MSS: MECHANICAL STANDARD SPECIFICATION

MSS.1 PREAMBLE AND SCOPE

This standard specification covers the general requirements for typical mechanical services which are to be provided within contracts relating to Water Infrastructure within eThekwini Municipality.

This specification must be read in conjunction with the project specification and drawings which provide specific detail related to the scope of work.

In the event of any discrepancy between a part or parts of the Standard Specifications and the Project Specification, the Project Specification shall take precedence. In the event of a discrepancy between the Specifications, (including the Project Specifications) and the drawings and / or the Bill of Quantities, the discrepancy shall be resolved by the Engineer before the execution of the work under the relevant item.

This Specification lays down the performance, quality and overall system requirements of the Works. Deviation from the Specification will only be considered if the Engineer considers such deviation an improvement.

MSS.2 SAFETY

Safety shall be an all-important and overriding consideration and proper attention shall be paid to this aspect at the design stage. Equipment which is potentially dangerous shall be designed in accordance with a relevant South African or international Standard.

Hazards must be avoided or guarded. Nip points shall be guarded; sharp corners shall be rounded off; operating handles, supports and protrusions shall be kept clear of access ways.

Moving parts shall be properly guarded to the satisfaction of the Engineer.

An emergency stop button shall be installed in a convenient position next to each machine. The installation shall be designed to provide immediate access without the danger of accidental operation. In addition, trip wires which will stop the driving motor when pulled shall be provided along the accessible side/s of moving conveyor belts, chains and the like irrespective of operating speed and irrespective of guards provided.

Where, in the opinion of the Engineer, an installation is not safe, the Contractor shall remedy such defect at his own cost to the satisfaction of the Engineer.

MSS.3 DESIGN FACTORS

A high-quality standard is demanded and reliability, long-life, trouble-free operation, efficiency, ease of maintenance and operation, and neatness are essential.

All plant and equipment shall be of robust construction and the design shall, as applicable, be based on:

- the full range of duties which can be reasonably anticipated
- the power and torque transmitted by the driver system under full load and stalled conditions
- the maximum pressure or vacuum which can be produced by pumps, blowers and compressors under all conditions including blocked or closed inlet and outlet circuits

- conservative service and safety factors based on approved standards or laid down in the printed specifications of reputable and approved manufacturers
- suitable safety margins where relevant and specified in the standard specifications, in addition to any service or safety factors the original equipment manufacturer (OEM) deems necessary
- twenty-four hour per day operation
- a minimum life of 100 000 hours before repair or major part replacement
- prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and, as far as is practical, mal-operation, if these occurrences cannot be avoided by good design.
- Machines with non-overloading characteristics shall be selected wherever possible; e.g.: motors shall be sized so that they cannot be overloaded by the driven machine.

MSS.4 FAIL-SAFE OPERATION AND PROTECTIONS

Where damage can occur from normal operational or other foreseeable problems, Plant, equipment and systems must be designed to be fail safe; i.e. must have built-in redundant elements, or be fail-to-safe; i.e. must return to a safe condition where no further damage can be done in the event of a failure, malfunction, mal-operation, overload and, as far as practical, misuse. All reasonable and economically justifiable protections to prevent or limit damage to Plant and equipment, particularly in high risk situations, must be incorporated. Protections shall:

- be directed at the source of the problem, limit forces to safe levels and act quickly enough to prevent damage;
- stop or prevent from starting all equipment at risk;
- activate an alarm with a labelled indicator on the control panel whenever a protection operates;
- not permit unauthorised tampering;
- operate reliably after long inactive periods exposed to corrosive and dirty conditions.

MSS.5 MOVING PARTS

The following general requirements apply not only to machines but to all equipment with moving parts such as headstocks, extension spindles, swivelling davits, heavy duty hinges, pivots and the like:

- All rotating or swivelling shafts, pins and the like, shall be adequately supported, guided and restrained by lubricated or self-lubricating bearings, collars and/or bushes.
- Swivelling joints on linkages and the like shall be of the "universal" or fork and rod type with bearings or bushes fitted to the eyes or forks.
- On abrasive applications, abrasion resistant materials and slow speed operation shall be utilised.
- Susceptibility to fatigue failure shall be minimised by proper design and manufacturing procedures. In particular, changes in section shall be radiused and care must be taken to avoid the use of welded components in areas of fluctuating stress.
- The locking of nuts and pins in position shall be done to the approval of the Engineer.
- Wearing parts shall be designed for interchangeability and ease of removal and replacement.\

MSS.6 ARRANGEMENT AND MOUNTING

The arrangement and general design shall take the following requirements into consideration:

- Lifting eyes, lugs, hooks, etc., shall be provided on heavy or large items to facilitate handling.

- Castings or fabrications shall have machined pads for seating and be mounted on either soleplates or baseplates as appropriate.
- Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.
- The needs of operation and maintenance including neatness, access, working space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.
- With Plant and equipment to be mounted on or against concrete or brick structures, provision shall be made for adjustment in the mechanical design. Any special accuracy requirements must be specified on the Contractor's Drawings.

