



Project No: 176150

INSTALLATION OF WATER TANKS, BOOSTER PUMPS
AND/OR BOREHOLES FOR THE NKANGALA DISTRICT
MUNICIPALITY BUILDING

C3.2: STANDARD SPECIFICATION

STANDARD SPECIFICATIONS

The standard specifications on which this contract is based are the **SANS 1200**

The following SANS specifications are also referred to in this document and the Contractor is advised to obtain them from Standards South Africa (a division of SABS) in Pretoria, but are not limited to:

- SANS 10396: 2003 : Implementing Preferential Construction Procurement Policies using Targeted Procurement Procedures
- SANS 1914-1 to 6 (2002) : Targeted Construction Procurement
- SANS 1921 – 1 (2004) : Construction and Management Requirements for Works Contracts
Part 1: General Contracting and Construction Works where accommodation of traffic is involved:
- SANS 1921-2 (2004) : Construction and Management Requirements for Works Contracts
Part 2: Accommodation of Traffic on Public Roads Occupied by the Contractor.
- SANS 241-1: 2015 (Ed 2) : South African Drinking Water Standard.

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MECHANICAL STANDARD SPECIFICATIONS

1. GENERAL MECHANICAL REQUIREMENTS

1. **References:**

The following Standards will be considered in this section. Equipment, Materials and operational methods shall conform to the latest edition of the relevant national and/or international Standards.

- SANS 62
- SANS 200
- SANS 719
- SANS 936/7
- SANS 989/992
- SANS 1034
- SANS 1062
- SANS 1123
- SANS 1186
- SANS 1200H
- SANS 1217
- SANS 1465
- SANS 1700
- SANS 1804
- SANS 10044
- SANS 10104
- SANS 10160
- SANS 10108
- SANS 1587
- SANS 50025
- SANS 60034-5
- SANS/ISO 4427
- BS 970
- BS 1400
- BS 1452
- BS 1490
- BS 2789
- BS 3100
- BS 3790
- BS 4515
- BS 4872
- BS 7845
- BS
- EN 681
- BS
- EN 1092
- BS EN ISO 23936
- ISO Sa3
- ISO 4184
- ISO 8501
- ISO 10816

2. **Materials:**

2.1. **General**

All materials used for manufacturing and construction shall be new by all definitions. The contractor is to ensure that the materials used are selected in accordance with the best current engineering practice to suit the working conditions and environment of the equipment.

2.2. **Structural Steel**

Steel used shall comply with the requirements of SANS50025 and shall be legibly marked.

2.3. **Stainless Steel**

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The grade of stainless steel shall be selected as specified.

Unless otherwise specified, rolled material shall be supplied with a matt, annealed and pickled surface finish (Or otherwise de-scaled). For wrought steels, the equivalent BS970 grade may be used.

Manufacturer's test certificates are to be provided for each batch detailing the material analysis and any mechanical tests performed (if any). Each item shall be clearly (permanently) and legibly marked with the grade of stainless steel used.

2.4. **3CR12:**

3CR12 shall always be supplied with a annealed and pickled finish. In cases where it is to be coated, it shall be adequately abrasive blasted as specified by coating material supplier.

2.5. **Poly Materials:**

Fibre reinforced polymers and thermoplastics shall be UV resistant and shall have adequate structural integrity to suit the application. PVC is not to be used unless specified and per the Engineer's written approval of the technical specifications.

3. **Casted items:**

3.1. Castings shall comply with the following standards:

General Purpose Steel	SANS 1465, BS3100
Grey Cast Iron	SANS 1034I, BS1452
S.G. Iron	SANS 936/7, BS2789
Aluminum	SANS 989/992, BS1490
Stainless Steel	DIN 17 445
Copper & Copper Alloys	SANS 200, BS1400

3.2. **General**

Finish	Fettled
Porosity, Sharp Edges, inclusions	Not Tolerated
Areas under Boltheads, Nuts, Washers	Machined (Spot Faced) for a flat and smooth pressure bearing area. Space to be sufficient for sockets or ring-spanners.
Pressure Retaining Castings	Pressure Tested to 1.5 the maximum working pressure
Repairs and welds	Not Tolerated without written permission of the Engineer
Metallurgy	Castings shall be heat treated for purposes of corrosion protection and reasonable machinability. Stainless steel castings shall be heat treated to ensure all carbides are in solution to ensure optimal grain size and provide maximum corrosion protection.
Test Certificates	To be provided by the contractor for each batch of castings, detailing material analysis and heat treatment, and any mechanical tests performed.

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4. Steel Fabrication:

4.1. General

Construction, fabrication and installation shall be in accordance with the relevant requirements of SANS 1200H. Welding compliance is discussed in the next section (§5.). Surface Defects (Sharp Edges, pits, spatter, undercuts, indentations) are not accepted. Edges shall be rounded to a minimum radius of 2mm and design shall avoid inaccessible hollows, pockets and sharp edges. Inspection shall be done upon completion of fabrication.

4.2. Carbon Steels

Standards:	SANS 50025
Finish:	Surfaces to be coated will be accesible by blast spray equipment. Bad weld profiles and hollow pockets which are inaccessible are not accepted. The angle of blast impact shall not be less than 45°. Edges shall be rounded for safety and proper coating.
Normative Compliance:	"Hot Dip Galvanisers Association of South Africa" requirements - if item is to be hot dip galvanised.
Design:	To provide adequate access for proper entry of the molten zinc into open spaces such that drilling etc is avoided.

4.3. Stainless Steels

Standards:	
Finish:	Pickled and Passivated over the full surface. Even coloring Avoidance or coarse grinding marks (if grinding is required before pickling).
Normative Compliance:	"The Stainless Steel User Manual" by Columbus Stainless or literature by equivalent authority.
Design:	

4.4. 3CR12

Standards:	
Finish:	
Normative Compliance:	Shall comply with the recommendations in §4.3 and "The 3CR12 Fabrication Guide" by Columbus Stainless or literature by equivalent authority.
Design:	

4.5. Highly Alloyed Stainless Steels

Standards:	BS 4515 pt 2 (Welding) or equivalent.
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Finish:	
Normative Compliance:	Manufacturers Guidelines for duplex, super austenitic and other highly alloyed stainless steels.
Design:	

5. Welding:

Standards	Complying with good modern Practice and acceptable to the engineer. Recommendations of the SAIW are acceptable. Welders are to be qualified and experienced artisans in accordance of BS4872 or equivalent.
Weld Appearance	Free of splatter, projections, blowholes, pinholes and undercuts. Flux, spatters and imperfections shall be removed. Beads with an irregularity of greater than 3mm or any sharp edges shall be ground.
Elimination of Crevices & Continuous Welding	Crevices shall be eliminated, including of which arose from welding. This applies to welding of all metals. The Welding procedure shall be designed to prevent deformation. Welding shall be Continuous on all sides of a joint. Design to allow for continuous welding. Welds only accesible on one side shall be prepared that the root run provides an acceptable profile and prevent crevices from forming. Pipework shall be designed that welds can be inspected, and pickled & Passivated (if applicable). incontinuous welds are to be approved in writing by the engineer.
Stainless Steel and 3CR12	All steps shall be taken to ensure maximum corrosion resistance and structural integrity of the weld and welded material. Prolonged heating shall be avoided and weld shall be passivated. Steel contamination and discoloration shall be removed by pickling or otherwise as approved by the Engineer. Welding rods used shall be that most suitable to the welded material and only artisans experienced with the welding of stainless steel shall be used.
Site Welding	To be avoided, only undertaken with the written approval of the Engineer.
Inspections	All fabrications are to be inspected by the Contractor prior to dispatch from the fabricator workshop.

