GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

C3.6 SPECIFICATIONS

Part C – Standard Mechanical Specifications

Part D Particular Specification for Hydraulically Operated Diaphragm-Actuated Control Valves

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

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PART C STANDARD MECHANICAL SPECIFICATIONS (SMS)

SMS1 MATERIALS AND EQUIPMENT

This section provides standard specifications for mechanical materials and equipment. The specifications are of a general nature and not all items described may necessarily be required in the execution of the project.

SMS1.1 Cast Iron Pipes and Fittings

All Cast iron pipes and fittings shall comply with the requirements of BS 2035 as amended by BS 4772 and unless otherwise specified shall be of Class B quality for straight pipes and Class AB quality for fittings or equal grade defined under BS 4772. Materials used in the manufacture shall comply with the requirements of BS 1452 Grey Iron Castings grade 220.

Flanges shall be machined flat and without a raised joint face and drilling dimensions shall comply with the requirements of BS 4504 for the working pressure as specified for each application. Where the working pressure is not specified drilling shall be to Table 10. Spot facing of the rear of flanges shall be carried out to prevent uneven load distribution from bolt heads. Where pipes pass through and will be cast into walls they shall be provided with puddle flanges which shall form an integral part of the casting. Puddle flanges shall have the same dimensions as the standard flanges but shall be undrilled.

All cast iron pipes and fittings shall be painted in accordance with the requirements stated in the detailed Specification. External surfaces where pipes pass through walls shall be uncoated.

SMS1.2 Castings

Grey iron castings shall comply with the requirements of BS 1452 with grade as stated in the detail specification. All castings shall be carefully fettled and cleaned by abrasive blasting before machining.

Spheroidal graphite or modular graphite castings shall comply with the requirements of BS 2789 with grade as stated in the detail specification.

SMS1.3 Copper Tubes

Copper tubes shall comply with the requirements of SABS 460. Bends, where permitted by the Engineer, shall be formed with a purpose made bending machine and shall be of constant radius.

Fixing shall be of compatible non-corrodible material and affixed to maintain line and level. Joints and bends shall be brass compression fittings complying with the requirements of SABS 1067 Type A.

SMS1.4 Couplings - Flexible

General purpose flexible couplings for carbon steel and cast iron piping shall be of the 'Viking-Johnson' type or similar approved. Surface treatment shall be to the same system applied to the pipes to be jointed.

Couplings fitted on pipelines where the anticipated operating pressures will exceed 5 bar or may be subject to surge and water hammer shall be fitted with adjustable restraints.

Vibration couplings between rotating machinery and its associated pipe work shall for low temperature and pressure operation be of the 'Vibraflex' or similar type incorporating an adequately rated body of synthetic rubber. Backing flanges shall be in accordance with the requirements of Clause C1.5.

Compensators to accommodate expansion shall be manufactured from the same material as the pipeline in which they are installed or better and shall accommodate the anticipated maximum operating temperature and be adequately rated to meet the required pressure. Restraints shall be provided to all compensators manufactured from the same material as the body.

All buried couplings shall be completely wrapped with 'Denso' or equal approved mastic impregnated tape after installation.

SMS1.5 Flanges

The dimensions and drilling of standard flanges shall comply with the requirements of BS 4504 for the working pressure as specified for each application. Where the working pressure is not specified drilling shall be to Table 10. Flanges shall be machined flat and without a raised joint face. Where pipes pass through and will be built into walls they will be provided with puddle flanges which shall have the same dimensions as the standard flanges but be undrilled.

Flanges for low pressure applications (less than 10 Bar) shall be of the slip on type. Flanges for high pressure applications (greater than 10 Bar) shall be of the socket weld type.

Flanges shall be manufactured from materials equal to or better than the pipes to which they are connected.

SMS1.6 Galvanising

Galvanising shall be in accordance with the requirements of SABS 763 (for hot dip zinc coatings) for heavy duty applications in accordance with Table 2. As the highest quality finish is required careful handling of the items is required both during the galvanising process stacking and transport.

All galvanised material shall be passivated and free from white rust when it is erected.

All fabricated mild steel components shall be galvanised after manufacture.

SMS1.7 Glass Reinforced Plastics (GRP)

Manufacture of glass reinforced plastic (GRP) products shall be carried out under carefully controlled conditions. Moulds shall be smooth and free from indentations and burrs which will affect surface finish. Joints in moulds shall be filled and smooth before applying a suitable mould release liquid. The resins and glass reinforcement shall be selected to be compatible with the environmental conditions and liquids or materials contained, and provide adequate structural strength to resist cracking and decay.

The design of structural members, vessels or tanks shall be in accordance with the requirements of BS 4994:1987.

The design of laminated GRP for non structural applications shall comply with the requirements of SABS 141.

The surface of completed components shall be finished with a smooth 'gel' coat so as to effectively seal the complete area.

Where GRP lining of vessels and tanks is required a spark test will be carried out on completion to check for any porosity. Where failures are identified in excess of 5% (five percent) of the total area the lining shall be removed and replaced. Local repair will only be permitted where the failures are confined to less that 5% (five percent) of the total area. Spark tests will be repeated until the lining is found to be free of all porosity.

Manufactured GRP components shall be crated or protected for transport and placed carefully into position to prevent damage. Where holes are drilled during installation the exposed face shall be sealed with resin to prevent ingress of moisture.

SMS1.8 Jointing Materials

Jointing gaskets for flanged joints shall comply with the requirements of BS 4865 and be cut to the full width of the flange. The materials shall be suitable for and compatible with the required pressure and temperature duties, and characteristics of the material conveyed. All gaskets on jointing shall be spiral wound Flexitallic type of 316 Stainless Steel.

SMS1.9 Malleable Cast Iron Fittings

Malleable cast iron fittings used in conjunction with screwed and socketted pipes shall comply with the requirements of SABS 509 and be 'hot dip' galvanised.

SMS1.10 Carbon Steel Pipe work and Fittings

Carbon steel pipes and fittings, other than steam tubing and screwed and docketed pipes for general application, larger than 150mm diameter, shall be electric resistance welded complying with the requirements of SABS 719 Grade A or ASTM A106 or API5L Grade A and shall have walls of thickness not less than 6mm for pipe sizes up to 300mm diameter inclusive and 8mm for pipe sizes of 350mm to 500mm. Helical seam welded pipe will not be permitted unless specifically approved by the Engineer.

Pipe work, other than screwed and docketed of sizes up to and including 150mm nominal bore, shall comply with the requirements of SABS 62 or ASTM A106 or API5L Grade A for seamless steel pipes. These pipes shall be heavy duty and with a minimum wall thickness of 5mm.

The use of fabricated carbon steel fittings will only be permitted where approved by the Engineer and where a standard butt weld fitting cannot be accommodated. Where such fittings are permitted they shall be of the closely spaced mitre type to an approved arrangement. Butt weld fittings shall comply with the requirements of BS 1640 or ASTM A234.

Steam piping shall be seamless tubing complying with the requirements of BS 1600 or ASTM A106 and be used in conjunction with butt weld fittings to the latter specification or to BS 1640. The pipe class shall be as stated in the detail Specification.

Welding and visual examination of carbon steel pipe work shall be carried out in accordance with BS 4871 Part 1 and BS 2633 or BS 2971 or an equivalent, except where stated in the Detail Specification. Dye penetration examination to BS 6443 shall be undertaken on not less than 10% of all weld connections.

All screwed and docketed pipes and fittings shall comply with the requirements of SABS 62 Heavy class and shall be 'hot dip' galvanised. Unless otherwise specified all screwed and docketed pipes shall not be used for the conveyance of steam gas and compressed air, or liquids containing same.

Plain ends of pipes and fittings shall be covered and protected against damage whilst being transported and stored.

SMS1.11 Stainless and Steel Alloy Pipework and Fittings

Stainless steel pipes shall be Grade TP304 L or TP316 L as stated in the Detailed Specification complying with the requirements of ASTM A312 for seamless pipe.

Stainless steel butt weld fittings shall comply with the requirements of ASTM A403 Class WP-S and be of the same material as the pipes with which they connect. Dimensions shall comply with ANSI B.16.9 and B.16.28.

Flanged fittings for stainless steel and alloy pipes shall be manufactured from butt weld fittings as specified above provided with short straight pipe extensions suitable for insertion in slip on or socket weld flanges.
Unless otherwise stated in the Detailed Specification the material thickness for all stainless steel pipes and fittings shall be equivalent to Schedule 40 for pipes up to and including 150mm diameter and Schedule 20 for pipes exceeding 150mm diameter.

Welding and visual examination of stainless steel pipe work shall be carried out in accordance with BS 4871 Part 1 and BS 2633 except where stated in the Detailed Specification. Dye penetration examination to BS 6443 shall be undertaken on not less than 10% of all weld connections.

SMS1.12 Nuts, Bolts and Fasteners

Nuts, bolts and other fasteners for the assembly and installation of fabricated components and standard flanges other than anchor bolts shall be hexagon head type and comply with the requirements of SABS 135 with ISO threads of the coarse pitch series. Fastener material shall always be of equal or better corrosion resistance or coating than the items being fastened.

Washers of similar materials to the bolts shall be provided at each nut and the use of multiple washers will not be accepted. Spring washers together with flat washers shall be fitted to all nuts subject to vibration. Bolts shall project not less than 3mm and not more than 8mm from the heads of nuts after tightening. Projections on individual and common flange sets shall be identical.

High tensile bolts shall only be used where essential and shall be coated to the approval of the Engineer.

Jacking bolts and holding down bolts to be built into concrete shall be stainless steel Grade 304 or 316 with threads complying with SABS 135 of the ISO coarse pitch series. Bolts to be installed under water, except where stated in the Detailed Specification, shall be stainless steel Grade 304 or 316. Bolts for flexible couplings and flanges for underground installations shall be 'hot dip' galvanised.

Where the possibility of galvanic action may occur, non-metallic sleeves and washers shall be provided.

Brackets and other mountings shall preferably be affixed to concrete walls and structures with cast in anchors. Where this is impracticable approved stainless steel Grade 304 or 316 'wedge' anchors will be provided and installed by the Contractor including all drilling. The Contractor shall clearly indicate on his drawings submitted to the Engineer the minimum reinforcement cover required to accommodate these anchors.

Unless otherwise stated in the detailed project specification, all fasteners will be of the following materials:

Immersed conditions	-	SS316
Above water	-	Hot Dip Galvanised carbon Steel

SMS1.13 Polyethylene Pipes and Fittings

High density polyethylene pipes and fittings shall comply with the requirements of SABS 533 with type and class as specified for each application. Installation of polyethylene pipes shall comply with SABS 0112.

SMS1.14 Structural Steelwork and Mild Steel Fabrication

Mild steel structural steelwork shall comply with the requirements of BS 4360 and shall be of Grade 43A or alternatively SABS 1431 Grade 300WA for use in the manufacture of trusses bridges, ancillary structures, and general mild steel fabrications.

Structural steelwork shall be constructed, fabricated and erected in accordance with the requirements of SABS 0162 'The Structural use of Steelwork'.

Welding of carbon steels for bridges, ancillary structures and mild steel fabrications shall be carried out in accordance with BS 5135. The Contractor shall include on his manufacturing drawings full details of welding procedures as outlined in Clause 23 of BS 5135. Welders undertaking manual and semi-automatic welding of steel fabrications shall be experienced competent artisans meeting the requirements of BS 4872 Part 1.