MSS.7 LIFTING EQUIPMENT

All lifting equipment shall comply with the following requirements unless otherwise stated:

- All aspects of lifting equipment, including design, fabrication and installation work shall be full in accordance with the relevant aspects of the Occupational Health and Safety Act and Regulations.
- Lifting equipment shall be designed and constructed in accordance with a generally accepted technical standard.
- The safe working load (SWL) shall be marked clearly on all items.
- The complete installation shall be inspected and shall be tested over its complete lifting range using a load which is at least 125 % of the safe working load.
- High-tensile or alloy steel chains shall have a factor of safety of at least four.
- Chains shall have a factor of safety of at least five.
- Steel-wire ropes shall have a factor of safety of at least six.
- Man made fibre ropes or woven webbing shall have a factor of safety of at least six.
- Natural fibre ropes shall have a factor of safety of at least ten.

MSS.8 NAME PLATES

All machinery shall have a plate affixed showing the name and address of the manufacturer, rated loadings, speeds, etc. and any further information the manufacturer may feel necessary for the satisfactory operation of the plant.

Plates shall harmonise with the equipment on which they are fixed and shall be of non-corrosive material with non-corrosive fixings.

Pump plates shall indicate manufacturer, model, type and serial numbers, number of stages, total mass, rated speed, duty flow (m^3/hr), duty head (m), rated power (k). Motor plates shall show manufacturer, model, type and serial numbers, country of manufacture, rated speed, frame size, enclosure, insulation class and total mass. Bearing lubrication details are also to be displayed.

MSS.9 MATERIALS OF CONSTRUCTION

MSS.9.1 General

The Works shall comply with the following:

- When erected and installed, the Plant and equipment shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order.
- The requirements of Sub-clause "Arrangement and Mounting" must be noted.

- The Contractor shall provide all foundation bolts, supports, hangers, brackets, etc. required for the support and fixing of equipment.
- The use of more than three shims in the alignment of equipment will not be permitted. Machined spacers shall be prepared where necessary. Shims and spacers shall be of a corrosion resistant material such as stainless steel.
- Corrosion protection requirements shall be carefully attended to and the relevant paragraphs of Sub-clause "Paint Application" (see Clause "Corrosion Protection : Paint Coatings) must be noted. All mating faces must be coated before and sealed after assembly.
- Fastener threads must be coated with a nickel-based, anti-seize compound before assembly.
- Crevices which are formed between two surfaces shall be filled, prior to final fastening, with a suitable formable packing. This applies particularly to stainless steel.

MSS.9.2 Alignment of shafts

Shafts for drives, such as motors, shall be aligned to the driven shaft as follows:

- Final alignment shall be done after installation and before commissioning, shall be checked in the presence of the Engineer and shall be to his approval. Alignment shall be sufficiently accurate to ensure that no initial pre-load is placed on the shaft coupling.
- Each motor shall be aligned to its pump using laser aligning equipment.
- The use of pourable epoxy resin chocks shall be acceptable. If pourable chocks are used, the baseplate feet do not have to be machined but each machine foot shall be provided with a screw for vertical alignment. The chock thickness shall not be less than 15 mm.

MSS.9.3 Materials

Materials – generally

All materials used in the manufacture and construction of Plant and equipment shall be new, unused and shall be the best of their respective kinds. The Contractor shall ensure that the materials are selected in accordance with the best engineering practice to suit the working conditions and an extremely corrosive environment.

Steel

All structural steel shall comply with the requirements of SANS 1431 grade 300W and shall be legibly marked with the maker's name or trademark and identification marks.

Plastics

Thermoplastics and fibre reinforced polymers shall be UV resistant, have adequate tensile strength and high impact strength and generally suit the application. PVC is regarded as too brittle and shall not be used unless called for in this Specification or approved in writing by the Engineer before supply.

MSS.9.4 Castings

Castings shall comply with the relevant South African or British Standard for the material used, including the following:

- Grey Cast Iron Castings - SANS 1034 BS.1452
- S.G. Iron Castings - SANS 936/7 BS.2789
- Steel Castings (General Purpose) - SANS 1465 BS.3100
- Aluminium Castings - SANS 989/992 BS.1490
- Copper and Copper Alloy Castings - SANS 200 BS 1400

Particular attention shall be paid to cleanliness, soundness and neat fettling and dressing of castings. Surfaces shall be smooth and irregularities caused by mould washaways, and the presence of porosity and sand and slag inclusions will not be tolerated. Areas under bolt heads, nuts and washers, shall be machined or spot faced to ensure a flat and smooth pressure bearing area, and sufficient space shall be provided for the use of ring or socket spanners.

All pressure retaining castings shall be hydrostatically tested to not less than 1,5 times the maximum working pressure after machining and shall be pressure tight.

No repairs shall be undertaken to castings without the written permission of the Engineer and welding will not be permitted on cast iron castings.

Castings shall be heat treated to provide optimum corrosion resistance and toughness combined with reasonable machinability. In particular stainless steel castings shall be heat treated so as to ensure that all carbides are in solution, to ensure optimum grain size and to provide maximum corrosion resistance.

