installations shall be energised for a minimum continuous period of 96 hours immediately prior to the Engineer's Practical Completion inspection to verify lamp stability and reliability of power reticulation

AB 09 REPAIR WORK TO LIGHTING INSTALLATIONS

AB 09.01 The various electrical systems shall be repaired during the first phase of the repair and maintenance contract.

AB 09.02 The scope of the repair work shall include, but shall not be limited to the activities listed below.

AB 09.03 The Contractor shall record the repair actions in tabular format before the Contractor's responsibility for maintenance commences.

AB 09.04 Repair work shall be executed within the approved period for repairs.

AB 09.05 New equipment and material shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of practical completion. These guarantees shall be furnished in favour of the Department of Public Works.

AB 10 INSTALLATION TECHNICAL DETAILS

AB 10.01 INSTALLATION DESCRIPTION

Repair and maintenance work of the building electrical systems shall be categorised under the following installations:

Distribution boards and cabling

Lighting installation

Power outlets and Equipment

Lightning Protection & Earthing

AB 10.02 SCOPE OF REPAIR WORK

The above mentioned repair work includes all the electrical installations of all the buildings

SCHEDULE OF DISTRIBUTION BOARDS ARE INDICATED AS FOLLOWS FROM AB.8-AB.19

OPERATIONAL AREA			
<u>BUILDING NR</u>	<u>BUILDING NAME</u>	<u>DB</u>	<u>DESCRIPTION</u>
1	Carport House B1		
2	House B1	DB	Service
3	Carport House B2		
4	House B2	DB	Service
5	Carport House B3		
6	House B3	DB	Service
7	Carport House B4		
8	House B4	DB	Service
9	Carport House B5		
10	House B5	DB	Service
11	Carport House B6		
12	House B6	DB	Service
13	Carport House B7		
14	House B7	DB	Service
15	SARS Kitchen Parkhome	DB	Service
16	SARS Export Office	DB	Service
17	SARS Import Office	DB	Service
18	BCOCC Offices	DB	Service
19	Scanner Room	DB	Service
20	Pedestrian Canopy	DB	Service
21	Administration Block	DB	Service
22	Carports		
23	Data Server Container	DB	Service
24	Oil Store 1		
25	Oil Store 2		
26	Oil Store 3		
27	Carports	DB	Service
28	Store Rooms	DB	Service
29	Generator Room	DB	Service
30	Cell Block Offices	DB	Service
31	Carports		
32	Arrival Public Ablution	DB	Service
33	Departure Public Ablution	DB	Service
34	House A1 Garage	DB	Service
35	House A1	DB	Service
36	House A2 Garage	DB	Service
37	House A2	DB	Service
38	House A3 Garage	DB	Service
39	House A3	DB	Service
40	House A4 Garage	DB	Service
41	House A4	DB	Service
42	House A5 Garage	DB	Service
43	House A5	DB	Service
44	House A6 Garage	DB	Service
45	House A6	DB	Service
46	Fire Booster Pump Station	DB	Service





OPERATIONAL AREA			
<u>BUILDING NR</u>	<u>BUILDING NAME</u>	<u>DB</u>	<u>DESCRIPTION</u>
47	High Level Water Tank	DB	Service
48	Borehole 1	DB	Service
49	Borehole Building 2	DB	Service
50	Tennis Court Building	DB	Service
51	Bore Hole Building	DB	Service
52	Fire Hydrant Water Tank	DB	Service
53	Lapa Recreation Building	DB	Service
54	Sewer Pump Station	DB	Service





AB 10.02.01 Distribution boards and cabling





- (a) Service distribution boards: inspect and clean the distribution boards, treat the enclosure for moisture ingress and corrosion and re- powder coat internal and external panel.
- (b) Check for rigidity and fastening of equipment trays, panels, doors and handling devices
- (c) Check locking mechanism and fit padlock. All padlocks shall be of local manufacture with brass bodies and 75 mm chrome shackles. Three keys (with pvc labels) shall be provided for each lock.
- (d) Replace damaged or missing faceplates, doors, mounting frames, handles, thumb catches, etc.
- (e) Check operation of distribution board equipment and meters, replace if faulty or damaged with an approved type.
- (f) Remove all obsolete equipment and meters.
- (g) Check and fasten wiring and cable terminations.
- (h) Re-arrange wiring and equipment to give a neat installation.
- (i) Trace outgoing circuits.
- (j) Fit labelling and blank face plate covers.
- (k) Replace the distribution boards if required and replacement is approved by Engineer.
- (l) Check earth bar and earth continuity, record.
- (m) Label all wiring and cabling with Grafoplast Trasp PVC markers.
- (n) Replace cabling as indicated
- (o) Rewire buildings as indicated





SCHEDULE OF LUMINAIRES ARE INDICATED AS FOLLOWS FROM AB.21-AB.28





EXISTING LIGHTS SCHEDULE






TYPE	DESCRIPTION	
A	HB50-MV	
		<p>Existing surface/ceiling mounted industrial highbay light fitting with 125 / 250 / 400 watt lamp. Lamp type of MV, MH, HPS</p>
B	B60	
		<p>Existing surface/ceiling mounted industrial light fitting with 125 / 250 / 400 watt lamp. Lamp type of MV, MH, HPS</p>
C	SPOTLIGHT	
		<p>Existing surface/ceiling mounted industrial light fitting with 125 / 250 / 400 watt lamp. Lamp type of MV, MH, HPS</p>
D	C10-258	
		<p>Existing surface mounted vapour proof cold room fitting with 2 x 58 watt fluorescent lamps.</p>





E	<p>HL2-258-ECG</p> 	<p>Existing surface mounted open channel fluorescent luminaire complete with control gear and 2 x 58 watt lamps.</p>
F	<p>B10-CLR-BLK-1PL9-DS</p> 	<p>Existing surface mounted bulkhead luminaire complete with control gear and 1 x 9 watt compact fluorescent lamps</p>
G	<p>B40</p> 	<p>Existing surface mounted industrial ec light fitting with 125 / 250 / 400 watt lamp. Lamp type of MV, MH, HPS</p>
H	<p>B10-CLR-BLK-2PL9-DS</p> 	<p>Existing surface mounted bulkhead luminaire complete with control gear and 2 x 9 watt compact fluorescent lamps</p>

I	POLICE LIGHT 	Existing wall mounted Police luminaire complete with control gear and 2x26 watt compact flourescent lamps
J	HL-GAL-8"-PORC-11W ENERGY SAVER-ES-GLS-OPL	
		Existing ceiling mounted 200mm dia. Bowl type bathroom luminaire complete with porcelain lamp holder and 1 x 11 watt energy saver BC lamp. The luminaire shall have an IP rating of 55.
K	HL2-272 (8FOOT)	
		Existing surface mounted open channel flourescent luminaire complete with control gear and 2 x 72 watt lamps.
L	HL- SAFE-11W	
		Existing wall mounted safe luminaire with 11 watt lamp.

<p>M</p>	<p>SM31-258</p>	 <p>Existing decorative prismatic mounted fitting with 2 x 58 watt fluorescent lamps.</p>
<p>N</p>	<p>SPOTLIGHT</p>	 <p>Existing surface/ceiling mounted industrial light fitting with 125 / 250 / 400 watt lamp. Lamp type of MV, MH, HPS</p>
<p>O</p>	<p>HL-EC02-11W ENERGY SAVER-ES-R80-WHT</p>	 <p>Existing surface mounted spot light luminaire with 2 x 11 watt energy saver lamp.</p>
<p>P</p>	<p>HL-EC3-11W ENERGY SAVER-ES-R80-WHT</p>	 <p>Existing surface mounted spot light luminaire with 3 x 11 watt energy saver lamp.</p>

<p>Q</p>	<p>BEKA BULK LED</p>	 <p>Existing ceiling/wall mounted die-cast aluminium lm 6 base, fitting, with led lamps.</p>
<p>R</p>	<p>HL-WELL GLASS-11W-ENERGY SAVER-BC</p>	 <p>Existing surface mounted well glass fitting with 1 x 11 watt energy saver lamp BC.</p>
<p>S</p>	<p>E10-M-2PL9-EXIT</p>	 <p>Existing surface mounted emergency escape route light, 8 watt cfl with signage, single sided wall mounted 1 way with low lumen output.</p>
<p>T1</p>	<p>GREY FRP</p>	 <p>Existing 3.5m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)</p>

<p>T2</p>	<p>SKY-H35-125W-GREY</p> 	<p>Existing grey post top 70 / 125 watt lamp and diffuser. Lamp type of MV, MH, HPS</p>
<p>U1</p>	<p>Scissors mask</p> 	<p>Existing 30 or 40m Scissors high mask</p>
<p>U2</p>	<p>SPOTLIGHTS</p> 	<p>Existing 1000W MV/MH/HPS spotlights mounted on the existing 30 or 40m Scissors high mask</p>
<p>U3</p>	<p>STREETPOLE</p> 	<p>Existing Streetlight pole 9m</p>
<p>U4</p>	<p>BEKA LED STREETLIGHT</p> 	<p>Existing Beka Streetlight led</p>

U5	<p>SPOTLIGHTS & WOODEN POLE</p> 	<p>Existing 1000W MV/MH/HPS spotlights mounted on the existing 8 or 11m wooden pole</p>
V	<p>STREETLIGHT</p> 	<p>Existing streetlight fitting with 125 watt lamp. Lamp type of MV, MH, HPS</p>
W1	<p>FRP POLE</p> 	<p>Existing 3.5m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)</p>
W2	<p>Beka Ray</p> 	<p>Existing Beka Ray</p>





NEW LIGHTS SCHEDULE

TYPE	DESCRIPTION	
XA	LEDBAY	
	 <p>LED BAY</p> <p>LED Bay - midi</p>	<p>108W LEDbay midi - Replaces 250W High Bay</p>
XB	OMNIstar	
	 <p>OMNIstar-midi</p>	<p>108W OMNIstar midi - Replaces 250W</p>
XC	OMNIstar	
	 <p>OMNIstar-midi</p>	<p>108W OMNIstar midi</p>
XD	Vapourline	
		<p>Vapourline 4FT 46W</p>





<p>XE</p>	<p>Vapourline</p> 	<p>Vapourline 4FT 46W</p>
<p>XF</p>	<p>B10-CLR-BLK-1PL9-DS</p> 	<p>Series 31 9W LED</p>
<p>XG</p>	<p>nova 35W LED</p> 	<p>nova 35W LED</p>
<p>XH</p>	<p>B10-CLR-BLK-2PL9-DS</p> 	<p>Retrovit existing surface mounted bulkhead luminaire to led</p>

XI	POLICE LIGHT	
		<p>2*26W Police Version Telegrey</p>
XJ	Series 31 9W LED - White in colour	
		<p>Series 31 9W LED - White in colour</p>
XK	Vapourline	
		<p>Vapourline 4FT 46W</p>
XL	HL- SAFE-11W	
		<p>Retrovit existing wall mounted safe luminaire with led</p>

XM	BEKA Roughguard 4FT 55W	
		BEKA Roughguard 4FT 55W
XN	108W OMNIstar midi - Replaces 250W	
		108W OMNIstar midi - Replaces 250W
XO	HL-EC02-11W ENERGY SAVER-ES-R80-WHT	
		surface mounted spot light luminaire with 2 x 11 watt energy saver lamp.
XP	HL-EC3-11W ENERGY SAVER-ES-R80-WHT	
		surface mounted spot light luminaire with 3 x 11 watt energy saver lamp.

XQ	BEKA BULK LED	
		<p>bulk 18W LED</p>
XR	HL-WELL GLASS-11W-ENERGY SAVER-BC	
		<p>Retrovit existing surface mounted well glass fitting with led.</p>
XS	E10-M-2PL9-EXIT	
		<p>Ceiling / Wall mounted emergency escape route light, led with signage, single sided wall mounted 1 way with low lumen output.</p>
XT1	GREY FRP	
		<p>4m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)</p>

XT2	BEKA Zela 55W LED	
		Zela 55W LED
XU1	Scissors mask	
		30 or 40m Scissors high mask
XU2	SPOTLIGHTS	
		OMNIsat Maxi 463W 5121 optic
XU3	STREETPOLE	
		Streetlight pole 9m with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)
XU4	BEKA LED STREETLIGHT	
		LEDflood maxi 279W

XU5	SPOTLIGHTS & WOODEN POLE	
		<p>OMNIsat Maxi 463W 5121 optic</p>
XV		
		<p>LEDlume mini XP 36W 5068 optic</p>
XW1	FRP POLE	
		<p>4m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)</p>
XW2	Beka Ray	
		<p>BEKAray LED</p>

AB 10.02.02

Lighting system

(a) Indoor luminaires

(i) Operational and complete luminaires

- Remove lamps and wash luminaire body with detergent. Clean polycarbonate diffusors with detergent. Clean polished pure aluminium diffusors / reflectors with benzine.
- Check condition of luminaire seal, entrance gland, lampholder and internal wiring.
- Ensure that earth stud and earth connection is sound.
- Replace missing screws, catches, bolts and plugs.
- Check condition of suspension cords of pendant luminaires.
- Re-lamp.

(ii) Damaged or incomplete luminaires

- Remove luminaire.
- Replace luminaire and reconnect.
- Fit new lamps.

(iii) Fluorescent luminaires 2400mm long

- Remove luminaire.
- Replace luminaire with 1500mm double fluorescent luminaire.
- Fit new lamps.

(iv) Bulkhead luminaires with incandescent lamps

- Remove luminaire.
- Replace luminaire with a bulkhead with 2 x 26 Watt lamps.
- Fit new lamps.

(b) Light switches

Note: All light switches shall have steel face plates with permanent glued Traffolite labels.

- Remove switch cover.
- Check continuity of earth connection.

- Check operation of switch and replace if suspect.
- Replace switch cover, fit new csk stainless steel screws if required.
- Replace light switches as indicated

(c) Photocells

- Wash translucent body with detergent.
- Cover photocell and verify operation.
- Check bypass manual switching circuit.
- Enclose all exposed wiring in 16 mm ø sprague.

(d) Floodlight and bulkhead luminaires

- Remove lens and lamp. Wash lens thoroughly.
- Wash luminaire body with detergent.
- Clean polished pure aluminium reflectors with benzine.
- Check condition of internal wiring, capacitor, ballasts and starters.
- Check condition of neoprene seal and replace if worn or damaged.
- Check condition of lampholder.
- Seal conduit and wiring entry with silicone to eliminate water ingress.
- Fit new lamp.
- Check condition of earth stud and luminaire earth connection.
- Replace all missing screws, lens catches, bolts.
- Close cover securely, check stirrup bolts.
- Replace luminaires as indicated

AB 10.02.03 Power outlets and fixed appliances

Note: All power outlets shall have steel face plates with permanent glued Traffolite labels.

- (a) Inspect all power outlets and verify earthing.
- (b) Check contact points and tighten screws.
- (c) Replace missing screws and covers for outlet and draw boxes.
- (d) Replace missing, faulty or damaged socket outlets and plugs.
- (e) Check conditions and operation of local isolators and control switches for fixed equipment and replace if faulty, damaged or missing.

- (f) Check earthing of fixed appliances and test for earth continuity.
- (g) Inspect cable and wireways.
- (h) Check for rigidity and fastening of the cable ducts, ladders, ducting, powerskirting and surface conduiting, fasten or replace if loose or damaged, check earthing and test for earth continuity.
- (i) Replace equipment as indicated

AB 10.02.04 Earthing, bonding and lightning protection

- (a) Check earthing and bonding of outlet points, equipment, cable and wireways, fixed appliances, water and gas pipes, etc.
- (b) Check installation and termination of protective conductors and earth electrodes
- (c) Test for earth continuity.
- (d) Provide 6 mm² copper earth wire jumper between roof cladding and all gutter downpipes. Fasten with lugs and galvanized zinc bolts. Typically ten downpipes per housing unit. Earth at least two gutter downpipes by means of 16 mm² green insulated earth wire connected to 1,2 m earth electrode by means of cadwelding. Typically two downpipes per 25 m long housing unit.
- (e) Supply and install lightning protection as indicated

AB 10.03 REPAIR WORK : MEASUREMENT AND PAYMENT

AB 10.03.01 Distribution boards and cabling

<u>Item</u>	<u>Unit</u>
-01 Service distribution board	No

The unit of measurement shall be the number of distribution kiosks or boards opened and serviced.

The tendered rate shall include full compensation for the opening of the distribution board or kiosk, internal cleaning of the enclosure, cleaning of equipment and meters, removal of obsolete distribution board equipment, re-arrangement of equipment and wiring, treatment of the enclosure for moisture ingress and corrosion and re- powder coating, vermin protection, fastening and / or replacement of wiring, tracing of outgoing circuits, labelling of outgoing wiring and mcb's and cable terminations and earth testing.

The tendered sum shall further include for replacement of damaged, missing or faulty distribution board switchgear, meters, face plates, mounting frames, handling devices, doors, circuit breaker blanks, test and labelling of all existing circuits and new circuits with a legend card in each board, etc.

<u>Item</u>	<u>Unit</u>
-02 Replace distribution board	No

The unit of measurement shall be the number of distribution boards removed and replaced if replacement is approved by Engineer.

The tendered rate shall include full compensation for the dismantling of the DB equipment, removal of the dilapidated enclosure, supply and installation of

an epoxy painted new enclosure, mounting frames, plates, equipment, meters, tracing of outgoing circuits, labelling etc.

The tendered sum shall further include for re-wiring of the board, cable termination, cable labelling, remedial builders work and earth testing.

<u>Item</u>	<u>Unit</u>
-03 Replace cabling	m

The unit of measurement shall be the linear length of cable supplied and installed.

The tendered rate shall include full compensation for the removal of the existing cabling; supply, handling, installation and termination of the specified type of cable.

This rate shall further include for the supply of all cable ties, clamps and other material necessary to ensure that the installation conforms to the specification.

<u>Item</u>	<u>Unit</u>
-04 Replace wiring	m

The unit of measurement shall be the linear length of conductors supplied and installed.

All light circuits must be wired with 2,5mm² PVC insulated conductors plus 2,5mm² earth wires.

All socket circuits must be wired with 4mm² PVC insulated conductors plus 2,5mm² earth wires.

All air-conditioner and geyser circuits must be wired with 4mm² PVC insulated conductors plus 2,5mm² earth wires.

The tendered rate shall include full compensation for the removal of the existing conductors, the supply, handling, installation, pulling in conduit and termination of the specified type of conductor.

This rate shall further include for the supply of all cable ties, labelling, and other material necessary to ensure that the wiring conforms to the specification.

<u>Item</u>	<u>Unit</u>
-05 Jointing and termination of cables	No

The unit of measurement shall be number of cable joints or terminations.

The tendered rate shall include full compensation for the cost for providing the kits, complete with compound, ferrules and cable lugs, the cost for cutting the cable, handling and fitting kits and the cost of testing the joints and terminations. Position of joints shall be indicated on as-built drawings.

<u>Item</u>	<u>Unit</u>
-06 Supply and install padlocks	No

The unit of measurement shall be number of padlocks supplied and installed.

The tendered rate shall include full compensation for the ordering, supply and installation of the 75 m locally manufactured padlocks and locking devices as well as fitting each of the three keys with purpose-made PVC labels.

<u>Item</u>	<u>Unit</u>
<p>-07 Excavate in all materials for trenches, backfill, compact and dispose of surplus material</p> <p>The unit of measurement shall be the cubic meter of material excavated in trenches.</p> <p>The tendered rate shall include full compensation for clearing and grubbing the trench areas, for excavating the trench, preparing the bottom of the trench, separating material unsuitable for backfill and dealing with any surface or subsurface water.</p> <p>The tendered rate shall furthermore cover the cost of installing the sand bed and sand cover, backfilling, compacting and disposing of the surplus material and for complying with the requirements of SABS 1200 DB and 1200 LB.</p>	<p>m³</p>
<p>-08 Supply and install cable sleeves</p> <p>The unit of measurement shall be the linear length in meter of the cable sleeve supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply, delivery, handling and installing the specified sleeves including all the required, couplings, steel draw wires and plugs.</p>	<p>m</p>
<p>-09 Supply and install plastic warning tape</p> <p>The unit of measurement shall be the linear length in meter of the plastic warning tape supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply, handling and laying of the plastic warning tape.</p>	<p>m</p>
<p>-10 Termination of the low voltage cable</p> <p>The unit of measurement shall be the number of low voltage cable terminations.</p> <p>The tendered rate shall include full compensation for providing the cable glands and shrouds, and the cost of handling, fitting and cutting the cable.</p>	<p>No</p>
<p>-11 Supply and install earth continuity conductor</p> <p>The unit of measurement shall be the linear length in meter of the earth continuity conductor supplied and installed.</p> <p>The tendered rate shall include full compensation for procuring, furnishing and laying the specified earth continuity conductor.</p>	<p>m</p>

	<u>Item</u>	<u>Unit</u>
-12	<p>Termination and connect earth continuity conductor</p> <p>The unit of measurement shall be the number of earth continuity conductors terminated and connected.</p> <p>The tendered rate shall include full compensation for supplying all the material required to terminate and connect the earth continuity conductors and the connecting thereof to the earth bars, including label tags.</p>	No
	<u>Item</u>	<u>Unit</u>
-13	<p>Supply and installation of circuit breakers</p> <p>The unit of measurement shall be the number of circuit breakers supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified type and size of circuit breaker, including printed pvc labelling.</p>	No
	<u>Item</u>	<u>Unit</u>
-14	<p>Supply and installation of isolators</p> <p>The unit of measurement shall be the number of isolators supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified isolator, including printed pvc labelling.</p>	No
	<u>Item</u>	<u>Unit</u>
-15	<p>Supply and install contactors</p> <p>The unit of measurement shall be the number of contactors supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified type of contractor, including engraved labelling on rear tray.</p>	No
	<u>Item</u>	<u>Unit</u>
-16	<p>Supply and install switching timers</p> <p>The unit of measurement shall be the number of switching timers supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified type of switching timer, including labelling.</p>	No
	<u>Item</u>	<u>Unit</u>
-17	<p>Supply and install earth leakage units</p>	No

The unit of measurement shall be the number of earth leakage units supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of earth leakage units, including labelling.

<u>Item</u>	<u>Unit</u>
-18 Supply and install fuses	No

The unit of measurement shall be the number of fuses supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of fuse, including engraved label indicating fuse rating.

<u>Item</u>	<u>Unit</u>
-19 Supply and install surge arrestors	No

The unit of measurement shall be the number of surge arrestors supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of surge arrestors, with visual indication.

<u>Item</u>	<u>Unit</u>
-20 Supply circuit breaker blank covers	No

The unit of measurement shall be the number of specified blank covers supplied.

The tendered rate shall include full compensation for the procurement and delivery of the blank covers as specified.

AB 10.03.02 Lighting system

<u>Item</u>	<u>Unit</u>
-01 Re-lamp luminaire	No

The unit of measurement shall be the number of lamps replaced.

The tendered rate shall include full compensation for the supply and installation of the specified lamp according to the manufacturer's instructions. Replacement date must be written on lamp.

<u>Item</u>	<u>Unit</u>
-02 Service luminaire	No

The unit of measurement shall be the number of luminaires opened and serviced.

The tendered rate shall include full compensation for the servicing of the luminaire, including washing, checking of seals, glands, lamp holders, cleaning of diffusers, tightening of fixing screws and bolts, corrosion protection and the checking of earthing continuity and aiming angle if applicable. All external luminaire conduit entries are to be sealed with silicone, which cost is included in this payment item.

	<u>Item</u>	<u>Unit</u>
-.03	<p>Replace luminaire</p> <p>The unit of measurement shall be the number of luminaires replaced.</p> <p>The tendered rate shall include full compensation for the removal of the existing luminaire and for the supply and installation of the specified type of light fitting complete with lamp and control gear, if applicable, according to manufacturer's instructions.</p>	No
	<p><u>Item</u></p>	<u>Unit</u>
-.04	<p>Replace light switch</p> <p>The unit of measurement shall be the number of light switches replaced.</p> <p>The tendered rate shall include full compensation for the removal of the existing light switch and for the supply and installation of the specified type of light switch to manufacturer's instructions. Light switch face plate shall be fitted with an engraved Traffolite label as per Nosa-standard, cost of which is included in rate.</p>	No
	<p><u>Item</u></p>	<u>Unit</u>
-.05	<p>Replace photo-electric switch</p> <p>The unit of measurement shall be number of photocell units replaced.</p> <p>The tendered rate shall include full compensation for the supply, connecting and testing of the switch.</p> <p>The rate shall further include full compensation for the cost of providing and installing all hardware, screws, wall plugs, 16 mm ø sprague and other material required to install the photo electric light switch in accordance with the manufacturer's specification.</p>	No
	<p><u>Item</u></p>	<u>Unit</u>
-.06	<p>Replace luminaire diffuser</p> <p>The unit of measurement shall be number of luminaire diffusers replaced.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified type of diffuser, including fixing screws and clips.</p>	No
	<p><u>Item</u></p>	<u>Unit</u>
-.07	<p>Service light switch</p> <p>The unit of measurement shall be the number of light switches opened and serviced.</p> <p>The tendered rate shall include full compensation for the servicing of the light switch, internal cleaning of the enclosure, inspection of the contact points, switching mechanism, earthing, etc.</p>	No

The tendered sum shall further include for replacement of any missing outlet covers and fixing screw and earth testing. Light switch face plate shall be fitted with an engraved Traffolite label as per Nosa-standard, cost of which is included in rate.

<u>Item</u>	<u>Unit</u>
-08	Remove, clean, store and reinstallation of luminaire

No

The unit of measurement shall be the number of light fittings removed, cleaned, stored and reinstalled.

The tendered rate shall include full compensation for the removal, disconnect, cleaning, storage (4 weeks) reinstallation, reconnection and testing of the luminaire.

The rate shall further include full compensation for the installation of 2 x 700 mm supporting timber members above the ceiling (114 x 38 Par SA Pine) and the mounting of 63 mm ø round conduit outlet box complete with 2 x 4 x 60 mm galvanised screws.

AB 10.03.03 Small power and fixed appliances

<u>Item</u>	<u>Unit</u>
-01	Replace socket outlet

No

The unit of measurement shall be the number of socket outlets replaced.

The tendered rate shall include full compensation for the removal of the existing socket outlet and the supply and installation of the specified type of socket outlet.

All socket outlets shall be supplied complete with cover plates and boxes where required. The tendered rate shall therefore include for the supply of the cover plates and fixing screws where applicable. Outlet face plate shall be fitted with an engraved, Traffolite label as per Nosa-standard, cost of which is included in the rate.

<u>Item</u>	<u>Unit</u>
-02	Replace isolator

No

The unit of measurement shall be the number of isolators supplied.

The tendered rate shall include full compensation for the supply and installation of the specified type of isolator or control unit.

The tendered sum shall further include for the provision of 4 wire, 3 phase connections to the fixed appliance. Isolator face plate shall be fitted with an engraved Traffolite label as per Nosa-standard, cost of which is included in the rate.

<u>Item</u>	<u>Unit</u>
-03	Replace plug tops

No

The unit of measurement shall be the number of plug tops replaced.

The tendered rate shall include full compensation for the supply and installation of the required type of plug top.

	<u>Item</u>	<u>Unit</u>
-.04	<p>Replace conduit</p> <p>The unit of measurement shall be the linear meter of conduit supplied and installed.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified type and size of conduit, including all fixing accessories.</p>	m
	<p><u>Item</u></p>	<u>Unit</u>
-.05	<p>Replace wiring channel</p> <p>The unit of measurement shall be number of linear meter of wiring channel replaced.</p> <p>The tendered rate shall include full compensation for the supply and installation of the specified type of wiring channel with 6 x 60 mm fasteners, including the cover and all the necessary accessories.</p>	m
	<p><u>Item</u></p>	<u>Unit</u>
-.06	<p>Supply and install connections to fixed appliances</p> <p>The unit of measurement shall be number of connections made.</p> <p>The tendered rate shall include full compensation for the supply and installing of the connections to the fixed appliances.</p>	No
	<p><u>Item</u></p>	<u>Unit</u>
-.07	<p>Service socket outlet</p> <p>The unit of measurement shall be the number of socket outlets opened and serviced.</p> <p>The tendered rate shall include full compensation for the servicing of the socket outlet , internal cleaning of the enclosure, inspection of the contact points, switching mechanism, if applicable, earthing, etc. Outlet face plate shall be fitted with an engraved, Traffolite label as per Nosa-standard, cost of which is included in the rate.</p> <p>The tendered sum shall further include for replacement of any missing outlet covers and fixing screw and earth testing.</p>	No
	<p><u>Item</u></p>	<u>Unit</u>
-.08	<p>Service isolator</p> <p>The unit of measurement shall be the number of isolators opened and serviced.</p> <p>The tendered rate shall include full compensation for the servicing of the isolator , internal cleaning of the enclosure, inspection of the contact points, switching mechanism, earthing and connections to the fixed appliance. Isolator face plate shall be fitted with an engraved Traffolite label as per Nosa-standard, cost of which is included in the rate.</p>	No

The tendered sum shall further include for replacement of any damaged or missing outlet covers and fixing screw, connections to appliances including earth continuity testing.

	<u>Item</u>	<u>Unit</u>
-09	Replace power skirting	m

The unit of measurement shall be the linear metre of power skirting supplied and installed.

The tendered rate shall include full compensation for the removal of the existing power skirting, the supply and installation of the specified type and size of powerskirting including all accessories.

	<u>Item</u>	<u>Unit</u>
-10	Supply and install Pratley boxes	No

The unit of measurement shall be the number of Pratley boxes supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type of Pratley box.

	<u>Item</u>	<u>Unit</u>
-11	Supply and install draw boxes	No

The unit of measurement shall be the number of draw boxes supplied and installed.

The tendered rate shall include full compensation for supplying and installing the draw boxes including cover plates where no equipment is installed in the box.

	<u>Item</u>	<u>Unit</u>
-12	Supply and install draw box cover plates	No

The unit of measurement shall be the number of draw box cover plates supplied and installed.

The tendered rate shall include full compensation for the supply and installation of the specified type and size of cover plates for draw boxes including the fixing screws.

	<u>Item</u>	<u>Unit</u>
-13	Replace “stop-start” local control panel	No

The unit of measurement shall be the number of “stop-start” local control panels supplied and replaced.

The tendered rate shall include full compensation for the supply and installation of “stop/start” local control panel including emergency stop button and 32A 3 pole contactor in an IP55 polycarbonate enclosure. The rate shall include an engraved Traffolite label indicating load and supply DB.

	<u>Item</u>	<u>Unit</u>
-14	Test and service ceiling mounted fan	No

The unit of measurement shall be the number of ceiling fans tested.

The tendered rate shall include full compensation for the servicing of the fan, disconnection, testing, inspection of the contact points, switching mechanism, earthing and re-connection of the ceiling fan.

	<u>Item</u>	<u>Unit</u>
-15	Replace ceiling mounted fan	No

The unit of measurement shall be the number of ceiling fans supplied and installed.

The tendered rate shall include full compensation for the disconnection of the damaged ceiling fan and for the supply, installation and connection of the new ceiling fan.

	<u>Item</u>	<u>Unit</u>
-16	Service ceiling mounted fan control switch	No

The unit of measurement shall be the number of control switches opened and serviced.

The tendered rate shall include full compensation for the servicing of the control switch, inspection of the contact points, switching mechanism, if applicable, earthing etc.

	<u>Item</u>	<u>Unit</u>
-17	Replace ceiling mounted fan control switch	No

The unit of measurement shall be the number of control switches replaced.

The tendered rate shall include full compensation for the supply and installation of the control switch.

The tendered sum shall further include for the provision of connection to the ceiling fan.

	<u>Item</u>	<u>Unit</u>
-18	Supply and install new isolator outlets	No

The unit of measurement shall be the number of the specific outlets.

The tendered rate shall include full compensation for the supply and installation of the complete outlet.

Supply and install outlet points as indicated, which must be wired with 2 x 4mm² PVC insulated copper conductors plus 1 x 2,5mm² PVC copper earth wire in a 20mm diameter conduit. A double-pole 30 Amp isolator complete with an indicator lamp in a box with a cover plate must be installed adjacent to the equipment. The connection between the equipment and the isolating switch must be done with a flexible cord complete with approved glands at the geyser.

The end of the conductors must be fitted with approved crimping lugs for connection to geyser terminals.

The tendered sum shall further include for the provision of connection to a new circuit.

	<u>Item</u>	<u>Unit</u>
-19	Supply and install new socket outlets	No

The unit of measurement shall be the number of the specific outlets.

The tendered rate shall include full compensation for the supply and installation of the complete outlet.

Socket outlets shall be installed in the positions as indicated. Socket outlets shall be similar or equal and approved to the "LUMEX CLIPSAL 2000" type. The sockets on the power skirting must be of the "LUMEX S2000 2002" sockets that are on a 45° cradle.

All socket outlets shall be of the combination switch-type, 16 A. 3 Pin. Only socket outlets of the same manufacturer will be accepted.

Switch socket circuits shall be wired by means of 4mm² PVC insulated copper conductors and a 2,5mm² copper earth in 20mm diameter conduit unless otherwise indicated.

Socket circuits shall be protected by means of earth leakage's units as detailed.

Socket outlets shall be mounted in power-skirtings and 400mm or 1400mm above finished floor level unless otherwise indicated.

The tendered sum shall further include for the provision of connection to the existing circuit or a new circuit.

AB 10.03.04 Earthing and bonding

<u>Item</u>	<u>Unit</u>
-01 Supply and install earthing and bonding for the installation	Lump sum

The tendered lump sum shall include full compensation for the provision of all material required for the earthing and bonding of the installation in accordance with the specification.

<u>Item</u>	<u>Unit</u>
-02 Testing of the earth installation by a specialist contractor	Lump sum

The tendered lump sum shall include full compensation for the testing of the earth installation by a specialist contractor approved by the Engineer.

<u>Item</u>	<u>Unit</u>
-03 Supply and install earth electrodes	No

The unit of measurement shall be the number of earth electrodes supplied and installed.

The tendered sum shall include full compensation for the supply and installation of the specified type and size of earth electrodes including termination by means of approved clamps.

<u>Item</u>	<u>Unit</u>
-04 Provide cadweld joint	No

The unit of measurement shall be the number of cadweld joints provided.

The tendered sum shall include full compensation for the supply and installation of the specified type and size of cadweld joints.

