

PART 1

DBSA

HEUWELLANDS PRIMARY SCHOOL

FIRE PROTECTION SPECIFICATION

TECHNICAL SPECIFICATION

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PART 1

DBSA **HUEWELLANDS PRIMARY SCHOOL**

FIRE PROTECTION SPECIFICATION

GENERAL & TECHNICAL SPECIFICATION

NOTICE TO TENDERERS AND CONTRACTORS

This installation is to comply fully in all respects with SANS 0287 together with the requirements of the "Rules for Automatic Installation", 10th Edition.

In the case of conflict, SANS 0287 shall take precedence.

Even if not shown on the drawings or specifically mentioned in the specification, all equipment and appurtenances required by SANS 0287 and/or the 10th Edition (ASIB) are to be allowed for in the tender offer and installed accordingly.

1. GENERAL

The work shall be carried out strictly in accordance with:

1. The Occupational Health and Safety Act, Act 85/1993
2. All relevant Regulations and Bylaws of the Municipal Council and Fire Department concerned
3. SANS 0287- Edition 1,2000. Automatic Sprinkler Installations for Fire Fighting Purposes

Where no Building, Municipal, Health or Fire Department Act, Regulation, Bylaw or other requirement exist, nor any SANS standard or detailed requirement by the Engineers then the Contractor's terms of reference shall always be the current edition of the Sprinkler Rules as issued by the automatic Sprinkler Inspection Bureau.

All tests shall be to the satisfaction of the Consulting Engineer or his representative who shall have the right to inspect the installation at all reasonable hours during the progress of the works.

2. THE PROJECT

The project shall consist of the supply installation, testing, commissioning and 12 months guarantee (with free maintenance during the guarantee period) of Heuwellands Primary School: Fire installation.

The fire design shall include the installation of SABS approved following firefighting equipment;

- 4.5 kg DCP fire extinguishers on backing boards as required in Part TT 37 of SABS 10400
- 4.5kg CO2 fire extinguishers on backing boards as required in Part TT 37 of SABS 10400
- Fire hose reels
- Fire hydrants
- Fire storage tanks
- Fire pumping systems

- Fire blankets

The installation of SABS approved fire equipment and fire escape signage. Provision must be made for frames for signage for certain areas as directed and such signage frames shall be approved by the architect.

2.2 **Miscellaneous**

The fire subcontractor shall;

Supply 3 sets of as-build drawings and operating and maintenance manuals upon completion of contract, complete with CAD drawings on compact disk

Provide 12 months maintenance with guarantee

Attend site meetings as required

Carry out all required hydraulic calculations and provide an installation totally in compliance with the ASIB and SANS 0287 requirements and to the complete satisfaction of ASIB.

The Contractor is responsible for painting all piping under his contract and the final coat to be applied one-week handover.

3. **GUARANTEED PERFORMANCE**

The system and individual items of the system shall be guaranteed by the Contractor to operate efficiently.

It is the Contractor's responsibility to establish, to the Engineer's satisfaction, that the installation performs as specified.

If at any time during the tender period or course of the contract the Contractor has any doubt about the specified installation he must check and if necessary contact the Engineers in order to satisfy himself.

Hydraulic calculations for all pipe work must be checked by the Contractor from his shop drawings and any variations to pipe work during installation of the system must be allowed for and the necessary compensations provided.

4. **CO-ORDINATION**

The Contractor shall be responsible for the co-ordination of his own work, and is to be mindful of co-ordination with all other services as regards both physical clashes and installation programme.

5. **EMPLOYER TRAINING**

A representative of the Contractor shall be available to instruct the proprietor's building maintenance staff (or his appointed representative) in the operation of his system, and to ensure that such persons are fully conversant with the control and operation of the system.

This instruction exercise is to take place prior to the system being left operational. The Engineers are to be informed in writing as to when this instruction period is scheduled to commence. On the completion of this exercise the contractor is to obtain the Proprietor's

representative's formal acceptance of this hand-over tuition, thus acknowledging his complete understanding of the operation procedure for this installation.