The Contractor shall provide a test certificate for each casting or batch of castings, except for those made of grey cast iron, giving details of the material analysis, the heat treatment and any mechanical tests carried out.

MSS.9.5 Fabrication of carbon steels

Standards

Steelwork shall be constructed, fabricated and erected in accordance with SANS 1200H where applicable.

Finish

Weld spatter and other protrusions shall be removed. Sharp edges shall be rounded to a radius of at least 2 mm.

Requirements for corrosion protection

In addition to finishing requirements, the requirements of corrosion protection application shall be taken into consideration. All surfaces must be accessible for surface preparation and coating. Inaccessible pockets, open hollow sections or the like shall not be permitted except where hot-dip galvanizing (without painting) is called for. Surfaces which cannot be properly prepared after fabrication must be abrasive blasted and coated with a two-pack epoxy pre-weld primer before fabrication.

Inspections

The Contractor shall arrange for the Engineer to inspect fabrications, including fabricated pipework, in the

fabrication workshop and prior to corrosion protection.

MSS.9.6 Fabrication of stainless steels

The requirements regarding the fabrication of carbon steels apply to the fabrication of stainless steels as well. In addition, the following requirements apply to the fabrication of stainless steels:

- Surfaces which become contaminated with steel or otherwise stained or otherwise marked so as to be of uneven colour, shall be cleaned by pickling or electro-cleaning rather than by grinding.
- The Contractor shall arrange for the Engineer to inspect fabrications, including fabricated pipework, in the fabrication workshop.

MSS.9.7 Welding

General Welding Requirements

Standards: Standards complying with good modern practice, and acceptable to the Engineer, shall be adopted. These include the following:

- BS 5135 - Arc welding carbon and carbon manganese steelwork
- BS 4677 - Arc welding austenitic stainless-steel pipework
- BS 2633 - Class 1 Arc welding of steel pipework
- BS 2971 - Class II Arc welding of steel pipework.
- BS 806 - Design and construction of ferrous piping in connection with land boilers (used for arc welding specification of all pipe flanges).
- Welders shall be experienced competent artisans approved in accordance with BS 4872.

Welding to be continuous: All welding shall be continuous on all sides of any joint unless otherwise approved in writing by the Engineer. No crevices will be permitted and where stitch welding has been approved by the Engineer, the crevices so left shall be sealed with an approved filling compound after priming but before further painting.

Weld appearance: Welding shall be free of blowholes and all welding flux shall be removed. All weld spatter and other sharp imperfections shall be removed prior to abrasive blasting. Prior to painting, weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground. Weld grinding must not be performed on 304L or 316L stainless steel, however, unless unavoidable.

Site welding: Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Engineer.

Type of stainless steel: Austenitic stainless steels to be welded shall be of the low carbon grade (i.e.: 304L, 316L, etc.).

Welding rods: The welding rods used shall be the most suitable for the metal and purpose. Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing.

General: All possible steps shall be taken to ensure maximum corrosion resistance, strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Welds shall be passivated. Discolouration and steel contamination must be removed by pickling or electro-cleaning as approved by the Engineer but should rather be avoided by taking the appropriate measures.

MSS.9.8 Guards

Guards shall comply in all respects with the Occupational Health and Safety Regulations and the following points shall also be noted:

- Guards are required to cover all moving or revolving components of machinery. Guards which do not adequately cover moving protrusions such as keys, lock-nuts, lockwashers, setscrews, etc., or irregularities such as keyways, will under no circumstances be accepted.
- Guards shall be neatly and rigidly constructed and fixed and shall not vibrate or cause noise during operation.
- Where expanded metal or similar mesh is used, the mesh opening shall not permit a circular object 10 mm or larger to penetrate.
- Mesh shall not be used for chain guards but on belt drives the side of the guard most conveniently sited for inspection shall be constructed of expanded metal or similar. Mesh should similarly be used in other situations where inspection or ventilation is required.
- Guards shall completely enclose drives and shall entirely prevent a person from touching any moving protrusion.
- Allowance must be made for adjustment on belt guards or where adjustment will be required.
- It shall be possible to remove the guard easily for maintenance purposes.
- Guards shall preferably be fabricated of 316 stainless steel (uncoated) but may also be hot-dip galvanized, zinc-sprayed or aluminium-sprayed carbon steel, coated to specification in all these cases. Fasteners shall be M10 or larger and shall be of 316 stainless steel.

MSS.9.9 Machine vibration levels

The mechanical vibration of machines measured at all important points such as bearings shall be lower than that specified as "good" for that class of machine in BS 7854 (ISO 10816).

MSS.9.10 Noise control

Noise levels

The noise level of the complete installation shall not exceed the following:

- a maximum noise level at the Site boundaries not exceeding an equivalent continuous sound level of 55 dB(A) when all equipment installed is being operated;
- a maximum noise level at a distance of 1 m of each sound producing mechanical equipment of 80 dB(A).

Where the Contractor is unable to restrict the noise level of the machines to the maximum specified, by the appropriate selection of suitable equipment; e.g. by selecting slow speed or silent type machines, quiet type cooling fans, suitable silencers, etc. then an alternative solution, such as an acoustic hood or similar shall be offered.