In addition to the weld requirements for structural strength on welded connections a sealing weld shall be run the full length of each connection to provide corrosion protection. Where in the opinion of the Engineer seal or continuous welding may create unacceptable distortion an approved method of sealing interstices at connections and between weld runs prior to corrosion protection may be considered.

Visual examination of all welding shall be carried out in accordance with BS 2633. Dye penetration examination to BS 6443 shall be undertaken on not less than 10% of all weld connections.

SMS1.15 Stainless Steel and Fabrication for General Applications

Stainless steel for low pressure and temperature applications shall be Grade 304L or 316L to ASTM A240 or BS 1449 Part 2, as stated in the detailed specification. Where no welding is required Grade 304 or 316 may be used. Manufacturers test certificates shall be provided for each batch of stainless steel giving the chemical analysis of each material and each stainless steel item supplied shall be clearly and permanently marked with the grade of stainless steel and cross referenced to the applicable test certificate.

Welders undertaking manual and semi-automatic welding of stainless steel Grade 304L and 316L shall be experienced competent artisans meeting the requirements of BS 4872 Part 1 except where stated in the Detailed Specification.

Visual examination of all welding shall be carried out in accordance with BS 2633. Dye penetration examination to BS 6443 shall be undertaken on not less than 10% of all weld connections.

Welding of stainless steel shall be carried out using welding electrodes most suitable for the material and its application by reference to the manufacturer’s recommendations. Special precautions shall be taken to ensure that the strength and corrosion resistance of the material is not impaired by prolonged heating of the welds. All welds and adjacent areas shall be cleaned and pickled to remove the area of discolouration with a nitric and hydrofluoric acid formulation as recommended by the material suppliers. After cleaning / pickling all areas shall be thoroughly washed with clean water and repassivated thereafter with a proprietary passivating solution of 10% - 20% nitric acid in aqueous solution as recommended by the material suppliers.

SMS1.16 3CR12 Steel and Fabrication for General Applications

Where 3CR12 steel is specified it shall be manufactured by Columbus (Pty) Limited. Test Certificates and marking shall be as for stainless steel as set out in Clause C.16. All 3CR12 steel plate and sections shall be supplied 'passivated' and upon completion of fabrication welds and other areas where the passivating layer has been removed or damaged and area contaminated with mild steel or discoloured shall be cleaned and pickled using a nitric and hydrofluoric acid

formulation as recommended by the material suppliers. After cleaning / pickling all areas shall be thoroughly washed with clean water and repassivated immediately thereafter with a proprietary passivating solution of 10% - 20% nitric acid in aqueous solution as recommended by the material suppliers.

Welding of 3CR12 steel shall be carried out under controlled conditions using stainless steel Grade 309L welding rods or similar approved and recommended by the material suppliers. All welds shall be continuous and crevice free. Welders undertaking manual and semi-automatic welding of 3CR12 steel shall be experienced competent artisans meeting the requirements of BS 4871 or BS 4872 Part 1 as appropriate subject to the Engineers approval.

Cutting, forming, welding, cleaning and passivating of 3CR12 steel shall be carried out strictly in accordance with the procedures and guidelines provided by Middleburg Steel and Alloys (Pty) Limited.

SMS1.17 Unplasticized Polyvinyl Chloride Pipes and Fittings

UPVC pipes and fittings for pressure applications shall comply with the requirements of SABS 966 and shall be of the classes specified for each application. The installation of UPVC pipes except where stated in the Detailed Specification shall comply with SABS 0112.

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

STANDARD MECHANICAL SPECIFICATIONS

(INCLUDING GENERAL WORKS)

The following Standard Specifications shall generally apply to all equipment proposed on this Contract. However, there are specific requirements in certain sections of these Documents which pertain to particular items of Mechanical Equipment. These Particular Specifications shall supersede the Standard Specifications.

SERIES M1 GENERAL

M1001 General Mechanical Engineering

M1002 Corrosion Protection

SERIES M2 OPERATION AND MAINTENANCE AND SAFETY

M2001 Operation and Maintenance

SERIES M4 FASTENERS

M4001 Nuts, Bolts and Fastening Sets

SERIES M5 MEDIUM PRESSURE PIPES

M5001 Generals for Medium Pressure Pipes

SERIES M7 VALVES

M7001 General Valves

M7003 Actuators

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

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SERIES M1 GENERAL

SECTION: M1001: GENERAL MECHANICAL ENGINEERING

TABLE OF CONTENTS

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M1001: GENERAL MECHANICAL ENGINEERING

1. SCOPE

This specification sets out the general requirements applicable to mechanical installations and shall apply where it is relevant to the Contract unless it is superseded by the project specification.

2. DESIGN SPECIFICATION

2.1. General

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.

2.2. 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.

2.3. 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;
- a safety margin of at least 20% in addition to any service or safety factors which apply;
- twenty four hour per day operation;
- a minimum life of 100 000 hours before repair or major part replacement; and
- 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.

2.4. **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;
- 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; and
- operate reliably after long inactive periods exposed to corrosive and dirty conditions.

2.5. **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 inter-changeability and ease of removal and replacement.

2.6. **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.

2.7. **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.

Steelwire 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.

3. MATERIALS OF CONSTRUCTION

3.1. Installation

3.1.1. 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 Subclause "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 Contractor is not responsible for grouting puddle pipes which pass through liquid retaining walls or slabs but shall be responsible for all other grouting necessary for all plant and 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 Subclause "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.

3.1.2. Alignment of shafts

Shafts for drives, such as motors, with an output above 150 kW 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 preload 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 20 mm.

3.1.3. Materials

3.1.3.1. 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 the extremely corrosive environment.

3.1.3.2. 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 trade mark and identification marks.

3.1.3.3. 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.

3.1.4. 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.

3.1.5. Fabrication of carbon steels

3.1.5.1. Standards

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

3.1.5.2. Finish

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

3.1.5.3. 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.

3.1.5.4. Inspections

The Contractor shall arrange for the Engineer to inspect fabrications, including fabricated pipework, in the fabrication workshop and prior to corrosion protection.

3.1.6. 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.

3.1.7. 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 less than 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.

Welders: Only welders experienced with welding stainless materials shall be used.

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.

3.1.8. 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, lock-washers, 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.

3.1.9. 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).

3.1.10. Noise control

3.1.10.1. 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; and
- 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.

3.1.11. Bearings

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

3.1.12. Lubrication

3.1.12.1. 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.

3.1.12.2. Oil lubrication

Oil level indicators shall be fitted for visual checking. Drain cocks, including 316 S/S 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 siphon 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.

4. MEASUREMENT AND PAYMENT

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.

SERIES M1 GENERAL

SECTION M1002: CORROSION PROTECTION

TABLE OF CONTENTS

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M1002: GENERAL CORROSION PROTECTION

1. CORROSION PROTECTION: APPLICATION AND CONTROL

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.

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.

1.3. Systems to be used

Systems: The corrosion protection systems to be used on the plant and equipment will usually be specified for the equipment, 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.

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 equipment to Site.

Inspector qualifications: Inspectors appointed by the Contractor shall hold an appropriate qualification from either 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.

2. CORROSION PROTECTION: SURFACE PREPARATION

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 less than 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.

2.2. Abrasive blasting

Before coating all surfaces shall be properly degreased and abrasive blast cleaned to an SA3 finish with a 40-65 µm 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.

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.

2.4. Hot-dip galvanized surfaces

Hot-dip galvanized surfaces to be painted shall be free from white rust and shall be cleaned with 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.

3. CORROSION PROTECTION: METAL COATINGS

3.1. General

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

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.

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 to 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); and

- 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; and

- 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); and

- Application of two coats of polyurethane enamel (twin pack) to a minimum combined dry film thickness of 70 µm.

4. CORROSION PROTECTION: PAINT COATINGS

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.

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 equipment 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.

4.3. **Final colour code – general**

The final colour code shall be as follows:

PIPEWORK

CONTENTS OF PIPE	**BASIC COLOUR**	**COLOUR OF INDICATOR**		
		1 BAND	**2 BANDS**	**3 BANDS**
AIR				
Compressed, Power	Arctic Blue (F28)		-	-
Aeration	Arctic Blue (F28)	Canary Yellow (C61)	-	-
Instrument	Arctic Blue (F28)	Salmon Pink (A40)	-	-
Vacuum	Arctic Blue (F28)	Primrose (C67)	-	-
Lime Transfer	Arctic Blue (F28)	Crimson (A03)	-	-
Blower	Arctic Blue (F28)	Verdigris Green (E22)	-	-
CHEMICALS				
Aluminium Sulphate	Jacaranda (F18)	Verdigris Green (E22)	-	-
Sodium Aluminate	Jacaranda (F18)	Crimson (A03)	-	-
Ferric Sulphate	Jacaranda (F18)	Canary Yellow (C61)	-	-
Lime (dry powder)	Jacaranda (F18)	Salmon Pink (A40)	-	-
Activated Carbon	Jacaranda (F18)	Light Stone (C37)	-	-
Polyelectrolyte	Jacaranda (F18)	Cloud White (G80)	-	-
GASSES - (other than air); liquefied or gaseous				
Butane, Propane	Light Stone (C37)	-	-	-
Ammonia	Light Stone (C37)	Ultramarine (F09)	-	-

CONTENTS OF PIPE	BASIC COLOUR	COLOUR OF INDICATOR		
		1 BAND	2 BANDS	3 BANDS
Blast furnace	Light Stone (C37)	Crimson (A03)	-	-
Carbon Dioxide	Light Stone (C37)	Light Brunswick Green (H07)	-	-
Coke Oven	Light Stone (C37)	Light Grey (G29)	-	-
Producer	Light Stone (C37)	Verdigris Green (E22)	-	-
Chlorine, Hypoclorite	Light Stone (C37)	Canary Yellow (C61)	-	-
WATER				
Cold Drinkable	Brilliant Green (H10)	Cornflower (F29)	-	-
Hot Drinkable	Brilliant Green (H10)	Crimson (A03)	Cornflower (F29)	-
Boiler Feed (Distilled)	Brilliant Green (H10)	Crimson (A03)	Cloud White (G80)	Crimson (A03)
Boiler Feed (Demineralised)	Brilliant Green (H10)	Cloud White (G80)	-	-
Industrial, Raw	Brilliant Green (H10)	Golden Yellow (B49)	-	-
Reclaimed	Brilliant Green (H10)	Jacaranda (F18)	-	-
Backwash	Brilliant Green (H10)	Light Stone (C37)	-	-
Desludge	Brilliant Green (H10)	Canary Yellow (C61)	-	-
Stove Circulating	Brilliant Green (H10)	Salmon Pink (A40)	-	-
Hydraulic Power	Brilliant Green (H10)	Terra Cotta (A10)	-	-
Final Treated Effluent	Aquamarine (E67)	-	-	-
Interchange, Stage	Drakensberg Green (H36)	-	-	-
Raw Sewage	Olive Green (H05)	-	-	-
Sea Water	Light Brunswick Green (H07)	-	-	-
Primary Sludge	Dark Brown (B03)	-	-	-
Waste Activated Sludge	Light Brown (B15)	-	-	-
Digested Sludge	Light Brown (B15)	Light Olive Green (H21)	-	-
Pasteurised Sludge	Light Brown (B15)	Cloud White (G80)	-	-