<u>Item</u>	<u>Unit</u>	
-05	Earth building roof structure The unit of measurement shall be the number of roof structures earthed. The tendered sum shall include full compensation for the supply and installation of the specified type and size of earthwire and the termination there-of onto a 1,2 m Cu earth electrode driven into the soil 1,8 m deep.	No
AB 11 MAINTENANCE OF THE INSTALLATION		
AB 11.01	Monthly maintenance responsibilities for each installation, each portion, including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work. Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.	
AB 11.02	The following maintenance actions will be required under this contract::	
AB 11.02.01	routine preventative maintenance	
AB 11.02.02	corrective maintenance	
AB 11.02.03	breakdown maintenance	
	These actions are defined in the Additional Specification SA – General Maintenance.	
AB 11.03	The maintenance schedules and frequency of maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractor's responsibility in this regard is specified in the Additional Specification SA – General Maintenance.	
AB 11.04 SCOPE OF ROUTINE PREVENTIVE MAINTENANCE		
	The routine maintenance work to be performed and executed shall include, but not be limited to the items listed below. These actions and findings shall be logged and reported on the relevant approved schedules and exports.	
AB 11.04.01	Monthly maintenance	
	(a) Check operation of protective and monitoring devices.	
	(b) Verify operation of switching elements and meters.	
	(c) Check lamp operation	
	(d) Measure phase voltages and currents in distribution boards and record values in Record book	
	(e) Inspect and repair the following:	
	(i) any visible damage to the installation	
	(ii) setting of protective and monitoring devices	
	(iii) ensure presence of diagrams, instructions and similar information	

- (v) ensure upkeep of the labelling of the distribution board, equipment, cabling and wiring
- (vi) ensure presence of Nosa-type engraved labelling on face plates or bodies of light switches, socket outlets and isolators.

AB 11.04.02 Annual maintenance

- (a) Service all luminaires, distribution boards, socket outlets, isolators, light switches, etc.
- (b) Carry out all tests listed under section AB 04.02 above and record values in the Record book
- (c) Witnessed testing of all earth leakage protection units on all socket outlet units.
- (d) Visually inspect the following and repair if required:
 - (i) connection of cables and conductors including earthing and bonding.
 - (ii) presence of appropriate devices for isolation and switching.
 - (iii) correct connection of socket outlets, light switches, isolators, lampholders, etc.

AB 11.05 MAINTENANCE WORK : MEASUREMENT AND PAYMENT

Refer to clause SA 06 of the ADDITIONAL SPECIFICATION : SA GENERAL MAINTENANCE

TECHNICAL SPECIFICATION**FC HOT-WATER GENERATING INSTALLATIONS****CONTENTS**

FC 01	SCOPE
FC 02	STANDARD SPECIFICATIONS
FC 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
FC 04	OPERATING AND MAINTENANCE MANUALS
FC 05	TRAINING OF OPERATORS FOR THE OPERATION OF THE INSTALLATION AND EQUIPMENT
FC 06	LOGGING AND RECORDING PROCEDURES
FC 07	TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK
FC 08	QUALITY ASSURANCE SYSTEM
FC 09	COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION
FC 10	GUARANTEE OF INSTALLATION AND EQUIPMENT
FC 11	MAINTENANCE TOOLS AND SPARES
FC 12	REPAIR WORK TO INSTALLATIONS, SYSTEMS AND EQUIPMENT
FC 13	MAINTENANCE TO INSTALLATIONS AND EQUIPMENT

FC 01 SCOPE

This specification covers the general repair and maintenance of hot-water generating installations, which include the following:

- (a) Steam generated hot-water heating equipment
- (b) Electrical generated hot-water heating equipment
- (c) Primary and secondary pumps
- (d) Hot-water storage vessels
- (e) Lagging and cladding of vessels and piping systems
- (f) Hot-water reheating vessels
- (g) Corrosion protection linings to storage vessels and reheaters
- (h) Hot, cold and drainage pipework to the plant room installation
- (i) Electrical control systems, wiring and control panels
- (j) Thermostats and safety equipment.

This specification also addresses the training of

- User Client and associates, and
- maintenance staff.

This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and particular specifications compiled as part of this document.

This specification shall act as a guideline to the particular specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

FC 02 STANDARD SPECIFICATIONS**FC 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

FC 02.01.01 SABS and other specifications and codes

- SABS 0400 - The applications of the building regulations
 - SABS 0142 - Code of practice for the wiring of premises
 - SABS 0140 - Identification colour marking
 - SABS 044 - Parts I to IV: Welding
 - SABS 460 - Copper tubes for domestic plumbing
 - SABS 0252 - Parts I and II
 - SABS 0103 - The measurement and rating of environmental noise with respect to annoyance and speech communications
- SABS Specifications listed on page 3 of the DPW specification OW 371
 Atmospheric Pollution Prevention Act, No 45 of 1965
 BS 2790
 BS 1740
 BS 21
 BS 1640
 BS 5500

FC 02.01.02 Department of Public Works specifications

- OW 371 - Specification of materials and methods to be used (Fourth revision, October 1993)
 - STD.PWD.VII - Standard Specification for steam boiler installations
- Standard Specification for electrical installations and equipment pertaining to mechanical installations

FC 02.01.03 Occupational Health and Safety Act of 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) shall be adhered to.

FC 02.01.04 Manufacturers' specifications, codes of and practice and installation instructions

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

FC 02.01.05 Municipal regulations, laws and by-laws

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

FC 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to unless otherwise specified in the Particular Specification.

FC 03.01 GENERAL REPAIR AND INSTALLATIONS REQUIREMENTS

- (a) All materials and equipment supplied and installed shall be new and of high quality and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.
- (b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.
- (c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.
- (d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work, will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.
- (e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.
- (f) All new equipment, materials and systems shall be installed and positioned such as to not impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.
- (g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.
- (h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and User Client.
- (i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service and the least inconvenience to the User Client and public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

FC 04 OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

All information shall be recorded and reproduced in electronic format, as well as three sets of hard copies to be supplied to the Department.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

(a) System description

Complete system description and the working of the plant.

(b) Commissioning data

Complete commissioning, test and inspection data of systems and equipment.

(c) Operating data

- (i) Systems and equipment running check list and frequency of servicing required;
- (ii) Safety precautions to be implemented;
- (iii) Operator's duties (logging requirements);
- (iv) Lubricating oils and service instructions.

(d) Mechanical equipment

- (i) Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;
- (ii) Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc;
- (iii) Manufacturer's brochures and pamphlets;
- (iv) Schedule of spares with part numbers recommended to be held as stock;
- (v) Vessels pressure test and certification certificates.

(e) Maintenance instructions

- (i) Schedule of maintenance particulars, frequency of services and replacements;
- (ii) Trouble-shooting guide;
- (iii) Part number of all replacement items and spares;
- (iv) Capacity curves of all pumps;
- (v) Serial numbers of all items of equipment.

(f) Electrical equipment

- (i) Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
- (ii) Maintenance instructions;
- (iii) Manufacturer's brochures and pamphlets;
- (iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

(g) Instrumentation and control

- (i) Description of each control system;
- (ii) Schedule of control equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
- (iii) Maintenance instructions;
- (iv) Manufacturer's brochures and pamphlets.

- (h) Drawings
 - (i) Paper prints of all as-built mechanical and electrical drawings;
 - (ii) Wiring diagrams framed behind glass shall be mounted adjacent to each relevant control panel.

FC 05 TRAINING OF OPERATORS FOR THE OPERATION OF THE INSTALLATION AND EQUIPMENT

In addition to the requirements of Additional Specification SD: General Training, the Contractor shall allow and provide for additional training of the User Client's representative(s) as specified and set out in this specification. The objective of this training will be to ensure that the following be achieved:

- (a) The identification of pending faults and repairs at an early stage;
- (b) Reducing the maintenance cost of the equipment to an acceptable level, and maintaining the cost at this level;
- (c) Preventing maloperation of the systems and equipment.

The training course for the User Client's representative(s) shall include at least the following:

- (a) Equipment and component recognition.
- (b) How to operate the equipment including the following:
 - (i) Starting the equipment;
 - (ii) Manual and automatic controlling;
 - (iii) Shut-down and isolating of equipment and systems;
 - (iv) Cleaning of equipment.
- (c) Emergency procedures to be followed in the case of breakages, system faults, steam cuts, etc.
- (d) Safety precautions to be followed and implemented.
- (e) The identification, reporting and recording of faults and operation of equipment.
- (f) The logging of equipment operation, readings and settings.

FC 06 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional specification SA: General and Maintenance. This shall consist of a log and record book, which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, etc.

The logbook shall be kept in a safe place as agreed with the User Client and the Engineer and shall only be utilised by the maintenance personnel, the Contractor and the Engineer. Copies of the monthly entries and recordings into the logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

The logbook shall be structured to include at least the following:

- (a) Weekly inspection and maintenance actions;
- (b) Monthly inspection and maintenance actions;
- (c) Four-monthly inspection and maintenance actions;
- (d) Annual inspection and maintenance actions;
- (e) Breakdown reports;
- (f) Daily system and equipment operating conditions, observations, recordings and measurements;
- (g) Inspection and test comments and reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place as agreed with the User Client and the Engineer. This register shall be completed by all persons visiting the installation, including:

- (a) Maintenance personnel
- (b) Contractor
- (c) Inspectors
- (d) User client personnel
- (e) Engineer.

The register shall state the date, time-in, time-out, name, company and reason for visit.

A copy of the register shall be submitted by the Contractor together with his monthly report.

FC 07 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours written notice to the Engineer before commencing the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After completing the installation or system, all equipment shall be tested, adjusted a readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the efficiency of all equipment, as well as certificates to be obtained from all relevant authorities and statutory bodies, etc.

FC 08 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system that shall be submitted to the Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

FC 09 COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION**FC 09.01 GENERAL**

On completion of the repair work and/or the installation of new systems the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report.

FC 09.02 RECOMMISSIONING OF HOT-WATER GENERATING INSTALLATION AND ANCILLARY EQUIPMENT

On completion of any repairs the Contractor shall recommission the systems, installation and/or equipment influenced by such repairs.

This operation shall be done strictly in accordance with the manufacturer's specification and relevant standards, norms and specifications from the applicable body, authority and/or department. The operation shall include but not be limited to the following:

- (a) All required precommissioning mechanical checks
- (i) Check all steam, water and drain connections (when applicable).
 - (ii) Check all moving parts.
 - (iii) Check seals, gaskets and joints.
 - (iv) Reinstall all plugs and covers and check that they are properly secured.
 - (v) Check and record that all lubrication to equipment and components has been done in accordance with manufacturer's specification.
 - (vi) Check and ensure that all valves and safety valves are correctly installed and in the correct operating position. Safety valves are to be set in accordance with the required blow-off pressure for the installation.
 - (vii) Check and ensure that all control equipment such as pressure-reducing valves, heat control equipment, etc, are set and adjusted to the correct controlling value in accordance with the system parameters and manufacturer's specification.

- (viii) All steam and condensate precommissioning checks shall be done in accordance with Technical Specification FB (where applicable).
 - (ix) Check and confirm that all required tests and inspections to storage vessels, primary heater vessels and reheater vessels have been done and that all required certificates are in place.
 - (x) Check and ensure that the domestic hot-water and cold-water piping system is operational and that no leaks are present.
 - (xi) Check, test and inspect the correct installation and operation of all primary and secondary pumping systems (where applicable).
 - (xii) Check that all the required pressure testing to the repaired installations and/or new equipment has been done, witnessed and recorded in accordance with the relevant specifications.
 - (xiii) Check, test and inspect all bracketing and supports for the relevant installations and equipment to ensure that they are properly secured and installed in accordance with the manufacturer's specifications and installation specification.
 - (xiv) Check, inspect and ensure that all lagging and cladding to the vessels and piping installation are installed and repaired in accordance with the applicable specifications from the relevant controlling authority.
 - (xv) Check, inspect and ensure that no leaks to equipment, systems and installations occur.
- (b) All required precommissioning electrical checks
- (i) Check all wiring connections for tightness and repair any hot connections.
 - (ii) Check that all electrical equipment has been properly reconnected in accordance with the manufacturer's specification.
 - (iii) Perform and record all required electrical insulation tests on equipment.
 - (iv) Check and test all controls without livening up electrical equipment.
 - (v) Check all motor-driven equipment for correct rotational directions.
 - (vi) Check and test the operation of all indication and warning lights.
 - (vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specifications.
 - (viii) Run all motor-driven equipment for a period to ensure free movement and correct operation.

(c) Commissioning of equipment

On completion of the precommissioning checks the Contractor shall proceed with the commissioning of the equipment. This shall be done strictly in accordance with the manufacturer's specification and system parameters and shall include but not be limited to the following:

- (i) During the commissioning process all safety and warning system checks are to be performed on the thermostatic control system where applicable.
- (ii) During load conditions the equipment shall be readjusted and finally switched to automatic operation on completion of all automatic control functions for correct operation where applicable.
- (iii) Check that steam pressure valves are readjusted where necessary to the correct set point under load conditions where applicable. This shall be done in accordance with Technical Specification FB: Steam Generating Installations.
- (iv) Check the operation of all steam trap arrangements where applicable. This shall be done in accordance with Technical Specification FB: Steam Generating Installations.
- (v) Check that water pressure-reducing valves are adjusted and set to the correct operating value for the specific system.
- (vi) Check the correct operation of all systems. Readjust primary and secondary pumping control equipment where applicable.
- (vii) Test and check for any leaks to the system, equipment and installation.
- (viii) Check for any unnecessary strain to system, equipment and installation due to expansion and contraction.
- (ix) Check the correct functioning of all heating temperature control equipment to ensure the correct switching levels and that all safeties are operational.
- (x) Record temperatures and flow conditions.

The Contractor shall visit, inspect, test and readjust the systems, equipment and installation during the week following the recommissioning to ensure the correct functioning of the equipment and its associated components.

FC 10 GUARANTEE OF INSTALLATION AND EQUIPMENT

The Contractor shall provide guarantees obtained from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment, supplied and installed under the repair contract, complies with the required performance and will function as part of the complete system.

All new equipment, including, the complete new installations and the systems as a whole shall be guaranteed for a period of 12 (twelve) months commencing upon the day of issue of a certificate of completion for the repair work of the installation.

FC 11 MAINTENANCE TOOLS AND SPARES

Each installation shall be equipped with the necessary maintenance tools and spares required by the specific type of equipment and installation for the daily operation and maintenance of the system. At the start of the repair and maintenance contract the Contractor shall in the presence of the User Client make an inventory of the existing tools and spares, and any shortfall or damaged tools and spares shall be replaced with new. All replacement tools and spares shall be as specified by the equipment manufacturers. These tools and spares shall be kept in a lockable room or cabinet of which the maintenance supervisor and the Contractor shall carry keys. The Contractor shall on a monthly basis take stock of these items in the presence of the User Client's maintenance supervisor and record and report to the Engineer. Any shortfall shall be replaced by the Contractor as part of his responsibility under this Contract.

The tools and spares to be carried shall include but not be limited to at least the following:

- (a) Tools
 - (i) Grease and oil lubrication equipment;
 - (ii) Equipment operating keys and tools.
- (b) Spares
 - (i) Spare sight glasses for sight glass indicators, seals and gaskets (where applicable);
 - (ii) Spare seats, gaskets and gland packings for valves, etc;
 - (iii) Spare steam traps, at least one of each type present on the installation (where applicable);
 - (iv) Spare pressure gauges, at least one of each range and type;
 - (v) Spare electrical elements (where applicable);
 - (vi) Spare thermostats, at least one of each type present on the installation (where applicable);
 - (vii) Spare pilot lights, contactors, circuit brackets, relays, thermal overloads, etc, for electrical control panels;
 - (viii) Spare temperature gauges, at least one of each range and type.

FC 12 REPAIR WORK TO INSTALLATIONS, SYSTEMS AND EQUIPMENT**FC 12.01 GENERAL**

During the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but no be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

The repair work items are listed in the Particular Specification and Schedule of Quantities with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the specified durations listed in the Appendix to Tender. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months commencing on the date of issue of a certificate for completion of the repair work. These guarantees shall be furnished in favour of the Department of Public Works.

Repair work items for the steam generating installations shall be categorised under the following headings:

- (a) General requirements for hot-water generating installations
- (b) Steam and condensate pipework (where applicable)
Refer to Technical Specification FB: Steam Distribution Installations.
- (c) Hot-water storage vessels
 - (i) Existing hot-water storage vessels
 - (ii) Electrically driven storage vessels, new hot-water storage vessels
 - (iii) Heating services for hot-water storage vessels.
- (d) Lagging and cladding of vessels and piping
 - (i) Vessel lagging and cladding
 - (ii) Hot-water and hot-water return pipe lagging and cladding
- (e) Pressure testing
- (f) Corrosion protection linings
- (g) Sterilisation of installation
- (h) Heating control equipment
 - (i) Steam heating equipment
 - (ii) Electrical heating equipment
- (i) Instruments and controls
 - (i) Type of instrumentation and controls
 - (ii) Instrumentation and controls, installation requests
- (j) Primary and secondary pumping installations
 - (i) Primary pumping equipment
 - (ii) Secondary pumping equipment
- (k) Domestic hot-water and cold-water pipe installations
 - (i) Strainers
 - (ii) Valves
 - (iii) Air vents
 - (iv) Thermostatic water flow control valve
 - (v) Expansion equipment
 - (vi) Flow meters
 - (vii) Check valves
 - (viii) Vacuum breakers
 - (ix) Expansion release valve
 - (x) Safety valves

- (xi) Pressure gauges
- (l) Electrical installations
 - (i) Electrical control panels
 - (ii) Wiring and cabling.

Any repair work, which may be required on the systems, equipment and installation, shall be executed using approved materials, equipment, methods and tooling suitable for the specific application. The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, statutory regulations, manufacturer's specifications and codes of practice and as specified in all additional and particular specifications included in this document.

At the start of the repair and maintenance contract, the repair work specified in the Particular Specification shall be done in accordance with the items listed. Any repair work during the maintenance period shall also adhere to this specification.

FC 12.02 GENERAL REQUIREMENTS FOR HOT-WATER GENERATING INSTALLATIONS

All repair work and new installation of hot-water generating installations shall adhere to the standard specifications of the Department of Public Works and all relevant specifications, norms, standards and regulations applicable to this type of installation, including the following general requirements:

- (a) The hot-water generating installation shall be repaired, installed and maintained as a complete functional unit, with all the responsibilities, functions and operating parameters taken into account to ensure the continuous supply of hot water to the consumer points.
- (b) The hot-water generating installation shall be capable of providing ample supply of hot water to the consumer points by means of ensuring the correct sizing of the hot-water storage and production.

FC 12.03 STEAM AND CONDENSATE PIPEWORK

All steam and condensate installations shall be done in accordance with Technical Specification FB: Steam Distribution Installations.

FC 12.04 HOT-WATER STORAGE VESSELS

FC 12.04.01 Existing hot-water storage vessels

At the start of the maintenance and repair contract the Contractor shall inspect, repair, service, clean out and test all hot-water storage vessels.

The inspection shall include the following:

- (a) Isolate drain, open manholes and clean out hot-water vessels.
- (b) Inspect vessel welds.
- (c) Inspect internal corrosion lining and check for any pit holes and damages to the vessel material and connections.
- (d) Inspect lagging and cladding.
- (e) Inspect condition of all elements, steam heating coils, controls, safety valves, etc.

During this inspection the Contractor shall notify the Engineer in advance to allow the Engineer to witness the Contractor's findings. The Contractor shall submit a written report on the findings.

All manhole and pipe gaskets shall be replaced.
No repair work shall be proceeded with prior to approval from the Engineer.

Should any welding repair work be required it shall be performed by a coded welder in accordance with acceptable practices, codes and norms.

Should the corrosion lining be damaged or corroded, thus necessitating the relining of the vessel, this shall be done with an approved lining suitable for the water quality and operating temperature under which this system is functioning.

For further details on repair to resisting linings and installation of new linings refer to FC12.06.

All safety valves shall be serviced, overhauled and readjusted to the correct safety pressure blow-off part.

All lagging and cladding shall be inspected, repaired and where necessary replaced.

On completion of all repair and service work the Contractor shall reinstate all equipment, fill the hot-water vessel with water and pressure test it to 1,5 times the permissible operating pressure or allowable test pressure.

On passing of the pressure test the Contractor shall recommission the hot-water vessels and put it back on line.

FC 12.04.02 New hot-water storage vessels

Where new hot-water storage vessels are to be installed it shall be done in accordance with the following specification and on approval of the necessary workshop drawings to be provided by the Contractor.

The storage vessels shall be of the vertical cylindrical type with dished ends on both sides, and shall be manufactured to BS 5500 Category II in mild steel for a working pressure as indicated for the three systems. A pressure test certificate for each vessel shall be supplied by the manufacturer.

The vessel shall be equipped with at least the following :

- (a) Properly sized flanged manhole for easy access
- (b) Flanged inlets and outlets to SABS 1123 Table 10
- (c) Sparge pipe on the cold-water inlet
- (d) Correctly sized thermometer
- (e) Correctly sized temperature and pressure relief valve
- (f) Air release valve
- (g) Correctly sized pressure gauge
- (h) BSP threaded sockets for thermostats
- (i) 40 mm diameter BSP threaded socket at the lowest point of the storage tank for draining purposes
- (j) 50 mm diameter boss element segments for auxiliary elements.

An expansion relief valve shall be installed on the inlet to the storage vessels for thermal expansion.

Where pipe connections to the storage vessel are done with dissimilar materials (such as copper), isolating flanges shall be used (dielectric coupling).

Before ordering and manufacturing of storage vessels a workshop drawing shall be submitted to the Engineer for approval.

The Contractor shall satisfy himself that access and plantroom sizes are to the dimensions on the drawings and that the equipment will fit into the space allowed.

FC 12.04.03 Heating sources for hot-water storage vessels

(a) Electrical elements

Where electrical immersion elements are used to heat the water inside the hot-water storage vessel, these elements shall be replaced at the start of the repair and maintenance contract.

All the thermostat controls and safety cut outs shall be cleared, inspected, tested, adjusted to the set point and where necessary replaced.

(b) Steam heating

Where steam heat exchangers are used to heat the water inside the storage vessel, these coils shall be removed together with the steam chest and associated equipment. The coils shall be descaled, cleaned, inspected and tested.

Where necessary the heat exchanger and/or coils shall be replaced.

FC 12.05 LAGGING AND CLADDING

All lagging and cladding to hot-water vessels, primary heaters, secondary heaters and hot and circulation water piping shall be inspected for defects, damages and shortages at the start of the repair and maintenance contract. The Contractor shall report his findings to the Engineer in writing.

All repairs to be done shall match the existing installation and the Contractor shall ensure that no sharp edges from the metal cladding pose a danger to anybody.

The following specification shall be adhered to:

(a) Vessel lagging and cladding

The storage vessels shall be insulated with a 80 mm thick layer of mineral glass wool with a density of 88 kg/m³ and finally covered with 0,6 mm thick galvanized sheet metal. The sheet-metal work has to be done by a specialist. (All edges are to be rolled and no sharp edges will be allowed.)

(b) Hot-water and return water pipe lagging and cladding

All hot water and hot-water return pipes shall be insulated with preformed fibreglass sections covered with galvanized sheet-metal muffs in a water tight manner. Sheet-metal muffs shall be installed with the joints overlapping at least 50 mm and the longitudinal overlap pointing downwards to prevent ingress of water. The sheet-metal muff shall be strapped with 10 mm galvanized straps by means of a strapping tool with a minimum of 2 straps/section. All pipe bends, T-pieces, etc, shall be insulated with 25 mm diameter fibreglass rope covered with a 12 mm thick layer of self-setting fibre cement. A reinforcing gauze shall be wrapped over the fibre cement while wet and then painted with mastic paint when dry.

Table FC 12.05/1 below provides a guideline for the preformed fibreglass section thickness to be used.

The fibreglass sections shall have a density of 88 at least kg/m³.

TABLE FC 12.05/1: FIBREGLASS SECTION THICKNESS

PIPE SIZE (STEEL)	PIPE SIZE (COPPER)	THERMAFLEX THICKNESS
100 mm dia	108 mm dia	50 mm
80 mm dia	76 mm dia	40 mm
65 mm dia	67 mm dia	40 mm
50 mm dia	54 mm dia	25 mm
40 mm dia	42 mm dia	25 mm
32 mm dia	35 mm dia	25 mm
25 mm dia	28 mm dia	20 mm
20 mm dia	22 mm dia	20 mm
15 mm dia	15 mm dia	15 mm

FC 12.06 PRESSURE TESTING

The Contractor shall at the completion of the repair contract arrange for a complete pressure test to be executed on the hot-water generating installation. This shall be done in collaboration with the User Client and Engineer to ensure the minimum down-time of the installation, as well as to establish a suitable period for this pressure test. All leaks shall be repaired and the system shall be tested at the cost of the Contractor. This test shall be witnessed by the Engineer.

The tests shall be performed on all hot-water storage vessels, primary heating vessels, secondary heater vessels and domestic water pipe systems.

All safety and expansion release valves shall be removed and plugged, and on completion these shall be reinstalled.

The systems shall be filled with water after all branches have been plugged, sealed or closed.

The systems shall be hydraulically pressure tested by means of a suitable manually operated or mechanically driven pressure pump.

A pressure of at least 1,5 times the working pressure of the class rating of pipes or fittings shall be applied for a period of time specified in the specifications or as recommended by the manufacturers. (Refer to SABS 1200 for minimum and maximum test pressures.)

Tests should not be performed against closed valves.

Leakage which occurs shall be measured, calculated and checked against the allowable losses, as specified in SABS 1200.

If the completed sections comply with all specifications and pass the tests and inspection, it can be approved and the Contractor may be instructed to recommission the plant.

FC 12.07 **CORROSION PROTECTION LININGS**

All vessel corrosion protection linings shall be inspected and repaired and/or replaced where necessary.

Repairs shall only be done to linings where the supplier and installer of these linings approve of such repairs. These repairs shall then be done strictly in accordance with the manufacturer's specification and shall be certified by an approved inspection authority.

Where new linings are to be installed, the required preparation work including sand blasting and removal of old lining shall be done in accordance with the recommendation of the supplier of the new lining.

Where new linings are to be introduced they shall be similar or equal to the following:

- (a) Internally coated with a durable, high operating temperature glass flake lining with DTF of one millimetre, similar or equal to a Polygrass VE lining as supplied by Corrocoate, suitable for an operating temperature of 95 °C at the indicated working pressures.

The applications of these linings shall be witnessed and certified as being to the manufacturer's application standards by an approved inspection authority.

- (b) Externally the vessels shall be coated with two coats of red oxide paint.

FC 12.08 **STERILISATION OF WATER SIDE OF INSTALLATION**

The Contractor shall at the completion of the repair contract sterilise the complete water side of the hot-water system including vessels and pipes.

This shall be done as described in the following guidelines.

- (a) The complete system shall be filled with potable water chlorinated to a concentration of 15 mg of chlorine per litre of water which shall remain in contact with the inner surface of the pipeline for a period of not less than 24 hours. The pipeline shall be filled for sterilising in such a manner that no chlorine shock is created or air is trapped in the pipeline.
- (b) The Contractor shall submit full details of the proposed method for sterilising the pipeline to the Engineer for approval at least 14 days before commencing sterilising.
- (c) The cost of water for filling the pipeline for sterilising shall be borne by the Contractor.
- (d) The Contractor shall provide all materials, tools, equipment and labour necessary to sterilise the pipeline. After sterilising the pipeline the Contractor shall, at no extra cost, empty the pipeline and dispose of the water in a manner approved by the Engineer.

- (e) The Contractor may use the following products as a source of chlorine:
 - (i) Chloride of lime to SABS 295 yielding 33 % free chlorine by mass;
 - (ii) Calcium hypochlorite to SABS 295 yielding 70 % free chlorine by mass;
 - (iii) Chlorine gas applied by chlorinator.
- (f) After sterilisation, an approved water quality test to a minimum number of 10 % of the total water points, randomly selected, evenly spread and marked on drawings, shall be carried out. This test shall include a full bacteriological test as per SABS 241 and the results shall be submitted to the Engineer for inclusion in the Contract documents. Each abortive test shall be for the Contractor's cost.

When tested the water shall comply with the limits given in column 2 or 3, as relevant, of table FC 12.08/1.

TABLE FC 12.08/1: BACTERIOLOGICAL REQUIREMENTS

1 PROPERTY	2 RECOMMENDED MAXIMUM LIMIT	3 MAXIMUM ALLOWABLE LIMIT
Total coliform bacteria count per 100 millilitre	Nil*	5
Faecal coliform bacteria count per 100 millilitre	Nil	Nil
Standard plate count per millilitre	100	Not specified

Note:

* If any coliform bacteria are found in a sample, take a second sample immediately after the tests on the first sample have been completed; this sample shall be free from coliform bacteria.

Not more than 5 % of the total number of water samples (from any one reticulation system) tested per year may contain coliform bacteria.

FC 12.09 HEATING CONTROL EQUIPMENT

The Contractor shall at the start of the repair and maintenance contract inspect, test, repair, readjust, and if necessary replace heating controls for the hot-water system.

This shall include the following:

- (a) Check for correct switching and/or control temperature operating points.
- (b) Check, test and ensure that the safety cut-out mechanisms are in place and switch and/or control at the correct level.
- (c) Ensure that equipment has been installed in accordance with the manufacturer's specification.
- (d) Ensure that all pockets are descaled and free of any defects.

The following control equipment shall be serviced, repaired and where required replaced if damaged beyond repair.

FC 12.09.01 Steam heating control equipment

Where immersed type thermostatic steam control valves are utilised they shall be serviced and repaired as follows:

- (a) Dismantle and strip down thermostatic control valve including removal of pocket.
- (b) Descale and clean all equipment.
- (c) Replace element subassembly if necessary.
- (d) Replace cover joint, gland packing, heater joint, coupling joint and all gaskets where applicable.
- (e) Check valve seat and if necessary reseal.
- (f) Reassemble control valve and reinstall, test and adjust to correct level.

All other type of thermostatic heating control valves shall be serviced, repaired and overhauled in accordance with the manufacturer's specification.

FC 12.09.02 Electrical heating control equipment

All electrical thermostat control equipment shall be serviced and repaired in accordance with the manufacturer's specification.

This shall include the following:

- (a) Dismantle, clean and descale thermostat pockets.
- (b) Test switching actions for correct operation.
- (c) Test safety cut-out switching points for correct operation.

Replace thermostat if the switching does not take place in accordance with the manufacturer's specification.

FC 12.10 PRIMARY AND SECONDARY PUMP INSTALLATIONS

The Contractor shall at the start of the repair and maintenance contract inspect, test, service and if required replace primary and secondary circulating pumps.

The pumps are to be inspected, tested, serviced and repaired together with their associated equipment and pipework. All repair and service work shall be done strictly in accordance with the manufacturer's specification.

The repair work to the pumps and equipment shall include at least the following:

- (a) Inspect and test the pumps for correct operation.
- (b) Replace gland packings, seals and gaskets.

- (c) Inspect and test for any bearing noise and replace if necessary.
- (d) Clean out pump strainers, check non-return valves, valves, etc.
- (e) Test pump motor windings for balance phases, insulation test and check wiring.
- (f) Inspect pump mountings and repair if necessary.

Where in-line glandless canned pumps are used, these shall be inspected, tested, serviced where possible, impeller inspected and cleaned and if found beyond repair, replace with a suitable replacement in accordance with the operating parameters.

FC 12.11

DOMESTIC HOT AND COLD WATER INSTALLATIONS

The Contractor shall at the start of the repair and maintenance contract inspect, tests, service, repair and if required, replace damaged items on the complete hot and cold-water piping installation inside the hot-water generating plant rooms.

The repair work specification shall be read in conjunction with Technical Specification AA: Plumbing and Drainage Installations.

Repair work to the domestic hot and cold-water installation networks shall be as detailed in the Particular Specification and shall include, but not be limited to the following:

- (a) Replace damaged, broken, leaking and corroded above and underground pipework, fittings and equipment.
- (b) Repair, replace and service valves, including new gaskets, gland packings, seals, bolt and nuts, etc.
- (c) Test the proper closing of all valves and where valves do not close properly, the valves shall be refurbished, descaled and if necessary replaced.
- (d) Repair, clean and service all strainers including replacement of strainer elements where corroded and installation of new gaskets.
- (e) Repair, service, test and readjust pressure-reducing valves. Pressure gauges shall be recalibrated and checked. Up and downstream pressures are to be logged. Downstream pressure to be adjusted to an acceptable level taking the allowable working pressure of the system and its components into account.
- (f) Repair, service and check the proper functioning of all non-return valves.
- (g) Repair, service, readjust and calibrate all safety and expansion relief valves.
- (h) Repair, service and clean out all air release valves and vacuum breakers.
- (i) Do repair work to bracketing systems including fixing and repair of existing brackets and the introduction of additional brackets where required.

- (j) Hot-water pipe lagging and cladding shall be inspected, repaired, sealed and replaced where required.
- (k) Repair, service and log readings of watermeters including cleaning of integral strainers.
- (l) Water pipes are to be sampled for corrosion and scaling. The Engineer shall evaluate the actions to be carried out if the outcome of this sampling requires attention.
- (m) Water supply shall be sampled and chemically analysed for the suitability to the systems and materials it serves.
- (n) Pressure test and sterilise repaired new installation and equipment.
- (o) Reinstate and make good walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where any repair, upgrade and/or service work has been executed.

FC 12.12 ELECTRICAL INSTALLATION, WIRING AND CONTROL PANELS

FC 12.12.01 Instrumentation and controls

All instrumentation and control equipment shall be inspected, tested, repaired, adjusted and where necessary replaced. All repair and service work shall be done strictly in accordance with the manufacturer's specification.

The repair work to the instrumentation and control equipment shall include at least the following:

- (a) Test all equipment for correct operation.
- (b) Inspect, test, service, adjust setting and if necessary repair, and/or replace steam detector.
- (c) Inspect, recalibrate and, if beyond repair, replace steam pressure gauge.

FC 12.12.02 Electrical control panels

All electrical control panels shall be inspected, tested, and repaired, including all equipment inside the control panel. All repair and service work shall be done strictly in accordance with the manufacturer's specification.

The repair work to the electrical control panels shall include at least the following:

- (a) Test all control equipment for correct operation.
- (b) Check and test all MCBs, isolators, contactors, overloads, other type of motor drives, pilot lights, control switches, etc, and readjust all set points; where equipment is found to be faulty these shall be replaced with new approved equipment.
- (c) Check all wiring and connections for proper conducting and replace where hot connections are found.
- (d) Clean out panel interior and exterior, inspect panel body, fascias, doors, paintwork, etc, and repair where necessary.