6. AS-BUILT DRAWINGS

The contractor is responsible for the production of as-built drawings, and for the issue of one plastic copy of each drawing to the Proprietor's maintenance engineer. A further 3 paper print copies are required, these forming an integral part of his Maintenance Manuals.

These drawings are to illustrate any changes in the pipe routes and sprinkler heads. The as-built drawings are to include for control valve diagrams, block diagrams, and the piping layouts.

7. OPERATING AND MAINTENANCE MANUALS

7.1 GENERAL

Operating and Maintenance (O&M) manuals shall be prepared in accordance with the following guidelines. Changes to format may be required but these will be timeously advised by the Engineer.

The Contractor shall prepare a draft copy of the O&M manual and submit to the Engineer at least two month prior to the commencement of dry-commissioning. The Engineer shall solicit comments from Umgeni Water on the draft copy and furnish the Contractor with these comments within 30 days of receipt of the draft. The contractor shall then incorporate all comments and complete the O&M manuals as specified.

Provision of all five (5) sets of O&M manuals as specified is inter alia a pre-requisite for Practical Completion of the Works and Retention Monies will not be released until they are in hand.

7.2 PREPARATION OF THE MANUAL

The manuals shall be prepared within the contract, and shall be particular to the project. All charges that may be required by manufacturer's suppliers for the provision of information and literature shall be included in the contract price and the entire cost of producing and providing the O & M manuals shall be to the Contractors' account.

The manual shall be arranged with an index and referencing system. A matching flysheet will give the names and addresses of the principals involved on the project.

The covers shall be hard bound with a four-post loose-leaf system. The contract details shall be embossed on the front cover. Numbered card dividers shall be inserted between the sections.

The completed set of manuals shall be provided to the Engineers at practical completion.

7.2.1 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

The format of the manual shall be in accordance with the following sections, after a preface and index.

Section 1:

This shall comprise the introduction, abbreviations, and any warnings that may be required by the Machinery and Occupational Safety Act, Local Authorities and other such bodies.

Section 2:

A full description of each system, together with the main plant components and locations, plus the mode of operation of automatic control systems associated with such system shall be reflected in this section.

Section 3

This shall comprise the complete plant technical data of each item of equipment (e.g. manufacturers name and address, type and size of unit, serial number, bearing pulley and belt details, motor details, unit performance and duty details). This information shall be derived from a site inspection of identification plates together with information obtained from manufacturers.

Section 4:

This section shall describe in detail the operating procedures necessary for starting up, running and shutting down each individual system. This shall include the control panel starter and selection facilities together with any alarm and safety interlocks as identified on the control panels.

Section 5:

This shall comprise the maintenance operations on a daily, weekly, monthly etc basis for each item of plant. The preparation of this section shall be carried out by obtaining from the manufacturer his advice and recommendations for lubrication, adjustment and routine maintenance.

Section 6:

This section shall comprise the emergency procedures to be adopted by personnel engaged on the operation and maintenance of the mechanical and electrical services, with respect to fire, first aid, general failures to water and electrical systems, gas lines, chiller refrigerant pipework, and call-out procedures for maintenance personnel in working hours and out of working hours.

Section 7:

A recommended action on plant malfunction shall be detailed in this section. This is to assist both the user and maintenance engineer in the event of a fault developing in a system by indicating the nature of the fault and the recommended action.

Section 8:

This shall comprise a list of recommended spares and lubricants. The preparation of this section shall be carried out by obtaining the manufacturers recommendations and also incorporate the Clients requirements regarding spares.

Section 9:

A schedule of the record or as-built drawings together with reduced copies (A4 size) of the record drawings will be inserted in numerical order in this section.

Section 10:

This section shall comprise test certificates and commissioning reports. It shall also contain copies of fan and pump curves with the duty points clearly indicated.