OIL				
Diesel Fuel	Golden Brown (B13)	Cloud White (G80)	-	-
Hydraulic Power	Golden Brown (B13)	Salmon Pink (A40)	-	-
Lubricating	Golden Brown (B13)	Verdigris Green (E22)	-	-
Transformer	Golden Brown (B13)	Crimson (A03)	-	-
Paraffin	Golden Brown (B13)	Arctic Blue (F28)	-	-

PLANT AND EQUIPMENT	
EQUIPMENT	**COLOUR CODE**
FIRE FIGHTING	
Equipment and Pipework	Signal Red (A11)
ELECTRICAL	
Distribution Boards, Switchgear, Terminal Boxes and Conduits	Light Orange (B26)
Emergency Stop	Signal Red (A11)
MACHINE GUARDS	
Inside	Light Orange (B26)
Outside	Colour of Machine
Protruding Shafts, Exposed Gear Wheels and Rotating Parts	Light Orange (B26)
OVERHEAD TRAVELLING CRANE	
Final colour	Golden Yellow (B49)
HANDRAILS	
Horizontal Rails and Chains	Golden Yellow (B49)
Stanchions	Black
Protrusion, Sides of Ramps	Black and Yellow Diagonal Stripes
GENERAL	
Scour Pipes	Deep Buff (B24)
Valves	Basic colour of pipeline
WORKSHOP FLOOR DEMARCATION	
Demarcation Lines	Golden Yellow (B49)
Working Areas	Pastel Grey (G54)
No Parking, No Storage	Golden Yellow (B49)
Aisles and Walkways	Brilliant Green (H10)
Storage Area	Terracotta (A10)
Urethane based paint is to be used for concrete surfaces. Traffic paint is to be used for tarred surfaces	

Exception:

Items made of 316 or 316L stainless steel may be left unpainted provided the surface is of uniform self-colour without blemishes, rust, marks or stains. If blemished the surfaces must either be painted or cleaned by pickling and/or electro-cleaning (not grinding or other mechanical means).

4.4. **Painting systems**

Definition of terms

The abbreviation "d.f.t." used in this Specification shall mean dry film thickness given in microns and, except where otherwise specified is the minimum (not average) thickness permissible.

SYSTEM A/1

Three coats of a low solvent, high solids, polyamine/amide cured, epoxy (twin pack) to a minimum thickness of 350 µm.

Notes:

The coating shall undergo holiday detection over the full surface in accordance with SANS 1217. This test shall be done by an inspector holding an appropriate qualification from either the CISA, the SAIW or the SAQCC.

When applied to hot-dip galvanized surfaces, a suitable epoxy primer shall be used after careful surface preparation before applying this system.

This system shall be applied by a specialist applicator prior to delivery to site with particular attention to the required interval between coats.

The first and third coats shall be a different colour to the second coat.

Applied to:

Items subject to immersion and/or wet abrasion; e.g. screw pumps, clarifier rotating arms, scum boxes and weirs, pipework, chutes, tanks, etc.

SYSTEM A/2

System A/1, plus ..... d.f.t = 350 µm

Coat wash primer to SANS 723 ..... d.f.t = 40 µm

..... Total d.f.t = 390 µm

SYSTEM A/3

2 Coats of a micaceous iron oxide pigmented polyamine/ amide

cured epoxy sealer/coating (twin pack) with d.f.t = 60 µm per coat. ..... **Total d.f.t = 120 µm**

Notes:

Use Sigmarite Sealer, or equivalent.

Applied to Hot dry applications up to 200ºC.

SYSTEM A/4

3 Coats of a micaceous iron oxide pigmented polyamine/amide

cured epoxy sealer/coating (twin pack) with a d.f.t = 80 µm per coat. ..... **Total d.f.t = 240 µm**

Notes:

Use Sigmarite Sealer, or equivalent.

Applied to Immersed applications in potable water up to 100 ºC.

SYSTEM A/5

2 or 3 coats polyamine/amide cured coaltar epoxy..... **Total d.f.t. = 400 µm**

Notes:

Where paints are available in different colours, each coat shall be a different colour.

SYSTEM B/1

1 Coat aluminium filled epoxy (twin pack).....d.f.t. = 125 µm

1 Coat polyurethane enamel (twin pack).....d.f.t. = 40 µm

..... Total d.f.t. = 165 µm

Application a maintenance coat over weathered coatings on steel.

Notes:

Surface preparation shall include, as a minimum, removal of all loose mill scale, non-adherent rust and loose paint prior to wire brushing and degreasing and shall be in accordance with an appropriate internationally accepted standard such as the Steel Structures Painting Council of the USA or that of the Swedish Standards Institute's St standards.

SYSTEM B/2

1 Coat HB epoxy primer.....d.f.t. = 100 µm

2 Coats polyurethane enamel (twin pack).....d.f.t. = 60 µm

..... Total d.f.t. = 160 µm

Applied to motors, gearboxes, cast iron components, steel fabrications, etc.

SYSTEM C/1

1 Coat inorganic zinc silicate.....d.f.t. = 75 µm

1 Coat high build modified acrylic coating.....d.f.t. = 75 µm

1 Coat modified acrylic finish to approved colour .....d.f.t. = 30 µm

..... Total d.f.t. = 180 µm

Notes:

The primer must be factory applied. The intermediate and final coats may be applied on Site.

Particular care shall be taken to obtain the recommended anchor pattern during abrasive blasting and to achieve the required primer thickness on all surfaces in one coat.

The primer shall be tested for full cure before applying the subsequent coats.

This system shall not be used for items subject to immersion.

Intermediate coat shall be Sigma Topacryl, or equivalent.

Top coat shall be Sigma Topacryl Finish, or equivalent.

Applied to heavy fabricated steel items requiring a primer which travels well and/or can be left for an extended period before overcoating.

SYSTEM C/2

1 Coat inorganic zinc silicate.....d.f.t. = 75 µm

1 Coat epoxy tie coat.....d.f.t. = 75 µm

1 Coat polyurethane enamel (twin pack).....d.f.t. = 40 µm

..... Total d.f.t. = 190 µm

Notes:

The complete system must be factory applied and touch ups will be required on Site.

The primer shall be tested for full cure before applying the subsequent coats.

This system shall not be used for items subject to immersion.

Applied to:

Heavy fabricated steel items requiring a hard, high gloss colour finish - e.g. bridges, tanks, non-immersed piping, structural steel, etc.

SYSTEM C/3

1 Coat inorganic zinc silicate.....d.f.t = 75 µm

1 Coat modified silicone heat resisting coating suitable for 200 ºC .....d.f.t = 75 µm

..... Total d.f.t = 150 µm

Notes:

Particular care shall be taken to obtain the recommended anchor pattern during abrasive blasting and to achieve the required primer thickness on all surfaces in one coat.

The primer must be factory applied.

The primer shall be tested for full cure before applying the subsequent coat.

A tie coat suitable for 200ºC shall be included between the primer and top coat if so recommended by the paint manufacturer.

The top coat must cure at ambient temperatures.

Applied to:

Steel and cast iron items on dry heat applications with temperatures up to 200ºC continuous.

SYSTEM C/4

3 coats modified silicon ..... **Total d.f.t = 120 µm**

Notes:

Steel and cast iron items on dry heat applications with temperatures up to 540ºC continuous.

SYSTEM D/1

Hot dip galvanize to SANS 121 (ISO 1461), then after preparation by chemical cleaners or sweep blasting in accordance with Hot Dip Galvanizers Association Code of Practice for Surface Preparation and Application of Organic Coatings (HDGASA 01-1990).

1 Coat epoxy primer..... d.f.t = 35-40 µm
1 Coat epoxy intermediate with MIO (micaceous iron oxide) ..... d.f.t = 100-120 µm
1 Final coat of polyurethane sealer..... d.f.t = 30-40 µm
Total d.f.t. = 160-200 µm

Applied to:

- • Hot dip galvanized steel pipes, handrails and stanchions, guards, steelwork, etc. in very aggressive areas

SYSTEM D/2

Hot dip galvanize to SANS 121 (ISO 1461), then after preparation by chemical cleaners or sweep blasting in accordance with Hot Dip Galvanizers Association Code of Practice for Surface Preparation and Application of Organic Coatings (HDGASA 01-1990).

1 Coat epoxy primer..... d.f.t = 35-40 µm
2 Final coat of polyurethane sealer..... d.f.t = 60-80 µm
Total d.f.t. = 95-120 µm

Applied to:

- • Hot dip galvanized steel pipes, handrails and stanchions, guards, steelwork, etc. in aggressive areas

SYSTEM D/3

Hot dip galvanize to SANS 121 (ISO 1461), then after preparation by chemical cleaners or sweep blasting in accordance with Hot Dip Galvanizers Association Code of Practice for Surface Preparation and Application of Organic Coatings (HDGASA 01-1990).

1 Coat epoxy primer..... d.f.t = 35-40 µm
1 Final coat of polyurethane sealer..... d.f.t = 30-40 µm
Total d.f.t. = 65-80 µm

Applied to:

- • Hot dip galvanized steel pipes, handrails and stanchions, guards, steelwork, etc. in less aggressive areas

SYSTEM E/1

1 coat wash primer to SANS 723 ..... d.f.t = 10 µm

1 coat zinc chromate primer to SANS 679 Type 1 ..... d.f.t = 40 µm

1 coat universal undercoat to SANS 681 ..... d.f.t = 35 µm

2 coats silicone urethane gloss enamel top coat to colour code. ..... d.f.t = 70 µm

..... Total d.f.t = 155 µm

Notes:

If the specified dry film thickness of the zinc chromate primer of 40 µm is not achieved with one coat, an additional coat shall be applied.

The paints used shall be suitable for internal and external use.

An alternative priming and undercoat system of superior corrosion resistance may be used.

SYSTEM E/2

1 Coat phenolic based primer ..... d.f.t = 20 µm

1 Coat universal undercoat to SANS 681 ..... d.f.t = 35 µm

2 Coats machinery enamel ..... d.f.t = 50 µm

..... Total d.f.t = 105 µm

Notes:

The paints shall be suitable for internal and external use.

The paints selected shall not be damaged by oil spillage or grease and shall be reasonably chemical resistant.

SYSTEM E/3

1 coat zinc chromate self-etching wash primer to SANS 723 max ..... d.f.t = 10 µm

1 coat zinc chromate primer to SANS 679 Type 1 ..... d.f.t = 40 µm

1 coat universal undercoat to SANS 681 ..... d.f.t = 35 µm

2 coats single pack urethane gloss enamel ..... d.f.t = 60 µm

..... Total d.f.t = 145 µm

Notes:

All paints shall be suitable for internal and external use.

If the specified dry film thickness of the zinc chromate primer of 40 µm is not achieved with one coat, an additional coat shall be applied.

SYSTEM E/4

1 Coat water borne vinyl based primer; Dulux Corrocote 3 or equiv. ..... d.f.t = 40 µm

2 Coats Acrylic Semi Gloss top coats; Amercoat 234 or equivalent ..... d.f.t = 100 µm

..... Total d.f.t = 140 µm

Applied to:

General use on hot-dip galvanized surfaces.

SYSTEM E/5

1 Coat twin pack epoxy zinc chromate primer ..... d.f.t = 30 µm

2 Coats acrylic semi gloss coats; Amercoat 234 or equal approved ..... d.f.t = 100 µm

..... Total d.f.t = 130 µm

SYSTEM E/6

1 Coat epoxy strontium chromate primer ..... d.f.t = 25 µm

2 Coats Dulux Silthane Gloss enamel ..... d.f.t = 60 µm

..... Total d.f.t = 85 µm

Note:

The paints used for this system must be suitable for a continuous operating temperature of 120ºC or higher.