FC 13 MAINTENANCE TO INSTALLATIONS AND EQUIPMENT**FC 13.01 GENERAL**

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

This part of the Contract shall include:

- (a) Routine preventative maintenance;
- (b) Corrective maintenance, and
- (c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FC 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in Particular Specification PFC and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with a prescribed manufacturer's guarantee.

The maintenance work and items are to be categorised by the Contractor for each maintenance activity under the following headings:

- (a) Steam and condensate pipework (where applicable)
- (b) Hot-water storage vessels
- (c) Heating equipment
- (d) Lagging and cladding of vessels and piping
- (e) Corrosion protection linings
- (f) Circulating pumps
- (g) Domestic hot and cold-water piping systems
- (h) Electrical controls, panels and wiring.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

FC 13.02 ROUTINE PREVENTATIVE MAINTENANCE

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The routine maintenance work to be performed and executed shall include but not be limited to the items listed in tables FC 13.02/1, FC 13.02/2, FC 13.02/3 and FC 13.02/4 below under the respective headings.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE FC 13.02/1: WEEKLY ACTIONS AND MAINTENANCE

ITEM	MAINTENANCE DESCRIPTION	ACTION RESPONSIBILITY	ACTION
1	Inspect equipment, components and installations for any visible defects, leaks, damages and/or pending faults.	Contractor	Check/Record
2	Check and record all pressure gauge temperature and flow meter readings, and readjust equipment if necessary.	Contractor	Adjust/Check/Record
3	Check operation of pumps, heating equipment and controls for correct functioning.	Contractor	Check/Record
4	Check electrical control panels for any faults.	Contractor	Check/Record
5	Report any faults, defects, leaks, damages, etc, to Engineer.	User Client	Check/Record/Report

TABLE FC 13.02/2: MONTHLY ACTIONS AND MAINTENANCE

ITEM	MAINTENANCE DESCRIPTION	ACTION RESPONSIBILITY	ACTION
1	All as listed under table FC 13.02/1	Contractor/ User Client	Check/Record Adjust/Repair/Report
2	Blow down all dirt pockets and record.	Contractor	Service/Record
3	Clean out all stainers and record.	Contractor	Service/Record
4	Check all valve gland seals and packings for leaks and replace and repair if necessary.	Contractor	Check/Service/Repair /Record
5	Check, inspect and repair if necessary all expansion joints for leaks and damages.	Contractor	Check/Repair/Record
6	Check all safety devices for correct operation and repair and replace where necessary.	Contractor	Check/Service/Repair /Record
7	Check and test all electrical control functions and operations. Repair and report any faults and defects.	Contractor	Check/Service/Repair /Record
8	Complete logbook and report.	Contractor	Report

TABLE FC 13.02/3: FOUR-MONTHLY ACTIONS AND MAINTENANCE

ITEM	MAINTENANCE DESCRIPTION	ACTION RESPONSIBILITY	ACTION
1	All as listed under tables FC 13.02/1 and FC 13.02/2.	User Client/ Contractor	Check/Record/Adjust/ Repair
2	Service, repair, clean, replace seals gaskets, reset and/or replace worn parts as directed by the manufacturer of all steam traps (where applicable).	Contractor	Check/Service/Repair /Report
3	Service, repair, replace glasses and gaskets where necessary and clean all sight glasses.	Contractor	Check/Service, Repair, Report
4	Repair lagging and cladding where necessary.	Contractor	Check/Repair/Report
5	Repair all steam leaks.	Contractor	Check/Repair/Report
6	Repair all water leaks.	Contractor	Check/Repair/Report
7	Inspect and test all heating equipment Repair where necessary.	Contractor	Check/Repair/Report
8	Inspect all hot -water storage vessels for any leaks and packing faults. Repair if necessary.	Contractor	Check/Repair/Report
9	Test, inspect and repair all pumps.	Contractor	Check/Service/ Repair/Report
10	Lubricate all lubrication points in accordance with the manufacturer's specification.	Contractor	Check/Service/ Report
11	Complete logbook and report.	Contractor	Report

TABLE FC 13.02/4: ANNUAL ACTIONS AND MAINTENANCE

ITEM	MAINTENANCE DESCRIPTION	ACTION RESPONSIBILITY	ACTION
1	All as listed under tables FC 13.02/1, FC 13.02/2 and FC 13.02/3.	User Client / Contractor	Check/Record/ Adjust/Repair
2	Drain, clean out, inspect and repair all defects and linings on hot-water storage vessels.	Contractor	Inspect / Test / Service / Repair
3	Inspect and repaint all equipment where required.	Contractor	Inspect / Test / Service / Repair
4	Remove, strip, service, repair, adjust and replace where necessary all pressure control and safety valve equipment.	Contractor	Service / Repair / Adjust / Report

5	Complete logbook and report.	Contractor	Report
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FC 13.03 CORRECTIVE MAINTENANCE

This corrective maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance, and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such defects.

FC 13.04 BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specifications SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance specifications.

All breakdown maintenance shall be done in accordance with the relevant specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for any possible breakdowns.

TECHNICAL SPECIFICATION**FD HEATING, VENTILATION AND AIR-CONDITIONING SYSTEMS****CONTENTS**

FD 01	SCOPE
FD 02	STANDARD SPECIFICATIONS
FD 03	VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS
FD 04	OPERATING AND MAINTENANCE MANUALS
FD 05	TRAINING OF OPERATORS FOR THE OPERATION OF THE INSTALLATION AND EQUIPMENT
FD 06	LOGGING AND RECORDING PROCEDURES
FD 07	TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK
FD 08	QUALITY ASSURANCE SYSTEM
FD 09	COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION
FD 10	GUARANTEE OF INSTALLATION AND EQUIPMENT
FD 11	MAINTENANCE TOOLS AND SPARES
FD 12	REPAIR WORK TO INSTALLATION SYSTEMS AND EQUIPMENT
FD 13	MAINTENANCE TO INSTALLATION AND EQUIPMENT

FD 01 SCOPE

This specification covers the general repair and maintenance of heating, ventilation and air-conditioning systems, which include the following:

- (a) Room air-conditioning units with air cooled condensers
- (b) Refrigeration pipework
- (c) Fans and attenuators
- (d) Electric motors
- (e) Air filters
- (f) Canopies and grease eliminators
- (g) Duct work
- (h) Air terminals
- (i) Noise and vibration
- (j) Painting and cleaning
- (k) Labelling and identification.

This specification also addresses the training of

- User Client and associates, and
- Maintenance staff.

This specification shall form an integral part of the repair and maintenance contract document, and shall be read in conjunction with the additional and particular specifications compiled as part of this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

FD 02 STANDARD SPECIFICATIONS**FD 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

FD 02.01.01 SABS and other specifications and codes

- SABS 046 - Copper tube manufacturing code of practice
- SABS 0400 - The applications of building regulations
- SABS 0103 - The measurement and rating of environmental noise with respect to annoyance and speech communication
- SABS 0139 - The prevention, automatic detection and extinguishing of fire in buildings
- SABS 0140 - Identification colour marketing
- SABS 0142 - Code of practice for the wiring of premises
- SABS 0147 - Refrigerating systems, including plants associated with air-conditioning systems
- SABS 0173 - Installation, testing and balancing of duct work
- SABS 630 - Decorative high-gloss enamel paint for interior and exterior
- SABS 763 - General coating thickness
- SABS 1238 - HVAC duct construction standards
- Act 103 - National Building Regulations and Building Standard Act, 1977 (Act No 103 of 1977) as amended

FD 02.01.02 Department of Public Works Specifications

- OW 371 - Specification of materials and methods to be used (Fourth revision, October 1993)
- STD.PWD.VIII - Standard specification for refrigeration services

FD 02.01.03 Occupational Health and Safety Act of 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) shall be adhered to.

FD 02.01.04 Manufacturers' specifications, codes of practice and installation instructions

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

FD 02.01.05 Municipal regulations, laws and by-laws

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

FD 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to unless otherwise specified in the Particular Specification.

FD 03.01**GENERAL REPAIR AND INSTALLATION REQUIREMENTS**

- (a) All materials and equipment supplied and installed shall be new and of high quality and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.
- (b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.
- (c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SABS specifications and codes, except where otherwise specified or approved by the Engineer in writing.
- (d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.
- (e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.
- (f) All new equipment, materials and systems shall be installed and positioned such as to not impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.
- (g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.
- (h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and User Client.
- (i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service and the least inconvenience to the User Client and public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

FD 03.02**TESTING OF REFRIGERATION PIPING AND EQUIPMENT**

- (a) All new refrigerant pipe installations shall be thoroughly tested to be sure that they are absolutely tight. Nitrogen must be used to pressure test the system at 1,5 times the working pressure. A pressure-reducing valve must be used to set the test pressure. A leak test must be carried out on the entire system.
- (b) All new refrigerant pipe installations shall be vacuum pumped by means of a suitable vacuum pump. An absolute pressure of 2500 micron must be reached. Allow the system to stand under vacuum for a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged.
- (c) The dryness of the refrigeration system shall be indicated by an approved moisture indicator.
- (d) Should moisture be present, the system shall be leak tested and the leak repaired. Should no leak be present, the system shall be flushed with dry nitrogen and vacuum pumped again as described above.

- (e) If the completed system complies with all the Specifications and passes the test and inspection, it can be approved and the Contractor may be instructed to recharge the system with the correct refrigerant and refrigerant charge.
- (f) Under no circumstances shall the refrigerant piping/installation be purged.

FD 03.03 REFRIGERANTS

- (a) No CFC refrigerant shall be used in new installations.
- (b) Equipment still running on CFC shall be maintained until such time that a leak occurs or the system has to be decanted. The system shall then be converted to a compatible HCFC or HFC as described in the Montreal Protocol and recommended by the compressor manufacturer.
- (c) Any CFC refrigerant that has to be discharged, shall be decanted by means of an approved reclaiming system, and not discharged to the atmosphere. Should the Contractor not comply with this requirement, full action shall be taken contractually and statutory against him.
- (d) Any refrigeration system not supplied with three-way service valves, shall be provided with Schreuder type service valves. These valves shall be installed on both suction and discharge lines of the compressors. Tap-o-line valves shall not be fitted or used on the systems.
- (e) In the event of an electrical motor burn-out in a hermetic or semi-hermetic compressor, a burn-out drier shall be used. Purging only is prohibited. The burn-out drier shall be installed and removed as per the manufacturer's instructions.
- (f) No synthetic components or solutions shall be used to repair leaks in refrigeration piping, on coils or evaporators. Only approved gas welding shall be used. Should the leak be of such nature that repair is not possible, the item should be replaced.

FD 03.04 FANS AND ATTENUATORS

FD 03.04.01 General

- (a) Requirements under this heading apply to fans that are not integral parts of complete units supplied by recognised suppliers. Selected fans shall be such that the operating point is as close as possible to maximum efficiency.
- (b) Fan motors selected must be capable of supplying not less than 10 % above the specified air quantity without overloading.
- (c) The system resistance must be calculated and the fan selected to meet the required static pressure, taking into consideration the site altitude, system air temperature and air density at which the system duty shall be met. The selection must be submitted to the Engineer for approval before ordering the equipment.
- (d) Belt drives shall be designed for a minimum overload of 25 % and not less than two matched belts may be used. Belts shall be selected and installed according to BS 790.
- (e) Pulleys shall be of the adjustable speed taper-lock type and shall be accurately keyed to the shafts and aligned before the system is put into operation.

- (f) Belt guards shall be supplied in accordance with Occupational Health and Safety Act, No 85 of 1993. The guards shall have an expanded metal front and shall allow oiling and the use of a tachometer without removal of the guard.
- (g) Bearings shall be selected for a minimum life expectancy of 200 000 hours at the given duty.
- (h) Lubrication points shall be readily accessible and shall be extended to the outside to permit lubrication without removal of the fan. Fan shafts shall be suitably protected from rust and corrosion.

FD 03.04.02 Axial flow fans

- (a) Axial flow fans shall be in-line direct-driven type with the motor mounted inside the fan housing.
- (b) Fans shall be of the multi-bladed aerofoil type of a non-ferrous construction. The number of blades vary according to the application. The fans shall be provided with adjustable blade pitch indexed to permit field adjustment.
- (c) Fan casings shall be constructed of hot-dip galvanized mild steel with a minimum thickness of 3 mm and mild steel galvanized flanges on each side drilled for connections to matching flanges on ducting.

FD 03.04.03 Sound attenuators

- (a) Sound attenuators shall be installed in the positions indicated on the drawings and shall be selected to provide the noise criteria levels as specified. All sound attenuators shall be products of an accredited manufacturer who publishes selection data on these products. Data shall be submitted to the Engineer for approval before ordering.
- (b) Metalwork shall be galvanized steel and acoustic insulation shall be non-combustible material, properly bonded and covered so as not to permit particles to be eroded by air moving over it.
- (c) Sound absorbing lining material shall have a density not less than 48 kg/m³ and thickness of not less than 50 mm.

FD 03.05 CANOPIES AND GREASE ELIMINATORS

- (a) Kitchen canopies shall be connected to the extract fan by means of cuts of which the joints and seams are of the welded or soldered construction and shall be watertight. Cleaning openings shall be provided at such intervals on the ducting that the inside of the ducting can be reached for cleaning purposes. The fan shall be provided with a cleaning access door, as well as a drain point at the bottom.
- (b) Fire dampers, operated with fusible links, shall be provided in each air outlet connection and shall form an integral part of the canopy construction.
- (c) Lights shall be fitted into the canopy by the manufacturer. Access to the tube for tube replacement shall be through the face of the fittings without the use of tools.
- (d) Grease filters shall contain a series of vertical baffles to change the direction of the air flow and efficiently divert grease particles out of the air stream by centrifugal action. Each filter bank shall contain a condensate trough and removable grease storage container.

FD 03.06 **ELECTRIC MOTORS**

- (a) All electric motors shall be of one make, unless integral with the equipment, and shall not operate in excess of 1500 r/min unless previously approved by the Engineer for specific reasons. Motors, unless otherwise specified, shall be 380 volt, three-phase, 50 hertz for all sizes from and including 0,37 kW upwards. Smaller motors may be 220 volt, single-phase, 50 hertz.
- (b) All motors shall be totally enclosed, fan-cooled and have metric frame dimensions. Motors shall be quiet in operation to the full acceptance of the Engineer.
- (c) Three-phase motors shall all be squirrel cage induction type, special high torque motors being used on high inertia loads such as centrifugal fans, where otherwise excessively large motors, necessary to overcome driven equipment inertia, cause operation BHP to be less than 70 % of motor nameplate kW.
- (d) Starting methods for three-phase motors shall be as follows:

Motors up to 5,5 kW	-	DOL
Above 5,5 kW	-	Star-delta started, provided that the starting current does not exceed three times the full load amps.
- (e) Single-phase motors shall be capacitor started, induction run type with built-in manual reset overload protection.
- (f) Nameplate rating of electric motors shall be at least 15 % larger than the required driven equipment brake drive losses duly accounted for, on motors below 15 kW. On larger motors a 10 % margin shall suffice.
- (g) All switch panels shall have a phase failure and low voltage protection with automatic reset adjustable to a maximum period of 10 minutes.

FD 03.07 **DUCT WORK**

- (a) This specification covers the air distribution system as shown on the drawings. Duct work shall be manufactured in accordance with the standard specification for air-conditioning duct work, SABS 1238. Duct work shall be erected in accordance with the code of practice for the installation, testing and balancing of duct work, SABS 0173.
- (b) Fittings such as elbows, parallel flow branches, branch connections, off-sets and transitions shall be manufactured and installed in accordance with the SMACNA standards.
- (c) All ducting shall be sufficiently airtight to ensure economical and quiet performance of the system, and joints shall be suitably sealed in accordance with the relevant SMACNA standard with suitable non-combustible filler compound.
- (d) The Contractor shall provide all hangers and supports which are to be hot-dip galvanized after fabrication to SABS 193. No explosive fasteners to the building structure shall be allowed, only approved expanding bolts or clamps are permissible.
- (e) The duct work shall be connected to the air terminals by means of flexible ducting. Flexible ducting shall be coated fibreglass fabric with a mineral base. Flexible ducting shall be installed with "easy" bends of not less than one duct diameter centre line and shall be supported to SMACNA specification to ensure

that the ducting does not kink. The length of the flexible duct shall be kept to a minimum and shall not exceed lengths of 1200 mm.

FD 03.08 **AIR TERMINALS**

- (a) Air distribution shall be effected by means of the supply air grilles as indicated on the drawing. The finish of the grilles shall be epoxy powder-coated, the colour of which shall be advised and approved by the Engineer. Supply air grilles shall be of the double deflection type, consisting of two rows of individually adjustable aerofoil section vanes, front vanes horizontal rear vanes vertical, all vanes housed in a surrounding fixing flange with neat mitred joints in the corner.
- (b) Supply air grilles shall be of steel construction and shall be provided with burglar bars. The inner section will be only accessible from above and the face plate of the grille is fixed from above. No screws or fixing devices are accessible from below.
- (c) Supply grilles are supplied with a plenum box with spigot and connected to the spigot on the ducting by means of flexible ducting.
- (d) Transfer grilles shall be of steel construction and be provided with burglar bars. Standard door grilles may be installed with a burglar bar assembly in between.

FD 03.09 **AIR FILTERS**

FD 03.09.01 **General**

- (a) Provide and install air filters in the positions as indicated on the drawings.
- (b) Filters shall be standard products of a reputable manufacturer regularly engaged in the manufacture of the particular filter. The manufacturer shall submit evidence to the satisfaction of the Engineer that the filters have been tested by an independent authority and that they meet the minimum arrestance, efficiency and dust holding capacity.
- (c) Filters shall be tested in accordance with ASHRAE test standard 52 - 76.
- (d) A Megnahelic gauge calibrated from zero to 500 Pa shall be installed, connected with copper tubing to static pressure taps complete with isolating valves.

FD 03.09.02 **Primary filters**

- (a) Primary filters shall, unless otherwise stated, be washable on woven polyester material, pleated to provide an extended surface with a dust spot efficiency of minimum 40 % and an arrestance of 85 %.
- (b) Media shall be firmly held in place by rustproof wire screens to maintain pleat strength and spacing.
- (c) Media and support screens shall be continuously bonded into aluminium support.
- (d) Frames shall be folded to form a robust media support frame. The bonding between media and frame shall be continuous to prevent leakage.
- (e) Each filter shall be provided with a factory made holding frame, constructed of not less than 1,0 mm thick galvanized mild steel provided with suitable seals

and quick release spring type clips to securely hold the filter cell in place without permitting leakage of air.

- (f) The holding frames of multiple cell filter banks shall be suitably joined and sealed so as to prevent leakage of air between the frames.

FD 03.10 LABELLING AND IDENTIFICATION

All equipment shall be labelled and identified using black Traffolite labels with 10 mm high white lettering on the labels. Labels will be secured using epoxy base glue.

The identification number used on these labels shall correspond with the equipment number on the complete inventory list.

FD 03.11 NOISE AND VIBRATION

- (a) Particular care shall be taken in the selection, application and installation of all equipment used to ensure that the equipment will operate below the required noise level for public areas of NC 35 and with the least vibration possible, all to the satisfaction of the Engineer.
- (b) Equipment shall be mounted on vibration isolators of the correct type and selection depending on deflection requirement and vibrating frequency.
- (c) Anti-vibration connections shall be used on duct work where it joins vibrating equipment such as fans and air-conditioning units.
- (d) Suitable sound attenuating devices shall be incorporated within the duct work to reduce airborne noise to acceptable levels as specified.
- (e) The subcontractor shall provide sound level data to the Engineer on the completion of the installation detailing the noise levels in NC level for each separate area. No measurement shall be taken closer than 1 metre from any outlet.

FD 03.12 PAINTING AND CLEANING

- (a) No untreated metal surfaces shall be allowed on the project. Items which are not galvanized or similarly protected against rust and corrosion shall be painted as detailed below. No equipment, hangers, brackets, etc, shall be delivered to site in unprotected condition; they shall be factory coated with an approved zinc-rich prime coat before being despatched.
- (b) Painting shall comprise the following consecutive processes. Thoroughly clean, descale and degrease all surfaces, apply one coat of approved zinc-rich primer and one coat of universal undercoat, and finish off with two coats of quality high-gloss enamel. Final finish shall be to the full approval of the Engineer.
- (c) Items with galvanized finish, such as cable trays, need not be painted but shall be properly cleaned with suitable galvanized iron cleaning fluid. Where galvanized finish is painted, it shall be primed with a calcium plumbate primer.
- (d) It is not a requirement to paint duct work, conduits or pipework installed in roof voids and shafts, where they are not visible, if they are galvanized. Items as mentioned above shall be properly cleaned and painted as specified above.
- (e) Visible sections of the inside of ducting through grilles shall be painted matt black after degreasing and priming as specified above.

- (f) Plant and equipment shall be painted with the relevant colour in accordance with SABS.

FD 03.13 SELF-CONTAINED AIR-CONDITIONING UNITS

- (a) The self-contained packaged unit shall be a fully catalogued product and documentation shall include performance curves and selection tables.
- (b) Self-contained room air-conditioning units consist of unit casing, compressor, evaporator and fan, condenser and fan, refrigerant pipework with expansion device and the relevant controls. The condenser unit shall form an integral part of the unit or be separate for split applications.
- (c) Unit casings shall be of sheet metal construction with a baked enamel finish to give a corrosion resistance. Units shall be suitably insulated to ensure quiet operation.
- (d) Evaporator fans shall be of the double inlet centrifugal type with integral motor or belt-driven. The fan assembly shall be isolated from the unit by means of rubber mounts and the unit shall operate without vibration.
- (e) Condensate trays shall be manufactured of non-corrosive materials and shall be insulated and condensate shall be piped to the nearest drain point.
- (f) Washable WP 77 filters shall be provided and installed behind the inlet grille and shall be easily removable.
- (g) Compressors shall be of the hermetically sealed dome type with crankcase heaters and suitable vibration isolators.
- (h) Condenser coils shall be copper tubes with aluminium fins for inland use. Condenser fans shall be propeller fans or of the centrifugal type.
- (i) Refrigerant piping shall be installed and repaired as specified in FD 03.

FD 04 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals and system data sheets.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

The Contractor shall allow for the required equipment and facilities to establish the correct as-built information.

All information shall be recorded and reproduced in electronic format, as well as three sets of hard copies to be supplied to the Department.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

- (a) System description

Complete system description and the working of the plant.

(b) Commissioning data

Complete commissioning, test and inspection data of plant.

(c) Operating data

- (i) Plant running check list and frequency of servicing required;
- (ii) Safety precautions to be implemented;
- (iii) Manual and automatic operation;
- (iv) Maintenance duties and logging required;
- (v) Lubricating oils and service instructions;
- (vi) Pre-start checklist for each system;
- (vii) Starting and stopping procedures.

(d) Mechanical equipment

- (i) Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;
- (ii) Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc;
- (iii) Manufacturers' brochures and pamphlets;
- (iv) Schedule of spares with part numbers recommended to be held as stock.

(e) Maintenance instructions

- (i) Schedule of maintenance particulars, frequency of services and replacements;
- (ii) Trouble-shooting guide;
- (iii) Part number of all replacement items and spares;
- (iv) Capacity curves of pumps, fans and compressors;
- (v) Serial numbers of all items of equipment.

(f) Electrical equipment

- (i) Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
- (ii) Maintenance instructions;
- (iii) Manufacturers' brochures and pamphlets;
- (iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

(g) Instrumentation and control

- (i) Description of each control system;
- (ii) Schedule of control equipment indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
- (iii) Maintenance instructions;
- (iv) Manufacturers' brochures and pamphlets.

(h) Drawings

- (i) Paper prints of all as-built mechanical and electrical drawings;
- (ii) Wiring diagrams framed behind glass shall be mounted adjacent to each relevant control panel.

FD 05 TRAINING OF OPERATORS FOR THE OPERATION OF THE INSTALLATION AND EQUIPMENT

In addition to the requirements of Additional Specification SD: General Training, the Contractor shall allow and provide for additional training of the HVAC maintenance staff as specified and set out in this specification. The objective of this training will be to ensure that the following is achieved:

- (a) Understanding of equipment;
- (b) High plant operating efficiencies to reduce operating costs;
- (c) Reduce the maintenance cost of the plant to an acceptable level, and maintain the cost at this level in so far as they are affected by the operating conditions;
- (d) Prevent the maloperation of the plant and its associated equipment.

In the event of the designated staff not achieving the set goals the Contractor shall be responsible to ensure that such personnel attend an approved maintenance course as available from the Department or manufacturer.

The Contractor shall, in collaboration with the Engineer, ensure that the maintenance personnel be re-evaluated on an annual basis by means of a set examination, to ensure the upkeep of skill level and knowledge.

The evaluation and training course to be utilised for the evaluation of the HVAC maintenance staff shall include at least the following:

- (a) Equipment and component recognition;
- (b) Emergency procedures to be followed in the event of power failure, water shortage, and accidents related to refrigerator systems;
- (c) Safety precautions to be followed and implemented;
- (d) The identification, reporting and recording of faults and operation of equipment;
- (e) The logging of boiler plant operation, readings and setting;
- (f) In the event of plant running on ammonia, the full SAIRAC course on handling ammonia as refrigerant shall be attended by the maintenance staff.

FD 06 LOGGING AND RECORDING PROCEDURES

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional Specification SA: General Maintenance. This shall consist of a log and record book which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, etc.

The logbook shall be kept in a safe place at the maintenance section and shall only be utilised by the boiler house supervisor, the Contractor and the Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with this monthly report to the Engineer.

The logbook shall be structured to include at least the following:

- (i) Daily inspection and maintenance actions;
- (ii) Monthly inspection and maintenance actions;
- (iii) Six-monthly inspection and maintenance actions;
- (iv) Breakdown reports;
- (v) Statutory inspection and test comments and reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place at the maintenance section. This register shall be completed by all persons visiting the relevant plants, including:

- (a) Contractor and maintenance personnel;
- (b) Inspectors;
- (c) User Client and associates;
- (d) Engineer.

This register shall state the date, time-in, time-out, name, company and reason for visit. A copy of the register shall be submitted by the Contractor together with his monthly report.

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of the Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

FD 07 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK

On completion of repair work the Contractor shall prior to recommissioning test the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 08 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Except where otherwise provided in the Contract, the Contractor shall provide labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. Arrangements for these tests shall be made by the Contractor and he shall give at least 72 hours written notice to the Engineer before commencing the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is to be operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the certificate of practical completion of repair work is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign staff as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the performance of all equipment, as well as certificates obtained from all the relevant authorities and statutory bodies, etc.

The Contractor shall only utilise Departmentally approved inspection authorities for all inspections and tests to be conducted. This will be done and approved in writing among the relevant parties.

FD 08 QUALITY ASSURANCE SYSTEM

The Contractor shall institute an approved quality assurance (QA) system, which shall be submitted to the Engineer for his approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

FD 09 COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION

FD 09.01 GENERAL

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

FD 09.02 RECOMMISSIONING OF PLANT AND ANCILLARY EQUIPMENT

On completion of repair work the Contractor shall recommission the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer.

Recommissioning checks to be carried out shall be categorised under the following headings:

- (a) Mechanical checks
- (b) Electrical and control checks.

On completion of repair work the Contractor shall recommission the plant and its ancillary equipment. This operation shall be done strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer. This shall include but not be limited to the following:

- (a) All required recommissioning mechanical checks
 - (i) Check system for leaks;
 - (ii) Check rotation of all fans;
 - (iii) Check mountings of all equipment.

- (b) All required recommissioning electrical and control checks
- (i) Check all wiring connections for tightness and repair any hot connections.
 - (ii) Check that all electrical equipment have been properly reconnected in accordance with the manufacturer's specification.
 - (iii) Perform and record all required electrical insulation tests on equipment.
 - (iv) Check and test all controls with main circuits isolated.
 - (v) Check all motor-driven equipment for correct rotational directions.
 - (vi) Check and test the operation of all indication and warning lights.
 - (vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specification.
 - (viii) Run all motor-driven equipment for a period to ensure free movement and correct operation. Feed pumps only to be operated for a short interval to check rotation.

FD 09.03 COMMISSIONING AND COMPLETION OF REPAIRS

On completion of the recommissioning checks the Contractor shall proceed with the commissioning. This operation shall be done strictly in accordance with Clause SC 11.02 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out in accordance with the manufacturer's specification and shall include but not be limited to the following for the different types of equipment:

FD 09.03.01 Self-contained air-conditioning unit

- (a) Check evaporator and condenser pressures and superheat.
- (b) If the unit needs charging, find leak, decant, repair leak and recharge unit.
- (c) Check fans, fan speed control and fan motors.
- (d) Check entering and leaving air temperatures over evaporator coil.
- (e) Check operation of all safeties:
 - (i) LP cut-out pressure
 - (ii) HP cut-out pressure
 - (iii) Low on-coil thermostat
 - (iv) Set point of oil pressure safety
 - (v) Oil pressure trip.
- (f) Check anti-recycle timer.
- (g) Check all running amps of fans and compressors.
- (h) Check compressor unloading mechanism if applicable.
- (i) Complete commissioning data sheet.

FD 09.03.02 Ventilation system

- (a) Check fans, fan speed control and fan motors.
- (b) Check running amps of fans.
- (c) Check pressure drop over filters.
- (d) Check air quantity over filters or canopy face velocity.
- (e) Check outlet air quantities.

The Contractor shall visit, inspect, test and readjust the plant during the 30-day period following the recommissioning to ensure the correct functioning of the plant and its associated equipment.

FD 10 GUARANTEE OF INSTALLATION AND EQUIPMENT

The Contractor shall provide and obtain guarantees from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment supplied and installed under the repair contract, will comply with the required performance and will function as part of the complete system.

All new equipment, including the complete new installations and the systems as a whole, shall be guaranteed for a period of 12 (twelve) months commencing on the day of issue of a certificate of completion for repair work of the installation.

FD 11 MAINTENANCE TOOLS AND SPARES

Each maintenance workshop shall be equipped with the necessary maintenance tools and spares as required by the specific type of plants and installation for the daily operation and maintenance of the plant. At the start of the repair and maintenance contract the Contractor shall make an inventory of the existing tools and spares in the presence of the User Client, and any shortfall or damaged tools and spares shall be replaced with new. All replacement tools and spares shall be as specified by the boiler and equipment manufacturers. These tools and spares shall be kept in a lockable room or cabinet of which the maintenance supervisor and the Contractor shall carry keys. The Contractor shall on a monthly basis take stock of these items in the presence of the maintenance supervisor and shall record and report to the Engineer. Any shortfall shall be replaced by the Contractor as part of his responsibility under this Contract.

The tools and spares to be carried shall include, but not be limited to at least the following:

- (a) Tools
 - (i) Electric welding (arc welder)
 - (ii) Oxy-acetylene welding set
 - (iii) Soldering iron
 - (iv) Pipe cutter
 - (v) Swaging tool set
 - (vi) Flaring tool set
 - (vi) Leak detector (electronic or leak torch or Spectro light)
 - (vii) Vacuum pump
 - (viii) Service valve ratchet
 - (ix) Refrigerant reclaim unit
 - (x) Flow measuring hood
 - (xi) Pitot tube
 - (xii) Vacuum gauge

- (xiii) Digital thermo anenometer
- (xiv) Hygrometer
- (xv) Tung tester
- (xvi) Coil comb
- (xvii) Multimeter
- (xviii) Amp meter
- (xix) Combination spanner set
- (xx) Combination socket set
- (xxi) Allen keys
- (xxii) Screwdriver set
- (xxiii) Drill set
- (xxiv) Drilling (arc welder)
- (xxv) Pop rivet gun
- (xxvi) Tab and die set
- (xxvii) Three-jaw gear pulley
- (xxviii) Hacksaw
- (xxix) Level
- (xxx) Bench vice
- (xxxi) Assorted files
- (xxxii) Tape 5 m
- (xxxiv) Torch.

(b) Spares

It is recommended that essential parts be maintained in inventory. Essential parts are those parts used frequently in responding to routine and urgent work requests. Consider the accessibility to spares and the time it takes to obtain them. The goal is to avoid stockpiling parts, as well as to avoid being without a needed part. The following parts are regarded as essential spares:

- (i) Schreuder valves
- (ii) Relevant refrigerants
- (iii) Relevant refrigeration compressor oil
- (iv) Filter/dryers
- (v) Expansion valves
- (vi) Filter sets
- (vii) Relevant V-belts
- (viii) Lubricants and greases.

FD 12 REPAIR WORK TO INSTALLATION SYSTEMS AND EQUIPMENT

FD 12.01 GENERAL

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standard, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

The repair work items shall be listed in tabular form in the Particular Specification with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months from date of issue of a certificate for completion of the repair work. These guarantees shall be

furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items shall be categorised for the following installations:

- (a) Ventilation systems including canopies
- (b) Self-contained air-conditioning units.

FD 12.02 VENTILATION SYSTEMS

- (a) Replace fresh air intake screen.
- (b) Inspect and clean all duct work and canopy.
- (c) De-rust, neutralise and touch up paint work on ducting and canopy.
- (d) Check tightness of all securing bolts.
- (e) Replace all canvas collars with new.
- (f) Replace all filters.
- (g) Check bearings of fan motors and lubricate.
- (h) Check whether all duct supports are still in position and replace missing supports.
- (i) Check duct work for leaks and repair defects.
- (j) Replace all joint seal and gaskets with new.
- (k) Check all fire dampers for correct operation and reset.
- (l) Clean fan blades and check for unbalance.
- (m) Check fans, speed control and fan motor.
- (n) Check running amps of fan.
- (o) Reseal penetrations through roof.