Section 11:

This shall comprise the manufacturers' literature, arranged in alphabetical order to match the manufacturers list. It shall also give the manufacturers (or their local representatives) names, addresses and telephone numbers

8. **MAINTENANCE**

The Contractor shall be responsible for maintaining the installation during the initial 12 months of operating of the plant. Unless otherwise specified this shall require service visits not less than 3 months apart. The costs of the initial 12 months maintenance shall be built into the contract price, but will exclude the costs of expendables.

He shall service all the equipment supplied by him and as is normally carried out under a comprehensive maintenance contract as required by the current edition of the ASIB rules.

The Contractor is to negotiate and formalise a Maintenance Contract Agreement at least 3 months prior to the expiry of the free maintenance period

8.1 **Maintenance Contract**

Immediately following the service at the middle of the guarantee period, the Contractor is to submit a draft Maintenance Contract Agreement to the client, through the Engineers, in order that a maintenance contract (between Client and Contractor) can be formalised well in advance of the expiry date of the guarantee period. This draft agreement is to fully detail the work intended to be carried out under this contract.

9. **TESTING**

9.1 **TESTS TO BE PERFORMED**

- (a) *All pumping equipment shall be subject to the commissioning tests as described in Additional Specification SC: General Decommissioning, Testing and Commissioning.*
- (b) *At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow rate or volumetric flow testing facilities will be supplied by others, unless otherwise specified in the detail specification.*
- (c) *The operating point of each pump shall be determined.*
- (d) *Efficiency tests will only be performed when specified in the detail specification.*

NPSH tests will only be performed when specified in the detail specification.

9.2 PUMP OPERATING POINT

During the day 1 commissioning tests the pump operating point shall be determined by observing the following:

- (a) Pump delivery and suction pressures, and
- (b) Electric motor power consumption.

If no efficiency tests are required in the detail specification then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

9.3 FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS

- (a) *Testing will be done in accordance with BS 5316 Part 1, class C tests.*
- (b) *Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.*

9.4 TEST CONDITIONS

- (a) *All tests will be performed in situ.*
- (b) *The pumped medium or liquid specified as the process liquid in the detail specifications shall be utilised during the tests. The Contractor shall obtain from the pump manufacturer the test point for clean water corresponding to the specified duty point for the pumped liquid, in order to relate the measured performance to the pump supplier's curves which are based on water.*

9.5 ADDITIONAL TESTS

Additional tests may be specified in the detail specification.

10. COMMISSIONING PROGRAMME

The fire protection contractor shall adhere to the Principal Contractor's building programme for the installation. He shall be responsible for negotiating with the Principal Contractor for this programme to be drawn up or adjusted to allow for sufficient time for the installation and testing of the fire systems to ensure that his commissioning programme meets the following requirements:

Scheduled Contract Completion Date:

Beneficial occupation:

11. NON PRODUCTION OF AUXILIARY ITEMS OF THE INSTALLATION

The specification calls for the Contractor to furnish certain auxiliary items as part of his overall installation. Examples of such items are:

-The Operating and Maintenance Manuals.

-The Production of as-built drawings, including computer discs.

-The Production, framing and fixing of switchboard diagrams, piping schematics, simplified operating instructions etc.

-The instruction of the Employer's staff in the operation and routine maintenance of the works.

Should the Contractor fail to meet these requirements, monies will be withheld against the specific items at a value estimated by the Consulting Engineer. This estimate will be based on what it could cost the Engineer to undertake the task on behalf of the Contractor.

12. **PAINTING AND PLANT IDENTIFICATION**

The contractor shall be responsible for the painting and colour coding (all the details as specified under Part 5) of:

All brackets and fixings prior to erection

All metalwork which is not otherwise protected against rust

All piping (exposed and concealed within ceiling voids)

All items of equipment shall be identified by labels or painted inscription, and such identification be compatible with the corresponding identification on the mounted zone demarcation diagrams, drawings and labels on the switchboard.

