

JOHANNESBURG WATER (SOC) Ltd.

BULK WASTEWATER

PARTICULAR SPECIFICATION

M03: MECHANICAL EQUIPMENT FOR PRIMARY SEDIMENTATION TANKS (PST)



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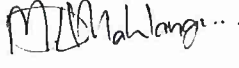


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PARTICULAR SPECIFICATION: M03 MECHANICAL PRIMARY SEDIMENTATION TANKS

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M03.1 SCOPE

This specification covers the detailed design parameters, manufacture, supply, off-loading on site, installation, test and commissioning of Primary Sedimentation Tanks scraper mechanisms, scum boxes, scum boards and weirs. The Specification shall be read in conjunction with Project Specification and other relevant Particular Specification.

M03.2 INTERPRETATIONS

This specification shall be interpreted as follows:

- For the Employer design components, it shall be regarded as a specification.
- For the Contractor design components obligations, it shall be regarded as an Employer's requirements.

M03.2.1 Definitions

For the purposes of this Specification the following definitions shall apply:-

- (a) **"Manufacture"** includes, as applicable, the purchase of materials or goods, fabrication and assembly, any specified corrosion protection measures and any off-site inspection or testing of materials or parts.
- (b) **"Supply"** includes, as applicable, the purchase of materials or goods, manufacture and fabrication, any specified corrosion protection measures and all required off-site inspection or testing.
- (c) **"Installation"** includes, as applicable, all handling and transport from storage, erection and aligning of Works.
- (d) **"Factory Acceptance Test (FAT)"** shall refer to all tests done on Plant or Plant items at the factory to ensure its functionality.

M03.2.2 Abbreviations

For the purpose of this Specification the following abbreviation shall apply:-

°C	: Temperature in degrees Celsius
A	: Current
AC	: Alternating Current
AGMA	: American Gear Manufactures Association
ANSI	: American National Standards Institute
API	: American Petroleum Institute
ASCE	: American Society of Civil Employer's Agents
ASME	: American Society of Mechanical Employer's Agents
ASTM	: American Society for Testing and Materials
BFP	: Belt Filter Press
BS	: British Standards Institution
BSPT	: British Standard pipe thread
CAD	: Computer Aided Drawing
CAM	: Computer Aided Manufacturing
CFD	: Computation Fluid Dynamics
CIP	: Cleaning in Place
COC	: Certificate of Conformance
D	: Diameter
DB	: Air Dry Bulb temperature
dB(A)	: Sound pressure level, "A" weighed in decibels
DCS	: Distributed Control System

DFT	: Dry Film Thickness
DIN	: Deutsch Industry Normen
DN	: Nominal diameter
DO	: Dissolved Oxygen
DP	: Differential Pressure
Eff.	: Filter efficiency in %
EPDM	: Ethylene Propylène Diène Monomer
ERW	: Electrical resistance weld
ETP	: Effluent Treatment Plant
FA	: Flange adaptor
FAT	: Factory Acceptance Tests
FBE	: Flanged both ends
FOE	: Flanged one end
FW	: Field weld
HDPE	: High Density Polyethylene
ID	: Inside diameter
ISO	: International Organisation for Standardization
JW	: Johannesburg Water
ℓ/s	: Flow in litres per second
LV	: Low Voltage
m	: Distance in metre
m.a.s.l	: Metres above (mean) sea level
m/s	: Air speed in metres per second
MCC	: Motor Control Centre
mm	: Dimension in millimetres
MPVC	: Modified Polyvinyl Chloride Pipes
MV	: Medium Voltage
N+1	: N units in operation + 1 installed spare
Nm ³ /hr	: Normal cubic meters per hour
O&M	: Operation and Maintenance
OD	: Outside diameter
OHS	: Occupational Health and Safety
Pa	: Pressure in Pascals
PBE	: Plain both ends
PE	: Plain end
PN	: Nominal pressure (Rating)
PPE	: Personal Protective Equipment
PQP	: Project Quality Plan
PSV	: Pressure Safety Valve
QCP	: Quality Control Panel
RFA	: Restrained flange adaptor
rpm	: Rotational speed in revolutions per minute
SAECC	: South African Electrolytic Corrosion Committee
SANS	: South African National Standards
SAT	: Site Acceptance Tests
SAW	: Submerged arc weld
SCADA	: Supervisory Control and Data Acquisition
SIS	: Swedish Institute of Standards
SOC	: Slip-on coupling
SS	: Soft Starters
SS	: Soft Starters
SS	: Stainless Steel

SST	: Secondary Settling Tank
STP	: Standard Temperature and Pressure (i.e. T = 20°C, P = 101, 3 kPa).
t	: Wall thickness of pipes
TDS	: Total Dissolved Solids
uPVC	: Unplasticised Polyvinyl Chloride
VSD	: Variable Speed Drive
WB	: Air Wet Bulb temperature
WB	: Air Wet Bulb temperature
WP (B)	: Weld preparation (Butt)