FD 12.03 SELF-CONTAINED AIR-CONDITIONING UNITS

- (a) Clean air intake screen.
- (b) Replace filters.
- (c) De-rust, neutralise and touch up paintwork.
- (d) Replace canvas collars.
- (e) Clean housing, ensure all panels are properly secured and door panels close properly.
- (f) Check setting and operation of all pressure switches, reset if required.
- (g) Check setting and operation of all safety switches, ie LP and HP switches, oil pressure switch.
- (h) Check setting and operation of thermostats.
- (i) Check timers and reset if required.
- (j) Check operation of seven-day timer.
- (k) Check running current of fans and compressor and settings and operation of overloads.
- (l) Check tightness of all electrical terminals.
- (m) Ensure operation of local and remote isolators.
- (n) Check condition of all cables and whether cables are neatly strapped and reposition and strap if required.
- (o) Ensure correct operation of emergency stop.
- (p) Carry out a leak test on all refrigeration piping and components inclusive of evaporator and condenser.
- (q) All leaks shall be repaired. Should a leak on a component be of such a nature that it cannot be repaired, the component shall be replaced. The procedure to follow is as set out in FD 03.
- (r) The superheat setting of the thermostatic expansion valve shall be checked and adjusted if required (setting approximately 8 °C).
- (s) The filter dryer shall be replaced.
- (t) Check compressor vibration mounts.
- (u) Test oil acidity.
- (v) Check refrigerant charge sight glass being clear or flashing.

- (w) Check moisture indication being dry.
- (x) Clean condensate tray and test drainage operation.
- (y) Clean evaporator and condenser blades and check unbalance.
- (z) Replace suction line insulation.
- (aa) Check all service valves for full operation, replace caps if missing.

FD 13 MAINTENANCE TO INSTALLATION AND EQUIPMENT

FD 13.01 GENERAL

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with commencement of the Contract. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

This part of the Contract shall include:

- (a) Routine preventative maintenance;
- (b) Corrective maintenance; and
- (c) Breakdown maintenance,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FD 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in Particular Specification PFD and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised by the Contractor for each maintenance activity under the following headings:

- (a) Ventilation systems
- (b) Self-contained air-conditioning units.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

FD 13.02 DEFINITION AND QUALIFICATION OF ACTIONS

FD 13.02.01 Daily maintenance actions

Daily actions are the responsibility of the User Client. These checks are to be performed by staff responsible of the facility. The self-contained air-conditioning units and ventilation systems should run during working hours and/or continuously. The status of these systems can thus be monitored by observation on a daily routine.

(a) Ventilation systems:

- Are the systems running and is the operation quiet?
- Is the kitchen hood removing vapour from the kitchen?

(b) Self-contained air-conditioning units:

- Does the unit perform and maintain temperature?
- Is the temperature in the areas concerned satisfactory?
- Is the condensate drain working properly?

These daily checks shall be logged at the facility, ie by the kitchen manager and the maintenance personnel.

FD 13.02.02 Monthly maintenance actions

TABLE FD 13.02.02/1: VENTILATION SYSTEMS

REFERENCE NUMBER	ACTION
V-1	Inspect air intake for blockages
V-2	Check all accessible duct work for leakages, damages, and damages supports
V-3	Clean filters
V-4	Check electric motor running temperature
V-5	Check electric connections for tightness
V-6	Check operation of relief air grilles and check that they are not blocked
V-7	Check for motor noise and check bearings
V-8	Check for leaks on canvas collars

TABLE FD 13.02.02/2: SELF-CONTAINED AIR-CONDITIONING UNIT

REFERENCE NUMBER	ACTION
S-1	Clean filters, replace if required
S-2	Inspect air intake and discharge for blockages
S-3	Check all refrigerant, drainage pipes for damaged and leaks
S-4	Check sightglass: clear or flash gas
S-5	Carry out visual inspection of condenser coil for blockages and correct operation of fans
S-6	Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan
S-7	Check enclosure for damages
S-8	Check electric motor running temperatures
S-9	Check electric connections for tightness
S-10	Test thermostat and control operation
S-11	Clean condensate tray and test drainage for proper operation
S-12	Check cooling and heating cycle

Note: The monthly actions shall include the activities of the daily maintenance actions.

FD 13.02.03 Biannual maintenance actions

TABLE FD 13.02.03/1: VENTILATION SYSTEMS

REFERENCE NUMBER	ACTION
V-1	Inspect air intake for blockages
V-2	Check all accessible duct work for leakages, damages, and damages supports
V-3	Clean filters
V-4	Check electric motor running temperature
V-5	Check electric connections for tightness
V-6	Check operation of relief air grilles and check that they are not blocked
V-7	Check for motor noise and check bearings
V-8	Check for leaks on canvas collars
V-9	Clean fan blades and check for unbalance
V-10	Clean exterior casing
V-11	Clean all grilles
V-12	De-rust, neutralise and touch up paint work
V-13	Check vibration mounts of fan and tightness of mounting bolts

TABLE FD 13.02.03/2: SELF-CONTAINED AIR-CONDITIONING UNITS

REFERENCE NUMBER	ACTION
S-1	Clean filters, replace if required
S-2	Inspect air intake and discharge for blockages
S-3	Check all refrigerant, drainage pipes for damages and leaks
S-4	Check sight-glass: clear or flash gas
S-5	Carry out visual inspection of condenser coil for blockages and correct operation of fans
S-6	Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan
S-7	Check enclosure for damages
S-8	Check electric motor running temperatures
S-9	Check electric connections for tightness
S-10	Test thermostat and control operation
S-11	Clean condensate tray and test drainage for proper operation
S-12	Check filter/dryer
S-13	Check superheat and functioning of expansion valve
S-14	Check operation of HP and LP switch
S-15	Check operation of controllers
S-16	De-rust, neutralise and touch up paint work
S-17	Check cooling and heating cycle
S-18	Clean evaporator and condenser coil chemically
S-19	Clean all filter frames and seals
S-20	Check fan motor and compressor current
S-21	Check and test overload settings
S-22	Lubricate all bearings

Note: The above biannual actions include the activities of the monthly maintenance actions.

HVAC COMMISSIONING DATA SHEET - AIR CONDITIONING UNITS

INSTALLATION:		
A/C MAKE :		
Model number	: Inside unit	
	Outside unit	
Serial number	: Inside unit	
	Outside unit	
Voltage	:	
Starting amps	:	
Running amps	:	
		COOLING
		HEATING
System discharge gauge pressure: (kPa and running)		
System suction gauge pressure: (kPa and running)		
Condenser : cooling medium inlet temperature:		
Condenser : cooling medium outlet temperature:		
Evaporator : air inlet temperature:		
Evaporator : air outlet temperature:		
Room dry bulb temperature after 1 hour A/C operation:		
Ambient dry bulb temperature:		

COMMISSIONED BY:

CONSULTANT:

.....
 PRINT SIGNATURE

.....
 PRINT SIGNATURE

DATE

DATE

TECHNICAL SPECIFICATION HA

MEDIUM AND LOW VOLTAGE EQUIPMENT

CONTENTS

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HA 01 SCOPE

HA 01.01 This specification covers the repair and maintenance of medium and low voltage distribution equipment. The equipment comprises of MV/LV distribution substations and miniature substations.

HA 01.02 This specification forms an integral part of the repair and maintenance contract document and shall be read in conjunction with Portion 3, the Additional Specification included with this document.

HA 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

HA 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof.

HA 02.02 SABS Specifications

- a) SABS 0400
- b) SABS 0142
- c) Refer to the repair and maintenance procedures for the specific standards applicable to each procedure.

HA 02.03 Department of Public Works Specifications

- a) PW 774

HA 02.04 Occupational Health and Safety Act of 1993

HA 02.05 Manufacturer's specifications and installation instructions

- HA 02.06 Additional requirements
- a) Equipment and material installed shall be new and unused.
 - b) The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on medium and low voltage equipment.
- HA 02.07 Additional standards, specifications, regulations and codes listed with the maintenance and repair procedures specified elsewhere in this document.
- HA 02.08 The Contractor shall familiarise himself with site and equipment conditions to ensure that all work can be performed in a safe manner.

HA 03 OPERATING AND MAINTENANCE MANUALS

HA 03.01 PROCUREMENT OF AVAILABLE AS-BUILT INFORMATION

- a) At the commencement of the contract, the Contractor shall obtain all available as-built documentation from the Engineer and from the various parties previously responsible for operations and maintenance tasks. These parties shall include employees of the Client, or external contracted personnel.
 - b) If this information is available the contractor shall attempt to obtain the internal wiring diagrams and associated operations and maintenance information from the manufacturers of all switchgear panels.
 - c) The contractor shall verify the correctness of all the abovementioned as-built information by surveying the installations. The surveying of the installation shall include the following :
 - i) The tracing (by sight only) of all equipment indicated on as-built information, excluding the instrumentation and/or control wiring of distribution equipment.
 - ii) The marking up of the as-built information to indicate the correctness or not of the as-built information. Equipment indicated on the drawings that are not installed on-site shall be indicated as non-existing, and equipment that exists on site but are not indicated on the as-built information shall be indicated as existing.
 - d) The contractor shall compile a complete single line or schematic diagram representation of the complete installations. This single line diagram shall indicate the distribution substations and miniature substations. The inter-connections between all the components of the distribution substation shall be shown, and the various components shall be labelled using names designated by the contractor.
 - e) All information that was verified and or compiled from existing sources as well as information that was compiled independently by the contractor shall be recorded in electronic format.
 - f) The contractor shall supply the Engineer with three sets of all the abovementioned information in electronic format, and three sets in hardcopy format. This information shall be compiled and completed during the repair phase of the contract, and shall be submitted not later than the end of the repair phase.
- HA 03.02 Over and above what is specified in the Additional Specification – SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall include the following maintenance data :
- a) A maintenance record of all materials and equipment replaced or worked on as part of this contract.

- b) Summary maintenance data recording the frequency of replacement of consumables and replacement material such as luminaires.

HA 04 TEST AND INSPECTION FOLLOWING COMPLETION OF REPAIR WORK

HA 04.01 Refer to the test and inspection requirements specified with each procedure.

HA 04.02 The Contractor shall perform the following tests on completion of any work on medium voltage cables or cable terminations:

- a) Voltage tests

Each section of the cable installation between miniature substations shall be subjected to a preliminary voltage or insulation resistance test to prove the insulation resistance.

- b) Continuity test

The resistance between each core and the lead sheath of the cable shall be measured for each section while the core and sheath is short circuited at the far end to ascertain if all connections have been correctly made.

All test instruments shall be of a high quality and shall, if required, be calibrated by the SABS or such body approved by the Engineer at the cost of the Contractor.

- c) DC medium-voltage tests

Each cable circuit, including joints and terminations, shall be tested by means of a direct current voltage of 18kV between the different cores and between the cores and the lead sheath or copper tape screen for a period of 15 minutes. The voltage shall be gradually raised to 18kV and kept there for 15 minutes.

HA 04.03 The Contractor shall undertake all repairs and replacements at his own cost in the event of the installation failing the above-mentioned tests. The tests shall be conducted in the presence of the Engineer before the Engineer shall agree to accept any part of the installation. The Contractor shall furthermore undertake any other tests the Engineer may prescribe to satisfy himself that the work is of an acceptable standard.

HA 04.04 The Contractor shall upon request provide the Engineer with test and calibrating certificates to prove that the measuring and testing instruments have been tested and calibrated by an organisation that is acceptable to the Engineer.

HA 05 MAINTENANCE TOOLS AND SPARES

HA 05.01 On commencement of the Repair and Maintenance Contract, the Contractor shall compile an inventory of the existing Tools and Spares in the presence of the Client.

HA 05.02 The Contractor shall supply all tools and spares required to perform the specified maintenance tasks, and he/she shall ensure that adequate tools and spares are available at all times to enable efficient repair and maintenance.

HA 06 QUALITY ASSURANCE SYSTEM

HA 06.01 Following formal approval of his Quality Assurance system by the Engineer, the Contractor shall implement the approved QA system.

HA 06.02 Records of this QA system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required.

HA 07 RE-COMMISSIONING OF INSTALLATION

HA 07.01 On completion of the initial repair work the installation shall be commissioned by the Contractor.

HA 08 MEASUREMENT AND PAYMENT

HA 08.01 The following payment specifications apply to all the repair and maintenance procedures specified in this contract :

For each of the repair and maintenance procedures, the tendered rate shall include full compensation for the following :

- a) All labour required to complete the procedure.
- b) The supply, delivery, installation, testing and commissioning of all equipment and material required to complete the procedure. (Except where exclusions to this clause is specified in the remaining specifications that forms part of the specific procedure).
- c) The prior arrangement by the contractor to obtain timely access to facilities, and the shutting down of equipment by the responsible persons as may be required to complete the procedure.
- d) All costs associated with the transportation to and no site, the operation of, and the insurance and safekeeping by the contractor of all specialised and other plant and equipment that may be required for the completion of the procedure.
- e) The execution of all site and other tests that may be required from the contractor to prove compliance with the specified standard specifications, regulations and codes. These tests shall be specified elsewhere as part of the procedure, or can be requested by the Engineer, or national and other laws, bylaws and regulations may require such tests.
- f) The supply of indisputable proof in documented format that all the equipment and material supplied and installed in terms of the procedure complies with the specified standard specifications, regulations and codes.

HA 09 REPAIR WORK TO MEDIUM AND LOW VOLTAGE EQUIPMENT

HA 09.01 All components of the medium and low voltage network shall be repaired during the first phase of the repair and maintenance contract, except in cases where the repair actions are specified to require specific approval for execution.

HA 09.02 The scope of the repair work shall include, but not be limited to the activities listed below.

HA 09.03 The Contractor shall record the repair actions in tabular format before the maintenance phase commences.

- HA 09.04 Repair work shall be executed within the approved period for repairs. This period shall be agreed at the start of the contract period.
- HA 09.05 New equipment and material shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of hand-over. These guarantees shall be furnished in favour of the Department of Public Works.
- HA 09.06 The maintenance phase of this contract shall commence once the repair work on the installation has been commissioned and handed over to the satisfaction of the Engineer.
- HA 09.07 The repair actions are specified in the form of work procedures. These procedures comprise of step-by-step instructions on how to perform each repair action.

HA 10 MAINTENANCE OF MEDIUM AND LOW VOLTAGE EQUIPMENT

- HA 10.01 The electrical distribution network shall be maintained in accordance with Additional Specification SA – General Maintenance.
- HA 10.02 The following maintenance actions will be required under this phase of the contract::
- a) routine preventative maintenance
 - b) corrective maintenance
 - c) breakdown maintenance
- HA 10.03 The maintenance schedules and frequency of maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractors responsibility in this regard is specified in the Additional Specification SA – General Maintenance.

HA 11 DISTRIBUTION NETWORK: TECHNICAL DESCRIPTION

- HA 11.01 This section describes the electrical distribution network that will be repaired and maintained in terms of this contract.
- HA 11.02 The electrical distribution network consists of the following components

HA 12 TECHNICAL DETAILS : INITIAL REPAIR PROCEDURES

- HA 12.01 This section contains the specifications for the initial repair procedures that will be completed as part of the contract. The contractor should note that the tendered rate for each procedure shall include both the supply, delivery, installation, testing and commissioning of equipment and material, and the labour and other costs associated with the completion of the procedure.
- HA 12.02 Scope of repair and maintenance work
- The repair and maintenance procedures are the following :
- RP01 Substation building cleanup
 - RP02 Installation of hasp-and-latch door lock mechanism
 - RP03 Replacement of glass windowpanes
 - RP04 Installation of window-louvres
 - RP05 Installation of ventilation-louvres

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RP06	Installation of padlocks
RP07	Installation of steel cable trench cover plates
RP08	Installation of wooden cable trench cover planks
RP09	Equipment oil cleanup
RP10	Replacement of lighting equipment
RP11	Replacement of photocell and reinstallation of outdoor light fitting
RP12	Replacement of socket outlet cover plate
RP13	Cleanup of tar/bitumen spills
RP14	Replacement of MV switchgear fuses
RP15	Ring-main unit overhaul
RP16	Replace ring-main unit contacts and contact blades
RP17	Insulation oil sampling and analysis
RP18	On-site insulation oil reconditioning
RP19	Supply and installation of insulation oil
RP20	MV circuit breaker oil service
RP21	Replacement of a cover plate for medium voltage switchgear panel
RP22	Installation of a transformer earth conductor
RP23	Replacement of transformer oil gaskets
RP24	Reparation of transformer bushing insulation
RP25	Replacement of transformer dehydrating breather
RP26	Sealing of a low voltage cable trench and sleeve section
RP27	General repairs to low voltage wiring in distribution panels
RP28	Replacement of ammeters
RP29	Replacement of voltmeters
RP30	Replacement of instrumentation fuses
RP31	Secure LV panels to floor
RP32	Installation of LV cable clamps
RP33	Reinstallation of LV distribution board front panel
RP34	Replacement of DB board front cover panel
RP35	Replacement of LV circuit breaker
RP36	Reparation of insulation on low voltage busbar
RP37	Reparations and LV cable replacements
RP38	Replacement and or reparation of MV cable terminations
RP39	Replacement of MV cable sections and the terminating of the cable
RP40	Reinstallation of a LV cable in a distribution kiosk
RP41	Test, clean, service and repair battery tripping unit
RP42	Test, clean, service and repair MV and LV overhead lines

HA 12.03 The repair and maintenance tasks are specified in the following procedures :

1. Substation building cleanup
 - 1.1 Procedure Number RP01
 - 1.2 Scope

This procedure covers the internal cleanup of a substation building.
 - 1.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.
 - 1.4 Task Description

All tasks described in this procedure shall be carried out in all three rooms of the substation building (MV switchgear room, transformer room, LV room). Generator rooms are excluded from this task.

 - a) The contractor shall remove all loose refuse and other scrap materials and objects from the substation and dispose thereof off site at a suitable location (excluding any equipment, material or

other objects which could be considered to be of value to the client).

- b) The contractor shall clean the substation floors and remove all sand, dust and other loose particles.
- c) The contractor shall wash all walls using a suitable cleaning agent (water alone shall not be acceptable) and sponges, cloths and other cleaning materials as may be required. All smudge markings and other removable dirt marks shall be removed from the walls as part of this task.

1.5 Measurement and Payment

- a) The unit of measurement shall be the number of substations cleaned. All three rooms of a substation building shall be considered as one unit.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the supply of all cleaning materials that may be required in the execution of this task.

2. Installation of hasp-and-latch door lock mechanism

2.1 Procedure Number RP02

2.2 Scope

This procedure covers the installation of steel clamping plates and a hasp-and-latch door lock mechanism, and the reinstallation of the existing door handles.

2.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.

2.4 Task Description

- a) The contractor shall remove the existing door handle and locking latch mechanism from both of the double external doors of the substation.
- b) The contractor shall supply and install two sets of clamping plates, one set on each of the two doors. Each set of clamping plates shall consist of two galvanised steel plates of minimum dimensions 2.5mm thickness x 200mm x 300mm. The clamping plates shall be installed in adjacent positions on the two adjacent double doors, and in a position such that it covers the area where the existing door handles are installed. Each set of clamping plates shall be installed at neatly aligned opposing sides of the door. The plates shall be secured with at least four bolts, washers and nuts, with a minimum bolt diameter of 8mm. The bolts shall be of the rounded head type and shall be installed with the rounded heads facing outdoors and the washer and nut ends facing indoors. The plates shall be aligned such that the edges of the plates do not protrude beyond the edges of the door, thereby preventing injury to persons opening and closing the doors.
- c) The contractor shall supply and install a hasp-and-latch combination onto the lower part of the clamping plates of the two doors. The hasp-and-latch unit shall be made of either stainless

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steel, galvanised steel, or chrome covered metal. The hasp-and-latch unit shall be of the type that closes onto itself, thereby completely covering all securing bolts and screws when in the closing position. The size of the hasp-and-latch unit shall be such that it is suitable for locking with no smaller than a 75mm shackle type Viro lock.

- d) The contractor shall reinstall all the original door handles onto the upper part of the clamping plates of both doors. The contractor shall supply and install suitable fastening bolts and screws for this purpose.

2.5 Measurement and Payment

- a) The unit of measurement and payment shall be a lump sum.
- b) The lump sum shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the supply, delivery and installation of all material and equipment that is required for the completion of this task.

3. Replacement of Glass Windowpanes

3.1 Procedure Number RP03

3.2 Scope

This procedure covers the replacement of windowpanes in substation buildings.

3.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

3.4 Task Description

- a) The contractor shall remove all broken glass particles and fixing putty from the frame where a windowpane has been broken.
- b) The contractor shall install a new windowpane by installing the glass and the fixing putty. The fixing putty shall be worked off to a smooth and sloped finish.
- c) The contractor shall measure the windowpane to determine the exact dimensions required.
- d) The glass supplied shall have a minimum thickness of 5mm.

3.5 Measurement and Payment

- a) The unit of measurement shall be number of windowpanes installed. The schedule of quantities shall specify the type of equipment in terms of the dimensions of the windowpane. The different types are the following:

- i) 1.0m wide x 1.5m high
- ii) 1.5m wide x 2.5m high
- ii) 0.2 m wide x 0.3m high

- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the measurement on site

of the dimensions of the windowpanes prior to the ordering of any material.

4. Installation of Window-louvres

4.1 Procedure Number RP04

4.2 Scope

This procedure covers the supply, delivery and installation of steel window-louvres to cover the outdoor side of substation building windowpanes. The reason for the installation is to protect the windowpanes from vandalism.

4.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.

4.4 Task Description

- a) The contractor shall permanently install frame mounted louvres on the outside of the substation windows. The frames shall be attached to the walls by means of anchor bolts.
- b) Each unit shall consist of a standard manufactured louvres arrangement and it (including the frame and fixing brackets) shall be manufactured from sheet metal painted with an anti-corrosive paint.
- c) The contractor shall measure the dimensions of each window frame, and the frame shall be manufactured according to these measurements to completely cover the exposed windowpane.
- d) The windowpane areas that shall be used to base the tender rates on shall be 1.0m wide by 1.5m high, and 1.5m wide by 2.5m high.

4.5 Measurement and Payment

- a) The unit of measurement shall be the number of louvres installed. The schedule of quantities shall specify the type of equipment in terms of the dimensions of the windowpane. The different types are the following :
 - i) 1.0m wide x 1.5m high
 - ii) 1.5 m wide x 2.5m high

5. Installation of Ventilation-louvres

5.1 Procedure Number RP05

5.2 Scope

This procedure covers the supply, delivery and installation of an inlet and outlet pair of wall mounted ventilation-louvres in the transformer room of a substation building. The installation shall include the breaking of a hole in the wall and the installation and cementing up of the installed louvres.

5.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with original equipment manufacturer's specifications, and operation and maintenance instructions.

5.4 Task Description

- a) The contractor shall install an inlet and outlet pair of sheet metal or aluminium ventilation louvres in the walls of the transformer room. The contractor shall break a suitably sized opening in the wall using suitable equipment, and the louvres shall be permanently installed inside the wall. The louvres shall not be surface mounted. The contractor shall finish off the sides of the opening with an approved building plaster after completion of the installation.
- b) The plaster work around the louvres shall be finished off to a smooth appearance, and shall be repainted with a similar paint to that on the existing wall sections.
- c) The louvres installed shall be a Trox Model WKL Weather Louver or equivalent model. The louvres shall be medium sized and of the vermin proof type. The outlet louver shall be a third size larger than the inlet louver to enable efficient free air circulation.
- d) The two louvres shall be installed in two walls opposite from each other. The outlet louver shall be installed high in the wall and the inlet louver shall be installed at a suitably lower height to enable efficient free air circulation.

5.5 Measurement and Payment

- a) The unit of measurement and payment shall be the number of ventilation-louvre pairs installed. (One unit rate shall apply to the combination of an inlet/outlet pair of louvres).

6. Installation of Padlocks

6.1 Procedure Number RP06

6.2 Scope

This procedure covers the supply, delivery and installation of padlocks to secure substation doors and metal enclosure doors such as those of miniature substations and low voltage distribution kiosks.

6.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

6.4 Task Description

- a) The contractor shall remove the existing padlocks from the specified substation doors, or metal enclosure doors such as those of miniature substations and low voltage distribution kiosks. This shall be done using a suitable sized bolt cutter or other equipment. Care shall be taken not to damage the door handle, latch or other locking mechanism during the removal of the old locks.
- b) The contractor shall install the new padlocks and close the lock on installation.
- c) All padlocks supplied shall be of the 75mm shackle Viro type.
- d) All padlocks supplied shall be of a single batch and shall be operated using a single master key.
- e) The contractor shall retain a set of keys, and supply the Engineer with a set consisting of twenty spare keys.

6.5 Measurement and Payment

- a) The unit of measurement shall be the number of padlocks supplied.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the installation of the locks on the various substation and enclosure doors throughout the installations, and the removal of old locks in accordance with this procedure.

7. Installation of Steel Cable Trench Cover Plates

7.1 Procedure Number RP07

7.2 Scope

This procedure covers the supply, delivery and installation of steel cable-trench cover plates at sections of cable trenches in substation buildings where existing cable-trench cover plates have been removed.

7.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

7.4 Task Description

- a) The contractor shall manufacture and install sections of cable-trench cover plates to fit the sections in substations where old cover plates have been removed. The contractor shall measure up the cable trenches and manufacture the plates to fit exactly in the required sections. The dimensions specified in this procedure shall only be used as a basis to determine the tendered rate.
- b) The cover plates shall be manufactured from mild steel chequered plate with a base thickness of 4.5mm and a chequered stud thickness of 6.1mm. Each cover plate shall have two guiding lengths of angle iron welded to the bottom of the plate. The guiding angle irons shall be welded in positions parallel to the length of the cable trench. The guiding angle irons shall be positioned at the edges of the plate, and shall form a tight fitting stop against the edges of the cable trench. The angle irons shall be mild steel with dimensions 40mm x 40mm x 3mm.
- c) Each cover plate shall be fitted with two mild steel lifting handles fitted at opposing ends of the plate (in line with the length of the cable trench). The handles shall be fitted through holes drilled in the plate, and shall be such that they form irremovable parts of the plate.
- d) All metal edges shall be chamfered to remove all burrs so that the cover plates can be handled without injury.
- e) Each cover plate and its handles shall be painted with a suitable anti-corrosive primer after all welding and chamfering has been completed. All metal surfaces shall be cleaned (prior to painting) and painted in accordance with the paint manufacturer's recommendations.

7.5 Measurement and Payment

- a) The unit of measurement shall be the number of cable trench cover plates supplied, delivered and installed. The schedule of quantities shall specify the type of cover plate in terms of its dimensions. The following types shall be supplied :

- i) 0.6m wide x 0.5m long
- ii) 0.6m wide x 0.6m long
- iii) 0.6m wide x 0.8m long
- iv) 0.6m wide x 1.5m long
- v) 0.6m wide x 1.8m long
- vi) 0.7m wide x 0.3m long
- vii) 0.7m wide x 1.5m long

8. Installation of Wooden Cable Trench Planks

8.1 Procedure Number RP08

8.2 Scope

This procedure covers the supply, delivery and installation of wooden cable-trench cover planks at sections of cable trenches in substation buildings where existing cable-trench cover plates have been removed.

8.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

8.4 Task Description

- a) The contractor shall manufacture and install sections of wooden plank trench cover plates to fit the sections in substations where old cover planks have been removed. The contractor shall measure up the cable trenches and manufacture the planks to fit exactly in the required sections. The dimensions specified in this procedure shall only be used as a basis to determine the tendered rate.
- b) The planks shall be cut so that the length of the planks is equal to (or slightly less than) the width of the cable trenches inlet grooves. The planks shall be arranged at right angles to the length of the trench, with a number of parallel planks making up the cable trench covering.
- c) Each plank shall be fitted with two finger-lifting holes of 20mm diameter at opposing ends of the plank.
- d) The planks shall be made from newly cut Sa-pele wood with minimum thickness and width 38mm and 150mm respectively.
- e) All planks shall be treated with an oil-based weather proofing substance.
- f) Only one plank in any cable trench section may be narrower than the specified width, and this width shall be such that the trench cover section is properly and completely covered.

8.5 Measurement and Payment

- a) The unit of measurement shall be the number of cable trench sections covered. (The number of planks shall not be used as measurement). The schedule of quantities shall specify the dimensions of the cable trench sections. The dimensions of the cable sections are the following :
 - i) 0.3m wide x 0.6m long
 - ii) 0.3m wide x 1.5m long

9. Equipment Oil Cleanup

9.1 Procedure Number RP09

9.2 Scope

This procedure covers the cleanup of oil on an indoor T3 or ring-main unit switchgear bank or on a transformer.

9.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

9.4 Task Description

- a) The contractor shall use a suitable solvent to remove the surface oil from the transformer or the three or four panels of the indoor ring-main unit or T3 switchgear bank.

9.5 Measurement and Payment

- a) The unit of measurement shall be the number of switchgear banks or transformers cleaned. The schedule of quantities shall specify the type of equipment components in terms of the type and size of the components. The different types are the following :
 - i) Transformer cleanup
 - ii) Switchgear bank cleanup

10. Replacement of Lighting Equipment

10.1 Procedure Number RP10

10.2 Scope

This procedure covers the supply, delivery and installation of lighting equipment at various places.

10.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS 0114
- c) SABS 163
- d) SABS 1012
- e) SABS 1084
- f) SABS 1250
- g) SABS 1279
- h) SABS 1777

10.4 Task Description

- a) The contractor shall remove the defective luminaires and or other equipment from their fittings.
- b) The contractor shall in install and reconnect the circuits to the newly installed lighting equipment.

- c) In cases where wiring defects are encountered, the contractor shall supply and install the required wiring and associated material to correct the defects.
- d) In cases where a complete light fitting (bayonet type or fluorescent tube luminaire) is installed, the contractor shall also be responsible for reconnecting the new light fitting with the existing light switch. The contractor shall be responsible to ensure that the newly installed light can be switched on and off using the existing light switch, and in cases where the existing light switch is defective or not in place, the contractor shall supply and install the necessary light switch, wiring and other fixing equipment and materials as part of the light fitting.

10.5 Measurement and Payment

- a) The unit of measurement shall be number of lighting equipment components supplied and installed. The schedule of quantities shall specify the type of equipment components in terms of the type and size of the components. The different types are the following :
 - i) Complete Light Fitting - Bayonet Luminaire Type

This component consists of a complete bayonet type luminaire unit. It includes a base unit for installation against a bulkhead or ceiling, a bayonet type globe, and a round globe of the type that screws into the base unit.
 - ii) Complete Light Fitting - Fluorescent tube Type

This component consists of a complete double tube fluorescent luminaire unit. It includes a base unit for installation against a bulkhead or ceiling (including a translucent cover unit to cover the luminaire tubes), two fluorescent tube luminaires (length 1.8m), and all the associated components such as starters and ballasts that form part of the luminaire unit.
 - iii) Fluorescent tube luminaire : Length 1.2m
 - iv) Fluorescent tube luminaire : Length 1.8m
 - v) Fluorescent tube luminaire : Length 2.4m
 - vi) Conventional size globe : 100W bayonet fitting
 - vii) Conventional size globe : 100W screw in fitting
 - viii) Fluorescent light starter : Length 1.2m
 - ix) Fluorescent light starter : Length 1.8m
 - x) Fluorescent light starter : Length 2.4m
 - xi) Fluorescent light ballast : Length 1.2m
 - xii) Fluorescent light ballast : Length 1.8m
 - xiii) Fluorescent light ballast : Length 2.4m

11. Replacement of photocell and reinstallation of outdoor light fitting

11.1 Procedure Number RP11

11.2 Scope

This procedure covers the replacement of a defective photocell, the reinstallation of an outdoor light fitting, and the reconnection of the light fitting and photocell to the internal distribution board of the substation building.

11.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

11.4 Task Description

- a) The contractor shall replace the defective photocell with a new and unused photocell. The contractor shall install the new photocell in a position that will ensure that the photocell is exposed to natural light in such a way that will correctly operate when exposed to outdoor light.
- b) The contractor shall reinstall the existing outdoor light fitting by means of the appropriate anchor bolts and/or other securing mechanisms.
- b) The contractor shall reconnect the photocell and outdoor light to the substation's internal distribution board and light switch. The contractor shall use (supply and install) a 20m length of surfix or equivalent type conductor (4mm² copper conductor) between the outdoor light and the internal substation distribution board and light switch. The contractor shall ensure that the surfix conductor is secured against the wall in a manner that complies with wiring regulations.
- c) The photocell shall comply with the following specifications :
 - i) The photocell shall be fitted with switch contacts able to carry no less than 5A.
 - ii) The photocell current shall not exceed 50mA during no-load conditions.
 - iii) The photocell shall be suited to 240V \pm 6%, 50Hz single-phase alternating current.
 - iv) The units shall be weather proof and vibration-resistant.
 - v) The units shall be designed to withstand damage by either stone-throwers or hail. If the units do not possess this quality, separate wire screens shall be provided for this purpose.
 - vi) The units shall be supplied with a standard NEMA plug and socket. The socket shall have an arm for mounting on a pole.
 - viii) All parts shall be treated to be corrosion-proof.
 - ix) The units shall be capable of operating in dusty conditions between - 5°C and + 55°C.
 - x) The units shall switch on when the light intensity drops to 15 lux \pm 20% and switch off when the light intensity reaches 40 lux \pm 20%.
 - xi) When the unit is in the on position, there shall be a time delay of approximately one minute before it switches off due to a sudden increase in the light intensity.
 - xii) The design of the switch shall ensure a positive on and off switching at all times.

11.5 Measurement and Payment

- a) The unit of measurement shall be the number of photocell and outdoor light units replaced and reconnected. One unit shall be

considered a single combined photocell and outdoor light combination.

- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the 20m length of surfix or equivalent conductor as specified in this procedure.

12. Replacement of socket outlet cover plate

12.1 Procedure Number RP12

12.2 Scope

This procedure covers the supply and installation of a conventional socket outlet cover plate.

12.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS code covering socket outlet cover plates.

12.4 Task Description

- a) The contractor shall supply and install a conventional socket outlet cover plate in the position where an existing cover plate is missing.
- b) The cover plate shall be a new and unused unit made of steel in compliance with the appropriate SABS code.

12.5 Measurement and Payment

- a) The unit of measurement shall be the number of socket outlet cover plates supplied and installed.

13. Cleanup of Tar/Bitumen Spills

13.1 Procedure Number RP13

13.2 Scope

This procedure covers the cleanup of tar/bitumen spills caused by leaking cable termination drums of indoor switchgear units.

13.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

13.4 Task Description

- a) The contractor shall cleanup the spill caused by the leakage of a tar/bitumen insulating cable termination box. The cable termination box as well as the floor underneath the cable termination box shall be cleaned.
- b) A suitable solvent shall be used and all traces of the tar/bitumen shall be removed.

13.5 Measurement and Payment

- a) The unit of measurement shall be the number of tar/bitumen spills cleaned.

14. Replacement of Switchgear Fuses

14.1 Procedure Number RP14

14.2 Scope

This procedure covers the replacement of fuses in ring-main units and T3's in both standalone and miniature substation units.