13. **LABELING**

13.1. **Valve Identification**

In instances where the sprinkler control valve room contains banks of valves, which serve different protected zones, each such zone shall be clearly identified by a label. The label is to be fixed in the vicinity of the valve. The label shall be of white traffolyte or equivalent material, with engraved letters. The letters shall not be less than 20mm in height.

The labels are to be rigidly fixed to the wall or to a framework fitted to the piping with chrome-plated screws or escutcheon pins. The use of adhesive tape will not be permitted.

Each alarm valve of a multiple valve installation shall also have a number indicated thereon. The corresponding alarm bell must bear the same number in bold figures.

13. 2. **Location Plate**

A location plate must be fixed on the outside of an external wall as near to the main stop valve as possible. It shall read;

STOP VALVE

INSIDE

All as detailed in clause 4312.3 of the Rules.

14. **BLOCK PLAN**

The block plan should be in black engraved letters on white perspex or stainless metal plate such as aluminium or stainless steel.

The block plan shall indicate only the buildings protected by the systems, which are served by the control valve or valves in the particular valve room. Should a building be served by valves from more than one valve room the block plan shall be provided in each valve room.

These block plans give a clear indication of the position of the particular valve room.

15. **FRAMED INSTRUCTIONS**

A diagrammatic instruction chart clearly indicating the procedure for operating the sprinkler valves, shall be mounted in a strong teak or approved metal frame with perspex front. This is to be fixed inside the valve room. The minimum design pressure of the system shall be clearly indicated on the chart.

16. **STANDARDISATION OF EQUIPMENT**

Equipment shall be made by one manufacturer when practicable. The Contractor shall not use items of different manufacture or type to perform the same function in different parts of the installation.

17. **VALUE ADDED TAX**

Allowance must be made for the Value Added Tax at the rate applicable at the date of tender for all items reflected in the Price Schedule.

18. **CONFLICT BETWEEN SPECIFICATIONS AND DRAWINGS**

Should the contractor note an inconsistency between the Specification and drawings he shall be responsible for notifying the Engineer and obtaining clarification or instructions prior to ordering or installing equipment.

19. **DEFINITIONS**

Supply	:	To purchase or procure and deliver complete with all necessary and additional specified accessories
Erect	:	to place or mount and fix in position
Install	:	to erect, connect up and commission, complete with related accessories
Indicated, Shown, Noted	:	As indicate or shown on drawings
Or Equal Approved	:	Equal or better in efficiency or performance and Compatibility with installation

20. **INSPECTION OF THE WORKS**

The Tenderer shall take every opportunity to familiarize himself with the existing conditions, tie in points etc, and how they will affect the proposed building works. No extra payment will be allowed for any conditions, which may arise due to the Tenderers lack of knowledge of conditions

21. **CO-ORDINATION WITH OTHER SERVICES**

Careful co-ordination of the Fixed Fire Systems with other services is required. Tenderers must make allowance for adjustments to be made on site to avoid clashes with other services, as no extra payment will be allowed for this.

22. **DESIGN OF LAYOUTS**

Tenderers shall submit workshop drawings to the Client or his agent for approval before commencement of the works. No extra payment will be made for any drawing or redrawing by the successful tenderer. Allowance must be made for this in the tender price.

23. **PRICING OF THE WORKS**

Rates in the Tender Price Schedule shall be fully inclusive of all Preliminary & General items, design work, drawings, fabrication, piping, fittings, hangers, galvanizing, painting and accessories. Adjustments to the Tender Price will only be made for additional elements listed in the Tender Price Schedule at the tendered rates. No re-measurement of piping or fittings will be allowed. No variation orders shall be permitted for changes to piping or fittings due to adjustment of head positions, or co-ordination with structure or other services. Tender rates shall be deemed to include sufficient allowance for this.

Tenderers shall be required to submit the breakdown of the Tender Price Schedule, with their tender. The onus shall be on the Tenderer to ensure that the quantities and calculations provided by him are correct.

24. **TIE-IN POINTS**

The Tenderer shall use the closest approved tie-in points. No extra payment will be made should alternative tie-in points be used by the successful tenderer. Allowance must be made for this in the tender price.