6. Installation:

6.1	The contractor shall provide all foundation bolts, hangers, brackets and supports etc. required for the fixing and support of equipment.
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	When installed, the equipment shall be of neat appearance, sturdy, evenly supported level, plumb, true to line and in working order.
6.3	The contractor shall be responsible for all grouting work associated with equipment and pipework.
6.4	The use of shims for alignment purposes are allowed (maximum 3). If clearance is too great, machined spacers are to be used where necessary. All spacers and shims are to be of a corrosion resistant material.
6.5	Crevices formed between two metal surfaces shall be filled with a suitable formable packing before final fastening.
6.6	Corrosion protection requirements are to be adhered to.
6.7	Mating Faces must be coated before, and sealed after assembly.
6.8	Alignment of shafts shall be adequately accurate such that no prior load is present on the shaft coupling.
6.9	Final Alignment of shafts are to be done after installation, prior to commissioning.

7. Civil Requirements for Mechanical Installations:

7.1.	General	The Mechanical Contractor is responsible for all grouting work required for pipework passing through walls and all other equipment, closing of apertures and anchoring of equipment as provided in terms of this contract.
7.2.	Deliverables	The Mechanical Contractor's documents shall indicate the civil and building details required to accommodate the installation of equipment. In accordance with, and subject to any details as shown on the drawings as provided by the engineer.
7.3.	Inspection	The Mechanical Contractor is to inspect related structures constructed by others for accuracy, suitability of construction and conformance prior to construction and installation. No additional payments shall be allowed in lieu of the contractor failing to check, and include within the contractor's documents, such work timeously.
7.4.	Puddle Pipes	The Mechanical Contractor is to install puddle pipes as required by the design. The mechanical contractor shall provide box-out details to the engineer. Box-outs shall be designed according to the puddle flange with an allowance of $\pm 35\text{mm}$ tolerance for civil work. Puddle flange dimensions are to be the same as standard flange dimensions.
7.5.	Grouting	The Structure shall be, if required, be tested for water tightness before access is granted for the installation of mechanical elements. Upon receiving access to the site, the contractor is to install the pipework, and shall grout the puddle pipes into the structure by using a non-shrinking grout to be approved by the engineer. The installations are to be water-tight and the Contractor shall be responsible for rectifying any leakage.
7.6	Baseframes & Pipe Supports	The Contractor is responsible for the grouting of pipe supports, baseframes, plinths or any area where metallic structures are to be fastened

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	to concrete structures. Methods for anchoring baseframes and pipe supports shall be submitted to the Engineer for approval and will include details on the material to be used. The grouting shall be done to prevent accumulation of dirt or water. Grout shall only be applied after the anchor bolts (fastener) has been tested for integrity. Plinths shall be casted after the installation of mechanical equipment. Refer to baseframe and pipe support specifications later in this document.
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8. Machine Guards

Compliance	Occupational Health and Safety Act of 1993 as Ammended
Requirements	Guards shall cover all moving or rotating parts of equipment. Guards should adequately prevent items such as setscrews, nuts, locknuts, keys or any other part to protrude. In the case of meshed guards, the openings shall not allow any item larger than 10mm to protrude.
Material	Mesh is to be used on any moving part where visual inspection and ventilation is required. Guards shall be sturdy and rigid, and shall not cause noise or vibration. Guards shall be 316 Stainless steel or Hot dipped galvanized carbon steel coated to specification.
Design	Guards shall be able to be removed easily for maintenance.
Corrosion Protection	In the case of carbon steel bein used, it may be hot dipped galvanised, hot metal zinc-sprayed or hot metal aluminum sprayed.
Fasteners	M10 or greater.

9. Shaft Couplings

Compliance	Occupational Health and Safety Act of 1993 as Ammended
Requirements	Couplings shall reduce the transmission of torsional oscillations and misalignment forces between the driven and driving machines.
Material	Elastomeric materials shall be urethane based.
Design	Tyre (Rubber) type shall be used. Rubber compression type may be used upon written approval of the Engineer.
Guards	Coupling Guards shall be in compliance with §8 of this section.
Lubrication	Couplings shall not require lubrication.
Alignment	Couplings shall be aligned accurately and shall be checked by the Contractor.

10. Driven Gearboxes

General	Gearboxes shall have an efficiency 96% or greater on 2-stage reduction and 95% or greater on 3-stage reduction and shall have a protection rating of IP55 or greater.
Service Factor	For Motor Driven Applications: Uniform Load Duty - minimum of 1.25 Moderate Shock Duty - Minimum of 1.5

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		Heavy Shock Duty - Minimum of 2. For Engine Driven Gearboxes the service factor shall not be less than 2.
Design	Gears	Case Hardened, Profile Ground & lapped Helical & spiral bevel gears.
	Housing	Rigid, Cast Construction, Split Horizontally.
	Mounting	Sole plates with jacking screws unless close coupled.
	Bearings	Designed for 100'000 hours life
	Breather	Yes, preventing moisture to enter.
Lubrication		Gearboxes shall have oil gauges (Visor or dipstick) and have adequately accesible drain and fill plugs. Greased points shall have easy accesible grease zerks. The contractor shall be responsible for draining and replacing the oil during the defects notification period.

11. Manual Gearboxes

General	Additional to §10 above, Manual gearboxes shall have an over-torque limiting device.
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12. Bearings

Selection	0-100kW	Grease lubricated
	101-999kW	Oil Lubricated
	>1000kW	Plain (oil film type)
	Plain (oil film type) shall also be used in applications where high shaft speeds and high temperatures are present.	
Requirements	Design and selection shall allow for safe shut down after power interruption and shall in variable speed applications be adequate for the full range of operation.	
Rolling Element Bearings	L-10 Bearing Life of at least 100'000 hours for shafts larger than 50mm, this can be reduced if the ewuipment works for less than 3000 hours a year. Greased bearings shall be relieved against over-greasing. Oil lubricated bearings shall be provided with an oil ring.	
Plain Bearings	Slide Bearings, Oil-film bearings, sleeve bearings must be provided with a oil ring, rotating dish or pumped by feed. During normal shut down or power failure, lubrication system shall be active.	
Thermal Alarms	To be set in accordance with manufacturer's requirements.	

13 Lubrication

General	Type of lubrication shall be adequate and dependant on severity of operating conditions. All lubrication systems shall be designed to prevent entrance of moisture and dirt. Draining of the system shall be possible and all air vents shall be filtered.
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Grease Lubrication	Acceptable where operating conditions are not severe. For Manual greasing, grease zerks shall be easily accesible or grease shall be conveyed through a pipe to the grease point from an easily accesible zerk. If Multiple grease points are present and are to be centrally greased, a central lubrication unit shall be installed (motorized or manual) per equipment set, and shall convey grease to the zerks of the equipment.
Oil Lubrication	Acceptable where operating conditions are severe. The contractor is responsible for the initial fill and first change, including draining and filling after initial run period (3months). Level Indicators shall allow visual checking.
Submerged Bearing Housings	This type of lubrication shall be used where extreme load bearing conditions are present. Grease lubrication shall be used via motorised lubrication. Seals shall be arranged to prevent over-greasing. This does not apply to equipment of which the bearing housing is contained within the equipment casing.

14. Pressure Gauges.

Construction	Suitable for industrial applications.
	Suitable for continuous operation.
	Filled with Glycerine to prevent damage from pressure fluctuations.
	Case and bezel shall be stainless steel.
	Accuracy Class: 1.6
	Durability Grade: A
	Compliance with SANS1062, visually marked.
	Reading: Gauge Pressure unless absolute pressure is specified.
	Scale Diameter shall be 100mm or greater.
	Calibration: Metres Water Column (units of measurement clearly shown.)
	Scale: Shall indicate normal pressure range in green.
	Scale: Normal operating range shall not be less than half of the full scale reading.
	Scale: Full scale reading shall be greater than the pump shutoff head.
Scale Markings: Radial, Black on a white background, Concentric, simmetrically spaced.	
Indicator Tip: Knife Edge, extending over scale markings.	
Installation	Gauges shall not be subjected to vibration.
	Mounted remotely for pipework larger than DN250 and shall have an isolation valve.
	Mounted Vertically, Easily read from floor level.