MSS.9.11 Bearings

Bearing systems shall be designed to provide safe shut down without damage under normal stoppages as well as electrical supply failure.

MSS.9.12 Lubrication

Grease lubrication

Grease lubrication is preferred, and all greasing points must be easily accessible.

Equipment with multiple greasing points shall be provided with grease lines which are piped, separately, to a single easily accessible position.

In cases in which motorised lubrication is provided to more than one destination; a distributor shall be provided. The distributor shall be a positive displacement device which ensures equal, successive lubrication to all destinations.

Pipework for grease distribution shall be of stainless steel or non-ferrous metal.

Oil lubrication

Oil level indicators shall be fitted for visual checking. Drain cocks, including 316 SS fittings where necessary to permit convenient draining, and plugged at the end, shall be provided for oil reservoirs exceeding 1.5 litre capacity. Drains shall be from the lowest point and syphon type drains are unacceptable.

Lubrication systems shall be designed to exclude dirt and moisture. Air vents on the oil reservoir shall contain an air filter.

MSS.10 CORROSION PROTECTION

Where corrosion of metal may be expected, the Contractor shall supply materials which are resistant to corrosion. Any material showing signs of corrosion, tuberculation or pitting before expiry of the Defects Liability Period must be replaced by the Contractor at no cost to the Employer. The Tenderer's prices will be held to include the cost of all painting or other surface treatment which is not separately specified or scheduled but which is nevertheless necessary for the protection of surfaces against corrosion.

MSS.10.1 Application and Control

MSS.10.1.1 Painting contractor

Surface preparation and coating application shall be carried out by experienced industrial painting contractors who are fully equipped and staffed to do such work in their own covered premises strictly in accordance with the paint manufacturer's recommendations. Before proceeding with the corrosion protection coatings, the Contractor shall submit the name of the painting sub-contractor for approval by the Engineer.

MSS.10.1.2 Site work

Surface preparation and coating application shall not be done on Site except for minor repairs, for application of the final aesthetic coat, where specifically called for or where permitted by the Engineer in writing.

MSS.10.1.3 Systems to be used

Systems: The corrosion protection systems to be used on the Plant will usually be specified for the Plant, but if not, the Contractor shall recommend a suitable system for approval by the Engineer. If doubt exists as to the system or colour to be used, the Engineer's requirements must be ascertained.

Alternative systems: Alternative systems superior to those specified may be used if approved in writing by the Engineer.

All items to be painted: Except where otherwise specified, all metal surfaces shall be painted. This includes hot-dip galvanized items and metal-sprayed coatings. In the latter case the paint shall be in the form of a sealer. Details of approved painting systems to be used are given below.

Coating appearance: After installation on Site the finished paintwork must be neat, smooth, of uniform colour and to the approval of the Engineer.

316 Stainless steel: It is not usually necessary to paint 316 stainless steel. If corrosion of 316 stainless steel does occur and depending on the appearance or extent of the problem, the Engineer may call for pickling, electro-cleaning, painting or replacement of the item at no additional cost. Painting may however be required if contaminated or stained surfaces cannot be properly cleaned or where stitch welding has been approved.

MSS.10.1.4 Quality control of coating application

Inspection: The Contractor shall arrange for the coating application on fabricated steelwork to be inspected throughout by the Engineer. The Engineer may approve inspections by an independent competent person (hereinafter called the Inspector) appointed by and at the cost of the Contractor.

Inspection report: A written report of the inspections, prepared by the Inspector and signed by both the Inspector and the Contractor, shall be submitted for appraisal by the Engineer before delivery of the Plant to Site.

Inspector qualifications: Inspectors appointed by the Contractor shall hold an appropriate qualification from any of the CISA, the SAIW or the SAQCC.

Identification of items: Every item to be coated shall be identified by a welded or hard-stamped code. Records shall be maintained for each item.

MSS.10.2 Surface Preparation

MSS.10.2.1 Imperfections

Welding shall be free of blowholes and all welding flux removed. All weld spatter, sharp edges and other imperfections shall be removed prior to abrasive blasting. Prior to painting, weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground. (Weld grinding must not, however, be performed on stainless steel). Areas to be painted shall be free of crevices. If the Engineer has permitted stitch welding, crevices shall be filled with a compatible sealing compound after the priming coat has been applied.

MSS.10.2.2 Abrasive blasting

Before coating, all surfaces shall be properly degreased and abrasive blast cleaned to an SA3 finish with a 40-65µm surface profile to Swedish Standard SIS 055900 of 1967. The abrasive shall comply with paragraph 4.3.3 of SANS 064 and shall be free from all traces of oil, grease, foreign matter and corrosive contaminants such as chlorides, etc. The prepared surface shall be given the first coat of the painting system within 4 hours after cleaning.

In instances where stainless steel and 3CR12 are to be painted, the surface shall be suitably abrasive blasted prior to primer application.

MSS.10.2.3 Between coats

Between coats or with previously painted surfaces in good condition, all traces of oils, greases, soluble salts and corrosive air borne contaminants shall be thoroughly washed from the surface to be painted using a detergent type cleaning agent, rinsed and dried. The previous coat shall then immediately be lightly sanded or otherwise prepared as recommended by the paint manufacturer, wiped clean, dried and painted. Solvents are not acceptable as a surface cleaning agent.