25. **COMPLIANCE WITH REGULATIONS**

The entire installation under this contract shall comply in all respects with Regulations set out in the current editions of the following publications, together with special requirements as described in these Specification Documents:

The Occupational Health and Safety Act No 85 of 1993

- The By-Laws and Regulations of the Pietermaritzburg Local Authority
- The 10th Edition Sprinkler Rules and Regulations as Amended
- SABS 0287 Sprinkler Installation Regulations
- SABS 0400 The National Building Regulations
- SABS 0142 Code of Practice for the Wiring of Premises

26. **QUALITY OF WORK**

The client or his agent shall have the right to visit the site at any reasonable time and inspect the progress of the work and materials used, and shall have the right to reject:

Any work which in his opinion is not to specification or standard, and which is badly or incorrectly carried out.

Any materials which are considered not to specification or are of an inferior quality. Only new materials shall be used.

For the full duration of the Contract, the work shall be carried out under the supervision of a skilled representative of the Contractor, who shall be able to receive and carry out instructions on his behalf. A sufficient number of workmen shall be employed at all times to ensure such progress as is commensurate with the progress of the construction work.

27. **BUILDERS WORKS**

Unless otherwise specified, all builders' work shall be excluded in this Contract.

28. **SCAFFOLDING**

Scaffolding shall be supplied by the Contractor, and shall in all respects meet the requirements of the Occupational Health and Safety Act.

29. **CLEAR AWAY RUBBISH AND MATERIALS**

All rubbish accumulated during the works and all superfluous materials not required for the completion of the Contract shall be removed from site by the Contractor on an ongoing basis, as directed by the Client or his Agent.

30. **LIAISON WITH OTHER CONTRACTORS**

The Contractor shall be required to carry out the works in close collaboration with other contractors. The Contractor shall liaise fully with other contractors, and shall co-operate to the fullest extent with all parties involved in the project.

31. **PROGRAMME**

The successful Tenderer will be required to submit a provisional programme within 2 weeks of being awarded the contract. This programme will show all activities anticipated for the completion of the works, including lead times on any Specialised Equipment.

32. **PIPING**

32.1 **MATERIALS**

All pipework (including valves and fittings), shall comply with the following requirements with regards to material selection:-

PIPEWORK CONTENTS	MATERIAL OR MANUFACTURE OR TRADE NAME	PRESSURE RATING
Water	UPVC STAINLESS STEEL GALVANISED STEEL (Less than 80mm NB)	Pressure as Appropriate Minimum 600 kPa

32.2 **GENERAL**

Flexible couplings shall be provided wherever a pipe section is fixed at both ends, to facilitate removal of the pipework, for maintenance or any other reason.

For steel pipework, these couplings shall comply with the relevant requirements of BS 534.

Flanges shall be provided in all pipework going through walls, within 200mm of the wall surface on both sides. In pipes where flanges are provided, flanges will be installed at regular intervals. Pipework which are joined by means of screwed couplings shall have unions at regular intervals.

Flow direction arrows shall be painted on all pipes. The painting of pipework shall be in accordance with the specification on painting.

All pipes larger than 100mm diameter, connected to equipment or fittings, or where specifically indicated, shall be flanged to SABS 1123 - 1977 as amended. All other piping with a diameter larger than 150mm shall be welded except where galvanised pipes are used.

Galvanised piping shall be screwed when smaller than 50mm and flanged above 50mm.

Matched flanges shall correspond in construction and dimensions to flanges on equipment. Matched flanges shall be provided with the correct bolts, nuts and packing rings. All piping shall be clean before connections are made.

Buried flanges and flexible couplings (where permitted), shall be wrapped with "Denso" tape.

Bolts and nuts shall be galvanised and shall comply with the relevant requirements of SABS 135 - 1985 and SABS 136 - 1985.

The length of each bolt shall be such that, after the bolt has been tightened, the end of the bolt is flush with the outside of the nut, or projects above the nut by not more than 2 full threads.