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	Gauges shall be fitted with an isolating and air bleed valve. Valves shall be stainless steel with adequate pressure rating.
15. Electronic Instrumentation.	
Environmental Protection:	Instrumentation and associated Displays and Transmitters Indoors or Outdoor above ground: IP55 or greater.
	Instrumentation and associated Displays and transmitters Underground: IP68 or greater. In a self-draining enclosure.
	Instrumentation and associated Displays and transmitters outdoors shall be fitted in an enclosure. The complete installation shall have an IP55 rating or greater.
	All enclosures shall provide 100mm (minimum) clearance around instruments.
	Cabling and instruments shall protect against electromagnetic interference.
	Calibration Certificates shall be included in the O&M Manual.
	Instrumentats shall be clearly and permanently marked.

16. Grid Flooring	
Design	Bearer bar depth shall be 30mm or greater.
	Bearer bar Pitch shall not be greater than 40mm.
	Bearer bar shall be across the shorter span.
	Panels shall be level and fixed to angle frames. (Saddle Clamped)
	All cut-outs and edges shall be banded.
	Corrosion protection shall be done after welding.
Material	Hot Dipped Galvanised Carbon Steel
	All Clamps (Saddle clamp and locking plate) shall be Hot dipped galvanised or stainless steel.
	Fasteners shall be EN grade 1.4401 (316) or better.

17. Guard Rails.	
General	Required where level drops of greater than 1m are present.
	Compliance with SANS 10104.
Requirements	To resist without damage and without excessive deflection the loadings as stipulated in Cat. E, in Table 7, in Clause 9.4 of SANS10160 2:2011, Ed. 1.1: - 1000 Newtons of force in any direction (Concentrated over 100mm length) - 1000 Newtons of horizontal force distributed per metre along the top rail.
Design	Hand and Knee Rails: OD 33mm or greater, Wall thickness 2.5mm or greater.

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	Span: Not greater than 1.5m, Greater spans may be accepted if heavier tube dimensions are used.
	Stanchions: Wall thickness of 3mm or greater.
	On Platforms, walkways, landings or around dangerous areas, the height shall be 1000mm or greater measured from the top of the handrail to the floor.
	On Stairways and fixed ladders, the rails shall be parallel to the strings. The vertical height from the nose of the tread to the top of the handrail shall be 900mm or greater.
	No opening shall allow the passage of an item with a diameter of 600mm.
	All material to be smoothly finished, free from burrs, sharp edges, sharp corners and projections.
	Welded Joints are preferred with all joints smoothly finished and free of shoulders.
	Bolted sections shall be securely fastened and secure under loading.
	Riveted installations are not preferred.
	Ended railings shall have positively fixed closure bends.
	At corners stanchions at both ends, with short radius bends shall be used, unless purpose built stanchions are used. No sharp corners or ends are allowed.
	Stanchions shall not accumulate dirt or water (Self draining, hollow)
	Stanchions shall be base mounted to suit arrangement requirements and shall be of solid welded construction.
	Stanchion bases shall be equal or greater than 8mmx60mmx150mm when affixed to metallic surfaces. Two fasteners shall be used and Fasteners shall be M16 or greater. Packing shall be used under stanchion feet to prevent formation of crevices.
	Stanchion bases shall be equal or greater than 10mm x 150mm x 150mm when affixed to non-metallic surfaces. Four fasteners shall be used and Fasteners shall be M16 or greater. Non-Shrinking grout shall be used under stanchion feet to prevent formation of crevices.
	Kickplates (Where required) shall have a height of 150mm above the walkway level.
	For Guard Rails in public Places, all requirements above apply, no opening in guardrails shall permit an item with a diameter of 100mm to pass.
Material	Carbon Steel, Hop-dip galvanised
	All corrosion protection to be done prior to shipment to site.
	If Welding or cutting occurs after corrosion protection, the material shall be returned for re-galvanising.
	If Stainless steel is used, all fabrication and welding are to be according to the requirements of stainless steel.

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Fasteners	EN Grade 1.4401 (316) Stainless steel, Diameter shall be M12 or greater.
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18. Fasteners.

Standards	Nuts and bolts shall be Hexagon head type, comply with SANS1700, coarse thread pitch.
Material	M12 and smaller: EN Grade 1.4401 (316) or better.
	Corrosive Areas: EN Grade 1.4401 (316) or better.
	Larger than M12 and non-corrosive areas, unless otherwise specified: Hot-dip galvanised.
	* Corrosive areas include any area where moisture is present such as open water or where continuous spray is expected.
	Plated Fasteners are not accepted.
High-Tensile Bolts	Hot-dip galvanised and painted. Bolt holes shall be filled and sealed prior to painting.
Anchors	EN Grade 1.4401 (316) or better.
	For Water Retaining Structures: Chemical anchor Type.
	For Brickwork: Chemical Anchor Type
	Other: Expanding Type or Chemical Anchor Type
	If an anchor is to extend through a supporting structure (Fastened with nuts from both sides), the anchors, brackets, studs, nuts and washers are to be EN Grade 1.4401 (316) or better.
	Submerged anchors: Chemical Anchor Type dsigned for submersion.
Material	Fastener material shall be of equal or greater corrosion resistance than the fastened material.
Washers	Flat Washers: Nuts and setscrew heads.
	Flat Washers: Under boltheads on painted surfaces.
	Flat Washers: Under bolt heads, If bolt is positioned in a slot.
	Spring Washers: Any area subject to vibration.
	Washers shall be of the same material as fasteners.
	Flat Washers showing visual deformation shall be replaced by washers of greater thickness.
	For anchor bolts for machinery, a flat and spring washet shall be used.
Thread Projection	Threads shall project no less than 2 threads and no more than 8 threads from the head of the nut when fastened. The engineer may approve longer projections if the contractor can show that bolts of a more suitable length are not manufactured.
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	After Installation, exposed surfaces of fasteners other than stainless steel shall be coated the same as the items being fastened.
	Recessed heads of fasteners (Allen type or equivalent) shall be filled with a non-hardening sealant.
Anti-Seize	Nickel-Based Compound is to be used. (Anti-seize/corrosion Protection.)
	Copper based compound is not acceptable.
	A small amount shall be applied along the full length of the exposed thread before fastening.
	Visibly Excessive compound shall be cleaned off.

19. Vibration

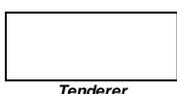
▪	Shall be lower than that specified as "Good" for that class of machine in BS7854 (ISO10816)
▪	All shaft shall be designed that the critical speed is outside of the operating speed range.
▪	For reciprocating machines, the design and installation shall allow for isolation of machine vibrations from the floor structure.
▪	Vibration isolation mountings shall be installed between the baseframe and the plinth to reduce vibration transmitted not less than 90%.

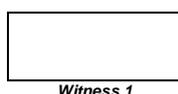
20. Noise

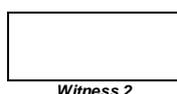
General	Noise shall be kept to a minimum, and shall not exceed levels as specified.
Levels	Sound emitted shall not exceed 89 dB(A) unless otherwise approved by the engineer.
	Where the contractor is not able to restrict noise the contractor shall inform the engineer in writing.
	All safety precautions are to be taken in noisy environments, including signagage etc.
Acoustic Treatment	Standard Acoustic enclosures shall be provided when called for.
Measurement	Noise levels will be verified by taking impulse weighted leq readings in dBA, over a set time-period (10 minutes) at specified positions. Readings are not to exceed the specified level by 2 dBA.
	Should levels exceed the specified parameters, the contractor shall take the necessary steps to obtain certified sound levels.