MSS.10.2.4 Hot-dip galvanized surfaces

Hot-dip galvanized surfaces to be painted shall be free from white rust and shall be cleaned with an approved water based galvanizing cleaner using non-metallic abrasive pads until a "water break free" surface is obtained. The surface shall then be thoroughly rinsed with clean potable water to remove all residues and dried immediately prior to painting. Where necessary to obtain adhesion a sweep blast of the surface shall be done after cleaning.

MSS.10.3 Metal Coatings

MSS.10.3.1 General

Fabrication of items to be protected by metal coatings shall be in accordance with SANS ISO 14713.

MSS.10.3.2 Hot-dip galvanizing

Standard: Hot-dip galvanizing shall be done in accordance with SANS 121 (ISO 1461:1999) Hot-dip Galvanized Coatings on Fabricated Iron and Steel Articles.

Thickness: Coatings shall be to the thicknesses detailed in the Standard.

Passivation: Hot-dip galvanized material which is to remain unpainted shall be passivated as specified in SANS 121. Items to be painted after hot-dip galvanizing shall be air dried and not passivated.

White rust: Hot-dip galvanized material shall be substantially free from white rust when it is erected on site. Stacking and storing shall at all times be done in a manner to prevent white rust forming.

Repair: Damage to hot-dip galvanizing caused by welding, grinding, etc. is not acceptable. The repair to hot-dip galvanizing damaged by handling or transport shall be done by cleaning the area and applying 3

coats of a zinc rich primer giving a dry film thickness of at least 100 µm and containing at least 94 % zinc in the dried film. If the opinion of the Engineer is that damage is excessive, such items will be rejected by the Engineer and shall be replaced by the Contractor at his own expense.

Welding: Welding after hot-dip galvanizing is not acceptable.

Test certificate: The Contractor shall supply a galvanizer's guarantee or test certificate prior to installation.

MSS.10.3.3 Sprayed metal coatings

Standard: Sprayed metal coatings shall be done in accordance with SANS 1391: Standard Specification for Thermally Sprayed Metal Coatings as amended below. The statements below apply to Part 1 of SANS 1391.

Symbols: The type symbol described in Table 1 of the Standard shall be used to specify material and thickness requirements; i.e. AL for aluminium, Zn for zinc, followed by the minimum average thickness in microns.

Thickness: The minimum coating thickness for both Aluminium and Zinc shall be 150 µm.

Thickness testing procedure: The procedure laid down in Clauses 4.2.1.3 a(1) or b(1) of SANS 1391: Part 1 for the determination of the coating thickness shall not be regarded as sufficient. The thickness shall be checked on every surface plane at points not more than 300 mm apart for small articles and 500 mm for large articles, e.g. angles shall be checked along all 4 surfaces, channels along all 6 surfaces, pipes in 4 planes etc. The minus tolerance on thickness in isolated areas shall also not exceed -10% and such low areas shall not be larger than 50 mm in diameter.

Period between preparation and coating: For the purpose of Clause 3.3 of SANS 1391: Part 1, the time between preparation and coating shall be shortened from 4 hours to 2 hours at any application area closer than 10 km from the coast.

Sealing: Unless otherwise specified, all metal coatings shall be sealed immediately after metal-spraying using a suitable pre-treatment wash primer followed by coats of low viscosity sealant until absorption is complete. This shall be followed by a suitable top coat system to give a smooth final finish. The various coatings used shall be as specified or, if not specified, shall be selected by the Contractor to suit the duty and submitted to the Engineer for approval. The final coat shall normally be applied on site after installation. Colours shall be as specified or as agreed with the Engineer.

Depending on the particular application, the following systems are acceptable:

System 1

- Application of micaceous oxide pigmented polyamide cured epoxy to achieve a dry film thickness of 60-80 µm; (Sigmarite Sealer, or equivalent).
- One coat of solvent borne modified acrylic coating to achieve a dry film thickness of 70 µm; (Sigma Topacryl coating, or equivalent).
- One coat of solvent borne modified acrylic finish to a dry film thickness of 30-45 µm; (Sigma Topacryl finish, or equivalent).

System 2

- Application of one coat of two component epoxy primer to a dry film thickness of 40 µm; (Intergard 269, Chemrite Carboline Rustbond Penetrating Sealer, or equivalent).
- Application of one intermediate coat chemical resistant vinyl copolymer to a minimum dry film thickness of 70 µm.
- Application of one coat of vinyl copolymer chemical resistant enamel to a minimum dry film thickness of 40 µm.

System 3

- Application of one coat of two component epoxy primer to a dry film thickness of 40 µm; (Chemrite Carboline Rustbond Penetrating Sealer, Intergard 269, or equivalent).
- Application of two coats of polyurethane enamel (twin pack) to a minimum combined dry film thickness of 70 µm.

MSS.10.4 Paint Coatings

MSS.10.4.1 Paint selection

Paint quality: Paint shall be of best quality, of approved manufacture and brand and comply with the requirements of the relevant SANS or BS specifications.