M03.2.3

Standards

All design standards for the primary sedimentation tanks shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10400	: National Building Regulations
PD 5304:2014	: Guidance on safe use of machinery (British Standards Institution)
SANS9606-1:	: Testing of welders, where applicable to the type of welding required
BS ISO1312-1:2018	: Rolling bearings. Accessories for sleeve type linear ball bearings. Boundary dimensions, geometrical product specifications (GPS) and tolerances for series 1 and 3
SANS 10162-1	: The structural use of steel Part1: Limit-states design of hot-rolled steelwork
SANS 10162-2	: The structural use of steel Part1: Limit-states design of cold-formed steelwork
SANS 10162-4	: Structural use of Steel Part 4: The design of cold-formed stainless steel structural
SANS 15614-1	: Specification and qualification of welding procedures for metallic materials - Welding procedure test Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
SANS 10064	: The preparation of steel surfaces for coating
SANS 10102-1	: Selection of pipes for buried pipelines Part 1: General Provisions
SANS 10104	: Hand railing and balustrading (safety aspects)
SANS 10111-2-1	: Employer's Agent or Representative Drawing Part 1: General principles Employer's Agent or Representative Drawing Part 2: Geometric Tolerancing Section 1
SANS 1550-1	: Motor vehicle tires and rims - Dimensions and loads Part 1: General
SANS 10341	: Installation and maintenance of bearings – General guidelines
SANS 1700-5-9	: Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless-steel fasteners-Bolts, Screws & Studs
SANS 1700-5-10	: Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless-steel fasteners-Nuts

M03.2.4 Other Particular Specifications

This specification must be read in conjunction with the following specifications:-

M08: Particular Specification for Gearboxes

M17: Particular Specification for Actuator equipment

M20: Particular Specification for Valves

M21: Particular Specification for Pressure Pipework

E01: Particular Specification for Electric Motors

G01: Particular Specification for Colour Codes

G02: Particular Specification for Corrosion Protection

Volume 1: Automation and Control Design Standards SCADA

Volume 6: Automation and Control Design Standards Cabling

Volume 8: Automation and Control Design Standards Flow Measurement

Volume 9: Automation and Control Design Standards Level Measurement

M03.3 **DESIGN OF PRIMARY SEDIMENTATION TANKS**

M03.3.1 General Design Parameters

Primary Sedimentation Tank equipment shall be designed such that the following requirements are met:-

- To ensure reasonable standards of engineering in design, materials selection and construction processes
- To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- The minimum availability of the equipment shall be 99 %
- The offered equipment shall be support in forms of spares by the original equipment manufacturer for at least 15 years in alignment with the specified life expectation of 15 years from project installation.
- To ensure safe and satisfactory operation for an acceptable life expectation of 15 years under the ambient conditions prevailing at the Site,
- To prevent undue stresses being produced by expansion due to temperature changes.
- To keep maintenance costs to a minimum that represent the value for money in both the initial purchase and subsequent running costs,
- To comply with the legal requirements in respect of safety such as the Occupational Health & Safety Act , 1993 and Regulations as well as the prevention of water and air pollution,
- To operate without undue vibration and excessive noise. Maximum of 75 dBA measured at 1 metre from operating equipment.
- To satisfy any specific requirement contained in the latest editions of published statutory codes and legislation, and
- To be suitable for operation 365 days per year, 24 hours per day under specified design conditions.

M03.3.2 Specific Design Parameters

Screened, de-gritted sewage shall be distributed to the primary sedimentation tanks for sludge accumulation. The objective of the primary sedimentation tanks is to remove readily settled suspended solids and scum from the screened and de-gritted wastewater, reducing the amount of suspended solids content in the wastewater and the organic load on the downstream biological treatment processes.

The primary sedimentation tanks shall be downstream of the head of works and flow divider, but upstream of the balancing (flow equalisation) tanks.

There shall be no less than two settling tanks per bio-reactor. The influent flow divider is to provide equal flow distribution and isolation as required.

The mechanisms of the Primary Settling Tank shall be designed to operate at the most extreme loadings and be capable of restarting once stopped. Safe access to components subjected to wear such as gearboxes, motors, bearings, driving wheels, centre bearing etc, shall be provided as part of design for purpose of maintenance and process.

The scum collection box and the rotational speed of the bridge shall allow for a descumming rate of 1000 m²/hr for a 35 m diameter tank, which shall increase or decrease in proportion to the classifier surface area for other tank dimensions

Design Loads:

- Typical thickened primary sludge concentration is 1-4 % TS
- Maximum thickened primary sludge concentration is 8-10% TS
- It is desirable to withdraw 1 - 2% sludge to allow proper screening through a 6 mm sludge screen without capturing a large amount of organics with the screenings.
- Hydraulic Flow rate $\leq 1.2\text{m}^3/\text{m}^2/\text{hr}$
- Peak flow shall be determined by the wastewater collection system peak factor shall be $\leq 2.5\text{m}^3/\text{m}^2/\text{hr}$

M03.3.3 Welds and Fasteners

All welds are to be in accordance with SANS15614-1. All submerged fasteners shall be 316 SS and mating flanges shall be sealed against the ingress of any crevice corrosion by means of a sealant suitable for underwater conditions and approved by the Employer's Agent or Employer's Representative.

All area where there is a direct contact between dissimilar metals. An insulation material shall be used to appropriately prevent any corrosion.

M03.3.4 Sludge

The sludge is a non-Newtonian pseudoplastic thixotropic fluid. The mechanism and drive train design should take account of the rheological properties of the fluid.