Satisfactory temporary end-covers shall be provided for protection of flanges, prepared ends of open-ended pipes and fittings and screwed ends, to prevent damage to internal lining during transportation and during handling on site.

32.3

ABS AND PVC PIPE SYSTEMS

ABS and PVC pipework will be in accordance with SABS 1059 - 1985, as amended.

Pipework will only be accepted if supplied by a SABS 0157 - listed company.

The requirements for the material and performance of the pipes shall be in accordance with the specific maximum working pressure requirements of the pipe installation.

Refer to paragraph 30.1 of this specification for material selection.

Only pipes bearing the SABS mark of approval will be accepted.

Provision shall be made in the selection of pipe routes for excessive thermal expansion.

Support centers shall be as specified by the pipe manufacturers, for the specific temperature application. In any event, the support centers shall not be greater than 2,5m apart.

The cold solvent cement welding of joints shall be done according to the manufacturer's specifications and only the prescribed cements shall be used. No jointing shall be done in rain or wet conditions.

ABS and PVC pipe systems shall be supported in a lateral manner to prevent radial movement of the pipe. At the same time these supports must allow free actual movement due to thermal expansion. Pipe clips recommended by the Pipe Manufacturer will be acceptable.

Adequate provision for expansion loops shall be provided for long pipe lengths where temperature variations occur. All ABS and PVC pipework which is exposed to sun will be painted. Refer to the Standard Specification on Paintwork for further details.

PVC pipe work components shall conform to SABS 966 - 1976, as amended.

PVC piping shall be joined, installed and laid according to the SABS Code of Practice 0112 - 1971.

All bends and fittings shall be molded. Fabricated bends and fittings shall not be permitted. All fittings shall be manufactured in accordance with the stipulations of BS 5750 Part 1.

33. **FIRE HOSE REELS**

These are to be installed in the locations indicated on the drawings, and are to be conformance with SANS 10400.

Each hose reel is to be of the disc type, complete with:

Stop cock

30 metres of fibre braid reinforced neoprene hose of 20mm internal diameter. Full way nozzle, of the adjustable spray or jet type, not larger than 7,5mm diameter.

The length of the hose must be clearly indicated on the front of the reel.

A pressure gauge graduated I kilopascals, must be fitted to the supply pipe in an easily accessible position.

A connection, not exceeding 50mm dia., with stop valve, for the fire hose reels may be taken off the underside of the sprinkler installation control valves, as permitted under Clause 2014 of the Rules.

34. **FIRE EXTINGUISHERS**

4.5 kg DC Ptype and 5 kg CO2 type fire extinguisher will be installed on hook back plates around the building. Fire extinguishers are to comply with SANS 1910, Portable refillable fire extinguishers.

35. **FIRE SIGNAGE**

Photo luminescent fire signage will be installed for escape routes, escape direction arrows, hose reels and red directional arrow.

Size of signage to be in line with SANS 1186-1/5 and ensure visibility from 18m.

Support detail of signage from above to be proposed by FC for architectural approval

A3 layout drawings showing escape path and fire information will be framed and placed at escape points.