Compatibility: To avoid incompatibility between paint coats due to variations in formulation, the different coats in any one paint system shall be provided by the same manufacturer.

Confirmation of suitability: Contractors shall obtain confirmation from their paint suppliers that, when using their paints, the systems specified are technically correct and suitable for the application and the material being coated.

MSS.10.4.2 Paint application

Surface preparation: All surfaces shall be properly prepared as specified in Clause "Corrosion Protection: Surface Preparation".

Painting: Paints shall be applied strictly in accordance with the manufacturer's instructions by tradesmen skilled in this class of work. Thinning of paint shall only be allowed for spray application and the manufacturer's recommended thinners shall be used.

Coating of hidden areas: Areas which will be inaccessible after erection and surfaces resting on floors shall receive the full paint system prior to erection. Mating or contact surfaces shall be prepared and primed and be brought together while the paint is still wet.

Items encased in concrete: Metal to be encased in concrete shall be painted externally up to 30 mm inside the concrete section, leaving the remainder bare so as to facilitate bonding with the concrete.

Crevices: Crevices will not be permitted. Where unavoidable crevices are accepted by the Engineer, such crevices shall be filled with a compatible filler after application of the priming coat.

Protection of machined surfaces: Where painting of machined surfaces is not possible or advisable, these surfaces shall be coated with an approved proprietary anti-corrosion compound giving 12 months protection under operating conditions. Shaft ends and machined mating or mounting surfaces or pads shall be so coated and shall not be painted.

Coating thickness: The dry film thickness shall be measured using a non-destructive thickness gauge such as the "Mikrotest" or equivalent and shall comply with the Specification.

Repair: Painted areas damaged during transportation, erection or any means whatever shall be repaired as follows - Rusted spots shall be removed and cleaned by means of a wire brush or emery paper to a bright metal finish and the surrounding paint which is still intact shall be feathered for a distance of 50 mm beyond the damaged area. Spot priming and repair shall consist of all the coats previously applied and shall overlap the undamaged area.

Protection on site: Proper and adequate use of cover sheets and other means shall be made to protect the existing paintwork from damage and from metal dust and sparks when welding, grinding, and wire brushing on site. Similarly effective steps shall be taken to prevent spillage or splashing or other damage to floors, walls and Plant when painting on site and any damage or mess caused shall be corrected at the Contractor's cost.

Final coat: The final external coat/s shall always be applied on site after installation except for System A/1, where all coats shall be applied by a specialist applicator at his premises. A professional, smooth finish with a uniform colour is required.

MSS.11 SPARES, TOOLS AND LUBRICANTS

Tenderers must submit in the appropriate Schedule a priced list of spare parts which it is recommended should be kept by the Employer for maintenance of the plant. All spares must be packed separately and the cases appropriately marked. All spares must be new and unused.

Tenderers must submit a price for any special spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied, together with a metal cabinet for same for mounting in a convenient position in a nearby building. All spanners, keys and tools shall be new and unused.

In addition to the lubricating oil to be provided for commissioning the plant (where applicable) an additional quantity of oil adequate for at least two complete refills of such plant must also be provided.

A grease gun suitable for use in conjunction with all the grease nipples on the plant must be provided together with at least 5 kg of the appropriate grease to be used. If more than one type of grease is required, a separate grease gun for each type of grease and 5 kg of each type of grease must be provided.

The spare parts to be offered shall not be limited to but shall include the following:

Centrifugal Pumps:

- Impeller Shaft sleeves
- Spacers Keys
- Bearings Seals

- Races Glands
- Wearing rings Shaft
- Two complete sets of gland packing and sufficient other parts for the complete replacement of all moving and wearing parts of one pump.

Electrical:

- One set of bearings for each size of motor.
- Two sets of fixed and moving main contacts for each type of contactor.
- One set of fixed and moving auxiliary contacts for each type of contactor.
- One operating coil for each type of contactor.
- One set of fixed and moving contacts for each type of relay.
- Two sets of HRC fuses for each size of fuse.

All spares that are ordered shall be supplied and handed over to the Employer. Each part shall be hermetically sealed and labelled by means of a corrosion proof label firmly affixed to it by wire. On each label shall be stated:

- The Manufacturer's name and address.
- The Manufacturer's catalogue or part number.
- A description of the spare part.
- A description of the particular plant for which the spare is supplied and the Contract Bills of Quantities item number under which the particular Plant was supplied originally.
- The date of supply of the spare part.

MSS.12 ELECTRIC MOTORS

The detailed specifications for the electric motors are included in the electrical technical project specifications that form part of this document. Electric motors are to be designed with an adequate safety margin as set out in the table below:

Maximum Power Absorbed by the Driven Machine Under All Operating Conditions	**Percentage to be Added to the Absorbed Power Under the Operating Condition of Maximum Power Absorbed**
Up to 4 kW	50%
> 4 kW & up to 30 kW	25%
> 30 & up to 100 kW	15%
> 100 kW	10%

MSS.13 PUMPS

The pumps offered shall be pumps of proven performance and preferably of standard design, except that the pumps must be located to suit the layout shown on the relevant drawing, if applicable, issued with the Tender Documents.