SYSTEM F

1 Coat vinyl copolymer polyester ..... **Total d.f.t = 100 µm**

Applied to steel floor grating.

SYSTEM - FUSION BONDED EPOXY

This is a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating in accordance with SANS 1217. The material used shall be of Type 2; i.e. a thermosetting powder-coating material. The finished coating shall have a thickness of 300 µm and no reading shall be less than 200 µm.

Note:

The Contractor shall execute holiday detection over the full surface in accordance with SANS 1217.

The items to be coated shall be prepared in accordance with Clause 4.1.1 of the SANS 1217 and, in particular, shall have edges ground to a radius of curvature of at least 3 mm.

The surfaces to be coated shall be prepared in accordance with Clause 4.1.2 of SANS 1217 and, in particular, shall be blasted to a preparation grade of Sa 3.

Pre-heating is needed to achieve the required coating thickness.

Applied to immersed objects, cast iron valve bodies, pipework, etc.

SYSTEM – HOT-APPLIED THERMOPLASTIC

This is a synthetic thermoplastic polyamide, Rilsan or equivalent, which shall be applied by dipping the hot object into a fluidised bed of the polymer. The coating shall be executed in accordance with the supplier's recommendations. The finished coating shall have a thickness of 300 μm and no reading shall be less than 200 μm.

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SERIES M2 OPERATION, MAINTENANCE AND SAFETY

SECTION M2001 OPERATION AND MAINTENANCE MANUALS

TABLE OF CONTENTS

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M2001: OPERATION AND MAINTENANCE MANUALS

1. SCOPE

This specification covers the supply of Operation and Maintenance manuals as called for in the schedule of pricing. The specification sets out the general requirements applicable to the Operation and Maintenance manuals and shall apply where it is relevant to the Contract unless it is superseded by the project specification.

2. GENERAL

The contractor must submit one full set of provisional Operation and Maintenance manuals to the engineer for checking and remarks, at least one month before any commissioning and testing exercises are undertaken. The manuals will be returned to the contractor, who is to incorporate the changes and comments into the final manuals, before re-submittal.

Four sets of the final Operation and Maintenance manuals must be submitted to the engineer once the manuals have received final approval. The engineer will thereafter distribute these final manuals to Client accordingly.

3. LAYOUT OF THE MANUALS

3.1. Appearance

The manuals are to be firmly bound in plastic covered files suitable for A4 sized paper, information leaflets, suppliers' information and manuals. The Operation and Maintenance manuals are to have the following information on their covers and spines:

- Operation and maintenance manual for the specific project;
- Contractors name, address and contact details; and
- Date at which the plant was handed over to the client.

All relevant information that is not of A4 size or which is of A4 size and cannot be bound / filed into the manual is to be folded / filed into an A4 plastic sleeve which in turn is to be bound into the final manual.

Drawings on large format paper are to be neatly folded and placed in plastic sleeves so as to be removed and replaced easily.

All sections of the Operation and Maintenance manuals are to be clearly labelled and neatly partitioned.

The Operation and Maintenance manuals are to be sorted in accordance to the way the plant has been segregated into various working areas and / or stations. Repeated equipment is to be referenced or cross-referenced to the appropriate section of the manual where the relevant information for the equipment is filed.

3.2. **Contents**

The following details / information shall be included in the manuals:

a) Maintenance Requirements

A summary, in tabular form, is to be provided for the major and minor services of the equipment supplied. Time intervals are to be clearly indicated.

- A summary, in tabular form, is to be provided for the standard inspection and adjustment of equipment supplied. Time intervals are to be clearly indicated.

These summaries shall specify the recommended consumables and quantitative adjustments for the equipment including contact details of the relevant suppliers. Suppliers of spares if different are to be provided along with the original equipment manufacturers details. If specialized services or maintenance is to be carried out on the equipment, the contact details of these specialists are to be provided.

b) Technical

A detailed technical description / specifications shall be provided for all equipment supplied under the contract. This shall as a minimum include:

- Tag number;
- Details of the design of the equipment including working drawings and the description of the equipment;
- Scope of operation including performance curves, where applicable;
- Electrical requirements, where applicable;
- Materials of construction including corrosion protection specification;
- List of spares and where necessary additional tools.
- Installation details; and
- Condition monitoring specifications and requirements.

4. OPERATION AND MAINTENANCE

The following procedures, operational philosophies and functions of the equipment shall be provided:

1. For all equipment, the start-up procedures shall be described including pre-start checks. This includes for equipment that automatically starts.
2. Shut down procedures for all equipment is to be described.
3. The operational time for each piece of equipment supplied shall be detailed.
4. The maintenance schedule, regularity of maintenance along with the time intervals between maintenance periods shall be clearly stated.

5. The checking of lubricant and coolant levels along with adjustment of machines shall be clearly described.

6. Standard inspections, services and adjustments shall be described clearly along with time intervals of when these procedures are to occur.

7. Major inspections, services and adjustments shall be described clearly along with time intervals of when these procedures are to occur.

5. MEASUREMENT AND PAYMENT

All costs sustained from the compilation of the Operation and Maintenance manuals shall be deemed to be included in the schedule of pricing, where called for in the supply of these documents.

The biddered sum shall include for the supply of a complete set of Operation and Maintenance manuals per set of equipment supplied. Final payment for these manuals will only be transferred once the engineer has approved and received the final documents along with the relevant plant drawings.

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SERIES M4 FASTENERS

SECTION M4001 NUTS, BOLTS, AND FASTENING SETS

TABLE OF CONTENTS

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

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M4001: NUTS, BOLTS, AND FASTENING SETS

1. SCOPE

This section of the Contract covers the requirements for fasteners and fastening sets which are to be included with all equipment offered and not as separate items.

2. DESIGN SPECIFICATIONS

2.1. Fasteners General

2.1.1. Standards

Bolts and nuts shall be hexagon head type complying with SANS 1700 with threads of the coarse pitch series. Allen head screws of any type shall not be used without the Engineer's written consent.

2.1.2. Fasteners M12 and Smaller

All fasteners M12 and smaller shall be manufactured of grade 316 stainless steel.

2.1.3. Fasteners Larger than M12 - in Corrosive Areas

All fasteners in corrosive areas shall be manufactured in 316 SS. Corrosive areas shall be taken to include any moist or wet area such as in and above settling tanks, in or in the vicinity of open channels, where a continuous spray can be expected and all internal and external areas in the vicinity of the inlet works of a wastewater treatment works. All fasteners embedded in brick, concrete or soil shall also be of 316 SS.

2.1.4. Fasteners Larger than M12 - Non-corrosive Areas

Fasteners larger than M12 which are in non-corrosive areas shall, except when specified otherwise, be hot-dip galvanized.

2.1.5. High Tensile Bolts

Where high tensile bolts are required by the design, they shall be hot-dip galvanized and painted. The bolt holes and crevices shall be filled and sealed prior to painting.

2.1.6. Material Compatibility

Fastener material shall always be of equal or better corrosion resistance than the items being fastened, e.g. 316 stainless steel bolts must be used to fasten together 316 stainless steel fabrications or flanges.

2.1.7. Washers

Washers of similar material to the bolts shall be provided under each nut and setscrew head. Multiple washers or shims shall not be used. Spring washers or other approved locking arrangement shall be used on all fasteners subject to vibration.

2.1.8. Anti-seize Compound

Before assembly, threads shall be treated with a nickel based, anti-seize/ corrosion protection compound; Chesterton 725: Nickel Anti-seize Compound, or equivalent. The thread shall be treated in the area under the final position of the nut. Compound on the exposed thread shall be cleaned off after installation. If it is found during inspection that compound has not been applied, the Contractor shall disassemble all fasteners and comply with this requirement.

2.1.9. Thread Projection

Bolt threads shall project between 1 and 6 mm from the head of the nuts when fixed. Longer projections will only be allowed if the Contractor can show that bolts of a more suitable length are not manufactured.

2.1.10. Corrosion Protection

After installation the exposed surfaces of bolts not made of 316 stainless steel shall be coated as for the items being fastened. If the use of Allen head or similar fasteners has been approved by the Engineer, the recessed heads shall be filled with a suitable non-hardening sealing compound.

2.2. **Anchor Fasteners**

2.2.1. Type and Material

All anchor fasteners shall be of grade 316 stainless steel.

Anchor fasteners for water retaining structures and for brickwork shall be of the chemical anchor fastening type. Anchor fasteners for other applications may be of the expanding type or chemical anchor type.

2.2.2. Hook Bolts

Grade 316 stainless steel hook bolts shall be supplied and grouted by the Contractor into pockets which will be provided in the concrete structure in accordance with the information to be supplied by the Contractor. The grouting products shall be used strictly in accordance with the manufacturer's instructions.

2.2.3. Alternative Anchor Bolts

The use of 316 stainless steel "Hilti Kwik Bolt" stud bolts or similar may be used as an alternative where approved by the Engineer. If steel reinforcing bars are encountered while the holes are being drilled, the Contractor shall knock a hole in the concrete around the steel and grout in a stainless steel hook bolt as described above.

2.2.4. Through-bolt Anchors

Where machinery is anchored by studs or bolts which extend through the supporting structure and is therefore fastened down with the use of nuts from both sides, these, together with associated washers and brackets, shall also be of grade 316 stainless steel.

2.2.5. Anti-seize Compound

All threads shall be coated with an approved nickel-based, anti-seize/ corrosion protection compound before assembly.

3. MEASUREMENT AND PAYMENT

All fasteners and fastening sets are to be included in the price for the item of equipment offered. The unit item offered will include the price of the fastener and fastening sets. Fasteners are to be included as ancillary equipment where reference is made to “ancillary equipment”

SERIES M5 MEDIUM PRESSURE PIPES

SECTION M5001: GENERALS FOR MEDIUM PRESSURE PIPES

TABLE OF CONTENTS

M5001: MEDIUM PRESSURE PIPES

1. SCOPE

This section of the Contract covers the supply, delivery, offloading, transport, double handling (if required), storage, erection, installation, commissioning, testing, adjustment, handing over in complete working order and upholding during the Defects Liability Period of medium pressure pipes that form part or of or will be supplied as part of or supplemenmtal to the mechanical equipment and mechanical installations.

2. DESIGN SPECIFICATIONS

2.1. General

2.1.1. Steel pipe – general duties

Steel pipes for general non-corrosive, non-abrasive duties for liquid, air and gas shall be as follows:

Up to DN 150 - SANS 62 medium class

Over DN 150 - SANS 719

Unless otherwise specified, steel pipework and fittings shall be hot-dip galvanised and painted.

2.1.2. Steel pipework

Pipework up to DN 600 shall be in accordance with SANS 1476. Pipework for the conveyance of water shall, in addition, comply with CCT-WS 11 Standard Specification for Steel Pipe, Fittings and Specials.

2.1.3. Stainless steel

Stainless steel pipework shall be to ASTM 312. Schedule 10 pipes and fittings shall be used except where otherwise specified.

2.1.4. Steam Pipework

Steam pipework smaller than DN 50 shall be of 316 stainless steel to ASTM A-312 Schedule 40 or approved equal. Steam pipework DN 50 and larger shall be manufactured to SANS 62 heavy class, ANSI B36.10 STD/Schedule 40 or to BS 1600 Schedule 40. Steel pipework shall be supplied with a suitable temporary corrosion protection both internally and externally in order to prevent corrosion during the storage, installation and pre-commissioning period. A primer similar to Plascon SNK 2, phenolic modified polyvinyl butyral self-etch primer, would be suitable.