36. **FIRE WATER BOOSTER PUMPS**

- 36.1 Fire water booster pumps shall be located in the Fire water Booster Pump House and shall be of low pressure single stage clear water centrifugal Fire pump set (1 run and 1 standby) long coupled, in back pull-out design as specified and manufacturers recommendation. The pumps are to be complete with axial suction nozzles and discharge nozzles pointing radially upwards. Shaft to be equipped with replaceable shaft sleeve/ shaft protecting sleeve in the shaft seal area. Impeller trimmed to match the specified duty point.
- 36.2 Pumps shall be designed and manufactured to DIN specification 24.255.
- 36.3 Pumps shall be of the Wilo series or any other approved make.
- 36.4 The pumps shall be selected to supply the following duty at the atmospheric conditions at the site:
- | | | | |
|----|--------------------------------------|---|------------------------------------|
| a) | No of pumps required: | - | 2 off (duty/standby) + Jockey pump |
| b) | Water volume to be pumped: | - | 21.5 litre/second per pump |
| c) | Pump Static Head: | - | 55 meter |
| d) | Motor sizing safety margin required: | - | 20% |
| e) | Maximum pump speed: | - | 2400 rpm |
| f) | Type seals: | - | Mechanical |
- 36.5 Pumps are to be hydraulically and dynamically balanced.
- 36.6 All pumps shall incorporate:
- (a) Stainless steel shaft.
 - (b) Shrouded corrosion resistant bronze impellers.
 - (c) Mechanical seal accommodated with a shaft protecting sleeve.
 - (d) Pressure ring for easy gland maintenance.
 - (e) Lantern ring.
 - (f) Ports on suction and discharge for pressure gauges.
 - (g) Priming port. These are to be fitted with an air cock.
- 36.7 Pump casings shall be designed for working pressures of not less than 1000 kPa, or 1, 2 times the actual working pressure of the pump, whichever is the highest.
- 36.8 Pressure classification of flange connections shall correspond to casing working pressure.
- 36.9 Low points of casings shall be provided with plugged drains and inlet and outlet connections shall be provided with properly located pressure gauge tapings. These drain points shall be connected to UPVC piping and piped to a drain point just outside the pump room. The piping shall be saddled with metal piping brackets (PVC or Polycop brackets will NOT be acceptable).
- 36.10 Each pump shall be coupled on both the suction and discharge sides to piping with rubber bellows type expansion joints with flanged connections.

- 36.11 Each pump shall be provided with a cast iron or fabricated steel bed-plate of ample size and rigidity to hold and keep both motor and pump in the correct alignment. The pump and motor shall be accurately aligned when running at normal temperature.
- 36.12 The pump and motor bedplate shall be mounted on a concrete plinth of adequate size and of 100 mm minimum thickness.
- 36.13 The bedplate shall be supported from the floor on spring type mountings, at 1200 mm centres max.
- 36.14 Each pump shall be equipped with a condensate drip pan manufactured from 3CR12 sheeting. The pan shall be installed on the bedplate of the pump and shall be big enough to cover the drip area under the pump
- All condensate dripping from the pump casing and all leaking water from the pump shaft, etc., shall be collected in this pan.
- A drain connection shall be installed at the bottom of the drain pan and a drain pipe shall be run from each drain connection and shall terminate with an air gap over a tundish.
- The gland drain pan below the pump shaft shall be separately piped directly in the lowest section of the drain pan, or into the nearest tundish.
- 36.15 The pumps shall be connected as a set connected to the same inlet and discharge manifold. Each pump shall be equipped with a gate valve, on both the suction and discharge side of the pumps. On the discharge side of the pump and before the gate valve a non-return valve shall be installed. On the suction side of each pump a strainer with a high micron mesh element shall be installed between the valve and the pump. All valves and fitting shall be flanged and shall be easily removable.
- 36.16 The piping inside the plant room shall be 150mm galvanised steel and all fitting shall be suitable for this. The piping shall be supported on manufactured Unistrut sections (50mm x 50mm) with galvanised U bolt clamps. Nickel plated screws and bolts will not be accepted.
- 36.18 All fittings and equipment shall be suitable for 1.5 times the working pressure or 1000kPa whichever the larger constraint is.
- 36.20 Pump protection against no flow or low water level will be will be installed in water supply reservoir as part of this contract.
- 36.22 The fire booster pump installation will be installed and shall be set up to function as follows:
- Pressure in the fire ring main drops below 350kPa. Fire booster pump duty pump start. If pressure is restored to 400kPa the fire pump switches off.
 - Should the duty pump be down and requires servicing or maintenance, the standby pump will operate.

The pump heads given in the schedules are given for tendering purposes only and the contractor shall place an order to the supplier of the pump(s), only after he is in receipt of a written document, which approves the calculated pump head. The contractor shall calculate the pump head and submit the calculations for approval to the Consulting Engineer.