All parts are to be properly designed with ample margin of safety and are to be suitable for their pumping duties.

The speeds should preferably be as stated in the relevant clauses (preferably be less than 1500 rpm but

must not exceed 3000 rpm) and should be such as to permit direct drive by a squirrel cage induction motor except in those cases where the drive is to be adapted to suit future changes in duty or where stated otherwise.

Belt-driven pumps chosen for the sole purpose of manipulating the speed of driven machinery shall not be acceptable. Belt-drive shall be motivated on a case-by-case basis and presented for acceptance to the Engineer.

Pumps shall be of maker's standard and approved design, capable of doing the duty required and shall be so balanced that there will be no end thrust when the pump is new or after wear has taken place, or alternatively, suitable heavy duty thrust bearings must be provided. Pump casings are to be of high-grade close-grained cast iron or cast steel of grade suitable to withstand the field or factor test pressure specified elsewhere, rigidly secured to a neat, properly designed bedplate or base. Impellers and guides shall be of stainless steel or phosphor bronze (for potable water pumps) and the shaft of high tensile steel with protecting sleeves of bronze or other suitable metal, the diameter being sufficient to withstand and transmit without whip and with ample margin of safety all torsional and bending stresses to which it may be subjected. The pump manufacturer shall utilise suitable materials for impellers, guides, shafts and protecting sleeves and other parts in contact with the fluid to be pumped so as to enable them to resist all corrosions and erosion damage. Bearings are to be of ample bearing area, dustproof with suitable provision for continuous lubrication.

MSS.13.1 Centrifugal Type

All centrifugal pumpsets shall be designed and supplied in accordance with ISO 9908 – Technical specification for centrifugal pumps - Class III. The Manufacturer / Supplier shall review the rated (guarantee) duties and offer his best technical and financial solution at the highest operational efficiency for each station, based on the type (i.e. end-suction, multistage or horizontal split casing), size and arrangement of pumpsets proposed.

The pumps offered are preferably to be of the self-regulating type with a "stable" characteristic i.e. for any selected manometric head each pump shall be capable of pumping at only one rate. Performance particulars and characteristic curves for each type of pump shall be submitted at the time of tendering. Efficiencies should be as high as possible in the normal indicated operating range. These will be taken into account in the adjudication of tenders. Pumps offered should operate within 10% on the Best Efficiency Point flow-rate.

Wherever possible axial thrusts should be counteracted by hydraulic balancing rather than by thrust bearings. The pumps shall be statically and dynamically balanced.

Components of the pumps should be so fitted and fixed that neither normal nor contra rotation can give rise to torques which will set them free to move out of their proper position.

The arrangements for bearing lubrication, water seals, air bleeding and priming of all pumps and pipework shall be such as to permit unattended stopping, starting and operation of the pumping plant by means of automatic remote control for the longest possible period under the control and operating conditions specified and in accordance with the general duty requirements.

The parts of each pump from suction inlet flange to delivery outlet flange shall be capable of withstanding

the internal hydraulic pressures or at least four times higher than those applicable under normal working conditions on the site, whichever is the higher.

Submersible (borehole) pumps shall utilise high grade stainless steel (304) for the outer case, impellers and diffusers, as a minimum. It shall have a Teflon floating wear ring, ceramic coated bearing journal and Nitrile rubber bearing bushes and O-ring. There must be a built-in non-return valve to protect against water hammer (although there must be another wafer-type non-return valve installed in the pump delivery piping above the surface of the reservoir). The submersible motors must cater for over-temperature protection.

MSS.13.2 Factory Testing of the Pumps

A hydrostatic test shall be performed for pressure-containing parts of a pump at a test pressure of at least 1.5 times the basic design pressure. This pressure shall be maintained for a period of at least 10 minutes. The Employer or his agent shall be entitled to witness the pressure tests (as required and indicated on the data sheets provided with this tender) and at least two (2) weeks' notice shall be provided before such testing takes place. A test certificate shall be issued after the successful completion of such tests, in an approved format.

Each pump shall be subject to a hydraulic performance and NPSH test in accordance with ISO 9906, Class I or II, at an approved test facility. The Employer or his agent shall reserve the right to witness all tests (as required and indicated on the data sheets provided with this tender) and shall be granted full and complete access to all test data taken during the course of the test. They shall furthermore, be provided with copies of all test sheets, calibration certificates etc. upon completion of the tests. At least two (2) weeks' notice shall be provided before such tests are undertaken.

Where pumps are supplied as complete pumpsets, these shall preferably be tested as such and shall be complete with own job motors.

It should be particularly noted that all test data and performance curves produced shall be presented in the units as described in the variation above.

In addition to the test point required to establish the guaranteed performance, a sufficient number of test points shall be measured so as to establish the shape of the full performance curve as presented in the Tender.

During the execution of the performance test, the mechanical operation of the pump shall be monitored with particular reference to abnormal temperature, noise, vibration and leaks.

Failure to achieve the rated (guarantee) point may render the equipment liable for rejection. Should this occur the manufacturer/supplier shall then be responsible to rectify the equipment to achieve such guarantees at own expense.