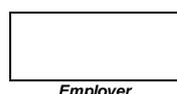
21. Spare Parts

▪	The contractor is to submit a list of all spare parts related to equipment offered within the Project Specification.
▪	Spare Parts shall be packed individually for related equipment.
▪	All spare parts shall be inspected by the engineer upon arrival to site and packaging (Boxes) shall be sealed.

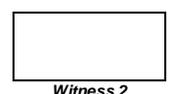

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22. Signage

General	All Signs shall be installed prior to comissioning.
Safety	Signs shall be of adequate material, UV light and corrosion resistant.
	Symbolic signs shall comply with SANS1186.
	Worded signs shall be approved by the engineer prior to printing.
	All signs shall be provided by the contractor and placed in clearly visible and suitable locations on the walls of the plant room.
	Signs shall include (but are not limited to) the following: <ul style="list-style-type: none"> - All statutory and special safety warning instructions. - Any operating restrictions of equipment. - Course of action during/after electrical shock. - Operating Instructions in case of electrical supply failure.
Operating Instructions	Shall be framed and installed to the wall in the control room and shall include the following: <ul style="list-style-type: none"> - Start-up and shut-down procedures. - Operating Instructions. - Actions to be taken in case of alarm conditions. - A layout drawing of equipment installation. - A P&ID. - A process flow diagram.

23. Electric Actuators

General	Installed where required as specified, Penstocks & Valves shall be operated by electrically driven actuators with integral reversing starters.
Environmental Protection	Shall be fully submersible (IP68) where flooding may occur and fitted with anti-condensation heater.
Limit Switches	Upper and lower limit and torque.
Controls	Local controls to be located in a lockable cover.
Electrical Supply	400V, 3 phase, 4 core, 50 Hz and shall accommodate control circuits.
Capacity	Each Actuator shall be adequately sized for its application and shall continuously rated to suit the modulating and control required.
Gearbox	Refer to §10 of this document and; The operating gear of all valves and gates shall be able to open or close againt unbalanced hydraulic conditions. Torque supplied shall be adequate for operation including seating and unseating loads, and sticking after prolonged disuse.
Operation	Electrical or alternatively manual operation shall be possible. The motor drive shall be automatically disengage when the unit is in manual mode.

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	"OPEN" (anticlockwise) and "CLOSE" (clockwise) directions shall be indicated at the handwheel.
Markings	"OPEN" and "CLOSED" positions shall be clearly marked, except on raised spinle penstock valves.
Torque	Actuator Motor Torque rating shall be 10% greater than the actuator torque requirement.
Starters	Shall be integral with the motor and shall be sized to provide an adequate margin to prevent overloading.
Terminals	For power supply, remote control and remote position indication.
Heaters	Heaters shall be "ON" when starters are "OFF" and shall be "OFF" when starters are "ON".
Output	4-20mA output signal is required for remote position indication.
Starter Characteristics	<p>2 x Three Phase Magnetically operated line contactors with no-volt release and electrical and mechanical interlock.</p> <p>1 x Three phase thermal cut-out device</p> <p>1 x 380V-110V Control Circuit Transformer fully protected by fuses on primary and secondary circuits.</p> <p>1 x Set of "OPEN", "CLOSE", "STOP" Buttons</p> <p>1 x lockable Local-Off-Remote switch</p> <p>1 x Set of torque and limit switches for OPEN and CLOSE positions.</p> <p>3 x Sets of Aux. limit switches in each direction.</p> <p>1 x Valve Position indicator</p> <p>1 x Set indicating lamps for "OPEN", "CLOSE", "IN TRANSIT"</p>

24. Thermal Insulation

24.1. General

All Items of Thermal insulation shall be conducted by an approved specialist thermal insulation sub-contractor. The Tenderer shall only employ skilled artisans with adequate relevant experience.

Thermal Insulation shall only commence upon completion of the respective installation wholly, including testing.

Standards: ASTM F 683

Any and all insulation shall be asbestos free.

24.2. Pipework

General	All Pipework conveying hot or gaseous liquids, as well as pipework exposed to freezing conditions shall be thermally insulated.
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Standards	BS5422:2009
Material	Plain Preformed rigid glass fibre or mineral wool sections.
Fastening	All insulation shall be secured using 19 SWG galvanised lacing wire, or self-adhesive tape bands at 300mm centres.
Installation	All insulated pipework shall be enclosed with fabricated aluminum cladding or polyisobutylene sheeting or approved equivalent. Cladding shall be firmly secured and sealed to form a continuous vapor seal. External cladding shall be protected against ingress of water.
	Insulation and cladding for bend and offsets shall be tailored to application. Mitred joints and lobsterback bends shall be provided in this regard.

24.3. Plant

Equipment	Boilers, heat exchangers, hot water geysers and associated ducts and pipework.
Method	As per equipment manufacturer's specifications.
Material	Water tanks mounted externally: polystyrene or rigid isocyanurete foam, secured with approved adhesive and reinforced with 25mm galvanised wire mesh netting and coated with 2 coats of fibre filled bitumen emulsion. Scrim cloth or hessian shall be embedded in the final coat.
Installation	Where valves or other equipment are to be accessed for operation or maintenance, a quick release removable casing shall be provided.
Lagging	The contractor shall provide full details on the lagging system he proposes to use for approval by the engineer. Unless otherwise specified for heat retention purposes, all parts that; under normal working conditions hotter than 60°C or colder than -5°C shall be adequately guarded by lagging or other approved means.

25. Fire Protection and safety Equipment

25.1 Portable Fire Fighting

Locations	Shall be provided in all control rooms, laboratories, offices, workshops and any other area that has a risk of fire
Type	Water type or Dry Powder type depending on location and possible hazard. Water type shall be used for Class A risk areas and shall be 9 litres capacity. Dry powder extinguishers shall be suitable for electrical, chemical and oil fires and shall be not less than 5kg (Powder).
Design	Extinguishers shall be color coded and clearly marked according to type, and the class of fire they are suitable for.
Standards	Shall comply with ISO or ANSI standards.
Other Markings	Numbers and dispositions shall be as per any local requirements and shall be as agreed by the Engineer

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25.2 Breathing sets (Compressed air)

Locations	Shall be provided where any dangerous chemicals are stored, or where emergency access to confined spaces are required. Locations to be agreed with the Engineer.
Design	Harness, back plate, air bottle, pressure reducer assembly, demand valve, contents gauge, face mask and all necessary hoses and fittings.
Capacity	Air bottles shall be sized to provide an endurance of not less than 30 minutes.
Enclosure	Sets shall be located in easily accesible GRP or steel enclosures with a clear glass or PVC front.

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2. PIPEWORK, VALVES

1. Steel Pipework:

1.1. General:

This section applies to carbon steel pipework and stainless steel pipework.

1.2. Configuration

Joins	Bolted Flanges, Gaskets.
Installation	Neat, Level, True to line, Plumb and adequately supported.
Support	Above Floor Level on supports or racks, or shall be wall mounted but shall not be installed directly on the floor.
Couplings/Bends	Yes, to allow for easy disassembly of all pipework without damage to any pipework or supports.
Draining	Yes, Allowance for all sections to be drained.
Venting	Yes, Air release shall be fitted in high points of pipework.
Valve Positions	Horizontal unless specified otherwise.
Anchoring	Adequately to withstand thrust. Thrust restraints to be constructed if pipework does not allow axial restraint.
Bends	Long Radius type. "Lobster Back" bends to have a minimum of 5 segments. Each flange shall be welded perpendicularly to the segment which it is attached to.
Convergences	"Sweep-tee" convergences shall be used rather than standard Tee-pieces.
Routing	Pipework shall be routed above floor level to allow for cleaning.