2.1.5. Hydraulic and oil pipework

Hydraulic pipework shall be to BS 778 or equal. All hydraulic and oil pipes and fittings shall be thoroughly degreased, descaled and cleaned internally and externally after fabrication by abrasive blasting or pickling, thoroughly cleaned and rinsed, dipped in a hot iron phosphate solution and coated internally with a corrosion inhibiting, oil soluble preservative. After treatment and drying all openings shall be sealed until the pipes are installed.

2.1.6. Butt weld fittings

Steel butt welding pipe fittings shall be to ANSI B 16.9, BS 1965 or BS 1640 of the same schedule as the pipework or heavier. Butt weld fittings in stainless steel shall be to ASA B 36.19 for schedule 5S and 10S and ASA B 16.9 for schedule 40S and 80S. Alternatively, fittings may be to BS 1640.

2.1.7. Malleable cast iron

Malleable cast iron fittings shall be to SANS 14 (SANS ISO 49).

2.1.8. Cast iron

Cast iron pipes and fittings shall comply with BS 2035 (Class D) and shall be pressure tested in accordance with Clause 12 of that Standard. The requirements of the Standard's Clause 6 regarding freedom from defects and casting appearance and Clauses 8, 9 and 10 regarding casting accuracy will be strictly applied. The requirements of the Standard with regard to protection and flanges shall be modified to comply with this Specification. Also refer to Clause "Castings" of this Specification.

2.1.9. Copper pipes

Copper pipes shall be to BS 2871 or approved equal.

2.1.10. Plastic pipework

Polyethylene or Polypropylene pipes shall comply with SANS 533 and SANS 1315 respectively and shall carry the SANS mark. The contractor manufacturing and installing the pipework shall satisfy the requirements of SANS ISO 9002. PVC pipework is not acceptable except where specified.

An operating life of 50 years shall be designed for and appropriate derating factors shall be applied to suit the application. The rated maximum working pressure at operating conditions of the class of pipe selected shall be not less than 1,5 times the actual maximum operating pressure. If the material used has insufficient resistance to solar radiation (U.V. light) for the application, suitable protection must be provided to achieve the required life.

Note that nominal bores and pipe diameters specified must be regarded as the minimum inside diameter.

2.2. **Pipework design**

2.2.1. Pipe type and material

The type and material of pipe to be used will be given in the Detailed Specification.

2.2.2. Pipe diameters

Unless otherwise specified in the Detailed Specification, pipe diameters shall be based on the following velocities. The velocities shall be based on the compressed volume at the operating pressure in the case of steam, air and other gases. Valves and other ancillaries shall generally be of the same nominal diameter as the pipe. Non-standard sizes shall not be used.

Fluid	**Fluid Flow [ℓ/s]**			
	0-2,5	**2,5-15**	**15-100**	**100-500**
	Allowance Flow Velocity [m/s]			
Liquid Grit Free:	0.75 max	1,25 max	1,5 max	2 max 1 min
High Solids or Grit:		0,8 min 1,5 max	1 min 1,75 max	2 max 25 max
Steam	10 max	15 max	20 max	
Air and Gas Above 10 kPa	5 max	8 max	10 max	12 max

Below 10 kPa	2,5 max	3 max	4 max	5 max

* Grit free liquids include potable water, final effluent, centrate, supernatant, etc. Liquids considered having high solids content will include raw sewage, sludge and grit slurry.

If anomalies occur within the same system using the above table, the larger pipe diameter shall generally be used.

2.2.3. Coupling arrangement

Screwed fittings may be used on DN 50 and smaller provided that sufficient unions or flanges are provided for disassembly and removal of equipment. Reducing sockets and not reducing bushes shall be used where required.

All steel pipes larger than DN 50 shall be flanged or fitted with pipe couplings as applicable.

Suitable flexible couplings shall be incorporated wherever necessary to facilitate maintenance or isolate vibration. A flexible pipe coupling shall be provided on each pump suction. Flexible couplings shall be adequately restrained by harnesses as specified in the Clause "Flexible Pipe Couplings".

2.2.4. Draining, venting and purging

On liquid lines provision shall be made for draining and venting where necessary. Vents shall be provided at all vertical down bends on gravity lines. On gas lines provision shall be made for purging.

2.2.5. Condensate drains

Automatic condensate traps with isolating valves and valved by-passes shall be provided at all necessary points including ahead of any globe type valve, orifice plate or concentric reducer in a horizontal line, at each change of level and immediately ahead of the user equipment.

A suitable well of a diameter equal to the pipe diameter with a bottom drain shall be provided at each condensate removal point. Condensate traps and valves shall be accessible and condensate shall be piped to the nearest drain. Pipework shall be sloped in the direction of flow towards a drain point with a slope of 1 in 150 and care shall be taken to avoid sagging at any point.

2.2.6. By-passes

Isolating valves and valved by-passes shall be provided around condensate traps, pressure reducing valves and valves with solenoid or other actuation which do not have provision for manual operation.

2.2.7. Encased pipes

Pipework to be permanently encased in concrete, cement or similar shall be of cast iron or 316 stainless steel for steel and stainless steel pipework respectively. The encased portion must be a separate section flanged both ends with adequate clearance between the wall surface and the flanges. Victaulic type couplings may in some instances be permitted instead of flanges.

Pipe sections through walls below ground or water level shall be provided with a puddle flange the same diameter as a standard flange. The encased area shall in such cases be uncoated up to 30 mm inside the wall surface and coated to Specification from there on.

2.2.8. Isolation

The layout design shall make provision for isolation and easy removal of mechanical equipment.

2.2.9. Nozzles for Fittings, Gauges, etc.

Nozzles on pipework (for installation of gauges, transmitters, drain pipes, cooling water take-offs, air valves, etc.) shall be designed so that the pipework corrosion prevention system is not affected.

Nozzles shall consist of a flanged, welded tee-off of at least 100 mm in diameter, painted internally and provided with a non-corrosive blank flange, e.g. grade 316 stainless steel. The blank flange shall be provided with tapped holes suitable for the equipment installation.

A nozzle on cement-lined, carbon steel pipework shall consist of a flanged, cement lined tee-off (of at least 100 mm diameter) and a non-corrosive blank flange.

Internally painted, small diameter carbon steel nozzles and screwed carbon steel tee-offs are both unacceptable as nozzles. Carbon steel pipework may be provided with small diameter, grade 316 stainless steel nozzles which are welded into the pipework if the Engineer considers this acceptable in the application.

2.3. Materials of Construction

2.3.1. Pipework installation

Appearance

Pipes and fittings shall be conservatively selected to suit the application, neatly installed, straight to line and level, adequately supported and shall operate without vibration.

Valve orientation

On sludge or raw sewage pipelines, check valves shall, wherever possible, be mounted horizontally and isolating valves with spindles vertical. Valve handwheels shall be arranged so that they are accessible to the operators.

Supports

No external loads shall be placed on items of mechanical equipment such as pumps, compressors, etc. Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

A drawing or sample of proposed pipe supports shall be submitted to the Engineer for approval prior to manufacture.

Pipe supports shall be so located that when an item of mechanical equipment is removed, the associated valves and pipework are still adequately supported. Supports shall be provided close to heavy items such as valves.

3mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and limit corrosion. Where roller or sliding supports are used to accommodate movement, suitable wear blocks shall be fixed to the pipe to prevent damage.

Where the Engineer approves the use of concrete pipe supports to be built by a civil contractor under a separate contract, these shall be constructed after installation of the pipework and temporary supports shall be provided by the Contractor in positions which will not interfere with the construction of the concrete supports.

Pressure testing

All pipelines shall be pressure tested to 1,5 times maximum working pressure. This shall be done before covering up the pipeline in any way where applicable and shall be witnessed by the Engineer.

2.3.2. Flanges

Standards

All standard flanges shall comply with SANS 1123. For flange sizes not included in the SANS standard, BS 4504 shall be used. Cast iron flanges and their mating flanges shall have flat faces. The flange table shall be as specified or, if not specified, selected to suit the maximum possible operating pressure but not less than Table 1000. Drilling and installation of flanges shall be "off-centre".

Flange fixing

Flanges DN 50 and smaller may be of the screwed on type. Metal flanges above DN 50 shall be welded on in accordance with BS 806 Type 6 unless otherwise agreed or specified.

Machining of flanges

All flanges shall be machined on the sealing face. Flanges cut from plate shall also be machined on the bore and outside diameter. Cast iron flanges shall also be machined or spot faced on the back of the flange to ensure a flat bearing surface for the fastener's head or nut and washer. All edges, including bolt-holes, shall be chamfered or rounded to a 2 mm radius.

Butt flanges

If the use of a loose hot-dip galvanized butt flange arrangement with stainless steel pipework is specified or approved by the Engineer, such arrangement and design shall comply with BS 4504 Table 6/6 or 10/6 as appropriate. The butt welded shouldered end for the pipe may be rolled from hot rolled stainless steel angle section. The hot-dip galvanized butt flange must be electrically insulated from the stainless steel pipework.

Rectangular flanges

The use of square or rectangular flanges shall be avoided and will not be accepted for pressures above 100 kPa. The thickness of flanges designed for positive or negative pressures between 20 and 100 kPa shall be not less than 75 % that of a circular flange of equivalent nominal opening area manufactured to Table 600 of SANS 1123. For pressures 20 kPa and below the flange thickness shall be to the Engineer's approval. Bolting shall in all cases be to the Engineer's approval.

Gaskets

The jointing material used on flange joints shall be of rubber or compressed asbestos fibre at least 3 mm thick complying respectively with BS 2494 or BS 1832, as applicable. Full face gaskets shall be used for full face flanges. Inner bolt circle gaskets shall be used on raised face flanges and when clamping items such as wafer type valves between flanges inside the bolt circle. Properly designed O-ring seals are also acceptable.

2.3.3. Flexible pipe couplings

Coupling types

Where movement or misalignment must be allowed for, or if necessary for any other reason, rubber expansion joints may be used if approved by the Engineer. The flexible material used for rubber expansion joints shall be chosen specifically for maximum resistance to bursting.

Flexible couplings and flange adaptors may also be used if approved by the Engineer and these shall be supplied without centre register unless otherwise specified.

Flexible couplings for cast iron pipes and, where specified, for asbestos cement pipes, shall be of the cast iron short or long collar type. Flexible couplings for steel or stainless steel pipework may be of the "Victaulic" type or approved equal for grooved or shouldered end pipes.

Couplings for plastic pipes shall be of the clamp type employing buttressed pipe ends.

Pipe ends

Pipe ends shall be prepared strictly in accordance with the coupling manufacturer's recommendations. Where machining is required, as in the case of cast iron pipes, the length of machining on each pipe shall be approximately equal to the total length of the coupling to ensure that the coupling can be separated for pipe removal.

Supports and anchors

Pipework using flexible couplings shall be supported and anchored strictly in accordance with the coupling manufacturer's recommendations. Harnesses against separating forces shall be provided where appropriate to the approval of the Engineer. Where this restraint is not provided by the layout, other neat and positive means of harnessing shall be provided. A system incorporating additional flanges or lugs cast on in the case of cast iron, or welded on for steel, and connected by tie bars or positively fixed to anchors, will be accepted. Systems relying purely on friction will not be acceptable.