M03.4 SEDIMENTATION TANK

M03.4.1 Sedimentation Tank Parameters

The mechanical equipment to be supplied under this Contract shall be installed, tested and commissioned on concrete structures, constructed to accommodate specific mechanical equipment for process functionality, to the dimensions indicated on the construction detail drawings and / or as site confirmation on the completed concrete structure.

The tank shall be circular with a conical bottom tank, a maximum diameter of 35 m and a minimum side water depth (SWD) of 4.0 m. The peripheral wall shall be finished to 1 m above the finished terrace level. The floor of the tank shall be sloped, vertical to the horizontal 1:6 (approximately 10° slope), to assist the sludge being scraped to a central collection hopper for withdrawal. The overflow launder width shall be 600mm (minimum).

M03.4.2 Baffled Inlet

A baffled inlet with centre feed will enter the tank vertically from the bottom and shall be constructed in reinforced concrete that will form the pivot point for the bridge. The diameter of the inlet baffle shall be between 0.15 and 0.2 times that of the tank diameter with a depth of 0.3 of the SWD.

M03.4.3 Inlet Pipe

The inlet pipe within the inlet baffle shall have a minimum diameter of 750 mm unless otherwise specified in the construction drawings and shall be manufactured from 304 stainless steel. The inlet pipe shall be supplied and installed as part of primary sedimentation tank structural work.

M03.4.4 Access Bridge Parameters

The rotating access bridge shall be manufactured in 304L SS and shall cover full diameter of the tank. The bridge will be supported by a hinged bearing on the inlet structure and by a driven wheeled support on the perimeter wall of the tank (peripheral drive). 304L stainless steel ladder with the necessary handrails shall be rigidly fixed to the outer end of the bridge for access purposes.

- Designed Load: 2500N per m² of walkway area
- Walkway: no less than 750 mm wide, 304L SS
- Chequer plate or Open grid: 304L SS with clamps.
- Hand and knee rails: 304L SS on both sides of walkway
- Kicker plates: 100 x 4,5mm 304L SS attached to both sides of the bridge

The bridge shall be designed to resist any torsion imposed by the scraper mechanism without excessive deflection.

The bridge shall furthermore be designed with sufficient camber to completely cancel the deflection which will be produced by the dead load of the complete bridge with the scraper mechanism attached the latter unsubmerged.

There shall be an access ladder, preferably with a spring loaded design at the carrier-end of the bridge which extends into the PST launder channel. This ladder shall be retractable in order for it to be above the water level when not in use. The ladder shall not interfere or serves as an obstruction for the rotating bridge. It shall be manufactured from robust corrosion-resistant material such as 304L stainless steel.

The access ladder dimensions shall be as a minimum:

- 20mm diameter rungs with 250mm spacing between them.
- The maximum width shall be 500mm
- The distance between the floor level (T.O.C) and the ladder shall be at least 100mm.

M03.4.4.1 Walkway

The walkway shall be assembled by welding joints should a chequer plate be used

The rotating bridge walkway should extend beyond the full diameter of the tank to allow safe and easy access by personnel but not more than the edge of the overflow channel.

M03.4.4.2 Centre Bearing

The hinged bearing and shall be designed as to withstand the maximum design load of the bridge. Roller bearings shall be used to pivot the bridge. The bearings shall be water resistant and shall be interchangeable with existing installation of bearings on site. Bearing lubricating point shall be provided reference to accessibility and safety

consideration.

M03.4.5 Protection

Suitable protection shall be provided for in the event of an obstruction causing the bridge operation to be interrupted. The protection provided shall interrupt the operation of the bridge thereby preventing damage to the motor and wheels of the bridge.

The protection device shall be of an Intelligent Motor Protection Relay type with built in phase angle protection and torque limit protection shall also be provided as minimum. All malfunction of the bridge drive unit shall be reflected on the Works SCADA.

M03.4.6 Motor

The bridge motor shall be provided with power from a slip ring system mounted in the centre of the tank along the centre bearing. The slip ring shall be provided with a corrosion resistant or UV resistant which is one piece and having a minimum protection of IP65. The slipring shall be adequately supported and accessible from the walkway for maintenance and/or installation.

The cables to the slip ring shall be bottom entry from the bottom of the tank which are sleeved in a plastic tube of a minimum 80NB. The sleeve tube shall not be bent less than a radius of 600mm (unless otherwise stated in the Project specification) and shall extend over the top water level of the tank towards the walkway by at least 300mm.

The motor shall be connected to a speed reducer giving a peripheral speed of approximately 2 to 3 meters per minute. The minimum rating of the motor shall be 0.75 kW. Refer to Particular Specification E01: for a detailed specification for the Electric Motors. The bridge will be operated by a double drive unit. The motor shall be supplied with standard shaft and flange connection which shall be fitted on any applicable gearbox.

M03.4.7 Gearboxes

Refer to Particular Specification M08: Volume M08 for a detailed specification for the gearbox.

M03.4.8 Wheels

At least two 125 mm wide polyurethane tyred wheels must be used for the bridge. The wheels must be accurately aligned so that the plane of rotation is normal to a line drawn through the pivot of the wheel and the centre point about which the bridge rotates, so as to minimise wear of the tyres.

The driving wheels shall be fitted with a 304L stainless steel protective cover, which shall be fixed to the end of the rotating bridge and provided with a front mounted adjustable guard that will push foreign objects off the wall and to the outside thereof. Wheel guards shall be easily detachable and not form part of the supporting structure. The wheel guard shall be designed with both a steel and rubber material combination. The portion of the rubber material shall allow access for routine maintenance on components of the wheel. The maintenance of the wheel shall be both easy and safe to the personnel.