14.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 2692 : Fuses for voltages exceeding 1000 V a.c.
- c) BS 2692 : Part 1 Current-limiting fuses
- d) BS 2692 : Part 2 1956 Expulsion fuses
- e) BS 2692 : Part 3 1990 Guide to the determination of short circuit power factor

14.4 Task Description

- a) The contractor shall replace blown fuses with new unused fuses.
- b) The fuse replacement procedure shall be done in strict accordance with the manufacturers operating and maintenance instructions.
- c) The fuses supplied shall be new 11kV HRC fuses, and if the switchgear enclosure allows this, a spare set of fuses shall mounted inside the equipment enclosure.
- d) The fuse rating shall be determined on the basis of the rating of the transformer supplied via the fuse.

14.5 Measurement and Payment

- a) The unit of measurement shall be the number of fuses replaced and installed. The same rate shall apply to all types of fuses.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the supply and installation of a suitably rated fuse.

15. Ring-Main Unit Overhaul

15.1 Procedure Number RP15

15.2 Scope

This procedure includes all tasks associated with the complete overhaul of all three units of a three-legged ring main unit or T3. This includes opening the oil chambers and servicing the normally immersed components of the equipment, and the replacement of the insulation oil. This procedure applies to both the ring-main units of miniature substations and the standalone ring-main units or T3 units in the distribution substations.

15.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 5730 : 1979 Codes of practice for Maintenance of Insulating Oil
- c) BS 5263 : 1975. Method for sampling liquid dielectrics
- d) SABS 555 : 1985 : Standard Specification for Mineral insulating oil for transformers and switchgear (uninhibited)

15.4 Task Description

- a) Replacement of Insulating Oil
 - i) The contractor shall drain the existing oil from all the oil chambers and remove the oil from site using suitable storage methods.
 - ii) The contractor shall clean the interior of each oil chamber by means of a chamois leather cloth. All sediments shall be removed from the bottom of the oil chamber.
 - iii) The oil chamber shall be filled to the recommended level with new insulating oil in compliance with the abovementioned specifications.
 - iv) Care shall be taken to handle, transport, and store insulation oil in accordance with the abovementioned specifications

- b) Overhaul of major ring-main unit parts

The following major overhaul tasks shall be completed in addition to the insulating oil service :

- i) The switching equipment shall be cleaned using only materials that comply with BS 5730 : 1979, and thereafter the equipment shall be cleaned by means of blowing a dielectric cleaner onto the switching parts.
- ii) The equipment shall be thoroughly inspected for signs of defects and or equipment damage. Should any defects be detected, these defects shall be reported to the Engineer in documented format. During the inspection specific attention shall be given to any signs of blade arcing.
- iii) All moving parts (that are recommended by the original equipment manufacturer to be lubricated) shall be lubricated using a lubricant complying with the requirements of the original equipment manufacturer.

15.5 Measurement and Payment

- a) The unit of measurement shall be the number of ring-main units overhauled. A single rate shall apply to standalone ring-main units or T3's, and to the ring main units of miniature substations. All three or four switching components of a ring-main unit or T3 shall be considered one item in the schedule of quantities, and the tendered rate shall include the work done on all three or four components.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the following :
 - i) All work associated with the overhaul of each piece of equipment as specified in this procedure, excluding the

reconditioning of insulating oil, which shall be considered another payment item.

- ii) The supply, delivery and installation of the full volume of new insulating oil required to fill all three or four oil chambers of the switching unit to the recommended level.

16. Replace Ring-Main Unit Contacts and Contact Blades

16.1 Procedure Number RP16

16.2 Scope

This procedure covers the replacement of defective contacts and contact blades on ring-main unit and T3 switchgear units (standalone and miniature substation applications).

16.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

16.4 Task Description

- a) The contractor shall replace defective contacts and contact blades if the inspection performed during the overhaul of the ring-main units proves that this replacement is required.
- b) The contractor shall remove defective contacts and shall supply and install new contacts and contact blades.
- c) The type of contacts and contact blades installed shall be as recommended by the original equipment manufacturer.

16.5 Measurement and Payment

- a) The unit of measurement shall be the number of sets of contacts and contact blades installed.

17. Insulation Oil Sampling and Analysis

17.1 Procedure Number RP17

17.2 Scope

The scope of this procedure includes all tasks required to analyse the condition of insulation oil in transformers. The transformers include both standalone and miniature substation transformers, and they are free breathing, dehydrator breathing, or hermetically sealed in type. These tasks include taking insulating oil samples from each separate oil unit, having tests done on each sample, and reporting the test results to the Engineer. All preparation tasks required for and associated with this work (such as arranging for and doing switching of electrical equipment) will be considered part of this task.

17.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 5730 : 1979 Codes of practice for Maintenance of Insulating Oil
- c) BS 5263 : 1975 Method for sampling liquid dielectrics

- d) SABS 555 : 1985 : Standard Specification for Mineral insulating oil for transformers and switchgear (uninhibited)

17.4 Task Description

- a) The contractor shall take oil samples from each unit of oil-immersed equipment that forms part of the facilities.
- b) Oil sampling shall be done in strict compliance with the operation and maintenance instructions of the manufacturers of the various units of equipment.
- c) Oil samples shall be taken from every single and separate oil unit of every piece of equipment, and each sample shall be separately labelled in order to discriminate between the result of different samples.
- d) Taking and handling of oil samples shall be done in strict compliance with the specifications outlined in BS 5263: Method for sampling liquid dielectrics.
- e) All oil samples shall be tested at a reputable laboratory (not on the Client's site) in accordance with the test procedures outlined in Appendix A of BS 5730 .
- f) The following insulating oil characteristics shall be tested for according to the methods outlined in Appendix A of BS 5730:
 - i) Odour
 - ii) Appearance
 - iii) Colour
 - iv) Electric strength
 - v) Water content
 - vi) Acidity (neutralisation value)
 - vii) Resistivity (at 20°C)
 - viii) Sediment and/or precipitable sludge
 - ix) Dissolved gas analysis (DGA)
- g) The results of the tests shall be supplied to the Engineer in documented format.
- h) The test result report shall contain at least the following information :
 - i) Unique description of equipment from which of oil sample was taken.
 - ii) Date of sample,
 - iii) Name of person taking the sample.
 - iv) Test results for the sample in terms of each of the specified oil characteristics.
 - v) Recommendations on whether the oil from which the sample was taken should be replaced or reconditioned or not.
 - vi) Summary recommendation of the general condition of the oil samples tested.
 - vii) Name of person who conducted the tests.
 - viii) Name and contact details of the test laboratory.

- ix) Certification by the test laboratory that these specific tests have been conducted in compliance with BS 5730.
- i) The contractor shall make arrangements with the Engineer prior to taking samples in order to ensure that access can be gained to all required facilities, and that equipment may be switched off as is required.
- j) The contractor shall supply the Engineer with proof of his proficiency and experience in taking and analysing insulating oil samples, and of the reputability of the laboratory that will do the tests.
- k) The contractor shall, at his own expense familiarise himself with the type and manufacturer of the various equipment on site, as is required for the proper taking of samples in accordance with the manufacturer's requirements.

17.5 Measurement and Payment

- a) The unit of measurement shall be the number of transformers from which samples are taken and analysed. The same rate shall apply to all sizes of transformers.

18. On-site Insulating Oil Reconditioning

18.1 Procedure Number RP18

18.2 Scope

This procedure covers tasks that form part of the on-site reconditioning of insulating oil presently used in all transformer and switchgear equipment. The transformers include both standalone and miniature substation transformers of the free breathing, dehydrator breathing, or hermetically sealed in type. Oil immersed switchgear comprises of ring-main unit and or T3 units. In the case of transformers, the procedure also includes the servicing of the dehydrating breather of the transformer.

This task includes the supply (for the contractor's own use only) of oil reconditioning equipment, and the completion of the oil reconditioning task itself. All preparation tasks required for and associated with this work (such as arranging for and doing switching of electrical equipment) will be considered part of this task.

18.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 5730 : 1979 Codes of practice for Maintenance of Insulating Oil
- c) BS 5263 : 1975. Method for sampling liquid dielectrics
- d) SABS 555 : 1985 : Standard Specification for Mineral insulating oil for transformers and switchgear (uninhibited)

18.4 Task Description

- a) The contractors shall recondition the insulating oil of the equipment that has been confirmed in writing by the Engineer to require reconditioning (based on the results of insulation oil tests that will be conducted). The contractor shall supply and install insulation oil and top up the oil chamber of the equipment in

cases where the present oil levels are below the maximum recommended oil level. The oil used for this purpose shall be in compliance with the insulation specifications as set out elsewhere in this document.

- b) The contractor shall use his own equipment for insulating oil reconditioning.
- c) The contractor shall submit details of the oil reconditioning equipment to the Engineer prior to commencing with any oil reconditioning. The contractor shall only be allowed to commence with oil reconditioning work once the Engineer has approved the equipment.
- d) The contractor shall recondition the full volume of insulation oil contained in each unit of equipment to the specified requirements.
- e) Oil reconditioning of transformers only shall be done on-load and without de-energising the transformer.
- f) The contractor shall ensure that the oil reconditioning equipment is properly used to ensure the maximum improvement of the oil characteristics. The contractor shall be required by the Engineer to perform on-site tests in order to demonstrate the condition of the reconditioned oil.
- g) The contractor shall ensure that the reconditioned oil conforms to the following minimum specifications :
 - i) Electric strength (minimum) 50kV
 - ii) Acidity (maximum) 0.1g KOH / mg of oil
 - iii) Water content (maximum) 30 p.p.m. (parts per million)
- h) The contractor shall familiarise himself with site conditions to ensure that an adequate electrical supply is available where required to operate the oil reconditioning equipment. The contractor shall be allowed to make use of the Client's facilities for this purpose provided that the contractor ensures safe operating practices for its own and the Client's personnel. Where no supply is available from the Client's electrical network, the contractor shall provide all generator equipment (including fuel and other consumable items) that is required for the oil reconditioning.
- i) The contractor shall familiarise himself with site conditions to ensure that adequate space is available where required to temporarily install and operate the oil reconditioning equipment.
- i) In the case of a transformer the contractor shall also do a complete service of the transformer's dehydrating breather. This service shall be done in accordance with the following specifications :
 - i) The contractor shall check the quantity and colour of the dehydrating agent (typically silica gel) and shall reactivate or replace it where necessary.
 - ii) The silica gel shall be considered to require replacement if its colour is pink or if the breather is not filled to the required level, and it shall be considered not to need replacement if its colour is deep blue and the breather is filled to the required level.

- iii) Silica gel used for replacement shall be new silica gel and shall comply with BS 3523.
- iv) The oil seal or bath at the base of the dehydrating breather shall be removed, cleaned out, and refilled with new insulation oil. The insulation oil used for this purpose shall be new insulation oil in compliance with SABS 555. The dehydrating breather shall be refilled with insulation oil to the level as prescribed in the manufacturer's maintenance instructions.

18.5 Measurement and Payment

- a) The unit of measurement shall be the number of transformers and the number of ring-main units reconditioned. The schedule of quantities shall specify the type of equipment to be oil-reconditioned. A single rate shall apply to all sizes of transformers, and the tendered rates shall be based on an average transformer size of 200kVA. A single rate shall apply to all standalone ring-main units or T3's, and this rate shall include full compensation for the reconditioning of all three or four oil chambers. The different types are the following :
 - i) Transformer
 - ii) Ring-main unit or T3
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. The supply of insulation oil used for topping up purposes shall be provided for elsewhere under a separate payment item. In addition to this, the tendered rate shall also include full compensation for the dehydrating agent, and or dehydrating agent reactivating equipment that may be required during this operation.

19. Supply and Installation of Insulation Oil

19.1 Procedure Number RP19

19.2 Scope

This procedure covers the supply, delivery and installation of insulating oil for use in switchgear insulation chambers or in power transformers.

19.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 5730 Codes of practice for Maintenance of Insulating Oil
- c) BS 5263 Method for sampling liquid dielectrics
- d) SABS 555 Standard Specification for Mineral insulating oil for transformers and switchgear (uninhibited)

19.4 Task Description

- a) The contractor shall supply, deliver and install insulation oil according to SABS 555.
- b) The oil shall be installed in transformer and or switchgear equipment in accordance with the applicable procedures elsewhere in this document.

- c) The contractor shall ensure that the transportation, handling, and storage of oil is done strictly in accordance with BS 5730.
- d) Oil shall only be supplied in terms of this procedure on the instruction of the Engineer. Oil shall further only be supplied if the existing insulating oil in equipment has leaked out or is below the required level. The contractor shall not replace existing insulating oil with new oil unless instructed so in writing by the Engineer.
- e) The oil chambers of the equipment being topped up shall be filled to the maximum level recommended by the original equipment manufacturer.

19.5 Measurement and Payment

- a) The unit of measurement and payment shall be litres of oil supplied and installed in either transformer or switchgear equipment.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation all costs associated with the proper transportation, handling, and storage of oil in accordance with this procedure.

20. MV Circuit Breaker Oil Service

20.1 Procedure Number RP20

20.2 Scope

This procedure covers the tasks associated with the oil servicing of medium voltage metal-clad oil insulated switchgear panels. The service includes the draining and cleaning of the oil chambers and the replacement of the insulation oil.

20.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 5730 Codes of practice for Maintenance of Insulating Oil
- c) BS 5263 Method for sampling liquid dielectrics
- d) SABS 555 Standard Specification for Mineral insulating oil for transformers and switchgear (uninhibited)

20.4 Task Description

This procedure applies to indoor oil insulated medium voltage circuit breakers.

- a) The contractor shall drain the existing oil and remove the oil from site using suitable storage methods.
- b) The contractors shall clean the interior of the circuit breaker oil chamber by means of a chamois leather cloth. All sediments shall be removed from the bottom of the oil chamber.
- c) The circuit breaker inside the oil chamber shall be serviced by means of blowing a dielectric cleaner onto the switching parts.
- d) The circuit breaker shall be thoroughly inspected for signs of faults and or equipment damage. Should any faults be detected,

these faults shall be reported to the Engineer in documented format. Specific attention shall be given to any signs of blade arcing.

- e) All moving parts (that are recommended by the original equipment manufacturer to be lubricated) shall be lubricated using a lubricant complying with the requirements of the original equipment manufacturer.
- f) The oil chamber shall be filled to the recommended level with new insulation oil in compliance with the abovementioned specifications.
- g) Care shall be taken to handle, transport, and store insulation oil in accordance with the abovementioned specifications
- h) The circuit breaker shall be closed and the circuit breaker trolley and panel shall be restored to the normal operational state.

20.5 Measurement and Payment

- a) The unit of measurement and payment shall be the number of circuit breakers serviced in accordance with this procedure.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for supply, delivery and installation of the volume of new insulating oil required to fill the oil chamber to the recommended level.

21. Replacement of cover a plate for a medium voltage switchgear panel

21.1 Procedure Number RP21

21.2 Scope

This procedure covers the supply and installation of a cover plate for a medium voltage switchgear panel.

21.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

21.4 Task Description

- a) The contractor shall supply and install a rear cable termination box cover plate for a switchgear panel.
- b) The cover plate shall be designed to fit perfectly onto the existing switchgear panel. The plate shall be made of the same type of steel as the original switchgear cubicle, and it shall be painted with an equal or higher quality anti corrosive paint. The steel cover plate shall be secured onto the existing switchgear cubicle using bolts and washers to suit the existing bolt and nut arrangement of the switchgear panel.
- c) The contractor shall obtain the exact dimensions of the switchgear panel and shall manufacture the cover plate in accordance with these dimensions.

21.5 Measurement and Payment

- a) The unit of measurement shall be number of switchgear panels for which cover plates are supplied and installed.

22. Replacement of transformer earth conductor

22.1 Procedure Number RP22

22.2 Scope

This procedure covers the supply and installation of an earth conductor between a transformer and the substation integral earth bar.

22.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS 1063 Earth rods and couplers

22.4 Task Description

- a) The contractor shall supply, install and connect an earth conductor between the transformer and the substation integral earth bar.
- b) The earth conductor used shall be a bare stranded copper conductor with a 70mm² cross sectional area.
- c) The earth conductor shall be connected to the equipment and to the integral earth bar using properly sized connecting lugs.

22.5 Measurement and Payment

- a) The unit of measurement shall be the number of transformers that are connected to the substation integral earth bar.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the following :
 - i) The supply and installation of a 15m length of earth conductor as specified in this procedure.
 - ii) The supply and installation of properly sized connecting lugs and connecting bolts, nuts and washers.

23. Replacement of Transformer Oil Gaskets

23.1 Procedure Number RP23

23.2 Scope

This procedure covers the supply, delivery and installation of various types of insulating oil gaskets for power transformers. The existing oil gaskets shall be removed on site and replaced with new gaskets that shall be cut to suit the transformer.

23.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) ASTM F104-95 : Standard Classification System for Non-metallic Gasket Materials

23.4 Task Description

a) Only personnel with proven experience of previous transformer oil gasket replacement tasks shall perform this procedure. The contractor shall supply the Engineer with proof of the experience on previous projects.

b) This procedure covers the replacement of the following types of gaskets on power transformers :

- main top gasket
- bushing gaskets (medium voltage)
- bushing gaskets (low voltage)
- sealing bolt / test plug gasket

The procedure for the replacement of the various types of gaskets are specified below. As part of this procedure (applicable to all types of gaskets specified) the contractor shall thoroughly clean the whole transformer and remove all oil spills and other dirt on the transformer's enclosure).

c) Main top gasket

i) The top gasket shall be removed and care shall be taken not to damage the gasket so that it may be used to determine the dimensions of the new gasket.

ii) The contractor shall supply and deliver new gasket material of sufficient quantity to cut a new gasket using a single sheet of gasket material. The contractor shall determine the dimensions of the transformer on site by means of measurement.

iii) The metal surfaces on the transformer enclosure and top cover plate on which the gasket is bedded shall be thoroughly cleaned and inspected for defects that may cause oil leaks. The contractor shall report any such defects to the Engineer.

iv) A new gasket shall be cut and installed to fit neatly on the transformer gasket area.

v) The gasket material supplied shall be a nitrile rubber compound of the Corkrite TF72 or equal and approved equivalent type according to ASTM F104-95. The thickness of the nitrile rubber sheet shall be 4.5mm. The contractor shall select the nitrile rubber sheet with a cork granule size that is in accordance with the manufacturer's specifications.

vii) The installation of the gasket shall be done strictly in accordance with the transformer and gasket material manufacturers' specifications.

viii) The contractor shall ensure that the transformer's top cover plate fastening bolts are tightened to the torque and in the sequence specified by the transformer manufacturer's specifications.

ix) The contractor shall familiarise himself with any requirements for the handling and or disconnection and reconnection of cables onto and from the transformer, and all such work shall be done as part of this procedure.

d) Bushing gasket (medium voltage)

This procedure applies to all three medium voltage bushings.

- i) The same procedure shall be followed except that only the bushings shall be removed instead of other components as specified in the procedure for the main top gasket.
 - ii) The contractor shall be responsible for the removal of the conductors that are connected to the medium voltage bushings, and for the reconnection of these conductors on completion of the task.
- e) Bushing gasket (low voltage)

This procedure applies to all four low voltage bushings.

- i) The same procedure shall be followed except that only the bushings shall be removed instead of other components as specified in the procedure for the main top gasket.
 - ii) The contractor shall be responsible for the removal of the conductors that are connected to the low voltage bushings, and for the reconnection of these conductors on completion of the task.
- f) Sealing bolt / test plug gasket

This procedure applies to sealing bolts and or test plugs on the transformer oil chamber that are sealed by means of oil gaskets.

- i) The same procedure shall be followed except that only the sealing bolts and or test plugs shall be removed instead of other components as specified in the procedure for the main top gasket.

23.5 Measurement and Payment

- a) The unit of measurement and payment shall be the number of sealing gaskets supplied and installed. In the case of bushing gaskets the unit of measurement shall be the number of three phase sets of bushings installed. (This means that one unit shall represent II three (in the case of medium voltage bushings) or all four (in the case of low voltage bushings) bushings of the transformer for which new gaskets were installed. The schedule of quantities shall specify the type of gaskets. The different types are the following :
 - i) Main top gasket
 - ii) Bushing gaskets (medium voltage)
 - iii) Bushing gaskets (low voltages)
 - iv) Sealing bolt / test plug gasket
- b) The tendered rates shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the following :
 - i) All the work associated with the shutting down of the transformer, the removal of the existing gasket(s), the installation of the new gasket(s), and the re-installation of the transformer's top cover plate and or other components.
 - ii) All the conductor handling work that may be required to complete this procedure.

24. Reparation of Transformer Bushing Insulation

24.1 Procedure Number RP24

24.2 Scope

This procedure covers the replacement of the covering insulation of transformer bushings with new insulating material.

24.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS 122 Pressure sensitive adhesive tapes for electrical purposes.

24.4 Task Description

- a) The contractor shall clean and remove all existing insulation material from the three medium voltage or low voltage bushings of the transformer, whichever is specified. The procedure shall apply to all the bushings in either the set of medium or the set of low voltage bushings whichever is specified.
- b) The contractor shall install the following insulation material on all the bushings in the set :
 - i) After it has been cleaned and old insulating material removed, the bushings shall be taped with at least 1.5m of insulating putty. The insulating putty shall be on the Scotchfil Electrical Insulating Putty type or equal and approved equivalent. The tape thickness shall be 3.2mm and the width shall be 38mm. An oil-based insulating putty shall not be used.
 - ii) The insulation putty shall be covered with at least 4 layers self fusing rubber tape of the Scotch No. 23 tape or equal and approved equivalent. Care shall be taken that this tape is not excessively stretched when applying it, as this may deform the insulation putty.
 - iii) The self fusing rubber tape shall be covered with at least 2 layers of adhesive colour coded PVC insulation tape of the Scotch No. 35 type or equal and approved equivalent. The colour coding of the tape shall correspond to the bushing phases, and the colours used shall be red, white, blue and black (the latter colour for the earth conductor).

24.5 Measurement and Payment

- a) The unit of measurement shall be the number of bushing sets (one set is equivalent to either three medium voltage bushings or four low voltage bushings) of which the insulation been restored. The sets shall be specified to be either one of the following :

- i) Medium voltage bushings
- ii) Low voltage bushings

25. Replacement of transformer dehydrating breather

25.1 Procedure Number RP25

25.2 Scope

This procedure covers the supply and installation of a new dehydrating breather on a power transformer.

25.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

25.4 Task Description

- a) The contractor shall disassemble and remove the defective dehydrating breather from the transformer.
- b) The contractor shall supply and install a complete new and unused dehydrating breather equal or equivalent to the existing unit of the transformer.
- c) The contractor shall fill the new dehydrating breather with dehydrating agent and insulating oil to the levels specified by the manufacturer.
- d) The replacement dehydrating breather shall be of the type specified as replacement by the original equipment manufacturer.

25.5 Measurement and Payment

- a) The unit of measurement shall be the number of dehydrating breather units replaced.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the supply and installation of the dehydrating agent and insulating oil that will be required as part of this task.

26. Sealing of a low voltage cable trench and sleeve section

26.1 Procedure Number RP26

26.2 Scope

This procedure covers the sealing of a low voltage cable trench and sleeve section on the side of a substation building.

26.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

26.4 Task Description

- a) The contractor shall clean up the section of the cable trench inside the building by removing all ground and other material from around the existing cables. Sufficient ground and other material shall be removed to enable the back filling of the area around the cables and directly underneath the substation wall with the specified back filling material to be carried out.

- b) After the cable trench has been cleaned up the cables shall be neatly laid out 50mm away from each other. If the cable trench dimensions do not allow such spacing then a lesser-optimised arrangement shall be used.
- c) The area around the cables and directly underneath the substation wall shall be bricked up with a weak mortar mixture. The mortar shall be a sand, cement and water mixture. The contractor shall ensure that the mortar mixture is sufficiently weak to allow it to be easily broken up if additional cables are to be installed at a later stage.
- d) The contractor shall not de-energise any of the cables during the process.

26.5 Measurement and Payment

- a) The unit of measurement shall be the number of cable entry sections refurbished. One cable entry section refers to the collective set of holes/sleeves through one wall where cables enter a cable trench.

27. General repairs to low voltage wiring in distribution panels

27.1 Procedure Number RP27

27.2 Scope

This procedure covers the general repair of the wiring in the low voltage distribution kiosk of a substation.

27.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS 1507 : Electric cable with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V)

27.4 Task Description

- a) The contractor shall reconfigure all cable termination in order to neaten the wiring arrangement and cable terminations in the distribution kiosk. This work shall include the disconnection of cables, the repositioning of the circuit breakers, isolators and other devices, the rerouting of cables where required, and the reconnecting of the cables.
- b) The contractor shall insulate and seal all unused cable terminations using appropriate electrical insulation and shall tie these cable terminations in a neat manner inside the distribution kiosk.
- c) The contractor shall disconnect, install cable glands, and reconnect all cable terminations that are not fitted with cable glands.
- d) The contractor shall disconnect, install cable termination lugs, and reconnect all cable terminations that are not fitted with cable termination lugs.
- i) The cable glands shall be of the adjustable type, equal or similar to the Pratley gland and shall be suitable for use with PVC SWA PVC cables complying with the latest edition of SABS 1507. All glands shall be installed with non-deteriorating neoprene

shrouds. For all gland installations on armoured cable, the outer sheath of the cable shall be cut back in accordance with the gland manufacturers' recommendations, so that a minimum of armouring is exposed between the gland and the outer sheath after gland installation. The shroud shall seal on the outer sheath of the cable.

- ii) All cable termination lugs shall be bi-metallic aluminium-copper lugs, equal to or similar to SIMEL type ACX.

27.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum.
- b) The tendered sum shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered sum shall also include full compensation for the supply and installation of all cable glands, terminating lugs and other wiring materials that shall be required as part of this task.

28. Replacement of Ammeters

28.1 Procedure Number RP28

28.2 Scope

This procedure covers the replacement of low voltage instrumentation ammeters in low voltage panels in substations and in miniature substations.

28.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 89 Part 9, Direct acting indicating analogue electrical measuring instruments and their accessories. Recommended test methods.
- c) IEC 60051-1 (1997-12), IEC 60051-2 (1984-12), IEC 60051-8 (1984-12), IEC 60051-9 (1988-05)

28.4 Task Description

- a) Each faulty ammeter shall be disconnected and removed from the kiosk or enclosure. The contractor shall ensure that no secondary circuits are open-circuited during this procedure.
- b) The replacement ammeter shall be installed in the same position from which the faulty ammeter was removed. All circuits shall be reconnected using appropriately sized lugs on all wire terminations.
- c) All ammeters supplied shall be maximum demand and instantaneous reading ammeters with maximum demand slave indicators. Ammeters shall be rated for the appropriate secondary current (1A or 5A) and shall be able to indicate up to 20% over full current rating.
- d) Ammeters shall comply with the following specifications :
 - i) Ammeters shall be rated for the supply voltage and frequency which is 400/230V and 50Hz respectively. All the ammeters supplied shall be from the range of a single reputable supplier and shall preferably have the same face

dimensions as the original ammeters. All ammeters shall comply with BS 89 Part 9 and/or IEC 60051.

- ii) Ammeters shall be screened against magnetic interference and shall have anti-static against magnetic interference.
- iii) Ammeters shall have anti-static impact resistant glass or "Macrolon" faces.
- iv) Ammeters shall be insulated to achieve a 2kV insulation resistance to earth.
- v) All instruments shall be splash proof and dust-proof unless more stringent requirements are specified for hazardous locations.
- vi) Instruments shall be sufficiently resistant to vibration that may be encountered in the specific application.
- vii) For normal environmental and supply conditions, instruments shall be suitable for use inside the limits specified in Tables III and VI of IEC 60051.
- viii) All instruments shall be capable of withstanding overloads of continuous or short duration in accordance with section 8.3 of IEC 60051.
- ix) Instruments shall be provided with studs for rear connection. Shrouds shall be provided to prevent accidental contact where instruments are to be installed in hinged panels of switchboards.
- x) Ammeters shall have a moving iron element to indicate instantaneous values.
- xi) Direct reading ammeters up to a maximum rating of 60 A may be used. Current transformer operated ammeters shall be 5 A full scale, calibrated to read actual primary circuit currents. The current transformer ratio shall be indicated on the faceplate.
- xii) A zero adjustment screw shall be provided.
- xiii) Where combined maximum demand and indicating ammeters are specified, a bimetallic spiral element shall be provided in the same housing to indicate mean value over a 15 minute period.
- xiv) The bimetal element shall drive a residual pointer to indicate maximum mean current between resettings. This pointer shall operate on the main scale and shall be of a distinctive colour. The pointer shall be resettable from the face of the meter.
- xv) The bimetal element shall be designed to compensate for limits of ambient temperature between -20°C and 70°C.
- xvi) Full load or rated current shall be clearly indicated, preferably with a red line. Unless specified to the contrary, a 100% condensed overscale shall be provided for instantaneous reading instruments and no overscale for combined maximum-demand ammeters.
- xvii) The intrinsic error, expressed in terms of the fiducial value in accordance with IEC 60051, shall be class 1,5 for the instantaneous readings and class 2,5 for the mean maxima.

- e) Each ammeter shall be supplied and installed with a faceplate with the correct current transformer scale ratio. The contractor shall verify the correct current transformer scale ratio prior to supplying and installing the ammeter.
- f) The contractor shall do all modifications that may be required to fit the new ammeter in the existing space, including the supply and installation of fixing brackets and material.

28.5 Measurement and Payment

- a) The unit of measurement shall be number of ammeters installed. The ammeter installation process shall be considered to include the removal of the existing ammeters.

29. Replacement of Voltmeters

29.1 Procedure Number RP29

29.2 Scope

This procedure covers the replacement of low voltage instrumentation voltmeters in low voltage panels in substations and in miniature substations.

29.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) BS 89 Part 9, Direct acting indicating analogue electrical measuring instruments and their accessories. Recommended test methods.
- c) IEC 60051-1 (1997-12), IEC 60051-2 (1984-12), IEC 60051-8 (1984-12), IEC 60051-9 (1988-05)

29.4 Task Description

- a) Each faulty voltmeter shall be disconnected and removed from the kiosk or enclosure.
- b) The replacement voltmeter shall be installed in the position from which the faulty voltmeter was removed. All circuits shall be reconnected using appropriate sized lugs on all wire terminations.
- c) Voltmeters shall comply with the following specifications :
 - i) Voltmeters shall be rated for the supply voltage and frequency which is 400/230V and 50Hz respectively. All the voltmeters supplied shall be from the range of a single reputable supplier and shall preferably have the same face dimensions as the original voltmeters. All voltmeters shall comply with BS 89 Part 9 and/or IEC 60051.
 - ii) Voltmeters shall be screened against magnetic interference and shall have anti-static against magnetic interference.
 - iii) Voltmeters shall have anti-static impact resistant glass or "Macrolon" faces.
 - iv) Voltmeters shall be insulated to achieve a 2kV insulation resistance to earth.

- v) All instruments shall be splash proof and dust-proof unless more stringent requirements are specified for hazardous locations.
- vi) Instruments shall be sufficiently resistant to vibration that may be encountered in the specific application.
- vii) For normal environmental and supply conditions, instruments shall be suitable for use inside the limits specified in Tables III and VI of IEC 60051.
- viii) All instruments shall be capable of withstanding overloads of continuous or short duration in accordance with section 8.3 of IEC 60051.
- ix) Instruments shall be provided with studs for rear connection. Shrouds shall be provided to prevent accidental contact where instruments are to be installed in hinged panels of switchboards.
- x) Voltmeters shall have a moving iron element to indicate instantaneous values.
- xi) A zero adjustment screw shall be provided.
- d) Each voltmeter shall be supplied and installed with a faceplate with the correct voltage transformer scale ratio. The contractor shall verify the correct voltage transformer scale ratio prior to supplying and installing the voltmeter.
- f) The contractor shall do all modifications that may be required to fit the new voltmeter in the existing space, including the supply and installation of fixing brackets and material.

29.5 Measurement and Payment

- a) The unit of measurement shall be number of voltmeters installed. The voltmeter installation process shall be considered to include the removal of the existing voltmeters.

30. Replacement of Instrumentation Fuses

30.1 Procedure Number RP30

30.2 Scope

This procedure covers the replacement of instrumentation fuses as used in voltmeters and ammeters.

30.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

30.4 Task Description

- a) The contractor shall replace the defective fuses with new unused fuses.
- b) The fuses shall be of the type and rating as specified by the original equipment manufacturer.

30.5 Measurement and Payment

- a) The unit of measurement shall be the number of fuses replaced.

31. Secure LV panels to floor

31.1 Procedure Number RP31

31.2 Scope

This procedure covers the securing of low voltage distribution panels to the floor of a substation building.

31.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

31.4 Task Description

- a) The contractor shall secure all the low voltage distribution panels of the substation to the floor by means of appropriately sized anchor bolts, or by means of attachment to the cable trench metalwork, whichever is the most practical.
- b) The contractor shall supply and install all anchor bolts, brackets and all other materials that will be required as part of this task.

31.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum.

32. Installation of LV cable clamps

32.1 Procedure Number RP32

32.2 Scope

This procedure covers the supply and installation of two cable clamps for securing two low voltage cables at their points of entry into low voltage distribution kiosks.

32.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

32.4 Task Description

This procedure applies to two low voltage power cables at the point of entry into low voltage distribution kiosks. The two cables are both PVC insulated four core copper conductors with a cross sectional area of 180mm². At present the cables are not clamped within the kiosks and the full weight of the vertical section of the cables rest on the termination bushings.

- a) The contractor shall supply and install the two wooden cable clamps to support the weight of the cables by clamping onto the cable sleeve and securing onto the distribution kiosk. The clamps shall be shaped to facilitate the clamping onto the cable sleeves without damaging the sleeves.
- b) The contractor shall ensure that the installation is done in such a manner that the weight of the two cables is carried by the clamps and not by the cable termination lugs and bushings.

32.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum.

33. Reinstallation of LV distribution board front panel

33.1 Procedure Number RP33

33.2 Scope

This procedure covers the reinstallation of the front cover panels of existing low voltage distribution boards. These panels have been removed from the distribution boards and the fastening bolts and screws are no longer in place.

33.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

33.4 Task Description

- a) The contractor shall reinstall the front cover panels of the low voltage distribution board in the substation where these are missing.
- b) The panels shall be secured by means of fastening bolts and brackets. Where possible the existing brackets, bolts and nuts of the original panels shall be used, however in cases where these are unusable the contractor shall manufacture, supply and install similar securing brackets, bolts, nuts and washers.