Corrosion protection

Cast iron couplings shall be painted. Steel couplings for gas applications shall be hot-dip galvanized. Steel couplings for fluid applications shall be coated in accordance with System - Hot Applied Thermoplastic or System - Fusion Bonded Epoxy.

Metal backing flanges for rubber expansion joints shall be of stainless steel or hot-dip galvanized steel.

Fasteners

Fasteners for Viking-Johnson type couplings shall be of grade 316 stainless steel. This includes coupling studs, stub studs (i.e. studs welded to the flanges of flange adaptors), washers and nuts.

Fasteners for other couplings shall be of stainless steel or hot-dip galvanized steel.

Underground protection

When couplings are part of a buried pipeline the couplings shall be enclosed with "Denso mastic" to a smooth finish, wrapped with "Denso tape" and then wrapped with a polythene sheet which is strapped in place. If the operating temperature is likely to exceed 70ºC the Denso paste and tape shall be replaced with suitable grease or a suitable sealer.

3. TESTING AND COMMISSIONING

3.1. Works testing

Tests on completion

Performance testing will be carried out on the equipment after commissioning and adjustment. All tests are to be witnessed by the Engineer, and contractors must give the Engineer 14 days notice prior to any test. The contractor must cover the cost of any tests that need to be repeated as a result of the equipment not being able to meet the requirements outlined below.

Checks on all equipment will be conducted for correct operation and functioning at 1 month, 5 months and 11 months after plant take-over.

4. SPARES

A list of the recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet. The list of spares is to be according to the equipment supplier's recommendations. Maintenance intervals of major and minor services are to be included.

5. MEASUREMENT AND PAYMENT

5.1. Design and supply

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The biddered rates shall include for full compensation for design, manufacture, factory testing, supply, delivery and storage on site of the unit.

5.2. Installation and commissioning

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The biddered rates shall include for full compensation for the installation, fixing of corrosion protection where needed and commissioning of the unit supplied, and for all other costs and actions that are necessary for obtaining an efficient and complete working system.

Payment will only be transferred once the engineer has received full Operation and Maintenance Manuals along with the relevant plant drawings.

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

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GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

SERIES M7: VALVES

SECTION M7001: STANDARD SPECIFICATION FOR GENERAL VALVES

TABLE OF CONTENTS

M7001: STANDARD SPECIFICATION FOR GENERAL VALVES

1. SCOPE

This section of the Contract covers the supply, delivery, offloading, transport, double handling (if required), storage, erection, installation, commissioning, testing, adjustment, handing over in complete working order and upholding during the Defects Liability Period of valves.

2. DESIGN SPECIFICATION

2.1. General

This specification covers valves required to be used on the more common applications. Where special valves are necessary for specific applications, the Bidderer must select suitable valves and provide details with his quotation submittals for approval by the Engineer.

2.2. Construction and design

Valves shall be designed and constructed to ensure reliable operation after long periods of non operation.

Valves shall be double flanged unless unavailable or otherwise specified.

Valves and their method of actuation shall be designed to provide operation under the full pressure rating of the valve.

2.3. Operating direction

The handwheel, lever, etc. on valves, valve actuators and valve gearboxes shall be clockwise closing unless otherwise specified.

2.4. Position indication

All valves, including valves with gearboxes and valves with actuators, shall be provided with indication of current position as well as indication of closing and/or opening direction. Valves with configurations which make this information apparent will be acceptable.

2.5. Corrosion protection

The specific application shall be taken into account in the corrosion protection of valves.

Cast iron valve components, including valve bodies, shall be protected with System - Fusion Bonded Epoxy.

2.6. Fasteners

Valve and valve gearbox fasteners shall be of grade 316 stainless steel.

3. MATERIALS OF CONSTRUCTION

3.1. Cast iron gate valves (Wedge Gate)

Wedge gate valves shall be used on raw water and treated water duties but shall not be used on raw sewage, raw water, effluent, sludge and general duties where some solids may be present. The valves shall comply with the following:

The valves shall comply with SANS 664 or SANS 665, Class 10 or higher as required.

The valves shall be double flanged.

Valve bodies, handwheels and bonnets shall be manufactured from spheroidal graphite iron, free from blow holes and carefully fettled after casting to remove surface imperfections. Spindles shall be manufactured from or stainless steel or equal approved material according to the duty requirements. The body shall be provided with channel guides and the gate shall be provided with shoes. Guides and shoes shall be of copper alloy or stainless steel and shall guide the gate along the complete travel distance. Spindle seals shall be of the nitrite rubber 'O' ring type with bush insert and provided with an external scraper ring. Replacement of the seals shall be possible with the valve under pressure.

Fixing lugs for end of travel limit switches shall be provided.

Valves shall have rising spindles unless otherwise specified or necessary. Non rising spindle valves shall be fitted with indicators showing the valve opening position.

Hand-wheel size and construction shall permit easy opening of the gate when subjected to a differential pressure equal to the maximum operating pressure anticipated. Suitable gearboxes shall be fitted to provide easy opening when necessary. These gearboxes shall be grease filled.

Extensions spindles shall be manufactured from 304 stainless steel. Headstocks shall be manufactured from stainless steel 304, 3CR12 steel or cast iron and to a pattern approved by the Engineer.

Valves larger than DN 150 shall be provided with bypass arrangements.

Valves larger than DN 250 shall be provided with doors for inspection and cleaning.

3.2. **Cast iron gate valves with resilient seals**

Resilient seal gate valves may be used on raw sewage, raw water, effluent and general duties where some solids may be present but must not be used on high solid applications such as sludge and grit duties.

The valves shall comply with SANS 664 or SANS 665, Class 10 or higher as required.

The valves shall be double flanged. Valves shall have rising spindles unless otherwise specified or necessary because of space restrictions. Non rising spindle valves shall be fitted with indicators showing the valve opening position.

Valve bodies, handwheels and bonnets shall be manufactured from spheroidal graphite iron, free from blow holes and carefully fettled after casting to remove surface imperfections. Spindles shall be manufactured from or stainless steel or EN57 or equal approved material according to the duty requirements. At least two spindle seals of the nitrile rubber “O” sealing rings in a corrosion resistant housing shall be provided, along with one nitrile rubber wiper ring to prevent the ingress of dirt. Replacement of the seals shall be possible with the valve under pressure.

Handwheels shall be of cast iron.

Fixing lugs for end of travel limit switches shall be provided

Handwheel size and construction shall permit easy opening of the gate when subjected to a differential pressure equal to the maximum operating pressure anticipated. Suitable gearboxes shall be fitted to provide easy opening when necessary. These gearboxes shall be grease filled.

Valves larger than DN 150 shall be provided with bypass arrangements.

3.3. **Knife gate valves**

Knife gate valves must be used on water sludges as well as on primary, waste activated and digested sludge duties. They shall also be used on other high solids application and may be used for duties specified under Clause "Cast Iron Gate Valves with Resilient Seals".

Valves shall be Insamcor HDH CI STD, or equivalent, with cast iron bodies, stainless steel blades, cast handwheels, and no carbon steel parts.

Valves for water sludges shall be anti clockwise closing. Valves for primary, waste activated and digested sludges shall be clockwise closing.

Valves shall have chamfered blade edges and resilient body seals, and may have either rising or non rising spindles. Gate position indication shall be provided if the overall design does not make this apparent. The blade shall be loaded through its central plane during opening and closing and this shall be achieved by the use of a clevis link or similar.

Blade scrapers shall be incorporated to protect the body seal and valve chest. As the valve is opened, the scrapers shall clean the blade surfaces before these contact the body seal. The scrapers shall be of a non elastomeric, non metallic material and shall be designed to cause minimal damage to the blade.

Valves shall be droptight in either flow direction. Suitable sealing shall be provided to prevent leakage from the valve and it shall be possible to adjust these seals while the valve is in line under pressure.

Internal and external surfaces of the valve body shall be protected with a water resistant, non toxic and non tainting, fusion bonded epoxy pipe coating in accordance with System Fusion Bonded Epoxy.

Valves shall be double flanged and shall suit the standard flange rating but may incorporate drilled and tapped fastener holes (the type of valve which is clamped between two flanges will be considered for acceptance only in positions where it is very likely that the pipe or flanged item on either side will never have to be removed or if isolation will not be necessary if it is removed). Fasteners may be studs or setscrews manufactured to suit the tapping depth.

3.4. **Butterfly valve**

Butterfly valves are for the use on air, gas and clean liquid duties and for the use on raw and potable water duties, shall comply with SANS 1849.

Butterfly valves shall be of the resilient seal type with suitably lined cast iron body and a lined or 316 stainless steel blade. Valve shafts and thrust pads for cast iron valves shall be of stainless steel 304 and seating rings of gun-metal or stainless steel 304, or approved synthetic material to suit the application. Valves, except where stated, shall be resilient seal type with neoprene blade seal, suitable for the working pressure. Bearing bushes are to be of 'Vesconite,' Teflon or similar approved material and gland seals of neoprene. Hand lever valve actuation with a locking system for incremental valve setting from fully shut too fully open shall be provided for valves up to and including DN 200. Valves larger than DN 200 shall be equipped with robust, weatherproof grease filled gearboxes with an indicator to show the degree of valve opening.

Valves shall be air, gas and water tight when closed.

For normal usage, the valves may be of the type which is clamped between two flanges. Where it is necessary to remove equipment on either side for maintenance purposes, suitable spacer pipes must be provided or the valves shall be flanged and provided with drilled and tapped holes.

The valves shall be installed with horizontal disc shafts.

3.5. Check valves

3.5.1. General

A shut off valve shall be installed downstream of each check valve.

The check valve installation shall ensure that flaps are able to open fully without being impeded by, for example, a shut off valve, bend or pipework internal lining. Where a check valve is located close to another valve, an intervening spool piece with a minimum flange to flange length of 1,5 times the valve diameter shall be provided.

Bronze swing type check valves may be used for pipework up to DN 50.

3.5.2. Check valves for water

Check valves for treated water and raw water duty shall be of the double flap, positive closing type.

Bodies shall be of cast iron or cast steel. Flaps shall be of the light, leaf type, shall be of bronze or stainless steel with machined sealing faces, shall be specifically designed to be non sticking, and shall have Teflon bearing washers. The gate, swing arm and hinge shall be designed to carry full shock loading on closure. Seals shall be of resilient material. The axis of rotation of the flaps shall be vertical, pins shall be of 316 stainless steel and closure shall be initiated by stainless steel springs, suitably rated for the duty so that closing is initiated prior to the onset of reverse flow. The valves shall seal effectively under all operating conditions and the design shall be such that the gate rests against the seat in the absence of flow or of differential pressure without the aid of the springs or external counterweights

Positive, external indication of the position of both plates shall be provided.

3.5.3. Swing check valves

Swing check valves shall be used on all sewage, sludge or similar applications. Valves for use with sewage, effluent or sludge shall be self cleansing at the base of the gate.

Swing check valves shall be flanged, shall be of all iron construction suitable for a working pressure of at least 1 000 KPa, and shall be fitted with a side lever and adjustable weight. External levers and counterweights shall be fitted to the hinge shaft which shall be extended through the valve body and provided with nitrile rubber 'O' ring seals which may be replaced with the valve under pressure. The level and counterweight shall be provided with facilities for adjusting the angle and weight positions.

Orientation of the valve installation shall comply with the manufacturer's recommendation.