1.3. Pumps: Suction Pipework

Couplings	2x Mechanical Couplings or 1x Rubber Bellow to be installed on each suction.
Compliance	Pipework to comply with adequate hydraulic design.
Manifold	For Flows <1.5m/s, legs may be tee'd off using normal Tee's
Sizing	Flow within the suction manifold shall not exceed 0.8m/s
High Points	Shall be avoided within the suction pipework. Pipework shall slope upwards toward the pump intake when applicable.
Air	Air leaks are to be prevented.
Reducers	Reducers on the suction end are to be eccentric sloping upwards toward the pump intake.
Length	The length of the pipework immediately adjacent to the pump intake is to be a minimum of 3 pipe diameters in length (Reducer included) with no other elements that may cause more turbulent flow.

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Pumps: Discharge

1.4. Pipework

Couplings	2x Mechanical Couplings or 1x Rubber Bellow to be installed on each discharge.
Reducers	Reducers on the discharge end are to be Concentric.

1.5. Reducers

Angle	The angle of divergence/convergence shall be 10° or less.
Weld	The taper shall not be welded directly to the flange, a short length of pipe shall be welded to the flange. A reducer is to have no more than 2 longitudinal weld seams.

1.6. Sockets

Purpose	For installation of Pressure Gauges, Air release valves, transmitters, cooling water take-offs, drain pipes etc.
Design	To adhere to corrosion protection system of the pipework.
Installation	All sockets shall be fitted with a ball valve to ease maintenance/replacement of the related instrument.
Position	The Position of the socket shall provide for minimum interference of the flow path.

1.7. Solids Handling Pipework

Design	Design is to allow for rodding eyes or similar at each flow direction change.
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1.8. Flanges

Standards	BS EN 1092/SANS1123, unless otherwise specified/required.
Drilling	Off-Centre unless otherwise specified/required.
Jointing	Bolted, gaskets to be suitable rubber material or compressed mineral fibre with minimum thickness of 3mm, full faced and compliant with BS EN 681 or EN ISO 23936 as applicable.

1.9. Puddle Pipework

Casting	Permanently casted.
Design	Staight Length of pipe, flanged both end and with a puddle flange. Sufficient distant shall be allowed between the wall and the flange to allow for bolts and nuts, as well as handwheels/actuators of valves, but keeping the length as short as practicality allows
Material	Pipe shall be of EN grade 1.4401 (316) or EN grade 1.4462 (2205 duplex). The puddle flange shall be of the same material as the pipe unless otherwise specified.

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Dimensions	The Puddle flange shall be of the same diameter as the normal flange and shall be positioned in the centre plane of the wall. The thickness of the puddle flange shall be at least half of the thickness of the normal flange.
Corrosion Protection	Full corrosion protection as specified will be received by the surfaces not directly encased in concrete. The coating shall extend 50mm into the concrete. The area in contact with the concrete shall be uncoated, but sandblasted to assist in bonding.
Methodology	The contractor shall submit a method statement to the engineer prior to works being executed.
Normative Reference	Refer also to §7.4 of section 1 of this Document.

Couplings, Alignment and

1.10 Tolerances

Purpose	To be provided where misalignment or dismantling is to be allowed for, or movement due to settling or causes alike.
Pressure Rating	Same or higher rating than pipework installed.
Type	Where not indicated, Mechanical couplings or bellows may be used. Mechanical couplings shall be rubber ring compression type (VJ type) and provided in pairs. Where restraint is required a minimum of 3 tie bars shall be used. Rubber Bellows with metal backing flanges are accepted for pipes with a nominal bore of 300mm or less.

1.11 Bell-Mouths

Position	Suction from open source.
Design	Flanged, to be bolted to the suction pipework and with an elliptical profile.

Quality

1.12 Assurance

In case of a dispute arising with regard to welding, SANS10044:3 shall be complied with. The contractor is to make all arrangements and pay for transport and accommodation for the Engineer to inspect the pipework prior to corrosion protection, after manufacturing.

The following shall be performed by the contractor in the presence of the engineer (unless otherwise agreed):

- | | |
|----|---|
| 1) | Approval of quality control documentation (Pre-fabrication) |
| 2) | Dye penetrant testing of all welds (100%) |
| 3) | Welds to be x-rayed upon request (10% of weld which may reduce depending on initial findings). If welds are found to be defective, repairs are allowed upon submission of a method statement to the Engineer. |

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4)	Visual inspection of pipework
5)	Paint thickness measurements
6)	Provide Pressure Test method statement for Engineer's approval for all underground/unvisible pipework.
7)	Provide Inspection Reports

2. Plastic Pipework

This section refers to Polypropylene and Polyethylene Pipes. High Density PolyEthylene pipes shall be used for new underground installations.

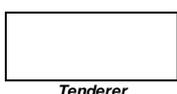
Standards	SANS/ISO4427 (Polyethylene), SANS15874(Polypropylene) - the SABS marking clearly visible.
PVC Pipework	Not accepted in applications where shock and vibrations are present.
Lifespan	Operating life of 50 Years.
Design	Class of pipe shall be allow for 50% higher pressure capacity than actual pressure expected.
Joining	Method Statement to be Submitted to the Engineer. Where pipe is to be fusion welded, qualified artisans shall be used. Where HDPE and Steel Pipe are to be joined, HDPE Stub ends are to be flanged and joints will be bolted. The flange tables will match.

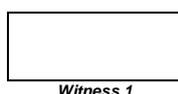
3. Valves

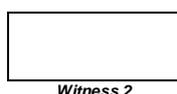
3.1. General

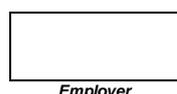
Manufacture, Supply, Deliver, install, comission and uphold for the defects period.

Design	Shall meet operational and environmental conditions and shall be specifically suitable for the medium present.
Pressures	Design shall be adequate to meet design and surge pressures.
Flanges	All valves shall be double flanged.
Valve Bodies:	All valve bodies shall have the following markings encasted: - Manufacturer's name - Hydraulic Operating Pressure - Size - Flow direction arrow
Installation	Positioned for easy access for replacement, maintenance and operation.
Maintenance	Shall be possible without removal of the valve from the pipework, and shall be possible without the removal of the actuator.
Extended Spindle	Shall be supplied where necessary. T-keys shall be designed to meet operating requirements and 2 pieces shall be supplied per respective operating area or as specified by the engineer.
Operating	

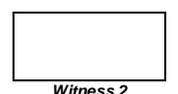

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	All valves shall be possibly operated by a single individual against unbalanced hydraulic conditions. Rim pull shall not exceed 40 kg otherwise a reduction gearbox shall be installed.	
Open/Close	Anti-Clockwise/Clockwise	
Actuated Valves	Shall be able to be operated manually.	
Valve Position	Shall be indicated by mechanical position indicators [Closed, 25%, 50%, 75%, Open] on all valves and headstocks.	
Actuators	Shall be of Gearbox type on butterfly valves. Over-torque and limit switches shall be present.	
Dimensions	All valves of the same diameter and pressure rating shall have the same physical dimensions and shall be interchangeable. Flanges shall allow integration with pipework.	
Media Characteristics	Medium	Raw Water / Sludge / Clearwater
	Medium pH:	5-7
	Medium SG	Varies
	Medium Temp.	10-25°C
	Location	As indicated in Project Specification

3.1. Sluice Gates

Sluice Type	Channel and Penstock Gates
Sealing Type	3/4 - Side Sealing
Operation type	Screw, hand wheel, head-frame mount
Gate operation type	Slot mounted, sides + floor, cast-in
Seals type	Neoprene / Thermoplastic, L-type
Bearing strip type	Low-friction HDPE, for min. bearing load
Head-gear design	100-150N effort, min. stroke time
Allowable leakage (L/min./m)	1.24 (AWWA C501)
Sluice gate & frame material	SS 304
Pedestal material	Carbon Steel, epoxy coated
Support bracket material	SS 304
Spindle & coupling material	SS 304
Seal material	Neoprene/Thermoplastic
Stop collar material	Bronze
Hand wheel material	Cast Aluminium
Spindle cover tube material	Clear PVC
Fish tail material	SS 304
Fasteners	SS EN 1.4401 Grade

3.2. Non-Return Valves (Check Valves)

General	
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	Shall be installed on all pump discharge lines or branches as required. Shall be suitable for the operating condition. Shall be complete with flanges, nuts and bolts
Standards	BS EN 1074
Type	Swing Check, Non-slam, long pattern.
Characteristics	minimum-slam, long pattern, fast acting.
Bypass	All non-return valves larger than 500mm shall have a bypass with integral gate valve.
Flaps	Renewable bronze/ gun metal sealing faces for flaps and the same for seating rings in the valve body. All seating/seals shall be positively located.
Lifting	Lifting eyes, feet and jacking screws are required for valves with diameter greater than 500mm.
Hinge Pin/Shaft	Stainless steel, Square in section, shall ensure positive location of flaps and secure fixing.
External Lever	Hinge Pin/shaft shall extend through a renewable sealing gland.
Back Flusing	If solid particles are present, valves shall have single door swing and heavy duty external lever.
Design	Shall accommodate hydraulic requirements and conditions and shall have adequate clearance around valve body.