The underside of the rotating bridge and the underside of the backing plates for the rubber scrapers shall have sufficient clearance to prevent any touching between metal and concrete when the tyres are worn down. The spacing of the wheels shall be such as to give adequate lateral stability to the bridge under all operating conditions.

All lubricating points on the driving mechanisms and wheels shall be accessible and such that no grease is deposited on the concrete surface on which the wheels run.

M03.4.9 Drive Train

The design of the drive train shall be such that no slippage occurs, under the maximum design load or during wet weather under 1, 5 x normal operating load, between the driving wheel and the riding surface that will consist of steel trowelled concrete.

M03.5 SCRAPER MECHANISM

M03.5.1 General

Where possible all adjusters shall be above the water level. A detailed drawing of the proposed mechanism shall accompany the Tender.

M03.5.2 Scrapper Mechanism Parameters

The scraper mechanism for the Primary Sedimentation Tank shall consist of a scraper blade assembly with multiple scrapper blades of length sufficiently designed, arranged in a volute pattern equivalent to a continuous spiral blade. The scraper shall provide a scrapping action for the full diameter of the tank towards the centre column with the sludge collection hopper. The scrapers shall be fitted to an underwater support system manufactured from 304L stainless steel, which shall be suspended from the overhead rotating bridge. No underwater bearings shall be permitted. The scraper mechanism and the bridge shall form one rigid unit on the side of the pivot point with an allowance of at least 30 mm vertical adjustment in the level of the floor scraper.

M03.5.3 Scrapers

The scrapers shall be of Echelon type fitted with synthetic rubber squeegees shaped to fit snugly on the floor. The installation arrangement of the squeegees shall be installed such that they do not overload the drive unit or cause it to trip under overload frequently. The overall height of the scraper shall be at least 300 mm, and the scrapers shall overlap by at least 10% of the scrapper blade length and shall ensure sludge is scraped constantly into the hopper at any bridge position. The scrapers at centre sludge hopper shall extend into the hopper by at least 50mm. Each scrapper shall be maintained without dismantling the entire scrapper system from the bridge structure.

The shape of the squeegees shall be such that at any point they will fit the curvature of the conical floor of the basin. Care must be taken to minimise the wear on the squeegees but no supporting wheels shall be considered.

M03.5.3.1 Squeegees

The squeegees are to be fitted to the scrapers by means of a back plate. The squeegees are to be secured 50 mm from the bottom of the scraper by means of a bolted connection. The bolt shall pass from the back plate, through the squeegees to the scrapper. The squeegees have a minimum thickness of 20mm manufactured from an elastomer with a minimum hardness of 80 shore A unless otherwise specified in the project specification.

M03.5.3.2 Back Plates

The back plates shall be manufactured from 304 stainless steel and shall be angled more than 60° to the radius. The back plates shall have a minimum thickness of 4.5 mm. The underside of the back plates shall be such that at any point it will fit the curvature of the conical floor of the basin.

M03.5.4 Structural Units

The cross-braced structural units suspending the scrapers from the bridge shall be

sufficiently sturdy to keep the scrapers in their relative positions without the metal back plates coming into contact with the floor. The structural units shall be manufactured from 304 SS.

The contractor shall be responsible for the estimated loading on the structure and the torque calculations required to design his equipment under specified maximum loads and shall utilise a factor of safety of not less than 1,5 in the selection of the drive and structural design components.

M03.6 DESLUDGING PIPE

The de-sludging pipe shall have a minimum diameter of 200 mm and shall have a compressed air purge connection and a blank flange 200 mm above the maximum water level in the tanks, as to remove any blockages in the pipe. The de-sludging pipes shall be provided with long radii bends in order to limit potential of any blockages occurring within the pipes. The number of bends in the pipe shall be kept at bare minimum as necessitated by the best pipe route chosen with consideration to gas built-up and blockages. No reducers on the sludge draw-off pipe shall be allowed. The pipeline design shall be subject to approval by the Employer's Agent / Employer's Representative.

M03.6.1 De-sludging Valves

Intermittent sludge removal shall be due to the differential hydraulic head controlled by an electric actuator; refer to "*Particular Specification M17: Actuator equipment for detail on actuators*", rising spindle knife gate valves shall be installed on the de-sludging pipework to control the flow of the de-sludging pipe. A differential hydrostatic head condition shall be initiated at predetermined time intervals (typically once per hour) by a timer controlled electrically operated actuated knife gate valve. This timer control shall take into account the rotating speed of the bridge structure to complete one revolution. The frequency and duration of the valve opening shall be timer controlled by a Programmable Logic Controller (PLC) which shall be supplied and installed as part of the scope, not installed by others.

The de-sludging valve shall be positioned to ensure effective de-sludging using a recommended design hydrostatic head of 3.0m (minimum), and further for refurbishment a hydrostatic head of 2 m shall be assumed to be available to drive the desludging operation.

The sludge knife gate valves shall be constructed from 304 SS.

M03.6.2 Sludge Hopper

The sludge hopper shall have a minimum depth of 1.5m with a side slope of 60°. The diameter of the sludge hopper shall be based on 0.12 to 0.15 times the tank diameter.