33.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum. The lump sum tendered shall include full compensation for the reinstallation of the cover panels in a single substation.

34. Replacement of DB board front cover panel

34.1 Procedure Number RP34

34.2 Scope

This procedure covers the replacement of a front cover panel for an existing wall mounted distribution board.

34.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

34.4 Task Description

- a) The contractor shall supply and install a new cover panel for a twelve way wall mounted distribution board.
- b) The contractor shall determine the exact dimensions of the front cover panel by measurement prior to the supply and installation thereof.

34.5 Measurement and Payment

- a) The unit of measurement and payment shall be the number of replacement front cover panels supplied and installed.

35. Replacement of LV circuit breaker

35.1 Procedure Number RP35

35.2 Scope

This procedure covers the supply and installation of a three phase three pole moulded case circuit breaker.

35.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

35.4 Task Description

- a) The contractor shall remove the defective circuit breaker from the circuit.
- b) The contractor shall determine the rating of the defective circuit breaker and shall replace it with a new moulded case circuit breaker with the same ratings as that of the defective circuit breaker. The contractor shall reconnect the circuit to the new circuit breaker.
- c) The type of circuit breaker is a moulded case three phase three pole circuit breaker. The circuit breaker shall be in compliance with the relevant SABS code.

35.5 Measurement and Payment

- a) The unit of measurement shall be the number of moulded case circuit breakers supplied and installed.

36. Reparation of insulation on low voltage busbar

36.1 Procedure Number RP36

36.2 Scope

This procedure covers the insulation of an exposed section of low voltage busbar conductor.

36.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

36.4 Task Description

- a) The contractors shall insulate the complete section of exposed busbar using the same procedure for the reparation of transformer bushing insulation (Procedure RP24).

36.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum.

37. Reparations and LV cable replacements

37.1 Procedure Number RP37

37.2 Scope

This procedure covers the reparation of a cable trench and the replacement of sections of exposed low voltage power cables that were damaged.

37.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

37.4 Task Description

The cables to which this procedure applies is installed on ground level in an outdoor fenced off area. The cable trench section is not backfilled and the cables are therefore exposed. These cables have been

damage to the outer sleeves and possibly to the internal insulation as well. The length of the exposed section of cable trench is approximately 10m.

- a) The contractor shall expose the damaged parts of the cables by removing backfilling material from the cable trench up to the full length required therefore.
- b) The contractor shall disconnect the low voltage cables cut the exposed and damaged ends so that the damaged sections are completely removed.
- c) The contractor shall supply and install four sections of replacement cable, four cable joints and four cable terminations for the jointing and reconnection of the four cable sections. The replacement cable sections shall be PVC insulated, PVC sleeved, steel wire armoured copper conductor cables with four cores and a cross sectional area equal to that of the existing cable sections.
- d) The contractor shall backfill the cable trench with fine-grained sand in such a way that the cables are not damaged. The cables shall be completely covered by the backfilling material in order to prevent exposure to the atmosphere. The cables shall be installed at a minimum depth of 0.5m. The contractor shall excavate the cable trench if necessary to obtain this minimum cable depth.
- e) The cable joints and cable terminations shall comply with the following specifications :
 - i) The cable joints shall be of the epoxy-resin type.
 - ii) The cable glands shall be of the adjustable type, equal or similar to the Pratley gland and shall be suitable for use with PVC SWA PVC cables complying with the latest edition of SABS 1507. All glands shall be installed with non-deteriorating neoprene shrouds. The cable glands shall be fitted with a nipple gasket and inner seal kit, rendering the gland suitable for type "e" equipment (increased safety equipment).
 - iii) For all gland installations on armoured cable, the outer sheath of the cable shall be cut back in accordance with the gland manufacturers' recommendations, so that a minimum of armouring is exposed between the gland and the outer sheath after gland installation. The shroud shall seal on the outer sheath of the cable.
 - iv) Bi-metallic aluminium-copper lugs, equal or similar to SIMEL type ACX, shall be used according to the manufacturer's specifications, where solid aluminium conductors are terminated onto copper busbars.

37.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum.

38. Replacement and or Reparation of MV Cable Terminations

38.1 Procedure Number RP38

38.2 Scope

This procedure covers the replacement and or reparation of medium voltage cable terminations at both oil filled and tar/bitumen filled cable termination boxes of indoor switchgear equipment.

38.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

38.4 Task Description

This procedure applies to the cable terminations of indoor switchgear units (T3's and ring-main units). These units are either oil filled or tar/bitumen filled. Different procedures apply to the two cases, and these differences are specified in this procedure.

- a) The following procedure applies to oil immersed cable terminations :
 - i) The contractor shall drain the insulation oil from the oil chamber and shall remove the oil from site.
 - ii) The contractor shall remove the cable from the cable termination box and shall clean the cable section in preparation for the reinstallation of the lead cable seal.
 - iii) The contractor shall reposition the cable and shall reinstall the lead cable seal in accordance with generally accepted lead cable sealing practices. The seal shall be tested to ensure that it forms a tight oil seal between the cable and the cable termination panel.
 - iv) The contractor shall reassemble the cable termination box and shall refill the oil chamber with new insulation oil. The insulation oil shall be in accordance with the insulation oil specifications as set out elsewhere in this document.
- b) The following procedure applies to tar/bitumen immersed cable terminations :
 - i) The contractor shall remove the cable termination cover panel and shall remove the cable termination from the cable termination box.
 - ii) The contractor shall disassemble and remove the complete cable termination box.
 - iii) The contractor shall manufacture and supply a new cable termination box. The new cable termination box shall be manufactured to fit in the place of the removed cable termination box, and shall be made of the same steel and painted with the same or higher quality anti-corrosive paint as that of the rest of the switchgear metal work. The new cable termination box shall be manufactured to contain a Raychem/Systol heat shrink type cable termination. The cable termination box shall be equipped with a cover panel that can be removed by removing four fastening bolts, thereby offering access to the cable terminations without removing the complete cable termination box.
 - iv) The contractor shall cut off and remove a length of approximately 5m from the cable termination end of the cable.
 - v) The contractor shall supply and install a new section of cable of the same type and size as the original cable. The contractor shall also supply and install a cable joint and cable termination to join the new cable section to the old cable and to terminate the cable section onto the

switchgear bushings in the newly installed cable termination box.

- vi) The contractor shall supply and install a wooden clamp onto the cable at the bottom of the cable termination box to carry the weight of the cable, thereby preventing this weight from being carried by the switchgear bushings.
- vii) The contractor shall reinstall the cover plate of the new cable termination box.
- viii) The cable joints and cable terminations shall be of Raychem/Systol or equal and approved type. The size of the cable joints and terminations shall be selected to suit the cable size.
- ix) The manufacturer's installation procedures and instructions shall be strictly adhered to.
- ix) In cases where earth continuity conductors are installed on existing cable sections, and where these sections are replaced in terms of this procedure, the Contractor shall supply and install a new earth continuity conductor of equal or larger cross-sectional area. The earth continuity conductor installed shall comprise stranded copper conductors.
- x) The Contractor shall conduct all the tests as specified in subclause HA 04.3 of this specification on completion of the cable termination installation.
- xi) Upon request all jointers shall produce proof of training in the performing of cable joints.

38.5 Measurement and Payment

- a) The unit of measurement shall be the number of cable terminations replaced and or repaired. The schedule of quantities shall specify the type of task to be performed. The two types of tasks are the following :
 - i) Reparation of oil immersed cable termination
 - ii) Replacement of tar/bitumen immersed cable termination
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the following :

- i) The supply of the lead and lead sealing equipment (in the case of oil immersed cable terminations only).
- ii) The supply and installation of a cable joint and cable termination (in the case of tar/bitumen immersed cable terminations only).
- iii) The supply and installation of five meter section of medium voltage cable (in the case of tar/bitumen immersed cable terminations only).
- iv) The design, manufacture, supply and installation of a complete new cable termination box (in the case of tar/bitumen immersed cable terminations only).

39. Replacement of a MV cable sections and the terminating of the cable

39.1 Procedure Number RP39

39.2 Scope

This procedure describes the replacement of a cable section between the transformer and switchgear unit of a substation building. The cable shall be terminated and reconnected onto the equipment at both cable ends.

39.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS 97: Electric cables - impregnated-paper-insulated metal-sheathed cables for rated voltages from 3,3/3,3 kV up to 19/33 kV
- c) SABS 1339: Electric cables: Cross-linked polyethylene (XLPE) – insulated cables for voltages from 3,8/6,6 kV to 19/33 kV

39.4 Task Description

- a) The contractor shall disconnect and remove the existing medium voltage cable from between the transformer and the switchgear unit. The contractor shall remove and dismantle the existing cable termination box of the tar/bitumen immersed cable termination switchgear unit. (This work shall be done in the manner specified as part of procedure RP38).
- b) The contractor shall design, manufacture, supply and install a new cable termination box for the switchgear unit. (This work shall be done in the manner specified as part of procedure RP38).
- c) The contractor shall supply and install a new section of medium voltage copper conductor XLPE cable of the same cross-sectional area as that of the existing cable. The contractor shall install two new and unused cable terminations on the two ends of this cable for connection onto the existing equipment.
- d) The contractor shall reconnect to the two cable terminations onto the transformer and switchgear unit respectively. The contractor shall supply and install two wooden cable clamps to carry the weight of the two respective cable ends.
- e) The cable terminations shall be of Raychem/Systol or equal and approved type. The size of the cable terminations shall be selected to suit the cable size.

- f) The contractor shall conduct all the tests as specified in subclause HA 04.3 of this specification on completion of the cable termination installation.
- g) Upon request the contractor shall produce proof of training in the performing of cable terminations.
- h) The medium voltage cable shall be a three core, copper conductor, XLPE insulated individually copper tape screened, galvanised steel armoured, PVC served medium voltage cable.

39.5 Measurement and Payment

- a) The unit of measurement shall be a lump sum.
- b) The lump sum shall include full compensation for all aspects specified in clause HA 08. In addition to this, the lump sum shall also include full compensation for the following :
 - i) The supply and installation of a 20m length of XLPE medium voltage cable.
 - ii) The supply and installation of two cable joints.
 - iii) The design, manufacture, supply and installation of a complete new cable termination box.

40. Reinstallation of a LV cable in a distribution kiosk

40.1 Procedure Number RP40

40.2 Scope

This procedure covers the removal of an externally installed loose low voltage cable, and the replacement thereof with a new low voltage copper conductor.

40.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

40.4 Task Description

- a) The contractor shall disconnect and remove the externally routed low voltage conductor.
- b) The contractor shall supply and install a new conductor in the place of the existing conductor. The conductor shall be installed, routed and secured inside the distribution panel. The conductor shall be a four-core PVC insulated, PVC sleeved, copper conductor with a cross-sectional area of at least 50mm².
- c) The conductor shall be terminated on both ends with appropriately sized cable glands and terminating lugs.
- d) The cable glands shall be of the adjustable type, equal or similar to the Pratley gland and shall be suitable for use with PVC PVC SWA PVC cables complying with the latest edition of SABS 1507. All glands shall be installed with non-deteriorating neoprene shrouds. For all gland installations on armoured cable, the outer sheath of the cable shall be cut back in accordance with the gland manufacturers' recommendations, so that a minimum of armouring is exposed between the gland and the outer sheath after gland installation. The shroud shall seal on the outer sheath of the cable.
- e) All cable termination lugs shall be bi-metallic aluminium-copper lugs, equal to or similar to SIMEL type ACX.

40.5 Measurement and Payment

- a) The unit of measurement and payment shall be a lump sum.
- b) The lump sum shall include full compensation for all aspects specified in clause HA 08. In addition to this, the lump sum shall also include full compensation for the following :
 - i) The supply and installation of a 5m length of copper conductor as specified in this procedure.
 - iii) The supply and installation of cable glands and cable terminating lugs.

41. Test, clean, service and repair battery tripping unit

41.1 Procedure Number RP41

41.2 Scope

This procedure covers the complete service and cleaning of the battery-charging unit, the replacing of the batteries and the testing of the unit.

41.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

41.4 Task Description

- a) The contractor shall clean and repaint the box of the charger.
- b) The contractor shall supply and install new batteries.
- c) The contractor shall test and repair the unit to full working condition.

41.5 Measurement and Payment

- a) The unit of measurement and payment shall be a lump sum.
- b) The lump sum shall include full compensation for all aspects specified in clause HA 08. In addition to this, the lump sum shall also include full compensation for the following :
 - i) The supply and installation of new batteries.
 - ii) The repairing to full working condition if it is not working.

42. Test, clean, service and repair MV and LV overhead lines

42.1 Procedure Number RP42

42.2 Scope

This procedure covers the complete test, service, cleaning and repairing of all MV and LV overhead lines complete with al cabling, poles, etc.

42.3 Normative references

SABS 753: 1994, *Pine poles, cross arms and spacers for power distribution, telephone systems and street lighting.*

SABS 754: 1994, *Eucalyptus poles, cross arms and spacers for power distribution and telephone systems.*

SCSSCAAD7 : *(latest revision) Specification for wood poles, cross-arms and spacer blocks.*

SCSSCAAU7 : *Quality requirements for procurement of assets, goods and services.*

SCSPVABS6 : *Technical evaluation of suppliers for products and / or services.*

42.4 Definitions

For the purpose of this standard the following definitions shall apply:

- 42.4.1 air/ground-line region: The critical area extending to 500mm above and 250mm below the ground-line.
- 42.4.2 approved supplemental treatment: An acceptable internal treatment consisting of chemicals designed to protect the ground-line are against fungal decay and insect attack.
- 42.4.3 crack: A crack in a pole is where the pole is split and where the split is parallel to the grain of the wood with a width greater than 7mm in width.
- 42.4.4 excessive cracks: Excessive crack are those where there are more than 3 cracks at any cross section on the pole, or where the length of an individual crack is greater than 10 X the diameter of the pole at the ground-line, or where an individual crack width is wider than 10mm but less than 15mm wide, or where the sum of the widths of the cracks at a particular point is greater than 40mm.
- 42.4.5 extreme cracks: Extreme cracks are those where there are more than 4 cracks at any cross section on the pole, or where the length of an individual crack is greater than 12 X the diameter of the pole, or where an individual crack width is wider than 16mm, or where the sum of the widths of the cracks at a particular point is greater than 50mm.
- 42.4.6 client: The Engineer region requesting the inspection and supplemental treatment of its utility poles.
- 42.4.7 contractor: The body conducting the inspection or supplemental treatment (or both) of in-service utility poles as agreed upon between the client and the contractor.
- 42.4.8 core sample: A sample consisting of either a cylindrical piece of wood extracted using an increment borer or shavings extracted using a drill bit.
- 42.4.9 drill bit: A twist type or screw drill bit consisting of a long shank with a maximum cutting diameter of 12mm.
- 42.4.10 dowel plug: A 13mm diameter wooden peg; the minimum length of the dowel rod shall be 80mm. The dowel rods shall be manufactured from pine wood and fully impregnated under pressure with creosote.
- 42.4.11 plastic plug: Used for plugging above ground inspection and treatment holes. The plug is screwed into a 12mm diameter hole drilled in the pole. It is manufactured from low density black Polyethylene containing 2% carbon black. The overall length is 43mm, the small tip diameter of 10mm and the large tip diameter is 19mm. The thread pitch is 5mm and thread depth of 0.5mm.
- 42.4.12 qualified inspector: An inspector of poles is considered qualified when he has inspected a minimum of 1000 poles under the direct supervision of a qualified inspector. Regional evaluation is required to approve qualified inspectors on a yearly basis, this is either done by trained personnel or an outside approved body such as SANAS as deemed necessary.
- 42.4.13 check scraper: A sharp instrument used to externally probe the outside layer of the pole.

- 42.4.14 shell thickness indicator: A tool designed specifically to extract wood fibre from the holes drilled, to probe for incipient decay and to measure the remaining sound shell thickness.
- 42.4.15 sound pole: A pole that has no apparent internal or external form of degradation. This shall be classified a class 1 pole.
- 42.4.16 serviceable pole: A pole that is classified a class 1, class 2 or class 3 pole. The pole may require stubbing to enable it to be serviceable.
- 42.4.17 stubbing of poles: The process whereby a pole is supported with a short stub wooden pole or an approved steel staking system, this to be approved by Distribution Technology, the approved stub is attached to the insitu pole and is capable of carrying the required load of a new pole.
- 42.4.18 unsound pole: A pole that has been rejected after assessment and that shall be replaced. An unsound pole is a class 4 pole or a class 3 pole that will not be stubbed by the region.
- 42.4.19 recorded poles: Poles that are recorded only in an inspection process due to non-wood pole or access problems.

42.5 Responsibilities

- 42.5.1 The relevant Responsible Person appointed in terms of the Occupation Health and Safety Act shall be responsible for ensuring compliance with this standard and that the correct inspection techniques and pole repairs as a result of the inspections are undertaken.

42.6 Planned inspection program

The purpose of a planned inspection program are:

- a) To identify unserviceable poles in the system;
- b) To identify poles where fungal and termite attack has occurred, at an early stage so that corrective action can be taken;
- c) To extend the life of the pole through remedial treatment;
- d) To identify poles that can be stubbed;
- e) To identify poles that must be replaced with new poles.

42.7 Inspection procedures

- 42.7.1 All poles in a line shall be inspected and a internal chemical shall be applied to the pole.
- 42.7.2 An external chemical shall be applied to the pole below the ground-line when shell rot is present.
- 42.7.3 The inspection and test procedures detailed shall be used to determine the extent of degradation and whether a pole is sound, serviceable and unsound.

42.8 Visual aboveground inspection

- 42.8.1 Inspect the area above ground-line of the pole and cross arm.
 - a) the pole manufacturers name;
 - b) if no pole tag is visible that shall be recorded;

- c) the year the pole was manufactured;
- d) the pole number and, if no pole number is visible, the pole shall be numbered in accordance with the client's numbering plan as agreed in the contract;
- e) the specie of the pole, eg (E55, E75 or P55); (Eucalyptus pole, 55Mpa Ultimate Stress)
- f) whether the pole was kiln or air dried (where indicated);
- g) the length of the pole if indicated on the pole tag;
- h) any lightning damage;
- i) excessive and extreme cracks on the pole;
- j) any poles leaning
- k) any decay or rot visible above the ground;
- l) any pole twisting (slight, medium or great); this is the degree the pole top has twisted in relation to the line of conductors (slight = up to 10°, medium = 10° to 20°, great = 20° to 50°); and
- m) the compaction of the soil around the pole;
- n) mechanical damage to stays or staywire;
- o) mechanical damage to the pole in any way;
- p) woodpecker damage on the pole or cross arm.

42.9 Excavation at the pole

The soil shall be removed around the pole to a depth of 250mm to enable an inspection and assessment to be made on the physical state of the pole below the ground.

Remove the soil that is stuck to the pole by cleaning the exposed area with a wire brush, taking care not to disturb any existing external degradation that still has to be assessed.

42.10 External inspection of ground-line region

This is the most critical area and it shall be thoroughly inspected in accordance with the following:

- a) all the soil or softwood on or in the cracks or voids shall be scraped off; and
- b) a check scraper shall be used to probe for external decay pockets and/or shell rot.

42.11 Internal inspection"

42.11.1 Drill two 12mm inspection holes. One hole drilled at the ground line and one 100mm below the ground-line, these two inspection holes to be drilled diagonally opposite to each other. The inspection holes are to be drilled towards the center of the pole using a "twist or screw type" drill bit. The holes shall be drilled at 45° to the horizontal 100mm below the ground-line. Drilling shall be directed towards the center of the pole to at least half the diameter of the pole.

42.11.2 Using the shell thickness indicator probe the hole for incipient decay, (spring wood decay) and termites, both dormant and active, and record the findings.

42.11.3 Where applicable measure the remaining sound wood (outer shell) and record the measurements.

42.12 Inspection of poles with cables

All poles with cables attached to the poles shall be excavated to 250mm deep around the pole and inspected. Extreme Care shall be taken when excavating around the pole to ensure the cable is not damaged. The pole shall be classified and treatment applied. The contractor is to take full responsibility for any damage to any cable above or below the ground which is at the pole inspected or at adjacent poles on a H pole structure.

Note:

Although the cable entry into the soil might be at one place, the cable might coil below the soil at varying depths and positions.

Extreme care should be exercised at H pole structures where cables come down one pole as the cable might pass the other pole of the H pole structure.

42.13 Classification

Each pole inspected shall be classified as being of the following:

42.13.1 Class 1 (Sound poles)

Utility poles where insect damage or decay of any sort, internal or external degradation or any other form of degradation are not apparent.

42.13.2 Class 2 (Minor ground-line damage)

Utility poles that have areas of biological degradation or physical damage, of such a nature that the pole can still be considered safe and serviceable. These poles will require internal remedial treatment. Damage shall be measured in accordance with the following criteria:

- a) limited internal decay/heartwood rot, with the shell comprising sound wood in excess of 70mm around the pole;
- b) external decay, affecting less than 3mm in depth of the outer shell;
- c) small decay pockets smaller than 50mm in diameter on the outside of the pole;
- d) other defects e.g., slight mechanical or slight lightning damage that cannot affect the integrity of the pole;

42.13.3 Class 3 (Major ground-line damage)

Utility poles that have ground-line areas of biological degradation or physical damage, of such a nature that the pole cannot still be considered safe and serviceable. These poles will require no internal chemical treatment below the ground, only internal treatment applied 300mm above the ground line and possibly an external treatment below the ground if there is shell rot present.

All class 3 poles to be stubbed shall have a further inspection hole drilled 300mm above the ground line at 45°. This is to ensure the pole has no fungal attack or termite activity, the pole shall then be classified as a class 4 pole and shall be replaced. This inspection hole shall be plugged with a treated wooden dowel rod.

Damage shall be measured in accordance with the following criteria:

- a) advanced internal decay/rot or termite damage that is inactive;
- b) the remaining shell comprising not less than 40mm and not more than 70mm of sound wood at any point around the diameter of the pole below ground level;
- c) external decay exceeding 3mm but less than 8mm in depth, determine the shell thickness at this point and if less than 30mm, then classify pole as a class 4 pole.
- d) excessive cracks;
- e) mechanical or lightning damage, and or untreated wood exposed.

42.13.4 Class 4 (Major damage)

Utility poles with advanced internal and external degradation that are considered as unsafe and not treatable. Damage shall be measured in accordance with the following criteria:

- a) major internal and/or external rot or termite attack throughout the pole below the ground-line area;
- b) the remaining shell comprising less than 40mm sound wood at any point around the pole below ground level;
- c) external decay exceeding 8mm in depth;]
- d) extreme physical damage; mechanical, fire or lightning damage;
- e) extreme cracks;
- f) any termite activity within the pole.

42.14 Required action resulting from pole classification

42.14.1 Class 1 Pole required action

- a) The poles shall be treated internally with an approved chemical. The approved internal chemical shall be applied to the pole through the three holes drilled at 20° to the vertical or any other method that is acceptable to Distribution Technology. These three holes shall be drilled at 50mm above the ground-line. Two chemical rods each 10mm diameter and 100mm long shall be applied to each hole. One approved chemical rod shall also be applied into each inspection hole at the ground line and 100mm below the ground-line. The inspection holes shall be plugged with a fully impregnated, 13mm diameter, 80 mm long creosote treated dowel rod. The three holes drilled 50mm above the ground for internal chemical application shall each be plugged with a removable plastic plug or a 13mm diameter 80mm long creosote treated dowel rod.

42.14.2 Class 2 Pole required action

- a) The poles shall be treated internally with an approved chemical. (see annex E). The approved internal chemical shall be applied to the pole through the three holes drilled at 20° to the vertical (see annex B) or any other method that is acceptable to Distribution Technology. These three holes shall be drilled at 50mm above the ground-line. Two chemical rods each 10mm diameter and 100mm long shall be applied to each hole. One approved chemical rod shall also be applied into each inspection hole at the ground-line and 100mm below the ground-line. The inspection holes shall be plugged with a fully impregnated 13mm diameter, 80mm long creosote treated dowel rod (see annex B1). The three holes drilled 50mm above the ground for internal chemical application shall each be plugged with a removable plastic plug or a 13mm diameter 80mm long creosote treated dowel rod.
- b) Where there is any signs of external shell rot, the pole shall be remedially treated externally with an approved chemical (see annex E) from 25mm above the ground-line to 250mm below the ground-line. A 0,25mm thick PVC plastic shield 300mm wide shall be wrapped around the treated area and stapled onto the pole to prevent the applied chemical leaching into the surrounding ground. The quantity of chemical applied externally shall be in accordance with the supplier's specification.

42.14.3 Class 3 Pole required action

- a) All poles to be stubbed shall not be treated internally below the ground-line. They shall be treated internally with an approved chemical 300mm above the ground-line. (see Annex B2). The approved internal chemical shall be applied to the pole through the three holes drilled at 20° to the vertical. Two chemical rods each 10mm diameter and 100mm long shall be applied to each hole. The three holes drilled 300mm above the ground for internal chemical application shall each be plugged with a removable plastic plug or a 13mm diameter 80mm long creosote treated dowel rod. The inspection holes shall be plugged with a fully impregnated, 13mm diameter, 80mm long creosote treated dowel rod.
- b) One approved chemical rod shall also be applied into the inspection hole, which is drilled at 300mm above the ground drilled at 45 degrees. The inspection hole shall be plugged with a fully impregnated, 13mm diameter, 80mm long creosote treated dowel rod.
- c) Where there is any signs of external shell rot below the ground, the pole shall be remedially treated **externally** with an approved chemical (see annex E) from 25mm above the ground-line to 250mm below the ground-line. A 0,25mm thick PVC plastic shield 300mm wide shall be wrapped around the treated area and stapled onto the pole to prevent the applied chemical leaching into the surrounding ground. The quantity of chemical applied externally shall be in accordance with the supplier's specification.

- d) Stubbing to poles shall be done **within 12 months** of the report sheets being received.
- e) All stubbed class three poles shall be re-inspected at least within a 10-year cycle.
- f) For H pole structures, any single pole deemed a class 3 shall make the structure a class 3 until the class 3 pole is stubbed or replaced.

42.14.4 Class 4 Pole required action

- a) The pole shall be replaced with six months of being inspected and rejected.
- b) For H pole structures any single pole deemed a class 4 shall make the structure a class 4 until the class 4 pole is replaced.

42.14.5 Leaning poles

All poles that are out of plumb by more than 500mm shall be straightened within one month after being reported.

42.15 Marking after inspection

Each pole shall be legibly and indelibly marked at a position 1.8m ± 50mm above the ground-line in one of the following ways:

42.15.1 Class 1 poles

A round aluminium tag shall be applied to each pole at 1.8m above the ground-line of the pole. The aluminium tag shall be 25mm in diameter. The tag shall have a hole in the middle of the tag to facilitate attachment. The tag shall be attached with a 15mm galvanized nail. The tag shall bear the following information:

- a) the words "Treated Internally" to be stamped on the label;
- b) the company identification, consisting of the name, trade name or trade mark of the contractor that undertook the inspection;
- c) the month and year in which the inspection took place; and
- d) the class of pole "class 1".

42.15.2 Class 2 poles

A round aluminium tag shall be applied to each pole at 1.8m above the ground-line of the pole. The aluminium tag shall be 25mm in diameter. The tag shall have a hole in the middle of the tag to facilitate attachment. The tag shall be attached with a 15mm galvanized nail. The tag shall bear the following information:

- a) the word "Treated Internally";
- b) the company identification, consisting of the name, trade name or trade mark of the contractor that undertook the inspection and treatment;
- c) the month and year in which the inspection and treatment took place; and
- d) the class of pole "class 2";

- e) Where poles are treated externally for shell rot.

42.15.3 Class 3 poles

A round aluminium tag shall be applied to each pole at 1.8m above the ground-line of the pole. The aluminium tag shall be 25mm in diameter. The tag shall have a hole in the middle of the tag to facilitate attachment. The tag shall be attached with a 15mm galvanized nail. The tag shall bear the following information:

- a) the words "above ground treatment" (this only for poles to be stubbed);
- b) the company identification, consisting of the name, trade name or trade mark of the contractor that undertook the inspection and treatment;
- c) the month and year in which the inspection and treatment took place;
- d) the class of pole "class 3".
- e) A **single white line**, 50mm shall be painted horizontally around the pole, the paint shall be an oil-based paint. This shall be painted on the pole 1.8m above the ground-line. ***This is to indicate that the pole must be stubbed.***
- f) If the pole is **not to be stubbed**, then the pole is to be rejected and classified as a class 4 pole.
- g) Where poles are treated externally for shell rot.

42.15.4 Class 4 poles

A square aluminium tag shall be applied to each pole at 1.8m above the ground-line of the pole. The aluminium tag shall have 25mm sides. The tag shall have a hole in the middle of the tag to facilitate attachment. The tag shall be attached with a 15mm galvanized nail. The tag shall bear the following information:

- a) the word "Rejected", on the label;
- b) the company identification, consisting of the name, trade name or trade mark of the contractor that undertook the inspection;
- c) the year and month in which the inspection took place;
- d) the class of pole "class 4".
- e) **Two white lines**, 50mm wide, shall be painted horizontally around the pole, the paint to be a oil-based paint. These lines being 100mm apart. The white lines shall be painted on the pole 1.8m above the ground-line. ***This is to indicate that the pole must be replaced.***

42.15.5 Poles treated with External Treatment

Poles treated for shell rot with external treatment shall also be marked with an additional label stating "external treatment". The aluminium tag shall be round and 25mm in diameter. The tag shall have a hole in the middle of the tag to facilitate attachment. The tag shall be attached with a 15mm galvanized nail.

42.16 Restoration of the inspection area

42.16.1 After the inspection and remedial treatment is completed the area around each pole shall be restored, using the following procedure:

- a) Backfilling shall be done by replacing the excavated material in 250mm layers and compacting the soil by ramming the soil with stampers, taking care cables are not damaged.
- b) excess excavated material shall form a mound at the base of the pole to cater for any subsidence that might occur.
- c) the area surrounding the pole shall be left in a clean and orderly state and all debris shall be removed from the site.

42.17 Recording

Full details of every inspected pole in the utility line shall be recorded on line pole inspection report forms.

A copy of the reports concerned and a summary sheet of the line shall be given to the person concerned as indicated in the contract. The contractor shall keep a copy of the records for a period of 12 years.

HA 13 TECHNICAL DETAILS : SCHEDULED MAINTENANCE WORK

HA 13.01 This section contains the specifications for the scheduled maintenance procedures that are to be carried out during the three year contract period. The scheduled maintenance tasks shall commence at the specified frequency once the initial repair work has been completed. The contractor should note that the tendered rate for each procedure shall include both the supply, delivery, installation, testing and commissioning of equipment and material, and the labour and other costs associated with the completion of the procedure.

HA 13.02 Scope of scheduled maintenance work.

HA 13.02.01 Monthly Maintenance Tasks

The following maintenance tasks shall be performed on a monthly basis :

- SM01 Standalone Power Transformer Service
- SM02 Miniature Substation Service
- SM03 Pole-mounted Transformer Service
- SM04 Distribution Substation Service

HA 13.03 All the scheduled maintenance work is specified in the following procedures :

- 1. Standalone Power Transformer Service
 - 1.1 Procedure Number : SM01
 - 1.2 Scope

This procedure describes the periodical service of standalone power transformers of ratings up to 200kVA. This procedure does not include the servicing of miniature substation transformers. The service includes the servicing of the dehydrating breathers (including the oil seal or bath).

1.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the following standard specifications, regulations and codes :

- a) The original equipment manufacturer's specifications, and operation and maintenance instructions.
- b) SABS 555 : Standard Specification for Mineral insulating oil for transformers and switchgear (uninhibited)
- c) BS 3523 : Specification for granular desiccant silica gel impregnated with cobalt chloride.

1.4 Task Description

a) General Service

The contractor shall complete the following actions :

- i) The transformer shall be checked for visible defects, and any such defects shall be reported in documented format to the Engineer.
- ii) The contractor shall maintain the transformer in a clean and dust-free condition using safe methods of cleaning and dusting.
- iii) The contractor shall check for and record any indication of oil leaks.
- iv) The contractor shall check for and record any indication of cracked bushings.
- v) The contractor shall maintain all cable terminations (MV and LV) in a good condition. All defects and deteriorated cable terminations shall be corrected and or replaced where necessary. Cable terminations shall be done in accordance with procedure RP13.

b) Dehydrating Breather Service

- i) The contractor shall check the quantity and colour of the dehydrating agent (typically silica gel) and reactivate or replace it where necessary.
- ii) The silica gel shall be considered to require replacement if its colour is pink or if the breather is not filled to the required level, and it shall be considered not to need replacement if its colour is deep blue and the breather is filled to the required level.
- iii) Silica gel used for replacement shall be new silica gel and shall comply with BS 3523.
- iv) The oil seal or bath at the base of the dehydrating breather shall be removed, cleaned out, and refilled with new insulation oil. The insulation oil used for this purpose shall be new insulation oil in compliance with SABS 555. The dehydrating breather shall be refilled with insulating oil to the level as prescribed in the manufacturer's maintenance instructions.

1.5 Measurement and Payment

- a) The unit of measurement shall be the number of time a standalone power transformer is serviced. A single rate shall apply to all sizes of transformers, and the tendered rates shall be

based on a transformer size of 200kVA. The unit rates shall be compiled and submitted in the point system format as specified elsewhere in the document.

- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for the following :
 - i) All work associated with the service of standalone power transformers, excluding the replacement of cable terminations, which shall be considered a separate payment item
 - ii) The supply of dehydrating breather and breather top up insulation oil as is required for the service of the dehydrating breather.

2. Miniature Substation Service

2.1 Procedure Number : SM02

2.2 Scope

This procedure describes the periodical service of miniature substations of ratings up to 630kVA.

2.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with original equipment manufacturer's specifications, and operation and maintenance instructions.

2.4 Task Description

- a) Metal Enclosure and Plinth
 - i) The contractor shall check the enclosure and plinth for visible defects. All defects shall be recorded in documented format.
 - ii) The contractor shall maintain all parts of the miniature substation in a clean and dust free condition.
 - iii) The contractor shall check that the miniature substation is properly installed on its plinth and that it does not lean over in any direction.
 - iv) The contractor shall check the condition of door hinges and that panel doors open and close correctly.
 - v) The contractor shall ensure that padlocks are installed on all lockable panel doors.
- b) Medium Voltage Compartment
 - i) The contractor shall check the MV compartment for visible defects. All defects shall be recorded in documented format.
 - ii) The contractor shall check all equipment components for looseness and bent or damaged brackets. All such defects shall be corrected.
 - iii) The contractor shall maintain all MV cable terminations in a good condition. All defects and deteriorated cable terminations shall be corrected and or replaced where necessary. Cable terminations shall be done in accordance with procedure RP13.