3.3. Wedge Gate Valves

Standards	BS EN 1171 2002
Type	Non-Rising Spindle, Resilient seal unless otherwise specified.
Flanged	Yes
Seating/Sealing	Renewable, replaceable without removal of the valve from the pipework. Valves on drainage lines shall have seatless seating faces and gates shall be detachable from above. Gate rings shall be screwed to the gates or shall be pinned over the complete circumference.
Handwheels	Yes, Unless otherwise specified.
Geared	All valves greater than 400mm shall have a geared headstock
Actuated	All valves greater than 200mm shall be suitable to be actuated.
Material	Valve body shall be of adequate quality ductile iron, high tensile brass spindles, wedge gates with gun-metal faces and seats, bronze gland bushes and bonnets fitted with soft packing glands. Drainage valves shall be cast iron and surfaces shall be coated with resilient nitrile rubber with a shore hardness of 55-65.
Inspection	Valves larger than 400mm diameter shall have removable covers for inspection, flushing and cleaning purposes.
Test Procedures	In accordance with requirements of BS EN 1171:2002, BS5163:2004 or BS ISO5208:2009

3.4. Knife Gate Valves

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Material	Valve body material shall be of cast iron or cast steel. Gates and spindles shall be of stainless steel.
Sealing/Seating	Approved non-biodegradable neoprene/polypropylene/nitrile rubber sealing strip or ring.
Opening	Shall be unrestricted when fully open.

3.5. Butterfly Valves

General	Rubber seated valves shall be bubble tight when closed.
Standards	BS EN 593:2010 for valves, BS EN 1092 for flanges.
Media	Not permitted for sludge
Operation	Shall be motor and manually operated via a 90 degree gearbox.
Body Material	Valve body shall be spheroidal cast iron, with no sharp edges. Valve body, flanges and bearing hubs shall be a single integral casting.
Seating/Sealing	Replaceable Stainless steel seat ring, secured by corrosion resistant stainless steel fasteners. Valve seat shall be replaceable nitrile rubber 70/75 IRHD, securely clamped to the disc edge by stainless steel seat retention members or equivalent. Retention members shall have stainless steel fasteners and all fastenings shall be flush to offer the least resistance to the flow.
Disc Material	Spheroidal cast iron with no sharp edges. Where required strengthening ribs shall be incorporated.
Disc Rotation	90 degrees from fully open to fully closed. Valve seating shall be at an angle normal to the pipe axis. Adjacent Pipework shall not be fouled by disc rotation.
Limits	Adjustable mechanical stops to prevent over travel in open and closed positions.
Actuator	Gear Box type
By-pass	Valves with a diameter greater than 500 mm as specified.
Stub Shafts	Two, shall carry the disc and shall be secured by high tensile stainless steel taper pins. Shafts shall be supported by self-lubricating bushes mounted in the body. One shaft shall extend through the body and seal chamber for the operating unit, the other shall act as a pivot point.
Design Safety	Shaft, disc and mechanical stops shall have a design safety factor of five (5).
Shaft Seals	Shall be rubber o-ring type
Packing	shall be Adjustable chevron type
Not accepted	Valve seats which extend over the face of the flanges to secure the seat in place, or which require surface grinding and/or hand-fitting of the disc, or designs which require the adjoining pipe flange to retain the seat in place and resist line pressure.

Diaphragm

3.6. Valves

General	
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	Shall be of the straight-through design with minimal flow resistance and glandless construction.
Standards	Compliance with BS EN 13397:2002
Design	Shall be made up of two durable body parts and the diaphragm. All shall be replaceable and valves shall be easily maintained. In the open state the diaphragm shall lift clear and not interrupt flow. Diaphragms shall be completely leak tight as specified by the Project Specifications.
Material	Diaphragm shall be moulded in a reinforced, flexible material to suit the specified duty and medium conveyed. Internal surfaces of the valve shall be lined to accommodate the diaphragm duty.
Operation	Hand-Wheel unless otherwise specified, being able to be locked in any position.

3.7. Ball Valves

General	Shall be suitable for the working pressure.
Standards	BS EN 1983:2006
Design	Shall be suitable for specified working pressure.
Material	Valve, ball and stem shall be Stainless steel.
Operation	Manual via stem unless otherwise specified.
Joints	Valve body shall be fitted with stainless steel bolts complete with gasket to ensure leak tightness of joints.

3.8. Plug Valves

General	
Standards	BS5158:1989
Material	Carbon steel body and cover, stainless steel bolts, tapered plug, and stem of the non-lubricated or soft seated type. Seat material shall be as recommended by the manufacturer for the specified pipe duty.
Tapered Plug	Shall be self-adjusting on separate seats providing positive seals at two or three way port body styles. Suitable for specified pressure.
Valve Stem	Shall be fitted with a long life seal capable of continuous adjustment under conditions of wear.
Operation	Lever, unless otherwise specified.
Design	Shall (When specified) Prevent buildup of static electricity.
Maintenance	Entry shall be convenient for replacement of seats and other maintenance. External indication of seat wear shall be possible.

Air Release

3.9. Valves

General	Shall be installed in high points of pipework. The valves shall exhaust entrapped air automatically at a sufficient rate to prevent restriction of water inflow. The valves shall allow air to enter automatically in case of vacuum conditions. Shall be provided with isolating valves (not integral
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	with the air valve) for maintenance, and flanged end connections unless otherwise specified.
Standards	BS EN 1074
Type	Exhaust & Vacuum
Material	Valve body, end caps and other elements exposed to water shall be stainless steel AISI304 or better. Elements not in contact with water shall be cast steel, coated with fusion bonded epoxy. Mesh screens and nuts&bolts shall be AISI 304 or better.
Type	Double orifice. Exhaust orifice may be bigger than the inlet orifice.
Design	Suitable for maximum working pressure and medium conveyed.
Testing	For pressure tightness in 200kN/m ² intervals until the working pressures are reached. Structural strength shall be tested at 1.5times the working pressure.
Seating/Sealing	The float shall only be raised by liquid and not liquid spr/air mixture. The seating shall prevent sticking of the float after prolonged periods in the closed position. The seal shall be air tight over the full operating pressure of the pipe. Floats shall be cylindrical and be solid HDPE or equivalent material. Spherical floats should be able to withstand a pressure of 80 bar without damage. Seat material shall be adequate as specified by the manufacturer.
Pipes > 1200 mm diameter	Anti-Shock type double orifice air release and vacuum brek valves shall be used.
Protection	Shall be protected from any debris entering by having adequate covers. Covers shall be adequately robust and perforated allowing passage of air.
Connections	DN25 and DN50 shall have flanged or screwed connections. DN80 and larger shall have flanged connections.