3.6. Pinch Valves

Pinch valve sleeves shall be manufactured form high strength synthetic fiber or steel cord reinforcement. The sleeve liner is to be natural rubber. The sleeves are to be tested to twice their maximum working pressure and supplied with a test certificate. The closing mechanism is to be design for ease of operation under pressure. The valve is to be supplied with an indicator for open/close indication. Where called for, pinch valves may be used as control valves with either electro-mechanical, pneumatic or hydraulic operation.

3.7. Bronze Isolating valves

May be used for isolating duties on clean air and liquid duties up to DN 50.

Bronze gate valves shall be to SANS 77 Ball or plug valves of appropriate construction may also be used where preferred.

3.8. Rubber Diaphragm valves

To be used on sludge and other dirty or corrosive liquid duties requiring valves up to DN 350. May also be used on clean liquid duties.

Rubber diaphragm valves shall preferably be of the straight through type with the diaphragm made of natural rubber.

This type of valve shall not be used on the suction side of pumps or on any line subject to vacuum.

3.9. Needle valves (above DN 150)

Needle valves shall be used for the regulation of flow and/or pressure in pipelines containing water where the size is DN 150 or greater unless this is overridden by the requirements of the Detailed Specification. The configuration shall be double flanged with co axial flanges unless otherwise specified.

The seal seat and associated downstream parts shall be selected to prevent any cavitation for the application. Such parts shall be of stainless steel or copper based alloy.

3.10. Air valves

Air valves for water shall be of the non slamming type, Vent O Mat, ARI or equivalent.

Air valves for sewage and similar duties shall be specifically designed for the application.

Air valves shall be installed above pockets designed to collect air. The pockets shall be designed in accordance with the requirements for nozzles in pipe-work. The diameter of the nozzle shall be at least half the diameter of the parent pipe work.

Air valves shall preferably be flanged and shall be provided with isolating cocks.

3.11. Corrosion Protection

Corrosion protection shall be carried out strictly in accordance with the standard specification for general corrosion protection. All valves unless otherwise specified are to conform to system – fusion bonded epoxy.

4. TESTING AND COMMISSIONING

4.1. Tests on completion

Performance testing will be carried out on the equipment after commissioning and adjustment. All tests are to be witnessed by the Engineer, and contractors must give the Engineer 14 days notice prior to any test. The contractor must cover the cost of any tests that need to be repeated as a result of the equipment not being able to meet the requirements outlined below.

The tests will be performed on the equipment over a single 8 hour shift. They shall consist of the following:

1. Smooth and efficient operation of the valves.

2. Appropriate closing direction of the valves according to the above specification.

3. The torque doesn't exceed the torque stated in the data sheets.

The equipment will be considered acceptable when:

1. The equipment meets the duty requirements as defined in this section of the Specification and stated in the data sheets.

During the Defects Liability Period

Checks on all equipment will be conducted for correct operation and functioning at 1 month, 6 months and 12 months after plant take-over.

5. SPARES

A list of the recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet. The list of spares is to be according to the equipment supplier's recommendations. Maintenance intervals of major and minor services are to be included.

6. MEASUREMENT AND PAYMENT

6.1. Design and supply

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The biddered rates shall include for full compensation for design, manufacture, factory testing, supply, delivery and storage on site of the unit.

6.2. Installation and commissioning

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The biddered rates shall include for full compensation for the installation, fixing of corrosion protection where needed and commissioning of the unit supplied, and for all other costs and actions that are necessary for obtaining an efficient and complete working system.

Payment will only be transferred once the engineer has received full Operation and Maintenance Manuals along with the relevant plant drawings.

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

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GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

SERIES M7 VALVES

SECTION M7003: STANDARD SPECIFICATION FOR VALVE ACTUATORS

TABLE OF CONTENTS

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

M7003: STANDARD SPECIFICATION FOR VALVE ACTUATORS

1. SCOPE

This section of the Contract covers the supply, delivery, offloading, transport, double handling (if required), storage, erection, installation, commissioning, testing, adjustment, handing over in complete working order and upholding during the Defects Liability Period of valve actuators.

2. DESIGN SPECIFICATION

2.1. General

Actuators shall be capable of transmitting sufficient torque or load to the shaft of the valve to unseat at the maximum working pressure for which the valve is rated and to operated the valve from the fully open to fully closed state within a reasonable. The speed of operation shall be such as to avoid any possibility of water hammer in pipelines.

3. MATERIALS OF CONSTRUCTION

3.1. Electric actuators

3.1.1. Actuator enclosure

Actuators should be protected to IP67 in accordance with IEC 144. All joints shall be O-ring protected.

3.1.2. Gearing

All torque transmitting housing parts should be out of cast iron. Aluminium die cast is only allowed for covers. The gearing should be totally enclosed and grease-lubricated. Lubricant must be PCE and PCT fee. All cover screws which must be opened for commissioning or setting must be captive so that they cannot be lost.

3.1.3. Performance

The actuator gearing must be self-locking so that the actuator stays in its last position. The self-locking feature must stay active if the actuator is changed into handwheel mode. The actuator must be able to be fitted in all mounting orientations.

3.1.4. Motors

The motors shall be 3-phase squirrel cage motors, specially designed for valve application providing high torque and low inertia. The motors should be totally enclosed, housing being one casting, non-ventilated, the insulating class should be F. Motors should be thermally protected by 3 thermostats, embedded in the motor windings, one for each phase. The motors should be time rated 5215 min to IEC 34 at nominal motor load and at least 33% of maximum valve torque for 15 min. The motor wiring should be connected to the main actuator housing by a plug and socket for easy removal.

3.1.5. Handwheel

A geared side-mounted handwheel of suitable size shall be provided for safe and efficient manual operation. The manual control shall be independent of motor drive. The changeover from motor operation to handwheel operation shall be accomplished by a declutching device which must be without load during the change into the handwheel mode. The changing from handwheel operation into motor operation shall be automatic. The force of the handwheel shall be in accordance with DIN 3210 Sheet 2.

3.1.6. Torque switches

The actuators shall incorporate two, from each other independent, settable torque switches.

3.1.7. Limit switches

The actuators shall be supplied with one limit switch for open end position and one limit switch for close end positions. The limit switches shall be directly geared to the output shaft of the actuator without any slipping clutch device. The limit switches must function independently of the torque switches. Overtravel of the setpoint, e.g. by hand operation, shall not change the set position. Adding additional switches - for intermediate or end position - must be possible without opening the lubricated main gear case.

3.1.8. Switches

Switches must be incapsulated to IP66 to IEC 144, as a separate part to protect them against getting wet during setting work on the actuators and allow setting while power is on. They should be rated at 5 Amps at 250 V AD. Switches got to be bouncefree. A minimum load of 20 mA at 24 V DC must be operated by a standard switch.

3.1.9. Position indicator

Actuators shall be fitted with an indicator showing valve or penstock opening position. The scale of the position indicator shall be marked open and close and show the actual degree of opening in mid-position of the valves. The installation of a feedback potentiometer or an electronic current feedback must be possible. They must be driven by a gearing selected in a way that at least 83% of the possible travel is used. The feedback drive must be fully assembled by the actuator manufacturer.

3.1.10. Heaters

Actuators shall have the possibility to incorporate a self-regulated anti-condensation heater of 015 W rating which shall be energised from the internal control transformer.

3.1.11. Output drive

Output drives should be in accordance to ISO 5210. In case of drive form A to ISO 5210 they should be separate from the main actuator housing in order to remove the complete actuator from the valve, while the valve stem is kept in position by the output drive of the actuator.

3.1.12. Control

The controls should be a part of the actuator design, suitably housed to prevent breathing and condensation build-up. All connections between the actuator and the control housing should be made by one plug and socket connection for easy removal of the complete control.

3.1.13. Contactors

The reversing contactors should be electrically and mechanically interlocked, rated appropriate to the motor size and suitable for 60 starts per hour.

3.1.14. Local control

As part of each control should be a local control station with a selector switch for local, off and remote, padlockable in any of these positions. Additional local switches for open, stop and close operations must be available.

3.1.15. Control signals

In remote control mode the actuator shall be controlled by open, close and stop contacts in the control panel. The contacts for this control in the control panel are voltage-free and are energised from the actuator. The inputs of these signals must be separated from the control by optocopplers in the actuator.

3.1.16. Indicating signals

The actuator shall provide for remote indication the following signals by voltagefree contacts rated at 250 V 1 Amp.

- open end position
- close end position
- LOCAL/OFF/REMOTE switch in Local
- LOCAL./OFF/REMOTE switch in Remote
- Collective fault signal containing power failure, wrong phasing, motor thermostat tripped, control voltage failure and torque switch operation in intermediate position of the valve.

Within the control LED's should be provided for indicating of torque switch operation in intermediate position of the valve or any electrical malfunction.

3.1.17. Programming

Within the control it should be possible to program the function of the end position switching i.e. torque switch or limit switch dependent. It must also be programmable for both opening and closing direction independent of each other whether the actuator runs after getting a control signal by self-retaining contacts into the end position or runs only as long the control signal is coming.

3.1.18. Internal wiring

All internal connections within the integral control and between the different boards should be made by plug and socket connections except for motorpower cables. All plug and sockets should have different sizes so that they cannot be mixed up.

3.1.19. External wiring connection

The external wiring connection should be done by one plug and socket for all control and motor wires. All terminations shall be clearly marked. Provisions should be made for three cable entries, one for the motor cable, one for the control cable and one for possible feedback signals.

3.2. **Pneumatic actuators**

Pneumatic actuators shall be diaphragm or piston operated single or double acting direct or yoke operated units as required in the Detailed Specification and designed to operate on wet air with traces of oil. Where stated in the Detailed Specification, a spring return shall be provided for closure under normal operation and in the event of air supply failure. Similarly hand operation using a handwheel shall be provided where specified to permit operation when the air supply has failed. The valves shall operate incrementally and maintain the position selected under all conditions and shall accommodate the maximum unseating torque or load of the valve plus provision for 100% overload. All components of the actuators shall be manufactured from robust non-corrodible materials. Pistons and tie rods shall be manufactured from stainless steel 304/316. Pistons shall be manufactured from acetyl resin and be provided with nitrile rubber seals. Actuator bodies/barrels shall be manufactured from anodized aluminium or epoxy powder coated carbon steel. Air supply lines to each actuator shall be fitted with isolating valves, strainers, automatic condensate traps and flushing connections.

Solenoid, spool, poppet, pilot and other control valves shall be constructed from die cast aluminium glass filled polyamide or similar robust material with non-corrodible internal components, encapsulated coils and IP65 electrical enclosures where applicable.

3.3. Hydraulic actuators

Hydraulic actuators shall be of the rotary or direct action piston type suitable for the mode of operation of the valve. In the event of failure of the actuator or hydraulic power pack the valve shall return to the closed position. Manual operation shall be provided as for the electric actuator above. All components shall be suitable for continuous operation under corrosive exposed conditions. Liners and other components in contact with the hydraulic fluid shall be hard chrome or other similar material suitable for the environment. The hydraulic pump and power pack shall be adequately rated for the specified altitude and temperature, and shall be designed to accommodate the maximum unseating torque or load of the valve plus 50%. Where actuators are required for positioning they shall be provided with robust hydraulic valves and components which will permit smooth operation and controlled location throughout the operating range.

4. TESTING AND COMMISSIONING

4.1. Tests on completion

Performance testing will be carried out on the equipment after commissioning and adjustment. All tests are to be witnessed by the Engineer, and contractors must give the Engineer 14 days notice prior to any test. The contractor must cover the cost of any tests that need to be repeated as a result of the equipment not being able to meet the requirements outlined below.