Items have been included in the Bills of Quantities to enable Tenderers to submit separate prices for factory hydraulic testing and factory performance testing of the three pumps.

MSS.14 BASEPLATES, COUPLINGS AND GUARDS

MSS.14.1 Common Baseplates

Both direct coupled and belt driven machines shall be mounted with their drivers on common cast iron or fabricated steel baseplates of rigid construction.

MSS.14.2 Corrosion Protection

Steel baseplates shall be hot dip galvanized unless specified otherwise in the Project Specification.

MSS.14.3 Machined Mounting Pads

The baseplate shall incorporate machined mounting pads at the support and fixing positions of each item of Plant to be mounted on the baseplate. On fabricated baseplates this machining shall be done after fabrication, stress relieving (if applicable) and hot dip galvanizing are complete. The thickness of the solid pads shall be not less than 1,25 times the diameter of the holding down bolts. The pads shall not be provided with threaded holes for machine screws but shall be drilled for inserting through bolts and adequate provision shall made for reaching the nut with a suitable spanner. In the period between machining and installation of the Plant, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening compound, Tectyl or equivalent, shall be applied to exposed machined surfaces and to the crevice formed at the foot of the Plant.

The above design may be suitably modified if the Contractor uses a pourable resin based chocking system. Such chocks shall be at least 15 mm thick.

MSS.14.4 Fasteners

Anchor fasteners shall be of grade 316 stainless steel with threads coated with a nickel based, anti-seize compound before assembly.

MSS.14.5 Alignment

Preliminary alignment shall be done at the factory to ensure that the baseplate has been correctly manufactured, but final alignment shall always be done on site after installation and grouting has been completed. Alignment shall be accurate and to the approval of the Engineer and a final alignment check witnessed by the Engineer must be carried out by the Contractor prior to start up.

MSS.14.6 Shimming

Not more than three shims may be used at any point, and these must be made of a corrosion resistant material.

MSS.14.7 Jacking Screws

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt driven units. Direct coupled motors above 10 kW shall be provided with jacking screws for horizontal alignment and direct coupled motors above 150 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be of grade 316 stainless steel.

MSS.14.8 Grouting

Baseplates shall be so designed and grouted as to eliminate collection points for water or dirt. Except where otherwise approved in writing by the Engineer, all baseplates on concrete plinths shall be fully grouted in. Grouting holes must be provided on baseplates having a continuous top plate. Tapped holes and fixing setscrew protrusions shall be suitably protected.
The material used for grouting shall be a non-shrink, cementitious grout (ABE Duragrout 1000, or equivalent). ABE Epidermix 324, or equivalent, is acceptable if the Contractor's design requires an epoxy grout to be used.

The initial grouting shall be overseen by the supplier's technical representative.

MSS.14.9 Soleplates

In applications where baseplates are not practical, machined soleplates, suitably fixed and grouted to the concrete plinths, shall be provided. No machine may be mounted directly onto a concrete base without the use of either a baseplate or soleplate.

MSS.14.10 Couplings

Except in cases where special drives are required for future duty changes, in which cases the drive shall be arranged by the Contractor to suit his plant, each pump shall be direct coupled to its corresponding motor by means of pin and bush type, shrouded, flexible couplings of robust design constructed to restrict end-float of the motor shaft as required to prevent damage to motor bearings. Coupling halves shall be precisely machined and securely fitted so that the rims and faces of the two halves of any coupling may be used for checking alignment errors of parallelism and angularity of motor and pump shafts to accuracies of ± 0,025 mm and ± 0,025 mm on 100 mm, respectively
.
The coupling shall be of the so-called "tyre" type ("Fennaflex" or similar approved) which can tolerate slight mis-alignments. The coupling selection shall incorporate a minimum service factor of 1.5 of the rated power of the motor.

Clearance between the two halves of the flexible couplings shall be adequate to avoid interference between the metal halves. Sufficient clearance is to be provided between the halves of the coupling to allow unhampered end-wise movement of the shaft of the motor to the limit of its bearing clearance. The running position of the motor-half of the coupling is to be checked by the Contractor by running the motor alone and the couplings halves set on the shafts accordingly.

The importance of ensuring that the suction and/or delivery pipework does not impose any forces onto the pump casing(s) is recognised. The Engineer will therefore require the Contractor to complete carry out the following after completion of the installation of the pump sets and pipework but before hydraulic testing:

- Remove all the bolts and nuts in the pump suction/suction pipework connecting flange.
- Remove all the bolts and nuts in the pump delivery/delivery pipework connecting flange.

There shall be no apparent movement of either the pump flanges or the pipe flanges and each bolt shall not require excessive force to insert it back into its hole in the abutting flanges. In the event of it not being possible to easily (without force) insert every bolt, the Contractor shall rectify the matter.

Thereafter the hydraulic pressure test shall be carried out.

MSS.14.11 PAYMENT AND MEASUREMENT

The provision of all general mechanical design, construction and material requirements as specified within this standard specification shall be included for in the overall price of equipment offered and measured and paid on a re-measurement basis or as otherwise indicated in the Project Specification.