- iv) All miniature substation fuses shall be checked for condition and to ensure that they are correctly rated. Should any fuse be blown and or be incorrectly rated, it shall be replaced with the correct fuse. All fuse replacements shall be recorded, and used fuses that are not blown shall be handed over to the Engineer.
- c) Transformer Compartment
 - i) The transformer shall be checked for visible defects, and any such defects shall be reported in documented format to the Engineer.
 - ii) The contractor shall maintain the transformer in a clean and dust-free condition using safe methods of cleaning and dusting.
 - iii) The contractor shall check for and record any indication of oil leaks.
 - iv) The contractor shall check for and record any indication of cracked bushings.
 - v) The contractor shall maintain all cable terminations (MV and LV) in a good condition. All defects and deteriorated cable terminations shall be corrected and or replaced where necessary. Cable terminations shall be done in accordance with procedure RP13.
- d) Low Voltage Compartment
 - i) The transformer shall be checked for visible defects, and any such defects shall be reported in documented format to the Engineer.
 - ii) The contractor shall check all equipment components for looseness and bent or damaged brackets. All such defects shall be corrected.
 - iii) The contractor shall check all circuit breakers, isolators, fuse links and instrumentation for correct operation, and record and report all defects.

2.5 Measurement and Payment

- a) The unit of measurement shall be the number of times a miniature substation is serviced. A single rate shall apply to all sizes of miniature substation, and the tendered rates shall be based on a size of 630kVA. The unit rates shall be compiled and submitted in the point system format as specified elsewhere in the document.
- b) The tendered rate shall include full compensation for all aspects specified in clause HA 08. In addition to this, the tendered rate shall also include full compensation for all work associated with the service of miniature substations, excluding the replacement of cable terminations, which shall be considered a separate payment item.

3. Pole-mounted Transformer Service

3.1 Procedure Number : SM03

3.2 Scope

This procedure covers the service of pole-mounted transformers and the associated low voltage distribution kiosks.

3.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

3.4 Task Description

- a) The pole-mounted transformer installation shall be inspected for visible defects, and any such defects shall be reported in documented format to the Engineer.
- b) The contractor shall maintain the low voltage distribution kiosk in a clean, vermin and dust-free condition using safe methods of cleaning and dusting.
- c) The contractor shall check the transformer for and record any indication of oil leaks.
- d) The contractor shall check for and record any indication of cracked bushings.
- e) The contractor shall check the continuity of the low and medium voltage earth installations.

3.5 Measurement and Payment

- a) The unit of measurement shall be the number of times a transformer installation is serviced. The unit rates shall be compiled and submitted in the point system format as specified elsewhere in the document.

4. MV/LV Distribution Substation Maintenance Inspection

4.1 Procedure Number : SM04

4.2 Scope

The procedure comprises of a general inspection of the various MV/LV distribution substations. These substations are all brick buildings comprising of three sections : a MV section, a transformer section, and a LV section. The purpose of this procedure is to perform a routine inspection of the complete substation to determine the condition and status of equipment, and at the same time performing minor routine maintenance tasks.

4.3 Standard Specifications, Regulations and Codes

All work carried out and all equipment and material supplied in terms of this procedure shall comply with the original equipment manufacturer's specifications, and operation and maintenance instructions.

4.4 Task Description

The following items shall be inspected and serviced:

- a) General defects inspection.
- b) All rooms of the substation building shall be thoroughly cleaned using a broom to sweep the floor and other equipment to dust and clean equipment.
- c) All luminaires and lamps and their fittings shall be maintained in a good working order. The contractor shall supply and install luminaires, lamps and their fittings as is required to have all this equipment operational at all times.
- d) Low Voltage Distribution Board

The Low Voltage distribution board shall be kept in a clean and neat condition. The contractors shall inspect the low voltage distribution equipment and record all defects.

4.5 Measurement and Payment

- a) The unit of measurement shall be the number of times a substation installation is serviced. The unit rates shall be compiled and submitted in the point system format as specified elsewhere in the document.

TECHNICAL SPECIFICATION HB

STANDBY POWER SYSTEMS

CONTENTS

HB 01	SCOPE
HB 02	STANDARD SPECIFICATIONS, REGULATIONS, CODES AND ADDITIONAL SPECIFICATIONS
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HB 10	DIESEL GENERATORS : TECHNICAL DETAILS
HB 11	UPS UNITS : TECHNICAL DETAILS
HB 12	MAINTENANCE OF STANDBY POWER INSTALLATIONS

HB 01 SCOPE

HB 01.01 This specification comprises all aspects regarding the repair and maintenance of standby power systems. The standby power sources consist of:

GENERATOR 1: 3 PHASE AUTOMATIC CHANGE OVER





GENERATOR 2:





HB 01.02 This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with the Additional Specifications included with this document.

HB 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

HB 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

HB 02.02 SABS Specifications

02.02.01 SABS 0400 : NATIONAL BUILDING REGULATIONS

02.02.02 SABS 0142 : WIRING CODE

HB 02.03 Department of Public Works Specification PW 774

HB 02.04 Occupational Health and Safety Act of 1993

HB 02.05 Manufacturer's specifications and maintenance instructions

HB 02.06 Additional requirements

Equipment and material supplied and installed shall be new and unused. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on cabling, wiring, fuel tanks, batteries and diesel engines.

HB 03 OPERATING AND MAINTENANCE MANUALS

HB 03.01 The Contractor shall be responsible for the compilation of a complete set of Operating-and-Maintenance manuals.

This shall be done in accordance with the Additional Specification SB – Operating and Maintenance manuals.

All information shall be recorded and reproduced in electronic format as well as supplying the Engineer with three sets of hard copies.

HB 03.02 Over and above what is specified in the Additional Specification – SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall be structured and shall at least include the following:

03.02.01 Description of installation

- a) Complete system description of each standby power source. This shall be done for each installation individually. The system description shall contain detailed information regarding the supply configuration (cabling, distribution boards), the switching arrangement (change-over and override facilities) and the refuelling procedure as well as the earthing, fire and lightning protection arrangement.
- b) Service records

03.02.02 Commissioning Data

- a) Complete commissioning, test and inspection data of standby power system.

This shall be done for each installation individually. The commissioning data will comprise voltage and output current measurements, running hour meter readings, battery voltage during starting and engine compression tests.

03.02.03 Operating Data

- a) Safety precautions to be implemented.
- b) Operation of systems; automatic, manual and bypass switching.
- c) Emergency starting and forced change-over procedure.

03.02.04 Maintenance instructions

- a) Recommended service intervals with service descriptions.
- b) Projected service life of:
 - diesel engine to next overhaul
 - diesel engine starter batteries
- c) Trouble shooting diagrams.
- d) Schedule of consumable spares.

HB 04 TEST AND INSPECTIONS PRIOR TO PRACTICAL COMPLETION OF REPAIR WORK

HB 04.01 It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters:

- 04.01.01 output phase voltages
- 04.01.02 output current per phase
- 04.01.03 insulation testing at 500V

- 04.01.04 system earthing resistance testing by means of wheat stone bridge instrument
- 04.01.05 load testing, utilising dummy loads

The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

HB 05 LOGGING AND RECORDING PROCEDURES

HB 05.01 The Contractor shall as part of this Contract institute a Recording system as part of his Maintenance Control Plan as defined in the Additional Specification SA – General Maintenance. This shall consist of a Record book which shall be utilised to log and record all faults, system checks, services, overhauls, breakdowns, maintenance visits, inspections, etc.

HB 05.02 The logbook shall be stored in a safe place inside each generator room and shall only be utilised by the Contractor and Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

This logbook shall be structured to at least include the following:

- 05.02.01 Monthly inspection and maintenance actions.
- 05.02.02 Scheduled services.
- 05.02.03 Breakdown / call out reports.
- 05.02.04 Major overhaul or battery replacements.

HB 06 MAINTENANCE TOOLS AND SPARES

HB 06.01 On commencement of the Repair and Maintenance Contract, the Contractor shall supply and deliver certain tools and spares to the user client. These tools and spares will be the property of the Department of Public Works. Any deficiencies or short fall or damaged Tools and Spares during the contract shall be replaced with new equipment / material.

HB 06.02 The Tools and Spares shall be kept safe in a lockable store room on site. The Contractor shall provide his own lock for the designated store room. The inventory of the Tools and Spares shall be verified on a monthly basis. Any short fall shall be replaced by the Contractor as part of his responsibility under this contract.

HB 06.03 The Tools and Spares shall at least include the following:

- Distribution Board key (3 off)**
- Distribution Board face plate square key (3 off)**
- Alarm panel key (3 off)**
- Change-over contactor coil**
- 20l HD diesel oil as per engine manufacturer’s specification**
- Oil funnel**
- 25l distilled water**
- Battery hydrometer**
- 12V diesel jockey pump**
- 5m 20mm Ø diesel hose**
- 10mm² battery jumper cables : 1 pair**
- Wall mounted paper towel dispenser with paper cartridge per generator room**

HB 07 QUALITY ASSURANCE SYSTEM

HB 07.01 Following formal approval of his Quality Assurance system by the Engineer to the Contractor shall implement the approved Quality Assurance system.

HB 07.02 Records of this Quality Assurance system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required by the Department.

HB 08 RE-COMMISSIONING OF INSTALLATION

On practical completion of the repair work, battery replacement and services, the installations shall be put into operation.

HB 09 REPAIR WORK TO STANDBY POWER INSTALLATIONS

HB 09.01 The various systems shall be repaired during the first phase of the repair and maintenance contract.

HB 09.02 The scope of the repair work shall include, but shall not be limited to the activities listed below.

HB 09.03 The Contractor shall record the repair actions in tabular format before the Contractor's responsibility for maintenance commences.

HB 09.04 Repair work shall be executed within the approved period for repairs.

HB 09.05 New equipment and material (eg. batteries, fuel pumps, starter motor, etc) shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of practical completion. These guarantees shall be furnished in favour of the Department of Public Works.

HB 10 STANDBY GENERATORS: TECHNICAL DETAILS

HB 10.01 Installation description

Refer to the enclosed photo report schedule.

HB 10.02 Scope of repair work : generators

HB 10.02.01 Clean plant room, clean and re-lamp luminaires. Seal all sleeves with chicken wire and builders foam. Put rodent poison inside cable trenches (2 x 500g).
Paint floor with epoxy paint.

Service diesel engine and steam clean engine, alternator as well as day tank.

Inspect all rubber hoses and wiring; replace if required.

Service existing battery.

Do cold starting volt drop test on prime mover starter battery; replace starter battery if required.

Clean sliprings and inspect brushgear. Open alternator terminal box, clean and tighten terminations. Check and record earthing value as measured with resistance measuring instrument.

Service alarm panel and clean internally and externally. Simulate and verify all alarm and shut down conditions. Replace all inoperative lamps, sirens and meters.

Repair lagging on exhaust system and reseal room exit port.

Reinstate fuel shut off system with fusible link.

Fit new padlocks on plant room.

HB 10.02.02 Do witnessed dummy load test.

HB 10.02.03 Service change-over switchgear. Disassemble contactors and clean. Test operation following service.

HB 10.03 **Generator repair work: measurement and payment**

HB 10.03.01 **Repair plant room**

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the repair and upgrade of the plant room. This includes repair work on luminaires, doors, locks including the fitting of new padlocks.

Walls and ceilings shall be washed with sugar soap. Floors shall be washed and painted with grey 2-part industrial epoxy paint.

Cable trenches shall be cleaned and finally vacuumed. All cable sleeves shall be sealed with builders foam and chicken wire.

HB 10.03.02 **Service genset**

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the complete mechanical service of the generator installation according to the manufacturer's instructions, replacement of wiring and hoses as needed, opening and cleaning of alternator and alarm panel as well as the steam cleaning of the assembly.

HB 10.03.03 **Diesel engine service**

The unit of measurement shall be the number of mechanical services performed on diesel engines in the 75kW to 250kW range.

The tendered rate shall include full compensation for the execution of a full engine service as per the manufacturer's recommendations including air, fuel and oil filters, oil and other consumable items.

HB 10.03.04 **Replace starter battery**

The unit of measurement shall be the number of diesel starter batteries replaced.

The tendered rate shall include full compensation for the removal of the existing battery, the installation and reconnection of a new "Delttec Heavy-Duty Freedom"-type battery and final test of start up volt drop.

HB 10.03.05 Dummy load test

The unit of measurement shall be the number of on-site dummy load tests performed.

The tendered rate shall include full compensation for the opening of the alternator terminal box, connection of dummy load, 30 minute full load test, recording of test results and disconnection of load and reconnection of site load.

HB 10.03.06 Change-over switchgear service

The unit of measurement shall be the number of assemblies serviced.

The tendered rate shall include full compensation for the disassembly of the change-over contractor pair, cleaning and reinstallation as well as the testing following completion of the test.

HB 10.03.07 Supply and install padlocks

The unit of measurement shall be the number of 75mm padlocks installed.

The tendered rate shall include full compensation for the ordering, supply, engraving and installation of the plant room padlocks.

HB 10.03.08 Supply of diesel fuel

The unit of measurement shall be the quantity of diesel fuel supplied and transferred into day tanks.

The tendered rate shall include full compensation for the supply, transport and transfer of diesel fuel.

HB 10.03.09 Supply of Tools and Spares

The unit of measurement shall be a lump sum. The tendered rate shall include full compensation for the supply and delivery of the Tools and Spares specified.

HB 11 UPS UNITS : TECHNICAL DETAILS

HB 11.01 Installation description

UPS DESCRIPTION :

Item No	Locality	Manufacture	Model	Output		Operational Yes / No	Approx year of install	Critical load supplied	Last service
				Single phase	kVA				
1	BUILDING	TOWER	1100	Yes	15	Yes	Unknown	Battery	
2	BUILDING	TOWER	1100	Yes	15	Yes	Unknown	Battery	
3	BUILDING	TOWER	3300	Yes	45	Yes	Unknown	Battery	
4									



HB 11.02 **Scope of repair work : UPS unit**

HB 11.02.1 Remove cabinet cover / doors. Clean unit internally and externally. Check operation of ventilating fan and replace air intake filter, if fitted. Check and record earthing value with prescribed resistance measuring instrument.

HB 11.02.02 Record output voltage, frequency and current in Record book. Record battery voltage.

HB 11.02.03 Clean battery cabinet and tighten terminals. Do witnessed dummy load test and submit report on condition of batteries.

HB 11.02.04 Replace UPS batteries upon instruction from Department.

HB 11.03 **UPS repair work: measurement and payment**

HB 11.03.01 **Service UPS electronic and battery cabinet**

The unit of measurement shall be the number of UPS systems opened and serviced.

The tendered rate shall include full compensation for the opening, cleaning , visual inspection of cable terminations, ventilating fans, battery links and the recording of earthing resistance.

HB 11.03.02 **Dummy load test**

The unit of measurement shall be the number of on-site UPS dummy load tests performed.

The tendered rate shall include full compensation for the connection of a UPS dummy load, 30 minute full load test recording of test results, including battery voltage and reconnection of site cabling as well as a written report on battery condition.

HB 11.03.03 **Replace UPS batteries**

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the disconnection and safe disposal of old batteries and supply, installation and connection of new sealed "Willard Vantage" UPS batteries.

HB 12 MAINTENANCE OF THE INSTALLATION

HB 12.01 Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with commencement of the Contract. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

HB 12.02 The following maintenance actions will be required under the contract:

- 12.02.01 routine preventative maintenance
- 12.02.02 corrective maintenance
- 12.02.03 breakdown maintenance

These actions are defined in the Additional Specification SA – General Maintenance.

HB 12.03 The maintenance schedules and frequency of services and maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractor's responsibility in this regard is specified in the Additional Specification SA – General Maintenance.

HB 12.04 **Generator maintenance: scope of work.**

HB 12.04.01 Monthly inspection

(a) The following activities shall be executed during the monthly generator inspections:

- check oil level and top up as required.
- check oil viscosity for dilution by water or fuel.
- check starter battery terminals and apply contact grease.
- check battery cables for damage and secure terminations.
- check battery electrolyte.
- check battery voltage and record.
- check battery voltage drop during engine cranking and record.
- check battery charger operation after cranking test.
- check starter motor for abnormal noise.
- check diesel engine while running for noise, vibration or loose components.
- check all flexible hoses for leaks, corrosion and ageing.
- check all engine V-belts.
- monitor engine / alternator coupling for noise.

(b) Verify that alarm functions are operational by simulation:

- low oil pressure.
- high engine temperature.
- low engine coolant level.
- abnormal speed.
- synchronising failure (if applicable)
- cooling water pump failure.
- cooling tower fan failure (if applicable).
- low battery voltage.
- low fuel day tank.
- fuel pump failure.
- low fuel bulk tank (if applicable).

(c) Test that following alarms trigger correctly by creating the alarm condition:

- Unit not in auto : turn selector switch to manual or test
- Battery charger failure : switch off AC supply to battery charger
- Auxiliary supply failure : switch off auxiliary power supply

(d) Alternator shall be checked for accumulation of dust on the regulator and for any loose components.

(e) Test run shall be undertaken, if possible on load, and volt, ampere and frequency readings recorded.

(f) Alternator shall be cleaned and switched back into 'auto' mode.

HB 12.04.02 Annual inspection

The following activities shall be executed in addition to the monthly maintenance work after every twelve months.

- (a) Drain an oil sample and submit for analysis to establish need for an oil change. Fix test report in Record book.
- (b) Record output parameters while on load.
- (c) Record running hours.

HB 12.04.03 Every two years : inspection and service

In addition to the annual service, the cooling system shall be drained, flushed and refilled with water and prescribed water conditioner.

HB 12.05 **Generator maintenance : measurement and payment**

Refer to Clause SA 06 of the ADDITIONAL SPECIFICATION : SA GENERAL MAINTENANCE.

HB 12.06 **UPS maintenance : scope of work**

HB 12.06.01 Two-monthly inspection

(a) The following activities shall be executed during each two-monthly inspection:

- record mains input voltage.
- record unregulated DC voltage.
- record battery charger voltage.
- visually check appearance of DC capacitors.
- visually inspect soft-start relays and resistors.
- record power supply output voltage on 5V and on 12V tops.
- measure "free running" frequency.
- check phase-lock loop.
- measure inverter output voltage and verify wave shape.
- check fan operation.
- check and record phase error voltage.

(b) The following must be measured and recorded:

- output voltage.
- load current.
- verify correct fuse ratings.

(c) Clean cabinets externally and internally.

HB 12.07 **UPS maintenance : measurement and payment**

HB 12.07.01 **Two-monthly inspection**

The unit of measurement shall be the number of two-monthly UPS inspections performed.

The tendered rate shall include full compensation for the execution of a two-monthly inspection as specified above. The rate shall also include the upkeep of the service documentation.

TECHNICAL SPECIFICATION

HC LOW VOLTAGE RETICULATION

CONTENTS

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HC 12	LOW VOLTAGE DISTRIBUTION KIOSKS: TECHNICAL DETAILS
HC 13	LOW VOLTAGE OVERHEAD DISTRIBUTION SYSTEM: TECHNICAL DETAILS

HC 01 SCOPE

- HC 01.01 This specification comprises all aspects regarding the repair and maintenance of low voltage systems. Low voltage comprises:
- Low voltage distributions boards
 - Low voltage kiosks
 - Low voltage overhead distribution system
- HC 01.02 This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with Part C, the Additional Specification included with this document

HC 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

- HC 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with the specification and shall deemed to form part thereof.
- HC 02.02 SABS Specifications
- SABS 0142-1
 - SABS 0142-2
 - SABS 141

HC.2

- SABS 1091
 - SABS 763
 - SABS 1195
 - SABS 784
- HC 02.03 Department of Public Works Specifications
- PW 774
- HC 02.04 Occupational Health and Safety Act of 1993 (OHS-Act)
- HC 02.05 Manufacturer's specifications and maintenance instructions
- HC 02.06 Additional requirements

Equipment and material installed shall be new and unused. All equipment shall bear the SABS stamp. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on low voltage distribution boards and kiosks.

HC 03 AS BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS

HC 03.01 **No current as built information on the installation is available.**

The Contractor shall be responsible for the compilation of a complete set of as-built drawings, inventory list and Operating- and Maintenance manuals. The Contractor shall be responsible for the verification of the correctness of all such information.

This shall be done in accordance with the Additional Specification SB-Operating and Maintenance manuals.

The Contractor shall allow for the required tools and equipment to establish the correct as-built information.

All information shall be recorded and reproduced in electronic format as well as supplying the Engineer with three sets of hard copies.

HC 03.02 Over and above what is specified in the Additional Specification – SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall be stored and shall at least include the following:

- System Description
 - Complete system description of the low voltage system. This shall be done for each low voltage installation individually. The system description shall contain detailed information regarding the system configuration (system input, cabling system output), the installed components (circuit breaker ratings, meter configuration) as well as the earthing and lightning protection.

HC.3

- Complete details of L.V. distribution boards, panels and kiosks and overhead reticulation system.

- Commissioning Data

- Complete commissioning, test and inspection data of the low voltage system.

This shall be done for each low voltage system individually. The commissioning data will comprise of usual inspection sheets startup and running current measurements. Full data on equipment fitted with installation dates.

- Operating data

- Safety precautions to be implemented.

- Maintenance instructions

- Procedure to verify operation of circuit breakers.
- Procedure to replace low voltage kiosk.
- Trouble shooting diagram.
- Equipment details, including manufacturer brochures/pamphlets. order number, list of components and equipment specifications.
- Schedule of serviceable components per low voltage system.
- Procedure to replace wooden poles for overhead reticulation.
- Procedure to replace broken isolators for overhead reticulation.
- Procedure to tension overhead conductors by adjustment of anchors.
- Hoisting equipment specification, if applicable.

HC 04 TEST AND INSPECTION FOLLOWING COMPLETION OF REPAIR WORK

HC 04.01 It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters:

- Phase voltages and current
- Earthing resistance testing

The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

HC 05 LOGGING AND RECORDING PROCEDURES

HC 05.01 The Contractor shall as part of this Contract Institute a Recording system as part of his Maintenance Control Plan as defined in the Additional Specification SA – General

HC.4

Maintenance. This shall consist of a Record book which shall be utilized to log and record all faults, system checks, services, overhauls, breakdowns, maintenance visits, inspections, etc.

HC.05.02 The logbook shall be stored in a safe place inside the main substation and shall only be utilized by the Contractor and the Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

This logbook shall be structured to at least include the following:

- Monthly low voltage equipment inspection and maintenance actions.
- Bi-annual inspection and testing of low voltage systems.
- Annual earthing and insulation test report.
- Breakdown/call out reports

HC 06 MAINTENANCE TOOLS AND SPARES

HC 06.01 On commencement of the Repair and Maintenance Contract, the Contractor shall compile an inventory of the existing Tools and Spares in the presence of the User Client. Any deficiencies or short fall or damaged Tools and Spares shall be replaced with new equipment/material, as part of the contract.

HC 06.02 The Tools and Spares shall be kept in a lockable store room on site. The Contractor shall provide his own lock for the designated store room. The inventory of the Tools and Spares shall be verified on a monthly basis. Any short fall shall be replaced by the Contractor as part of this responsibility under this contract.

HC 06.03 The Tools and Spares shall at least include the following:

- DB Key
- DB face plate square key

HC 07 QUALITY ASSURANCE SYSTEM

HC 07.01 Following formal approval of his Quality Assurance system by the Engineer, the Contractor shall implement the approved QA system

HC 07.02 Records of this QA system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required.

HC 08 RE-COMMISSIONING OF INSTALLATION

On completion of the repair work, the low voltage reticulation shall be put into operation.

HC 09. REPAIR WORK TO LOW VOLTAGE RETICULATION

- HC 09.01 The distribution boards, kiosks and overhead reticulation system shall be repaired as measured in the bills of quantities, during the first period of the repair and maintenance contract.
- HC 09.02 The scope of the repair work shall include, but shall not be limited to the activities listed below.
- HC 09.03 The Contractor shall record the repair actions in tabular format before the maintenance phase commences.
- HC 09.04 Repair work shall be executed within the approved period for repairs. This period shall be agreed at the start of the contract period.
- HC 09.05 New equipment and material shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of hand-over. These guarantees shall be furnished in favour of the User Client.
- HC 09.06 The maintenance phase of this contract shall commence once the repair work on the installation have been commissioned and handed over to the satisfaction of the Engineer.

HC 10 LOW VOLTAGE RETICULATION MAINTENANCE

- HC 10.01 The various low voltage systems shall be maintained following the initial repair work. The maintenance contract shall run for the balance of the 36 month contract period.

HC 11 LOW VOLTAGE DISTRIBUTION BOARDS: TECHNICAL DETAILS

HC 11.01 Installation description

This section describes the electrical distribution network that will be repaired and maintained in terms of the contract.

Substations

The low voltage supply is distributed from the low voltage room in substation.

This room contains floor standing low voltage panels that are installed over cable trenches. The enclosures contain low voltage circuit breakers and instrumentation equipment.

HC 11.02 Scope of Repair Work

HC.6

HC 11.02.01 General repair work

- Service low voltage distribution boards: clean, secure circuit breakers, secure terminations, label circuit breakers and cables.
- Move circuit breakers: Loosen circuit breakers move and secure in new position.
- Install circuit breaker.
- Re-paint front cover of emergency section.
- Disconnect and remove redundant switchgear.
- Replace circuit breakers.
- Disconnect and remove redundant street and security lighting control panel
- Disconnect and remove redundant cables.
- Replacement of undersized jumper cables.
- Installation of trench covers.

HC 11.03 Repair work: measurement and payment

<u>Item</u>	<u>Unit</u>
(a) Service low voltage distribution boards The unit of measure shall be the number of low voltage boards serviced.	No

The tendered rate shall include full compensation for the opening and cleaning of low voltage board, vermin protection, secure MCBs and terminations, fitting of engraved labels and blank covers.

<u>Item</u>	<u>Unit</u>
(b) Test ammeter and CT functionality. The unit of measure shall be the number of ammeters and CT's tested.	No

The tendered rate shall include full compensation for the removal, testing and replacement of meters.

<u>Item</u>	<u>Unit</u>
(c) Re-paint cover on panel	No

The unit of measure shall be the number of front covers of panels re-painted.
The tendered rate shall include full compensation for the removal, de-rusting and degreasing of panel and re-painting, fitting of engraved labels and re-installation of the cover with dimensions as specified in the Bill of Quantities.

<u>Item</u>	<u>Unit</u>
(d) Remove 5kA MCB's on incoming section of Main Substation low voltage Distribution board.	item

HC.7

The unit of measure shall be the sum for removal of the circuit breakers as specified.

The tendered rate shall include full compensation for the removal of the existing 5kA MCB's on the incoming section of the main board.

<u>Item</u>	<u>Unit</u>
(e) Removal of Fuchsware MCB's on Main Substation Low Voltage distribution board (local section)	item

The unit of measure shall be a sum for the removal of the circuit breakers as specified.

The tendered rate shall include full compensation for the removal of the existing MCB's and supply and installation of new MCB's as specified and connection.

<u>Item</u>	<u>Unit</u>
(f) Removal of redundant switchgear on Main Substation low voltage distribution board	item

The unit of measure shall be a sum for removal of the equipment.

The tendered rate shall include full compensation for disconnection and removal of redundant equipment and jumpers.

<u>Item</u>	<u>Unit</u>
(g) Removal of redundant security and perimeter light control panel in main Substation	No

The unit of measure shall be the number of panels removed.

The tendered rate shall include full compensation for locating and disconnection of all cables to this panel including removal of the panel from the substation

<u>Item</u>	<u>Unit</u>
(h) Remove redundant cable	No

The unit of measure shall be the number of cables removed.

The tendered rate shall include full compensation for the complete removal of the cable site.

<u>Item</u>	<u>Unit</u>
(i) Supply and install power outlets.	No

HC.8

The unit of measure shall be the number of power sockets installed.

The tendered rate shall include full compensation for the removal, supply and installation of single power outlets.

<u>Item</u>		<u>Unit</u>
(j)	Supply and install light switch	No

The unit of measure shall be the number of light switches installed. The tendered rate shall include full compensation for the removal supply and installation of a 1 way 1 lever light switch.

<u>Item</u>		<u>Unit</u>
(k)	Label cables	No

The unit of measure shall be the number of labels installed.

The tendered rate shall include full compensation for the installation of cable markers on both ends of all cables with a minimum font height of 18mm. The marking system used should be of type Graftoplast or equal.

<u>Item</u>		<u>Unit</u>
(l)	Install trench covers	No

The unit of measure shall be the number of covers installed.

The tendered rate shall include full compensation for the supply and installation of cable trench covers in sizes as specified.

<u>Item</u>		<u>Unit</u>
(m)	Supply and install circuit breakers	No

The unit of measure shall be the number of circuit breakers installed.

The tendered rate shall include full compensation for the supply and installation and connection of circuit breakers as specified.

HC 11.04 Scope of Maintenance work

HC 11.04.01 Monthly Inspection

- (a) Verify operation of volt and ammeters.
- (b) Check that access covers are secure.

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- (c) Visually check distribution board.
- (d) Check all connections.
- (e) Check operation of switching timers.

HC 11.04.02 Annual inspection

- (a) Service all low voltage boards.
- (b) Measure phase voltages and line currents in low voltage distribution board.
- (c) Record values in record book.

HC 11.05 Maintenance work: measurement and payment

Refer to clause SA 06 of the ADDITIONAL SPECIFICATION: SA GENERAL MAINTENANCE_

HC 12 DISTRIBUTION AND METERING KIOSKS: TECHNICAL DETAILS

HC 12.01 Installation description

This section describes the electrical distribution and metering kiosks that will be repaired and maintained in terms of this contract.

This part of the distribution network consists of freestanding low voltage outdoor kiosk. The kiosk contains breakers, switching and instrumentation equipment.

HC 12.02 Scope of repair work

- 1) Open distribution kiosk, check locks, door hinges, clean inside, provide rodent protection, secure circuit breaker and terminations: label all kiosks, label circuit breakers, label cables and provide warning notices.
- 2) Measure earth resistance.
- 3) Touch up kiosks: Remove all rust with an anti corrosion agent and repaint kiosks.
- 4) Replace handles and padlocks on distribution kiosks.
- 5) Remove and re-mount contractors.

HC.10

6) Replace door hinges and latches.

7) Replace panel catches.

8) Repair burnt connections.

HC 12.03

Repair work: measurement and payments

<u>Item</u>	<u>Unit</u>
-------------	-------------

(a) Service distribution kiosk	No
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The unit of measurement shall be the number of distribution kiosks serviced.

The tendered rate shall include full compensation for the servicing of the distribution kiosk, vermin protection, cleaning of circuit breakers, general cleaning of the kiosk, earth testing, securing of MCB and terminations. The contractor shall submit a report on the general condition of the kiosk (damage, rust etc.)

<u>Item</u>	<u>Unit</u>
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(b) Remove rust and paint kiosks	No
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The unit of measurement shall be the total number of kiosks painted.

The tendered rate shall include full compensation for the removal of rust with a anti corrosion agent and the repainting of the whole kiosk.

<u>Item</u>	<u>Unit</u>
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(c) Label kiosk	No
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The unit of measure shall be the total number of kiosks labeled.

The tendered rate shall include full compensation for the labeling of kiosks circuit breakers, cable and the warning notification to be installed.

<u>Item</u>	<u>Unit</u>
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(d) Supply and install padlocks	No
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The unit of measurement shall be the number of padlocks installed.

The tendered rate shall include full compensation for the ordering, supply, engraving and installation of the padlocks, locking devices and seals.

Lock shall be "key alike"

<u>Item</u>	<u>Unit</u>
(e) Replace distribution meter and stubby kiosks.	No

The unit of measurement shall be the number of distribution kiosks replaced.

The tendered rates shall include full compensation for the removal, the ordering, supply and installation of the new meter boxes and stubbies.

<u>Item</u>	<u>Unit</u>
(f) Replace door hinges on meter and distribution kiosks.	No.

The tendered rate shall include full compensation for the removal of damaged hinges, the supply, delivery and installation of new hinges.

<u>Item</u>	<u>Unit</u>
(g) Supply and install handles	No

(Perano type lockable turn catch door handle heavy duty)

The unit of measure shall be the total number of handles installed.

The tendered rate shall include full compensation for the removal of the old handle and ordering, supply and installation of a lockable turn catch handle.

<u>Item</u>	<u>Unit</u>
	No

(h) Supply and install low voltage PVC/SWA/PVC Cu cable and bare copper earth wire. The unit of measurement shall be the total length of cable supplied and installed.	
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The tendered rate shall include the ordering and delivery to site of the cable. (Excavations measured somewhere else).

<u>Item</u>	<u>Unit</u>
	No

HC.12

- (i) Termination of low voltage PVC/SWA/PVC Cu cables

The unit of measurement shall be the total number of terminations removed and new terminations made.

The tendered rate shall include full compensation for the supply and installation of cable glands and lugs.

<u>Item</u>	<u>Unit</u>
	No

- (j) Jointing of low voltage PVC/SWA/PVC Cu cable.

The unit of measurement shall be the total number of joints made.

The tendered rate shall include full compensation for the supply and installation of all material needed to complete the joints.

<u>Item</u>	<u>Unit</u>
	m ³

- (k) Excavations for cable trenches and meter boxes.

The unit of measurement shall be the total volume excavated and backfilled in dimensions as specified by the engineer.

<u>Item</u>	<u>Unit</u>
	meter

- (l) Supply and installation bare copper earth conductor

The unit of measure shall be the total length of cable supplied and installed. The tendered rate shall include the ordering and delivery to site of the cable (Excavations measured somewhere else).

<u>Item</u>	<u>Unit</u>
	No

- (m) Termination of bare copper earth conductor.

The unit of measure shall be the total number of terminations removed and new terminations made.

The tendered rate shall include full compensation for the supply and installation of cable glands and lugs.

HC.13

<u>Item</u>		<u>Unit</u>
(n)	Re-wiring of kiosk.	No

The unit of measure shall be number of kiosks re-wired.