M03.6.3 Flow Meter

Clamp-on or Magnetic Flow Meter . Measured as a possible and accessible common pipe from all PSTs. . Should a magnetic flow meter be offered to be used, a pipework bypass shall be allowed for. The full details of the flow measuring instrumentation shall be referred to in the Johannesburg Water (SOC) Control and Instrumentation Specification – Volume 8 for flow measurement.

M03.7 SCUM REMOVAL MECHANISM

M03.7.1 General

Where possible all adjusters shall be above the water level. A detailed drawing of the

proposed mechanism shall be submitted during Tender stage as part of returnable documents. The tank shall be de-scummed on each rotation of the scraper bridge.

M03.7.2 Scum Board

The scum board shall be constructed from 304L SS plate with a minimum dimension of 450 mm deep, at least 3 mm thick and 300 mm below the surface water level shall be provided along the perimeter of the overflow weir at a distance of not less than 300 mm from the inside face of the tank and supported by 304 stainless steel brackets adjustable in a horizontal direction.

M03.7.3 Scum Skimmer Plate

A scum skimmer plate shall be provided at least 3 mm thick 304 stainless steel and 150 mm deep to skim the water surface area within the scum board (including the stilling chamber) and a scum box hopper shall be provided. The scum skimmer shall be set at an angle to the bridge and supported at short intervals to prevent buckling. The part of the scum skimmer passing over the hopper shall be pivoted and shall be arranged in such a way that it will lift clear of the hopper. The skimmer plate will be fixed to the support structure by welds.

M03.7.4 Scum Box

The scum box opening shall measure at least 1200 mm in a radial direction and 500 mm in the direction parallel to the overflow weir and shall be made from 304 SS plate 4.5 mm thick. It shall be equipped with a gently sloping beach, sloping from a height of 300 mm to a height of 500 mm, with a length of 500 mm and a width of 1150 mm. The scum is then deposited in the collection trough which slopes towards the scum discharged pipe. The hopper shall be supported on the side wall of the tank and shall have sufficient cross bracing to ensure rigidity.

A 304L stainless steel projecting striker arm shall activate a 304 L stainless steel valve, which shall open for a period of between 20 – 40 seconds during the period that the scraper arm is above the hopper. The valve shall preferably consist of a weighted bung capable of shutting off the discharge pipe.

The projecting striker arm shall be activated by an adjustable 304L SS striker plate connected to the rotating bridge. The striker plate is to have sufficient adjustment in order to adjust the de-scumming time between 20 and 40 secs.

The scum box shall have a positive hydraulic scum removal action and shall be positioned facing the prevailing wind. The direction shall be specific to the works of installation.

M03.7.5 Scum Discharge pipe

The scum discharge pipe from the hopper shall have a diameter of at least 200 mm and manufactured from 6 mm thick 304L stainless steel. It shall slope towards the scum discharge scum valve chamber. A knife gate valve with internals constructed from stainless steel shall be installed on the discharge pipeline for the purpose of additional scum discharge control and management. For safety consideration with reference to the bridge movement, there shall be no protruding items on the bridge structure or from the scum discharge chamber in order to avoid any injuries from the personnel.

M03.8 **OVERFLOW WEIR**

A V-notched single overflow weir manufactured of 4,5 mm 304 stainless steel plate, 200 mm deep shall be provided and installed on the inside of the concrete wall of the launder. The overflow weir is to be attached to the wall of the tank by means of bolts.

The installation of the V-notched weir shall ensure that the effluent discharges freely and evenly around the whole circumference of the tank without leakage through the joint between the weir and the wall or the joints between weir sections. Tenderers shall allow in their process for sealing against “off the shutter” concrete finish and between ends of weir sections with an approved material such as closed cell expanded neoprene. Holes in the weir plate shall be slotted to permit adjustment.

M03.9

PIPEWORK

The following supply items shall be supplied and installed as part of primary sedimentation tank structural work:

- The inlet under the floor and inside the inlet structure of the tank
- The sludge draw-off pipe
- The effluent pipework

The pipework shall be manufactured from 304L stainless steel. Refer to Particular Specification M21: for detail on pipework. The contractor under this Contract must, however, supply and install the scum discharge pipe and valve up to the scum discharge manhole inside the scum valve chamber adjacent to the tank, which will be built as part of primary sedimentation tank structural work.

M03.10

Material Of Construction

The equipment unit components shall be constructed using the critical material specified in the table below:

<u>COMPONENT</u>	<u>MATERIAL</u>
Wet Fasteners	316 stainless steel
Pipework	316 stainless steel
Rotating access bridge	304L stainless steel
Steel ladders	304L stainless steel
Centre bearing base plate structure	3CR12
Carriage wheels	polyurethane tyred wheels
Protective covers	3CR12
Scraper support structures	304L stainless steel
Squeegees	synthetic rubber
Scraper back-plate	304L stainless steel
Scum box system incl. baffle plates and brackets	304L stainless steel
Overflow weir	304L stainless steel
Scum and sludge pipework	304L stainless steel
All other accessories shall be of manufacturer's standard coated material.	

M03.11

RECOMMENDED SPARES AND SPECIAL TOOLS

The Tenderer must submit on the appropriate schedule a priced list of spare parts which it is recommended should be kept by Johannesburg Water for maintenance of the plant. Spares which the Management decides to order must be manufactured simultaneously with the rest of the equipment and be subject to the same tests for dimensions, tolerances, strength, etc. All spares must be packed separately, and the cases appropriately marked. All spares must be new and unused.