The tests will be performed on the equipment over a single 8 hour shift. They shall consist of the following:

1. Smooth and efficient operation of the actuators.

2. Measurement of absorbed power using a calibrated kW/hour meter and calculation of efficiency of each actuator.

The equipment will be considered acceptable when:

1. The equipment meets the duty requirements as defined in this section of the Specification.

2. The tests defined above prove the acceptable operation of the equipment.

3. Where a power test is required, the power absorbed by each motor at duty point does not exceed the values stated in the Technical Data Sheets.

During the Defects Liability Period

Checks on all equipment will be conducted for correct operation and functioning at 1 month, 6 months and 12 months after plant take-over.

5. SPARES

A list of the recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet. The list of spares is to be according to the equipment supplier's recommendations. Maintenance intervals of major and minor services are to be included.

6. MEASUREMENT AND PAYMENT

6.1. Design and supply

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The biddered rates shall include for full compensation for design, manufacture, factory testing, supply, delivery and storage on site of the unit.

6.2. Installation and commissioning

The unit of measurement shall be for the unit supplied including all ancillary equipment and accessories as specified.

The biddered rates shall include for full compensation for the installation, fixing of corrosion protection where needed and commissioning of the unit supplied, and for all other costs and actions that are necessary for obtaining an efficient and complete working system.

Payment will only be transferred once the engineer has received full Operation and Maintenance Manuals along with the relevant plant drawings.

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GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

PART D: PARTICULAR SPECIFICATION FOR HYDRAULICALLY OPERATED DIAPHRAGM-ACTUATED CONTROL VALVES (PVN)

All equipment is to be supplied as per the data provided in the data sheets and general mechanical specification. The information below is specific and shall supersede the general specification.

TABLE OF CONTENTS

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

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GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS

1. SCOPE

This specification covers the selection, design, manufacturing supply, delivery, installation, testing, and commissioning of the hydraulically operated diaphragm-operated control valves that are required for the regulation of flow and/or pressure for use in water and wastewater installations.

The main valve is to be controlled by a pilot that compares its spring setting (set-point) to the process variable (i.e. pressure, flow, and/or level). As the process variable changes, the pilot must sense the change and compensate to keep the process variable as close to the desired set-point as possible. The valves are therefore single set-point control valves, and a set-point change will require an operator to change the spring setting of the pilot.

If control valves with hydraulic control systems require shut-off, a solenoid to isolate the pilot from the process can, depending on the availability of electric power, be employed to act as an override

2. INTERPRETATIONS

2.1. Supporting Specifications

The following forms part of this specification:

SANS 1808-31: 2010 - Water Supply and Distribution System Components - Part 31: Automatic Control Valves

2.2. Abbreviations

DN Nominal Diameter

PN Nominal Pressure - pressure rating

3. MATERIALS, WORKMANSHIP AND CONSTRUCTION

3.1. General

The types, sizes, end connections, pressure ranges and other functional details of the control valves required are tabulated below. Technical Data Sheets are included in the Returnable Schedules section of the quotation document to enable biddersers to provide specific details of their products being offered.

a) Each control valve and all other parts of the control valve assembly such as pilot valves, linkages, brackets, indicators, and all other components and everything necessary for the proper functioning of the control valve assembly shall be supplied and installed by the Contractor in accordance with the valve supplier's recommendations and instructions and checked by a representative of the supplier after installation.

b) Each control valve assembly shall then be commissioned and tested by the Contractor by using it to perform all of its automatic functions, as described below, in the presence of the Engineer and a representative of the firm which supplied the control valve to the Contractor.

c) After satisfactory testing and commissioning of each installation, the control valve assembly shall be demonstrated and explained to a representative of the Employer, attending on the Site for this purpose, who is to be handed triplicate copies of the Manufacturer's drawings and operating instructions prepared by the supplier of the control valve assembly.

d) Each control valve assembly shall operate in the system indicated on the drawings and amplified by certain data set out below.

e) The rates of opening and closing shall be slow enough to ensure that water hammer and surge pressures caused by the operation of the control valve do not cause the pressure at the inlet to the control valve to rise more than 100 kPa above the maximum static (zero flow) head.

f) An automatic pilot valve or other proven control device of positive operation shall be supplied and installed as part of the control valve assembly to restrict the rates of opening and closing and the said control devices shall permit in–situ adjustment of the maximum pressure rise on closing to 100 kPa above the maximum static (zero flow) head.

g) The control valve assembly shall operate automatically and smoothly without attendance under all normal operating conditions which shall include fluctuations in the rate of flow between zero and twice maximum inflow rate and fluctuations in the pressure at the inlet to the control valve between zero and maximum static plus 100 kPa. It shall neither cavitate nor vibrate unduly, nor shall it be noisy in operation.

h) The control valve shall be manufactured generally in accordance with SANS 1808-31 for automatic control valves and all components of the entire assemblies shall be made of specially selected corrosion resistant materials capable of withstanding the corrosive atmosphere which will exist in the valve chamber.

i) The control valve shall be fitted with an indicator to give visual indication of the position of the main diaphragm (i.e. to indicate the degree of the opening or closing of the valve).

j) Approved strainers that can easily be cleaned, shall be supplied and installed on all pilot piping to protect the small ports from becoming clogged with grit.

k) The bidderer shall include with his/her quotation, copies of the Manufacturer's illustrations and Quantity vs Head Loss curves for ¼, ½ and fully open valve and a letter from the intended supplier giving a full description of the control valve assembly prepared with reference to this Specification.

l) After acceptance of his quotation, the Contractor shall obtain, from the valve supplier, fully dimensioned drawings of the whole control valve assembly in triplicate, together with illustrations and the curves referred to above and submit them to the Engineer.

3.2. Local Content

The Department of Trade and Industry has, in terms of Regulation 9 (2) of the Procurement Regulations 2011, stipulated the "minimum threshold for valves products and actuators for local production and content" the details of which are set out in the National Treasury instruction that became effective from 3 March 2014. These requirements must be complied with.

3.3. Quality Verification

The valve manufacturer shall have in place, and shall fully comply with, a certified SANS 9001 integrated quality system that is applicable to the whole valve design, manufacturing, testing and coating processes.

3.4. Corrosion Protection

The interior and exterior surfaces of the control valve shall be coated with an approved epoxy compound as specified in Clause PVH 3.4 in Particular Specification PVH - Wedge Gate, Resilient Seal, Check (Reflux), Butterfly, and Air Valves.

4. VALVES

With reference to Annex A to SANS 1808-31: 2010 - Water Supply and Distribution System Components - Part 31: Automatic Control Valves.

a) The pressure rating of the valves are shown in the Table below.
b) All valves shall be coated and lined as specified in 3.4.
c) The type of coatings are as specified in 3.4.
d) The valve trim shall be stainless steel.

Details of the valves required are given in Table below.

5. ACTUATING MECHANISM REQUIREMENTS

5.1. Pressure Reducing

Pressure reducing valves shall:

Maintain the downstream pressure to a preset value.

5.2. Level Control

Level control valves shall control the filling and emptying of the water tower.

6. SYSTEM CONDITIONS AND CONTROL VALVE REQUIREMENTS

Descriptive data pertaining to the system in which the control valve assembly is to operate and the functions that the valve is to perform are given below:

6.1. Pressure Reducing Valve

A DN 250 PRV is to be installed on the DN 250 pipeline in the chamber shown on Sketch SK20160429 and so arranged as to ensure that the pressure downstream of the control valve cannot rise above RL 225.2 m MSL (2209.2 kPa).

Item	PRV in the valve chamber, Thembalethu
Nominal diameter of valve	DN 250
Flange drilling	SANS 1123 Table 16
Centreline of valve	205.2 m MSL
Maximum static head at inlet to closed control valve	227.7 m MSL
Maximum surge pressure that could occur in incoming pipeline due to abnormal system operating conditions that are not related to the control valve	295.0 m MSL
Maximum operating pressure at inlet to control valve	89.8 m
Pressure rating of control valve	PN 16
Factory test pressure of control valve	3200
Maximum operating flow rate required through the valve	To be confirmed
Minimum head at inlet to control valve with zero flow through the valve due to system operating conditions	To be confirmed
Minimum head at inlet to control valve with maximum flow passing through the control valve	To be confirmed
Maximum allowable head loss through valve at	To be confirmed

maximum flow rate	
Maximum head to be maintained downstream of the control valve	225.0 m MSL

6.2. **Flow Control Valve**

The valve shall be capable of controlling the flow into the water tower and preventing it from overflowing and to refill the tower as soon as possible after each occasion on which draw off from the water tower causes the water level to drop approximately 0,1 m below top pump operational water level.

The control valve shall not close until the water level has risen to within 50 mm of the tower top pump operational water level and it shall be drop-tight when closed.

Item	ACV in the valve chamber, Thembalethu
Nominal diameter of valve	DN 150
Flange drilling	SANS 1123 Table 16
Centreline of valve	204.875 m MSL
Maximum static head at inlet to closed control valve	227.7 m MSL
Maximum surge pressure that could occur in incoming pipeline due to abnormal system operating conditions that are not related to the control valve	295.0 m MSL
Maximum operating pressure at inlet to control valve	90.125 m
Pressure rating of control valve	PN 16
Factory test pressure of control valve	3200 kPa
Maximum operating flow rate required through the valve	To be confirmed
Minimum head at inlet to control valve with zero flow through the valve due to system operating conditions	To be confirmed
Minimum head at inlet to control valve with maximum flow passing through the control valve	To be confirmed
Maximum allowable head loss through valve at maximum flow rate	To be confirmed
Pump on at TWL	225.4 m MSL
Pump off at TWL	226.1 m MSL
Valve to close at TWL	226.05 m MSL
Valve to open when pump operational water level drops by 100 mm below TWL	225.3 m MSL

Item	ACV in the valve chamber, Pacaltsdorp
Nominal diameter of valve	DN 200
Flange drilling	SANS 1123 Table 16
Centreline of valve	202.6 m MSL
Maximum static head at inlet to closed control valve	231.5 m MS
Maximum surge pressure that could occur in incoming pipeline due to abnormal system operating conditions that are not related to the control valve	295.0 m MSL
Maximum operating pressure at inlet to control valve	92.4 m
Pressure rating of control valve	PN 16
Factory test pressure of control valve	3200 kPa
Maximum operating flow rate required through the valve	109 l/s
Minimum head at inlet to control valve with zero flow through the valve due to system operating conditions	To be confirmed
Minimum head at inlet to control valve with 109 l/s passing through the control valve	To be confirmed
Maximum allowable head loss through valve at 109 l/s flow rate	To be confirmed
Pump on at TWL	228.2 m MSL
Pump off at TWL	230.4 m MSL
Valve to close at TWL	230.35 m MSL
Valve to open when pump operational water level drops by 100 mm below TWL	228.1 m MSL

7. MEASUREMENT & PAYMENT

The prices biddered for supplying and installing the control valve assemblies shall cover all expenditure and everything necessary to be carried out by the manufacturer and supplier and Contractor in order to comply with the requirements of this specification, including attendance on site by a representative of the supplier for checking, testing and demonstrating correct operation all in accordance with the specification, and upholding insofar as supply of replacements for defective parts is concerned.

GEORGE MUNICIPALITY

QUOTATION NO. T/ING/016/2016

THE SUPPLY OF THE CONTROL VALVES FOR THE PACALTSDORP AND THEMBALETHU WATER TOWERS