The tendered rate shall include full compensation for removal of the existing wiring, re-wiring, labeling and commissioning of the kiosk.

<u>Item</u>		<u>Unit</u>
(o)	Reposition contractors on kiosk.	No

The unit of measure shall be number of contractors repositioned.

The tendered rate shall include full compensation for removal of the existing wiring, removal of contractors, mounting in new positions re-wiring, labeling and commissioning of the kiosk.

<u>Item</u>		<u>Unit</u>
(p)	Supply and install front covers	No

The unit of measure shall be number of covers supplied and installed.

The tendered rate shall include full compensation for measuring, manufacturing painting and installation of front covers.

HC 12.04 Maintenance Work

HC 12.04.01 Monthly

- a) Inspect and secure access doors and covers.
- b) Inspect distributions kiosks.

HC12.04.02 Annually

- (a) Service all distribution and metering kiosks.
- (b) Measure phase voltages and line currents in distribution and metering kiosks and record in book.

HC 12.05 Maintenance work measurement and payment

Refer to clause SA06 of the ADDITIONAL SPECIFICATION: SA GENERAL MAINTENANCE.

Remuneration for the maintenance work shall form part of the overall Medium and Low voltage Installation (Installation F).

HC 13 **LOW VOLTAGE OVERHEAD DISTRIBUTION SYSTEM: TECHNICAL DETAILS**

HC 13.01 Installation description

This section describes the low voltage overhead distribution system that will be repaired and maintained in terms of this contract.

This part of the distribution network consists of wooden poles, bare low voltage overhead conductors in a horizontal system configuration with cable connections to houses.

HC 13.02 Scope of repair work

- (a) Visual inspection of overhead conductors, insulators, securing of terminations and connections, adjustment to stay assemblies to re-tension conductors, labeling of cables and provision of warning notices.
- (b) Measure earth resistance.
- (c) Clearing of all vegetation within 1m distance from conductors.
- (d) Replacement of rusted distribution boards.

HC 13.03 Repair work: measurement and payments

<u>Item</u>	<u>Unit</u>
(a) Service overhead distribution system	meter

The unit of measurement shall be the linear length of three phase overhead distribution system network serviced.

The tendered rate shall include full compensation for visual inspection of conductors and insulators, clearing of vegetation, securing of connections and terminations. The contractor shall submit a report on the general condition of the overhead reticulation system.

<u>Item</u>	<u>Unit</u>
(b) Replace damaged insulators.	No

The unit of measurement shall be the total number of insulators replaced.

HC.15

The tendered rate shall include full compensation for isolation of the overhead reticulation system, temporary suspension of conductors if required, removal of damaged insulators, provision and installation of new insulators and securing of conductors.

<u>Item</u>	<u>Unit</u>
(c) Re-tensioning of overhead conductors	No

The unit of measure shall be the total number of stays adjusted.

The tendered rate shall include full compensation for isolation of overhead conductors, attachment of wire tensioning equipment to stays and adjustment of stay wires.

<u>Item</u>	<u>Unit</u>
(d) Replacement of wooden pole	No

The unit of measurement shall be the number of poles replaced.

The tendered rate shall include full compensation for isolation of overhead conductors, temporary suspension and disconnection of conductors and suspension assemblies, excavation, removal of existing pole, provision and plant of new pole, backfilling and compaction, re-installation of suspension assemblies and connection of conductors and re-tensioning of conductors if required.

<u>Item</u>	<u>Unit</u>
(e) Replacement of overhead house connection	

The unit of measurement shall be the number of house connections replaced.

The tendered rate shall include full compensation for isolation of overhead conductors, disconnection and removal of existing overhead house connection, excavation for new cable connection, supply and installation 16mm² 3 core Cu cables including all connections to existing meter and overhead supply line and backfilling of trench.

<u>Item</u>	<u>Unit</u>
(f) Replacement of existing distribution boards	No

The unit of measurement shall be the number of distribution boards replaced.

The tendered rate shall include full compensation for disconnection of existing cabling, removal of old distribution board, supply and installation of new board as per specification excluding equipment.

<u>Item</u>	<u>Unit</u>
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HC.16

- (g) Supply and install low voltage circuit breakers No

The unit of measurement shall be the number of circuit breakers supplied and installed.

The tendered rate shall include full compensation for supply of new circuit breaker with rating as specified, installation of breaker in distribution board and connection of breaker.

HC 13.04 Maintenance Work

HC 13.04.01 Monthly

- a) Inspect overhead conductors, insulators and poles.

HC 13.04.02 Annually

- a) Service overhead distribution system.
b) Measure phase voltages and line currents and record in book.

TECHNICAL SPECIFICATION HE

EXTERIOR LIGHTING SYSTEMS

CONTENTS

HE 01	SCOPE
HE 02	STANDARD SPECIFICATIONS, REGULATIONS, CODES AND ADDITIONAL SPECIFICATIONS
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HE 14	MAINTENANCE OF EXTERIOR LIGHTING SYSTEMS

HE 01 SCOPE

HE 01.01 This specification comprises all aspects regarding the repair and maintenance of external lighting systems. External lighting comprises:

- i) Area lighting
- ii) Security lighting along perimeter fences
- iii) Sports field lighting
- iv) Street lighting

HE 01.02 This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with Portion 3, the Additional Specifications included with this document.

HE 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

HE 02.01 The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

HE 02.02 SABS Specifications

02.02.01	SABS 0400	National Building Regulation
02.02.02	SABS 0142	Wiring code
02.02.03	SABS 0225	Lighting masts
02.02.04	SABS 1277	Read lighting luminaires
02.02.05	SABS 1088	Spigot entries
02.02.06	SABS 1749	Glass polyester poles
02.02.07	SABS 1250	Capacitors, ballasts & lamps
02.02.08	SABS 1279	Floodlight luminaires
02.02.09	SABS 1777	Daylight switches
02.02.10	SABS 763	Galvanised coatings
02.02.11	SABS 1266	Discharge lamps
02.02.12	ARP 035	Streetlighting maintenance

HE 02.03 Department of Public Works Specification PW 774

- HE 02.04 Occupational Health and Safety Act of 1993
- HE 02.05 Manufacturer's specifications and installation instructions
- HE 02.06 Additional requirements
- Equipment and material supplied and installed shall be new and unused. Luminaires, lamps and control gear shall bear the SABS stamp. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on cabling, wiring, luminaires, lighting poles and high masts.
- HE 03 OPERATING AND MAINTENANCE MANUALS**
- HE 03.01 The Contractor shall be responsible for the compilation of a complete set of Operating-and-Maintenance manuals.
- This shall be done in accordance with the Additional Specification SB – Operating and Maintenance manuals.
- All information shall be recorded and reproduced in electronic format as well as supplying the Engineer with three sets of hard copies.
- HE 03.02 Over and above what is specified in the Additional Specification – SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall be structured and shall at least include the following:
- 03.02.01 Description of Installation
- Complete system description of the lighting system. This shall be done for each lighting installation individually. The system description shall contain detailed information regarding the supply configuration (Distribution board, cabling, distribution kiosks, pole mounted distribution board), the switching arrangement (timers, photocells, override facilities) and the lighting (luminaire detail, lamp detail) as well as the earthing and lightning protection arrangement.
- 03.02.02 Commissioning Data
- Complete commissioning, test and inspection data of lighting system.
- This shall be done for each lighting installation individually. The commissioning data will comprise start-up and running current measurements at each termination point e.g. distribution board, kiosk and mast. Full data on lamps fitted with installation dates.
- 03.02.03 Operating data
- a) Safety precautions to be implemented.
 - b) Operation of lighting systems; automatic, manual and bypass switching.
- 03.02.04 Maintenance instructions
- a) Projected frequency of lamp replacement per lighting system.
 - b) Procedure to verify operation of photocell – controlled circuits.
 - c) Procedure to verify operation of timer – controlled circuits.
 - d) Trouble shooting diagram.
 - e) Luminaire details, including manufacturers brochures / pamphlets, order number, list of components and lamp specification.
 - f) Schedule of serviceable components per lighting system. These schedules shall include lamps, starters, ignitors, ballasts, lenses, etc.

HE 04 TESTS AND INSPECTIONS PRIOR TO PRACTICAL COMPLETION OF REPAIR WORK

HE 04.01 It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters:

- 04.01.01 Phase voltages
- 04.01.02 Current per phase
- 04.01.03 Illumination levels in lux
- 04.01.04 Insulation testing at 500V
- 04.01.05 Earthing resistance testing by means of wheat stone bridge instrument

The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

HE 05 LOGGING AND RECORDING PROCEDURES

HE 05.01 The Contractor shall as part of this Contract institute a Recording system as part of his Maintenance Control Plan as defined in the Additional Specification SA – General Maintenance. This shall consist of a Record book which shall be utilised to log and record all faults, system checks, breakdowns, maintenance visits, inspections etc.

HE 05.02 The logbook shall be stored in a safe place inside the maintenance supervisor's office and shall only be utilised by the Contractor and Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

This logbook shall be structured to at least include the following:

- 05.02.01 Monthly lamp inspection and maintenance actions.
- 05.02.02 Bi-annual inspection and testing of lighting systems.
- 05.02.03 Annual earthing test report.
- 05.02.04 Breakdown / call out reports.

HE 06 MAINTENANCE TOOLS AND SPARES

HE 06.01 On commencement of the Repair and Maintenance Contract, the Contractor shall supply and deliver certain Tools and Spares to the User Client. These Tools and Spares will be the property of the Department of Public Works. Any deficiencies or short fall or damaged Tools and Spares during the contract shall be replaced with new equipment / material.

HE 06.02 The Tools and Spares shall be kept safe in a lockable store room on site. The Contractor shall provide his own lock for the designated store room. The inventory of the Tools and Spares shall be verified on a monthly basis. Any short fall shall be replaced by the Contractor as part of his responsibility under this contract.

HE 06.03 The Tools and Spares shall at least include the following:

- 10 off 125W MV lamps
- 10 off 250W MV lamps
- 10 off 70 W HPS lamps
- 10 off 250 W HPS lamps
- 10 off 400 W HPS lamps
- 10 off 1500W Tungsten halogen lamps
- 10 off 100W Incandescent lamps

Distribution kiosk – special key
 Light pole cover triangular key
 DB key
 DB face plate square key
 Lighting mast cover square key
 Lighting mast rope set
 Safety harness for solid vertical masts
 High mast hydraulic lowering gear

HE 07 QUALITY ASSURANCE SYSTEM

- HE 07.01 Following formal approval of his Quality Assurance system by the Engineer, the Contractor shall implement the approved QA system.
- HE 07.02 Records of this QA system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required by the Department.

HE 08 RE-COMMISSIONING OF INSTALLATION

- HE 08.01 On practical completion of the repair work and lamp replacement, the lighting installations shall be put into operation.
- HE 08.02 Lighting installations shall be energised for a minimum continuous period of 96 hours immediately prior to the Engineer’s Practical Completion inspection to verify lamp stability and reliability of power reticulation

HE 09 REPAIR WORK TO EXTERIOR LIGHTING INSTALLATIONS

- HE 09.01 The various lighting systems shall be repaired during the first phase of the repair and maintenance contract
- HE 09.02 The scope of the repair work shall include, but shall not be limited to the activities listed below.
- HE 09.03 The Contractor shall record the repair actions in tabular format before the Contractor’s responsibility for maintenance commences.
- HE 09.04 Repair work shall be executed within the approved period for repairs.
- HE 09.05 New equipment and material shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of practical completion. These guarantees shall be furnished in favour of the Department of Public Works.
- HE 09.06 The following measurement and payment items shall apply for repair work

<u>Item</u>	<u>Unit</u>
HE 09.06(a) Excavate in all materials for trenches, backfill, compact and dispose of surplus material	m ³

This rate shall apply to all the excavations.

The unit of measurement shall be the cubic metre of material excavated in trenches, classified according to the depth and width specified listed. The width classification shall be in accordance with the authorised dimensions and

HE.5

the depth classification in accordance with the total depth of the trench and not with the depth range in which the material is situated before excavation. The depth of excavation shall be measured to the underside of the bedding.

The tendered rate shall include full compensation for clearing and grubbing the trench areas and the temporary removal of improvements from the line of the trench, for excavating the trench, preparing the bottom of the trench, separating material unsuitable for backfill, keeping the excavations safe, dealing with any surface or subsurface water, measuring, classification and keeping of all records and for separating topsoil and selected backfill material where necessary.

The rate shall furthermore cover the costs of installing the sand bed and sand cover, backfilling, compacting and disposing of the surplus material.

	<u>Item</u>	<u>Unit</u>
HE 09.06(b)	Extra over item HE 09.06(a) for excavating in hard material	m ³

The unit of measurement shall be the cubic metre of material excavated and classified as hard, in accordance with the classification set out hereunder.

The tendered rate shall be paid over and above the rate tendered for excavation in respect of items HE 09.06(a) in full compensation for the additional cost of excavating in hard material instead of soft.

The tendered rate shall include full compensation for any over break as well as the additional backfilling required, reinstating the trench bottom, and for any other incidentals resulting from over break.

The materials excavated shall be classified as follows for payment purposes:

Hard material:

Material which cannot be excavated efficiently except with the use of pneumatic tools, blasting or wedging and splitting, and shall include boulders exceeding 0,15 m; in volume.

Soft material:

All material not classified as hard material.

Notwithstanding the above classification, all material excavated from previously constructed fills, embankments, pavement layers and from above existing services shall be classified as soft material.

The decision of the Engineer as to the classification of the material shall be final and binding and any objection as to the classification shall be made before the excavation has been backfilled.

	<u>Item</u>	<u>Unit</u>
HE 09.06(c)	Extra over item 3.10.1.1 for excavating by hand in all materials	m ³

The unit of measurement shall be the cubic metre of trench material excavated by means of hand tools as instructed or authorised in writing by the Engineer where the use of conventional excavating equipment is either impractical or likely to cause damage to services, trees or property or where the electrical Contractor has to excavate by hand where he cannot excavate by machine.

The volumes of the trench excavation will be computed from the length and the depth to the bottom of the specified bedding layer and the minimum base widths specified in the drawings. The rate shall cover the cost of complying with the safety and protection requirements specified except where particular items are scheduled to cover particular costs for the excavation.

The tendered rate shall be paid extra over the rates tendered for item HE09.06(a).1 in full compensation for the additional expense of excavating by means of hand labour instead of conventional trenching equipment.

<u>Item</u>	<u>Unit</u>
HE 09.06(d) Extra over item HE09.06(a) for using backfill material obtained from sources provided by the Contractor	m ³

The unit of measurement shall be the cubic metre of imported backfill material.

Item HE09.06(d) above will not be measured for payment unless importation has been ordered in writing. The volume will be computed from the trench width and the depth from ground level to the top of the sand bed cover as shown on the tender drawings. The rate shall cover the cost of excavation and selection of suitable material, the moving of the material to the backfilling site, and the disposal of the material that becomes surplus as a result of the importation.

The tendered rate for item HE09.06(d) paid extra over item HE09.06(a) shall cover the cost of the acquisition of the material and of the disposal of the surplus material resulting from the importation together with all the costs of transporting the material to the site regardless of distance.

<u>Item</u>	<u>Unit</u>
HE 09.06(e) Supply and Install Cable Sleeves	m

The unit of measurement shall be the linear length in metre of cable sleeves supplied and installed.

The tendered rate shall include full compensation for the supply, delivery, handling and installing the cable sleeves including all the required couplings, steel draw wires and plugs.

<u>Item</u>	<u>Unit</u>
HE 09.06(f) Supply and Install Plastic Warning Tape	m

The unit of measurement shall be the length in meter of plastic warning tape supplied and installed.

The tendered rate shall include full compensation for the supplying, handling and laying the plastic warning tape.

<u>Item</u>	<u>Unit</u>
HE 09.06(g) Supply and delivery of low-voltage cable	m

The unit of measurement shall be the length of low-voltage cable supplied. The tendered rate shall include full compensation for the manufacture, supply and delivery of the specified cable to the site.

Separate items shall be scheduled under this payment item for each size and type of cable required.

	<u>Item</u>	<u>Unit</u>
HE 09.06(h)	Lay LV-cable	m
	The unit of measurement shall be the linear length in meter of LV-cable installed.	
	The tendered rate shall include full compensation for the handling, inspecting, laying, cutting and testing the cable. Cables shall be measured linearly over all lengths laid. Separate items shall be scheduled for each size and each type of cable laid.	
	<u>Item</u>	<u>Unit</u>
HE 09.06 (i)	Termination of LV-cables	No
	The unit of measurement shall be the number of LV-cable terminations.	
	The tendered rate shall include full compensation for providing the cable glands and shrouds, the cost of handling, fitting and cutting the cable. Separate items shall be scheduled for each size and type of cable.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(j)	Supply bare copper earth conductor	m
	The unit of measurement shall be the length in meter of bare copper earth conductor supplied.	
	The tendered rate shall include full compensation for procuring, furnishing and laying the specified earth continuity conductor.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(k)	Installation of bare copper earth conductor	m
	The unit of measurement shall be the length in meter of bare copper earth conductor installed.	
	The tendered rate shall include full compensation for procuring, furnishing and laying the specified earth continuity conductor.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(l)	Terminate and connect bare copper earth conductor	No
	The unit of measurement shall be the number of bare copper earth conductors terminated and connected.	
	The tendered rate shall include full compensation for supplying all the material required to terminate and connect the bare copper earth conductors and the connecting thereof to the earth bars.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(m)	Jointing of low-voltage cable	No
	The unit of measurement shall be the number of LV-cables joints.	
	The tendered rate shall include full compensation for the cost of providing the kits, the cost of cutting the cable, handling and fitting the kits and the cost of testing the joints.	

	<u>Item</u>	<u>Unit</u>
HE 09.06(n)	Re-lamp luminaire	No
	The unit of measurement shall be the number of luminaire lamps replaced.	
	The tendered rate shall include full compensation for the supply and installation of the lamp according to the manufacturer's instructions. Separate items shall be scheduled for each type of lamp.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(o)	Supply and installation of internal luminaire components	No
	The unit of measurement shall be the number of internal luminaire components replaced.	
	The tendered rate shall include full compensation for the supply and installation of the components according to the manufacturer's instructions. Separate items shall be scheduled for each component.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(p)	Internal wiring of luminaire	No
	The unit of measurement shall be the number of luminaires rewired with silicone insulated wiring.	
	The tendered rate shall include full compensation for the supply and wiring of a luminaire with silicone insulated wiring where the wiring are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(q)	Supply and install circuit breakers	No
	The unit of measurement shall be the number of circuit breakers supplied and installed.	
	The tendered rate shall include full compensation for the supply and installation of the circuit breakers where the circuit breakers are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(r)	Supply and install isolators	No
	The unit of measurement shall be the number of isolators supplied and installed.	
	The tendered rate shall include full compensation for the supply and installation of the isolators where the isolators are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(s)	Supply and install contactors	No
	The unit of measurement shall be the number of contactors supplied and installed.	
	The tendered rate shall include full compensation for the supply and installation of the contactors where the contactors are specified separately.	




	<u>Item</u>	<u>Unit</u>
HE 09.06(t)	Supply and install of low tension fuses	No
	The unit of measurement shall be the number of fuses supplied and installed.	
	The tendered rate shall include full compensation for the supply and installation of the fuses where the fuses are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(u)	Supply and install National photocell (plug-in type)	No
	The unit of measurement shall be the number of photocells supplied and installed.	
	The tendered rate shall include full compensation for the supply and installing of the photocells where the photocells are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(v)	Supply and install Heinemann SAT-R-Clip in timer	No
	The unit of measurement shall be the number of timers supplied and installed.	
	The tendered rate shall include full compensation for the supply and installing of the timers where the timers are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(w)	Supply and install 0-30A HRC fuses	No
	The unit of measurement shall be the number of fuses supplied and installed.	
	The tendered rate shall include full compensation for the supply and installing of the fuses where the circuit breakers are specified separately.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(x)	Supply and install end connectors and insulating sleeves	No
	The unit of measurement shall be the number of end connectors and insulating sleeves supplied and installed.	
	The tendered rate shall include full compensation for the supply and installation of the end connectors at the light pole or where cables forms a looping system.	
	The end connectors shall be similar or equal to Pratley No 2 end connectors and insulating sleeves.	
	<u>Item</u>	<u>Unit</u>
HE 09.06(y)	Supply of tools and spares	Lump sum
	The unit of measurement shall be a lump sum.	
	The tendered rate shall include full compensation for the supply and delivery of the tools and spares specified.	



HE 10 AREA LIGHTING: TECHNICAL DETAILS

HE 10.01 Installation description

AREA /STREET	POLE / MAST INFORMATION		LUMINAIRE INFORMATION	
	MOUNTING HEIGHT	DESCRIPTION / MATERIAL	DESCRIPTION	SWITCHING
OPERATIONAL AREA	11m	WOODEN POLE	1000W FLOODLIGHT	PHOTO CELL
LOWER AREA	11m	WOODEN POLE	1000W FLOODLIGHT	PHOTO CELL
UPPER AREA	11m	WOODEN POLE	1000W FLOODLIGHT	PHOTO CELL
UPPER AREA	4.5m	FIBRE POLE	125W AND 250W POST TOPS	PHOTO CELL
LOWER AREA	4.5m	GALVANIZED STEEL POLE	70W AND 125W	PHOTO CELL
OPERATIONAL AREA	WALL	WALL MOUNTED	250W AND 400W	PHOTO CELL

EXISTING TYPE

U5	SPOTLIGHTS & WOODEN POLE	
		Existing 1000W MV/MH/HPS spotlights mounted on the existing 11m wooden pole
T1	GREY FRP	
		Existing 3.5m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)
T2	SKY-H35-125W-GREY	
		Existing grey post top 70 / 125 watt lamp and diffuser. Lamp type of MV, MH, HPS

<p>W2</p>	<p>Beka Ray</p> 	<p>Existing Beka Ray</p>
<p>W1</p>	<p>FRP POLE</p> 	<p>Existing 3.5m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)</p>

HE 10.02 Scope of repair work

Service mast distribution boards and supply kiosks: Clean, label, check terminations and earthing. Service each luminaire, open control gear enclosures and treat for moisture ingress and corrosion. Wash luminaires with detergent and clean lenses. Check and replace neoprene seals.

Re-lamp luminaires. Replace luminaires: Remove existing damaged luminaires, supply and install similar and approved luminaires complete with lamps and control gear, if applicable.

Check consistency of aiming angles and tighten mounting bracket bolts

Check pole covers; measure earthing continuity and tighten foundation bolts. Replace all padlocks on distribution boards and kiosks.

HE 10.03 Repair work: Measurement and payment

<u>Item</u>		<u>Unit</u>
(a)	Re-lamp luminaire	No

The unit of measurement shall be the number of floodlight lamps replaced.

The tendered rate shall include full compensation for the supply and installation of the lamp according to the manufacturer's instructions.

<u>Item</u>		<u>Unit</u>
(b)	Service floodlight luminaire	No

The unit of measurement shall be the number of floodlight luminaires opened and serviced.

The tendered rate shall include full compensation for the servicing of the luminaire, including washing, corrosion protection, checking of seals and glands, cleaning of the lenses, tightening of stirrup bracket bolts and the checking of earthing continuity and aiming angle.

Item Unit
 (c) **Service light distribution kiosk or DB** No

The unit of measurement shall be the number of distribution boards or kiosks serviced.

The tendered rate shall include full compensation for the cleaning and opening of kiosk or DB, vermin protection, checking of MCB's, checking and tightening of wire terminations, fitting of labels and blank covers, etc.

Item Unit
 (d) **Supply and install padlocks** No

The unit of measurement shall be the number of 65mm padlocks installed.

The tendered rate shall include full compensation for the ordering, supply, engraving and installation of the padlocks, locking devices and seals.

Item Unit
 (e) **Service area light pole** No



The unit of measurement shall be number of area light poles opened and serviced.



The tendered rate shall include full compensation for the opening of pole cover, visual inspections, and straightening of pole.

Item Unit
 (f) **Replace floodlight luminaire** No

The unit of measurement shall be number of floodlight luminaires replaced.


The tendered rate shall include full compensation for the supply and installation of the specified floodlight luminaire complete with lamp and control gear according to manufacturer's instructions.

XT1	GREY FRP	
		<p>4m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)</p>
XT2	BEKA Zela 55W LED	
		<p>Zela 55W LED</p>

XW1	FRP POLE		4m mounting height glass fibre reinforced polyester pole, with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)
XW2	Beka Ray		BEKAray LED
XU5	SPOTLIGHTS		OMNIsat Maxi 463W 5121 optic

HE 11 SECURITY LIGHTING: TECHNICAL DETAILS

HE 11.01 Installation description

AREA /STREET	POLE / MAST INFORMATION		LUMINAIRE INFORMATION	
	MOUNTING HEIGHT	DESCRIPTION / MATERIAL	DESCRIPTION	SWITCHING
OPERATIONAL AREA (X3)	40m	SCISSORS MASK	6x1000W FLOODLIGHT	PHOTO CELL
U2	SPOTLIGHTS			
		Existing 6 x 1000W MV/MH/HPS spotlights mounted on the existing 40m Scissors high mask		

HE 11.02 Scope of repair work

Open distribution kiosk, check locks, clean inside, provide termite and rodent poison.

Open each pole cover and inspect fuse or circuit breaker, tray and shield plate as well as earthing connection. Check and replace cover seal if required. Wash luminaire and lens, replace neoprene seal and re-lamp luminaires.

Replace luminaires: Remove existing damaged luminaires, supply and install similar and approved luminaires complete with lamps and control gear, if applicable. Check aiming angle and adjust if necessary.

HE 11.03 Repair work: Measurement and payment

<u>Item</u>	<u>Unit</u>
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(a) Service security light pole	No
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The unit of measurement shall be the number of security light poles opened and serviced.

The tendered rate shall include full compensation for the opening of pole cover, visual inspections, straightening of poles, servicing of luminaires as specified.

<u>Item</u>	<u>Unit</u>
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(b) Re-lamp luminaire	No
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The unit of measurement shall be the number of security floodlight lamps replaced.

The tendered rate shall include full compensation for the supply and installation of the lamp according to the manufacturer's instructions.

<u>Item</u>	<u>Unit</u>
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(c) Service distribution kiosk	No
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The unit of measurement shall be the number of distribution kiosks or boards opened and serviced.

The tendered rate shall include full compensation for the opening of kiosk or distribution board, vermin protection, cleaning of circuit breakers, earth testing, etc.

<u>Item</u>	<u>Unit</u>
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(d) Replace security floodlight luminaires	No
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The unit of measurement shall be the number of security floodlight luminaires replaced.

The tendered rate shall include full compensation for the supply and installation of the luminaire complete with the lamp and control gear according to the manufacturer's instructions.

XU5	SPOTLIGHTS	 <p style="font-size: 1.2em; margin-top: 10px;">OMNIsat Maxi 463W 5121 optic</p>
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HE 12 SPORTS FIELD LIGHTING: TECHNICAL DETAILS**HE 12.01 Installation description**

AREA /STREET	POLE / MAST INFORMATION		LUMINAIRE INFORMATION	
	MOUNTING HEIGHT	DESCRIPTION / MATERIAL	DESCRIPTION	SWITCHING
N/A	N/A	N/A	N/A	N/A

HE 12.02 Scope of repair work

Open upstream distribution board. Check and fasten cable terminations, fit labelling and blank face-plate covers. Check locking mechanism and fit padlock.

Open distribution kiosk. Clean inside and add termite and rodent poison. Fit circuit labelling. Check locking mechanism and fit padlock.

Open each mast distribution board and inspect. Check earth bar and earth continuity. Check and fasten cable terminations, fit labelling and blank face-plate covers. Check locking mechanism and fit padlock. Check mast foundation bolts and earth connection to electrode.

Service luminaires by washing with detergent and re-lamping where necessary. Clean lenses. Check condition of seals and glands and test for earth continuity. Replace luminaires: Remove existing damaged luminaires, supply and install similar and approved luminaires complete with lamps and control gear, if applicable.

HE 12.03 Repair work: Measurement and payment

<u>Item</u>	<u>Unit</u>
(a) Service sports field light mast	No

The unit of measurement shall be the number of sports field light mast inspected and serviced.

The tendered rate shall include full compensation for the opening of pole cover, visual inspections and including servicing of sports field luminaires as specified.

<u>Item</u>	<u>Unit</u>
(b) Re-lamp luminaire	No

The unit of measurement shall be the number of sports field floodlight lamps replaced.

The tendered rate shall include full compensation for the supply and installation of the lamp according to the manufacturer's instructions.

<u>Item</u>	<u>Unit</u>
(c) Service distribution kiosk or distribution board	No

The unit of measurement shall be the number of distribution kiosks or boards opened and serviced.

The tendered rate shall include full compensation for the opening of kiosk, vermin protection, cleaning of circuit breakers, earth testing, etc.

<u>Item</u>	<u>Unit</u>
(d) Service sports field light pole	No

The unit of measurement shall be the number of light poles opened and serviced.

The tendered rate shall include full compensation for the opening of pole covers, visual inspections and servicing of luminaires as specified.

<u>Item</u>	<u>Unit</u>
(e) Replace luminaire	No



The unit of measurement shall be the number of sports field floodlight luminaires replaced.


The tendered rate shall include full compensation for the supply and installation of the specified luminaire complete with the lamp and control gear according to the manufacturer's instructions.

HE 13 STREETLIGHTING: TECHNICAL DETAILS

HE 13.01 Installation description

AREA /STREET	POLE / MAST INFORMATION		LUMINAIRE INFORMATION	
	MOUNTING HEIGHT	DESCRIPTION / MATERIAL	DESCRIPTION	SWITCHING
STREET LIGHTS:	9m	GALVANIZED STEEL POLE WITH SINGLE CROSS ARM	55W LED BEKA	PHOTO CELL
STREET LIGHTS:	wall	SINGLE CROSS ARM	70/125 MV/HPS	PHOTO CELL

U3	STREETPOLE	
		Existing Streetlight pole 9m
U4	BEKA LED STREETLIGHT	
		Existing Beka Streetlight led

V	STREETLIGHT	
		Existing streetlight fitting with 70/125 watt lamp. Lamp type of MV HPS

HE 13.02 Scope of repair work.

Open distribution kiosk, check locks, clean inside, provide termite and rodent poison.

Open each mast cover and inspect fuse or circuit breaker, tray and shield plate as well as earthing connection. Check and replace cover seal if required. Wash luminaire, replace neoprene seal, clean lens and re-lamp luminaires if required. Replace luminaires: Remove existing damaged luminaires, supply and install similar and approved luminaires complete with lamps and control gear, if applicable. Assess aiming angle and adjust if necessary.

HE 13.03 Repair work: Measurement and payment

<u>Item</u>	<u>Unit</u>
(a) Service streetlight pole	No

The unit of measurement shall be the number of light poles opened and serviced.

The tendered rate shall include full compensation for the opening of pole cover, visual inspections, straightening of pole, servicing of street light luminaire as specified.

<u>Item</u>	<u>Unit</u>
(b) Re-lamp luminaire	No

The unit of measurement shall be the number of street light lamps replaced.

The tendered rate shall include full compensation for the supply and installation of the lamp according to the manufacturer's instructions.

<u>Item</u>	<u>Unit</u>
(c) Service street light distribution kiosk	No

The unit of measurement shall be the number of distribution kiosks or boards opened and serviced.

The tendered rate shall include full compensation for the opening of kiosk, vermin protection, cleaning of circuit breakers, earth testing, etc.

<u>Item</u>	<u>Unit</u>
(d) Replace streetlight luminaire	No

The unit of measurement shall be the number of streetlight luminaires replaced.

The tendered rate shall include full compensation for the supply and installation of the luminaire complete with the lamp and control gear as per manufacturer's instructions.

XU3	STREETPOLE	
		Streetlight pole 9m with baseplate, glandplate, 1 x 5A 5kA circuit breakers and a heavy-duty access door. (exclude light fitting)
XU4	BEKA LED STREETLIGHT	
		LEDflood maxi 279W
XV	STREETLIGHT	
		LEDlume mini XP 36W 5068 optic

HE 14 MAINTENANCE OF THE INSTALLATION

HE 14.01 The various lighting systems shall be maintained in perfect working order following the initial repair work. The maintenance contract shall run for the balance of the 36-month contract period.

HE 14.02 The following maintenance actions will be required under this phase of the contract:

- 14.02.01 Routine preventative maintenance
- 14.02.02 Corrective maintenance
- 14.02.03 Breakdown maintenance

These actions are defined in the Additional Specification SA – General Maintenance.

HE 14.03 The maintenance schedules and frequency of maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractor's responsibility in this regard is specified in the Additional Specification SA – General Maintenance.

HE 14.04 The following shall be used as guidelines to ensure effective maintenance:

14.04.01 **Scope of maintenance work on area lighting**

- a) Monthly
 - i) Verify operation of switching element
 - ii) Check lamps
 - iii) Check mast door for weatherproof seal
 - iv) Check earth connection at footing, record value
- b) Annual
 - i) Service all luminaires
 - ii) Measure earth resistance of electrode
 - iii) Measure earth resistance of trench earth
 - iv) Record values in record book

14.04.02 **Scope of maintenance work on security lighting**

- a) Monthly
 - i) Verify operation of switching element.
 - ii) Check lamps.
 - iii) Check that all pole covers are secure.
 - iv) Visually check distribution kiosk.
- b) Annual

Measure phase voltages and line currents in distribution kiosk or local distribution board. Record values in record book. Do vermin protection. Service all luminaires.

14.04.03 **Scope of maintenance work on sports field lighting**

- a) Monthly
 - i) Verify operation of switching element.
 - ii) Check lamps.
 - iii) Check that all pole covers are secure.
 - iv) Visually check distribution kiosk and local mast distribution boards.
- b) Annual

Measure phase voltages and line currents in distribution kiosk. Record values in record book. Do vermin protection. Service all luminaires.

14.04.04 **Scope of maintenance work on street lighting**

- a) Monthly
 - i) Verify operation of switching element.
 - ii) Check lamps.
 - iii) Check that all pole covers are secure.
 - iv) Visually check distribution kiosk.

b) Annual

Measure phase voltages and line currents in distribution kiosk. Record values in Record book. Do vermin protection. Service all luminaires.

HE.14.05 Maintenance shall include all repairs, replacing of components or materials, routine setting or any other actions necessary to ensure a perfect functional condition.

HE.14.06 Remuneration for the monthly maintenance of exterior lighting systems shall be deemed included in the tendered rate for ten points of the installation of which exterior lighting systems forms part.