For special tools being used on offered equipment. Tenderers must submit a provisional price (requested in the Bill of Quantity) for a complete set of spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied. All spanners, keys and tools shall be new and unused.

M03.12 GUARANTEE OF PERFORMANCE

The Defects Liability period shall be a minimum period of 12 months calculated from the Completion of the Works as defined in the Contract Document. However, should a portion or all of the plant and equipment fail / or require rectification during this period, the Employer's Agent or Representative reserves the right to extend the Defects Liability Period in respect of such portion or all of the plant and equipment for a further period of at least 12 months calculated from the date of Commissioning of such plant and equipment after rectification

M03.13 GENERAL FASTENERS

Nuts, bolts, studs and washers for incorporation in the Works shall conform to the requirement of the appropriate approved standard.

Weir plates and scum baffles shall be attached to the tank using 316 stainless steel anchors set in holes drilled by the Contractor under this Contract. Bolts shall be of such standard length that a minimum of two to four complete threads shall protrude beyond the nut when in the fully tightened condition. The same shall apply to stud units. Mating surfaces shall be adequately protected against corrosion whilst awaiting assembly of the faces and bolting, all to the approval of the Employer's Agent or Employer's Representative.

All high tensile bolts and studs used in the Works shall bear the letter HTS stamped or engraved on the end.

Washers shall be provided under all bolt heads and nuts. The threads of bolts and studs shall be lubricated before assembly with a lubricating substance subject to the approval of the Employer's Agent or Employer's Representative. Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Employer's Agent or Employer's Representative.

Stainless steel bolts, nuts and washers shall be in accordance with SANS 1700 A70 and the grade of stainless steel shall be subject to the approval of the Employer's Agent or Employer's Representative. Hot Dip Galvanised fasteners shall comply with the requirements of SANS 121. High strength friction grip (HSFG) bolts, nuts, load indicator washers and washers shall be subject to the approval of the Employer's Agent or Employer's Representative and shall be hot dip galvanised. High strength friction grip bolts shall be tightened in accordance with the manufacturer's recommendations and the tension shall be re-checked not less than 3 hours after first tightening and then the bolts shall be retightened to the initial load all to the approval of the Employer's Agent or Employer's Representative.

All stainless steel holding down bolts, nuts and washers in contact with a dissimilar material shall be provided with isolating washers and sleeves (insulating kit) where appropriate to prevent galvanic corrosion, unless otherwise specified in the project specification. The bed plates and machinery shall be provided with means of adjustment for line and level to maintain the items of Plant in correct alignment during grouting. Packers used for adjustment shall be of non-corrosive material to the approval of the Employer's Agent or Employer's Representative. Holding down bolts which are to be tightened after grouting shall be provided with bond breakers where they pass through the grout.

Where there is a risk of corrosion, bolts and studs shall be designed so that the maximum stress in the bolt and nut does not exceed half of the yield stress of the bolt material under all conditions. The shear value of high strength friction grip bolts shall be reduced in proportion to the reduced tensile stress compared with the normal design stress.

No tapped holes in mild steel shall be allowed. Where tapped holes are unavoidable, this shall be done into stainless steel.

Where bolts and nuts are required to be removed and re-assembled on a regular basis, these shall be of stainless steel.

Metal coatings and other treatments applied to fasteners shall be carried out in a manner which will not cause hydrogen embrittlement of the parent material.

M03.14 Metal Preparation And Corrosion Protection

Refer to Particular Specification G02: Corrosion Protection.

M03.15 COLOUR CODES

The standard final colour codes for equipment supplied under this Contract shall be in accordance with Particular Specification G01: Colour Codes.

M03.16 QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE

QM shall be categorised as 'critical and major' for this section of the Project.

M03.16.1 Manufacture

The Contractor's Quality Management System shall be in accordance with industry standard.

The Contractor shall implement a comprehensive Quality Control programme and accept full responsibility for the quality of his workmanship and material used, irrespective of any quality surveillance that may be carried out by the Employer's Agent / Employer' Representative.

In keeping with the basic principles Quality Management System, the Contractor and Subcontractor(s) shall:

- Be responsible for compliance with all the requirements of the Specification in every respect;
- Carry out all inspections and tests called for in the Specification in the presence of the Employer's Agent / Employer' Representative. The cost of these inspections and tests shall be carried out at the sole expense and under the responsibility of the Contractor;
- Draft a Quality Control Plan for manufacture for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during manufacturing process of all components indicating all the intended stages of testing during manufacture, cleaning and preparation for application as well as necessary hold points for independent quality surveillance;
- Draft a Quality Control Plan for corrosion protection for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during corrosion protection process of all components indicating all the intended stages of testing during corrosion protection as well as necessary hold points for independent quality surveillance;
- Draft a Quality Control Plan for installation for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during installation process of all components indicating all the intended stages of testing during installation as well as necessary hold points for independent quality surveillance; and
- Draft Quality Control Plans for any other construction process as may be required for approval by the Employer's Agent / Employer' Representative and comply with

the approved Quality Plan during the execution of the process indicating all the intended stages of testing as well as necessary hold points for independent quality surveillance.