3.10. Pressure and flow control valves.

General	Valves shall be sized such that the fully open capacity is adequate to accept the specified maximum flow rate at the minimum differential pressure.
Flow Control Valve	Shall be designed to prevent the flow downstream rising above the specified requirement regardless of the operating pressures upstream or downstream of the valve. A relay system shall be operated by pressure difference measured across the main flow orificewhich shall be fitted upstream of the flow control valve.
Pressure Reducing Valves	Shall be designed to reduce a constant or variable inlet pressure to a predetermined constant outlet pressure at various flows. Adjustment of the outlet pressure shall be manually set as specified.
Pressure Relief Valves	Shall be designed to prevent over pressure in pipes. The ceiling pressure shall be a manually preset value and the valve shall remain closed at lower pressures.

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3. PLINTHS, BASEFRAMES

1. **General**

Equipment shall be mounted on baseframes and not directly on concrete surfaces. Base Plates are to be according to equipment manufacturers specifications unless otherwise specified. The Contractor shall provide the baseframe, anchor fasteners and chemical anchors. Driven and driving equipment shall be mounted on the same baseframe. The baseframe shall have adequate structural integrity.

2. **Design**

Dimensions	Length:Height shall not be greater than 12, Width:Height shall not be greater than 6.
Drainage	The design shall prevent water and dirt accumulation.
Anchoring	The baseframe shall have machined anchoring points and mounting pads. The thickness of the mountings shall not be less than 125% the diameter of the anchor bolts. Holes shall be drilled to allow through bolts and positioned to allow for access with a wrench.
Corrosion Protection	The surface of the baseplate is to be corrosion protected (Hot Dipped Galvanised) adequately for operating conditions.
Alignment	The Baseplate is to allow for alignment by means of jacking screws or otherwise indicated by manufacturer specifications.

3 **Fasteners**

Amount	For pumps with an inlet of <150mm six anchors (Minimum) shall be used. For pumps with an inlet >150mm eight anchors (Minimum) shall be used.	
Material	Fasteners shall be of EN Grade 1.4401 (316) or better. And shall be provided with a flat- and lock washer.	
Size	Pump Inlet (DN)	Fastener Size (Min.)
	50	M10
	100	M12
	200	M12
	300	M16
	400	M20
	500	M24
	600	M30

4. **Installation**

Shims	Maximum of 3 shall be used, Shim material shall be corrosion resistant.
Design	Accumulation points of water and dirt must be prevented.

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4. Pumps

1. **General**

Each pump shall be designed to be suitable for the media being pumped.	
Standards	BS EN ISO9905:1994, Technical Specification for Centrifugal Pumps Class I
Design	Shall allow to provide the specified output including all losses.
Efficiency	the Contractor shall match provided pump characteristics to the pipe system(s) to achieve the maximum possible efficiency and reliability.
Characteristics	Non-overloading over the complete operating range of head and flow quantities and the drive shall be capable of starting centrifugal pumps at maximum operating conditions.
Configuration	Where applicable as specified, each set shall be capable of running satisfactorily in parallel with other sets without throttling, and shall run by itself without cavitation or overload over the entire range of operating conditions within the system.
Reverse Rotation	Possible at maximum head differential without damage if non-return valves fail to close.
Prime	Pumps shall be arranged to be primed by gravity unless otherwise specified.
Pipework	Configuration shall be smooth, free fom recesses & obstructions.
Pump speed	Shall not exceed 1500 rpm nominal.
Head/Flow	Shall be stable under all possible operating conditions.
Sump	Design (Influent path and configuration) shall prevent air being entrapped which may cause cavitation.
Flow Velocities	Shall be sufficiently low in suction and discharge pipework to prevent turbulence and cavitation in the pump and pipework, and sufficiently high to prevent suspended solids from settling.

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Curves	The characteristic curve (as well as the drive motor) of the pump shall be selected as appropriate to allow increased head due to sliming (or other) of the rising main without significant loss of delivery during the lifetime of the pump.
Gauges	Pressure gauges shall be mounted via tapped connections, located at 2-3 pipe diameters from the suction/discharge of the pump on the suction and discharge lines respectively. The gauge shall be able to be isolated, and vented.

2. Pumps for Raw Water, Washwater, Backwash Water and Final Effluent

Configuration	Dry-well, horizontally mounted, end-suction.
Suction	Flooded Suction with adequate net positive suction head to prevent cavitation at the whole range of operating conditions. (Including for operation of a single pump normally designed for a parallel configuration).
Motor Size	Motors shall have a power rating (kW) greater than the maximum power demand of one pump operating unthrottled at the prevailing system head.
Plinths	Plinths shall adhere to all conditions in the section "1. General" and section "3. Baseframes, Plinths" and: Pumps shall be installed on reinforced concrete plinths. The mass of the plinth shall be 3 to 5 times the combined mass of the pumpset. Baseplate anchor bolts shall be the full length of the plinth and shall be cast in situ.
Baseplates	Shall adhere to all conditions in section "1. General" and section "3. Baseframes, Plinths" and: Shall include set-screws for alignment purposes. Alignment shall be provided by only metallic shims as necessary. Baseplates shall be grouted using an epoxy based non-shrinking grout. Alignment shall be checked by the Engineer.

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3. Sump Drainage Pumps

Configuration	Open Impeller, centrifugal type, vertically mounted, close coupled.
Guide Rails	Required for pumps with weight greater than 50kg, with duckfoot.
Motor Size	As per manufacturer's recommendations for required flow and head.
Voltage/Phase	400/3
Operation	Integral on/off switch.

4. Chemical Dosing Pumps

Type	Piston, piston diaphragm or mechanical diaphragm type.
Stroke Return	Positive
Speed	Shall not exceed 100 strokes per minute.
Dosing Adjustment	Shall be by Stroke Adjustment or pump speed variation where flow-proportional dosing is required.
Stroke Adjustment	Manual or by electric or pneumatic stroke positioner with stepless adjustment between maximum and minimum stroke length.
Speed Variation	Output variation shall be achieved by varying the speed of the pump motor and not the stroke length.

5. Pump Casings

Refer to section "1. General" and:	
Design	Shall ensure alignment is maintained between assemblies by recesses. Spigots and dowels shall be such that all components subject to wear can be replaced.

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	Manufacturer's name shall be permanently marked, and where dowels are not used, permanently marked for correct assembly.
	Shall be of substantial construction to provide a long life under abrasive conditions and suitable to withstand shock due to suspended solids.
Material	Shall be Grey or spheroidal cast iron as specified.
Flanges	Yes, in accordance to BS EN 1092 ti match related pipework.
Maintenance	Shall be facilitated by manholes/hand holes to allow components to be inspected without removal of the pump especially in pumps conveying solids/slurry. Removal of pump impellers shall permit minimum disturbance to pipework.
Joints	Shall be Machined and faced. Bolt holes shall be drilled and arbourred.
Casing wear rings	Renewable, Bronze.
Test	Testing pressure shall be 1.6 times the manometric design pressure of 1.5 times the pump closed valve head whichever is greatest.
Corrosion Protection	Any internal coating shall be of glass flake epoxy type or equivalent specialised coating designed specifically for the application and applied according to manufacturer's guidelines. Ordinary epoxy paint coatings shall not be accepted.

6. Impellers

Material	Impellers and guide vanes (if any) shall be of bronze or stainless steel, smoothly finished and accurately machined to minimise hydraulic friction.
Characteristics	Rotating elements shall be balanced for minimum vibration. Statically and dynamically balanced before final assembly. The pump shall be such that the glands are protected against abrasive material. Clearance at eye rings and wear plates shall be kept to a minimum.

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Wear Rings	Shall be renewable. Eye rings and wear rings shall be bronze or equivalently suitable material and shall be replaceable without machining.
Balancing	Impellers shall be hydraulically balanced as far as practical to reduce end thrust on bearings to the minimum possible. Holes shall not be machined into the impeller for balancing purposes.