The Quality Control Plans will not be compromised once approved and shall be adhered to at all times. The Contractor shall operate approved quality assurance and control programmes in the Supplier's and Manufacturer's premises and on Site in order to verify that the Works comply with this Section. Prior to the commencement of any work, the Contractor shall prepare and submit to the Employer's Agent / Employer' Representative for approval, quality plans describing the procedures, standards of acceptance, hold point inspections, routine and type tests to be carried out for each component both during manufacture and on Site.

Although it shall remain the responsibility of the Contractor to ensure that the Works conform to the Specification, the Employer's Agent / Employer' Representative shall be entitled to inspect, examine and test the materials, workmanship and performance of every item of Plant. The Employer's Agent / Employer' Representative will notify the Contractor which tests or inspections, detailed in the quality plan, he will attend.

Approval by the Employer's Agent / Employer' Representative of materials, workmanship, etc., during manufacture or at Site will not relieve the Contractor of his obligations to comply with all the requirements of the Contract.

All instruments and appliances necessary for the complete inspection and testing shall be provided by the Contractor. Calibration certificates for instruments shall be produced to the Employer's Agent or Representative for review prior to the commencement of any tests and, if required by the Employer's Agent / Employer' Representative, instruments shall be re-calibrated at the Contractor's own account before commencement of the tests.

M03.16.2 Material Tests

The Manufacturer's material test data and the Contractor's quality records shall be subject to examination by the Employer's Agent / Employer' Representative. Reasonable samples of the cleaning and coating materials to be used may be taken for testing.

Rejection of the samples shall place a hold on the use of the materials of the same batch number and any components that have already been cleaned/coated with rejected material shall be re-cleaned and coated.

M03.16.3 Type Tests

Where the Contractor offers Plant selected from the standard range of products from a specialist manufacturer, type tests in accordance with a recognised international standard are required on one unit of each type to prove satisfactory design and quality of manufacture of that Plant.

The Employer's Agent / Employer' Representative may waive the requirement for type tests if he is satisfied that tests have previously been performed on identical Plant. The Contractor shall submit the data and results with his Quality Plan in sufficient time to allow for repeat tests without delaying the Works should the Employer's Agent / Employer' Representative not approve the evidence submitted

M03.16.4 Manufacture

Tenderers shall submit with their tender a detailed Project Quality Plan, stating how they control the flow of paperwork from commencement of the Project through final handover to the Client, a sample of their Quality Control Plan, (QCP) and Project

Quality Plan, (PQP) both during the course of the Project, manufacture and finally, installation.

The successful Tenderer shall submit a QCP covering all aspects of the manufacturing process, indicating held points to allow the Employer's Agent or Representative opportunities to evaluate the equipment for compliance to this specification.

All items of equipment shall be subject to inspections by the Employer's Agent or Representative during design and manufacture per these QCP's.

In general, it is anticipated that this Project shall be in accordance with the relevant ISO 9000 requirements.

M03.16.5 Installation

The successful Tenderer shall submit a QCP covering all aspects of the installation of each item of equipment to be installed under this Project. The Employer's Agent shall be requested to attend certain stages of completion of installation to ascertain compliance with the Specifications and to witness the Contractor's site inspections at the Employer's Agent's discretion.

M03.17 **SYSTEM PERFORMANCE**

M03.17.1 Works' testing

Each item of equipment shall be subject to inspection and testing prior to despatch from the works. All performance test results shall be made available to the Employer's Agent or Representative for verification or when the QCP's require intervention or hold points for inspection.

In the case of gearboxes, they shall be subject to testing under operating conditions for at least 12 hours on the test bed. All results shall be available for inspection

M03.17.2 Before commissioning

- Check for correct oil level in gearboxes and that motors are greased properly.
- Ensure all HD bolts are torqued down correctly.
- The alignment and levelling of each assembly shall be checked, and the results shall be available for inspection by the Employer's Agent or Representative.
- The electrical functions and control shall be checked by a responsible inspector prior to attempting to start any motor on this Project.

M03.17.3 Prior to Filling of the Tanks

M03.17.3.1 Driving Wheels

During the above tests the concrete surface under the driving wheels shall be thoroughly wetted.

M03.17.4 During Commissioning

- Ensure all equipment lubrication are sufficient and all control and safety switches are functional
- Ensure all equipment are secured and in correct positions.

M03.17.5 After filling of the Tanks

M03.17.5.1 Weirs

That there is even distribution of flow over the weirs without any bypassing of the weir.

M03.17.5.2 Scum Removal

That there is positive removal of scum.

M03.17.6 Before Expiry of the Defects Liability Period

The Employer's Agent or Representative requires the Contractor to visit the site every quarter to inspect for the correct operation of the installed equipment. A report after each visit shall be submitted in writing

M03.18 EQUIPMENT TRAINING PROCEDURE

Training shall be provided by the Contractor (or specialist equipment suppliers) based on the supplied and approved operation and maintenance (O&M) manuals for all supplied equipment. This training shall be provided to the Operations and Mechanical including other support discipline staff of the Employer along with the Employer's Agent and/or Representatives. The duration of the training period shall be advised by the Contractor and agreed with the Employer's Agent and/or Representatives.

The training structure for the equipment and/or system should include both the theory and practical components of the equipment derived from the O&M manuals.

The preparation of the O&M manuals shall be based on the Johannesburg Water (SOC) Particular specification for Commissioning and Operation.

M03.19 OPERATION AND MAINTENANCE MANUAL SUMMARY

The Contractor shall hand over to the Employer' Agent or Employer's Representative four sets (x2 hard copies and x2 electronic copies on non-locked USB) of the Operation and Maintenance Manual compiled for each installation not later than at the time of commissioning of the installation. These manuals are a prerequisite for final takeover of the plant. A copy of the Operating and Maintenance Manual for each equipment type shall be bound in with the Operating and Maintenance Manual for the project. The manual shall be A4 size and properly bound. Drawings larger than A3 size shall be contained in separate plastic pockets.

The Operation and Maintenance Manual will contain the following:

- Brief description of the plant and installation.
- Concise operating instructions including start-up, operating, shutdown and troubleshooting procedures.
- Routine maintenance instruction this shall include failure mode analysis and preventative strategies.
- Precautionary measures, elementary trouble location, rectifying measures and emergency actions.
- Detailed information on equipment.
- Lists of spare parts including names and addresses of suppliers.
- Schematic Diagram and Drawings
- Risk, Health and Safety Assessment with proposed control measures.

M03.20 INTERCHANGEABILITY

Where two or more similar types of equipment are required, these units shall be

identical in all respects.

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

M03.21 DRAWINGS

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

Before the Contractor carries out any work, they shall submit detailed working drawings to be approved by the Employer's Agent or Employer's Representative. . Approval of these drawings does not relieve the Contractor from their responsibility for the correctness of the drawings.

M03.22 MEASUREMENT AND PAYMENT

No separate payment will be made for required equipment unless otherwise specified in the detail/project specifications. All direct and indirect costs associated with such required equipment shall be deemed to be included in the rates tendered for the equipment.

Where separate payment is required for equipment and specified as such in the detail /project specifications, the following payment items shall be applicable:

M03.22.1 General

The following items shall, inter alia, be included in the rates:

- Supply of all design and pre-manufacture documentation and obtaining approval thereof;
- Procurement/manufacture of required equipment with associated equipment items and delivery to Site;
- Installation of complete required equipment with associated equipment items and testing; and
- Services required during period of initial use before handover to the Employer.

Payment under scheduled items shall be made per complete installation as specified, electrical connections, etc and grouting, etc. Measurement and payment will distinguish between supply / delivery; installation and testing; and commissioning and trial operation of the equipment.

M03.22.2 Supply and delivery to site with documentation

<u>Item</u>	<u>Unit</u>
Supply and delivery to site with documentation	No

The tendered rates shall include for full compensation of all costs incurred in design, drawings, manufacture, supply, testing at the manufacturers works, inspections, quality control, quality assurance, factory acceptance testing, corrosion protection, packing, delivery to site including transportation costs and offloading on site including any craneage requirements. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.

M03.22.3 **Installation, Testing and Commissioning of the Equipment**

<u>Item</u>	<u>Unit</u>
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Installation, Testing and Commissioning of the Equipment.....	No
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The tendered rates shall include for full compensation of all costs incurred in installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified on Site including the provision of all labour, supervision, instruments, equipment, transport, on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the Employer's Agent / Employer' Representative), materials and Temporary Works necessary to completely install, test and commission and render fully operational surface aeration equipment.

The rate shall also include the cost of the installation of all auxiliary equipment not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified until taken over by the Employer; the putting into service of the complete installation; remedial work and any other work as specified and necessary.

The rate shall also include for all preliminary testing and the provision of testing equipment therefore including all disruptions to installation caused by such testing.

Payment will only be effected after full compliance of the equipment items with this Section and associated documentation has been approved by the Employer's Agent / Employer' Representative.

The Contractor shall include in the Tendered rate for straining of the gearbox oil after 600 hours of initial operation. The Contractor shall furnish the Employer's Agent with a report recording any irregularities when cleaning the sieves after straining.

M03.22.4 **Trial Operations**

<u>Item</u>	<u>Unit</u>
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Trial Operations.....	No
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This specification allows for a number of calendar days within which the system Trial Operation can be completed after completion of commissioning process. The Contractor shall programme and price for providing full technical and operational support during trial operation.

M03.22.5 **Employer's Operator Training**

<u>Item</u>	<u>Unit</u>
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Training	No
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Payment for Training of the Employer's Operational Staff will be made under this Section as set out in project specification or agreed with the Employer's Agent / Employer' Representative. The lump sum shall be inclusive of all costs associated with the training programme and on-site training of personnel.

M03.22.6

Spares Equipment

Item

Unit

Spares.....No

The cost of spares, considered to be necessary by the Contractor other than spares required by the Employer, delivered to Site and handed over will be paid as a lump sum. A Spare Part Schedule subject to approval by the Employer's Agent/ Employer's representative shall be submitted before procurement of spares.

The actual lump sum to be paid shall be based on the unit rates priced in the Bill of Quantity for the actual spares ordered and supplied and the Employer is entitled to purchase all, some or none of the items listed. A provisional sum will be allocated in the Bill of Quantity for the complete list of spare parts as listed by the Contractor. The rate tendered shall provide for the manufacture, supply, delivery to Site and handing over of the spares ordered and shall include permanent packing for long term storage. The spares shall be manufactured at the same time as the installed items

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