7. Pump Shafts

General	The shaft shall be complete with easily renewable stainless steel protecting sleeves at glands and bearings.
Material	High tensile stainless steel adequately sized.
Characteristics	Good fatigue, shock load and corrosion resistance
Critical Speed	The duty speed shall be below the first critical speed of the shaft.
Design	Where changes in diameter occurs, the shoulders shall be filleted or undercut to reduce stress concentrations.

8. Bearings

Selection	All bearings shall be liberally selected to allow cool running, and meet load factors specified.
Design	For vertically installed pumps, the top bearing shall be a combined thrust and journal type, designed to prevent any thrust loads being imposed on the motor. The pump bottom bearing shall be lubricated by either a water lubricated sleeve (potable water applications) or by grease (sewage applications) unless otherwise specified.
Greased lubrication	If applicable, removable screw grease zerks shall be fitted. Refer to §13 in section "1. General." of this document.

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9. Shaft Seals

Selection	The contractor shall select the seal the most compatible to the equipment and application at the worst possible conditions over the entire operating range of the equipment.
Material	Shall be PTFE impregnated cotton packing for all water applications. All seal materials shall be compatible with and/or resistant to the fluid being conveyed and specifically approved for use in the water industry. Special care shall be taken in material selection to prevent electrolytic action between the shaft sleeve and seal components, especially when long period of idle conditions are expected during the duty cycle.
Glands	Shafts shall be provided with renewable gland sleeves. Glands subject to abrasive conditions or negative pressures shall have suitably positioned lantern rings and a clean water continuous flushing system for operation. Gland adjustment nuts shall be readily accessible for maintenance purposes. Gland drainage pipework with adequate rodding capabilities shall be installed.
Mechanical Seals	Shall, in abrasive conditions or subject to negative pressures or corrosive elements, shall be provided with a clean water continuous flushing system for operation. A back-to-back sealing arrangement with a flushing/cooling system shall be accepted for satisfying the requirements of this clause.
Lubrication	Gland lubricating systems shall include suitable filters to prevent abrasive material from entering and shall be easily removable for cleaning.

10. Miscellaneous

-	Indicating pressure gauges shall be provided with an isolating ball valve.
-	The contractor shall ensure that adequate net positive suction head (NPSH) is available to prevent cavitation in pumps under the worst operating conditions.

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-	Cooling and lubrication water pipework shall be fitted with flow indicators where indicated.
-	On horizontal pump sets fitted with hydraulic balance devices, the couplings shall permit free axial movements of pump shafts under load.
-	On vertically installed pumpsets, where the shaft couplings are of the screwed type, the couplings shall be positively locked.
-	Automatic float type air valves with isolating ball valves shall be fitted in the highest part of the casing to assist with priming. Air valve drainage shall be conveyed to drains.

11. Performance

Tests	Any guarantees with regard to output, overall efficiency and NPSH shall be tested and verified according to BS EN ISO 9906:2000 Class 1 (Factory Acceptance Tests) at the manufacturer's workshop in presence of the Engineer. Negative tolerances in respect of Head, Quantity and efficiency shall be accepted. Any tests performed shall be done so using the pump's own motor.
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5. OPERATION & MAINTENANCE MANUAL

1. General

This section Specifies the general requirements for the Operation & Maintenance Manual(s) for the Contract.

2. Submission

The O&M manual shall be submitted to the Engineer for Approval. If the manual does not comply with the specifications of this contract, the Contractor shall Resubmit it.

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The final version shall consist of 4 copies as approved by the Engineer and shall be provided prior to the Defects Notification Period.

3. Requirements for Compliance

3.1.	The Manual shall be in English and shall be presented in a neat and practical manner in hardcopy and softcopy.
3.2.	The Manual shall be for the complete works as specified in this contract.
3.3.	The original manual shall contain all original documents, and shall be marked as "ORIGINAL", the three remaining copies sharing the same content as the original shall be marked as "COPY 1, COPY 2, COPY 3".
3.4.	The Manual shall indicate the Contract Number, Title, Contractor's Name, The Consultant's Name, Project Title, Site/Plant Name, Volume number and Contents.
3.5.	Manufacturer's Printed material shall be clearly marked to indicate the relevant model provided.
3.6.	Sections shall be Titled, numbered and legibly spaced as in good writing practice.
3.7.	Drawings provided shall be scaled to make details clear. A3 and A4 Drawings may be bound within the O&M Manual. Larger Drawings shall be bound in a separate Drawing Book/Register.
3.8.	Drawings shall be provided in hardcopy and Electrinoc data storage (Softcopy).
3.9.	The complete manual shall be Provided in PDF Format (§3.8)
3.10.	Cross-referencing within the manual is accepted if it avoids duplication.

4. Contents and Format.

The document shall, in general, comply with the following format and contents. The format of the final document may be modified to suit the project. The final document is subject to the approval of the engineer. This Document shall be suitable as a training manual.

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#	Section Heading	Content
1.	General	
1.1.	Table of Contents	Complete list of contents of the Manual
1.2.	Description of the Works	Description of the equipment installation, including layout drawings, process flow diagrams and operating parameters.
1.3.	Equipment List	List including the full technical details of each piece of equipment installed.
1.4.	Drawing Register (List)	List of Contractor's Drawings.
2.	Operation	
2.1	System Operation	Description of the operation of the system including (but not limited to): - Start-up, operating, Shut-Down (Manual and Automatic) - Emergency operating procedures. - Settings, Setpoints, Alarms/trips, Protection
2.2	Comissioning	Comissioning Results
3.	Maintenance Schedule	
3.1.	Maintenance	
3.2.	Lubrication	
4.	Equipment (Mechanical)	
4.1.	Item 1	- Make, Model, S/N, performance data, motor and drive details, design range, supplier's details. - Dimensional Drawing (Overall Dimentions). - Operating Curves, test results and all other relevant technical Data. - Picture of the nameplate. - Manufacturer's O&M Manual.
4.2.	Item 2	
4.3.	Item 3	
4.4.	Item 4	
4.5.	Item 5	
4.6.	Item 6	

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4.7.	etc.	
5.	Equipment (Mechanical)	
5.1.	Item 1	Similar to §4 above and: - Wiring Diagrams - MCC Layout drawings - Single Line Diagrams - Control and Electrical details, logic sequence, circuit Diagrams, Software. - Electrical Reticulation Drawings.
5.2.	Item 2	
5.3.	Item 3	
5.4.	Item 4	
5.5.	Item 5	
5.6.	Item 6	
5.7.	etc.	
6.	Instrumentation	
6.1.	Item 1	Similar to §5 above and: - Installation Arrangement. - Operating Range. - Calibration Procedures. - Circuit diagrams of systems and instruments.
6.2.	Item 2	
6.3.	Item 3	
6.4.	Item 4	
6.5.	etc.	
7.	Control	
7.1.	Equipment List	Make, Model of all HMI's, PLC's, Transmitters etc.
7.2.	Input/Output List	Cross Referenced List of all Inputs & Outputs used.
7.3.	SCADA	Prints (color) of SCADA Mimic Screens, Control faceplates, sequences and trend screens.
7.4.	Program	Software on Electronic Storage Device, Loop & Logic Diagrams, System control diagram & logic sequence chart, Annotated program listing.
7.5.	Documents	SCADA Hardware diagnostic, Schedule of cable terminals.
8.	Documents	
8.1.	Drawings	All Contractor's As-Built Drawings, P&ID's, MCC Drawings etc.

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8.2.	Schedules	Cable Schedules (Power, Data, Control&Instrumentation). This shall include cable construction, conductor material, insulation, voltage rating, start and finish terminations, route length, load, duty, voltage drop, core area, core amount, gland size. For cables >400V, the above and also: Specification, purchase details, date of manufacture.
8.3.	Misc.	Spare Parts List, Certificate of Compliance (Electrical), Corrosion protection systems used and coating supplier data sheets & repair procedures.

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