37. **ELECTRIC MOTORS**

STANDARDS

All electric motors shall comply fully with the relevant standard specifications:

- SANS 60034 – 25 Rotating Electrical Machines Part.25: Guide for the design and performance of cage induction motors specific requirements
- BS 2613: 1970 “The Electrical Performance of Rotating Electrical Machinery”.
- BS 60034-25: “The Electrical Performance of Fractional Horsepower Electric Motors and Generators”.

MOTOR SPECIFICATIONS

Standard Squirrel Cage Motors shall be three phase (or single phase up to 3 kW), continuously rated, screen-protected drip-proof, suitable for direct on line, soft or variable speed drives..

Motors with a speed in excess of 1500 r/min except in the case of submersible motors, will not be accepted unless agreed to by the Engineer.

All motors shall be S1 Duty, IE2 - Premium Efficiency Plus motors with Class H insulation.

MOTOR RATINGS

When determining motor rating, the following shall be taken into account:

- (a) All motors shall be rated for continuous full load duty.
- (b) The Continuous Maximum Rating (C.M.R.) of the motor shall be 20% in excess of the full load running duty of the load in order to withstand the tolerance of 105% - 120% in the tripping characteristics of over-load protection devices allowed in BS 4941 Part 1.
- (c) All starting times, irrespective of the load characteristics or the method of starting **shall be limited to 20 seconds** unless prior approval to the contrary is obtained from the Engineer. The safe locked rotor time shall be well in excess of the run-up time to allow protection discrimination.
- (d) All motors shall be capable of a **minimum** of three **consecutive** starts per hour with the load connected and employing the method of starting to be installed without exceeding the allowed temperature limits of the insulation. In addition, the motor shall be capable of the numbers of starts per hour for the particular load as may be specified or as may be experienced under normal operating condition.
- (e) Unduly over-rated motors resulting in a low power factor and efficiency are not acceptable.
- (f) The motor starting torque and speed/torque characteristics shall be carefully matched to that of the load to ensure that the motor does not stall at a low speed. A safety margin shall be allowed to overcome voltage drops and load fluctuations.

The maximum torque developed by the motor in its final running condition (i.e. when the motor is switched to its final running configuration in the case of pole-changing motors and all starting devices have been switched out of circuit in the case of assisted starting) shall be 1.6 times the rated full load torque to overcome temporary overloads and voltage fluctuations.

(g) The actual ambient temperature in which the motor will be operating (and not the prevailing outside ambient temperature only) shall be taken into account.

It is a requirement that the above information and any other requirements that will affect the type of motor to be used, be submitted to the motor manufacturer when ordering the motor. The Contractor may at the discretion of the Engineer be required to submit written proof that the **motor manufacturing** will guarantee the performance of the motor for the expected duty and load.

Special attention shall be paid to the starting requirements of motors. It is essential that the starting torque produced by motors under the starting conditions specified, will be sufficient to accelerate the load within the time period allowed by the manufacturer of the motor with a maximum starting time of 20 seconds (refer above). The Contractor may be required to submit calculations showing accelerating torque available, load torque characteristics and run-up time. The following formula may be used to calculate the run-up time:

$$T_e = \frac{\left(\frac{T_1}{T_2} - 1\right) \times (T_1 + T_2)}{\left(\frac{T_1}{T_2} + 1\right) \times \text{Log}_e\left(\frac{T_1}{T_2}\right)} \quad t = \frac{GD^2 N}{9.55 T_e}$$

T_e = equivalent accelerating torque in N-m
 T_1 = Maximum accelerating torque in N-m
 T_2 = Minimum accelerating torque in N-m
 GD^2 = Moment of inertia of the rotating parts of the load and motor in kg-m²
 N = Final speed in r/min.
 t = Run-up time in seconds

Accelerating torque is the difference between motor torque and load torque at any given speed on the torque/speed characteristic curve.

Where inching operations occur or where motors are controlled by pressure or level switches where frequent cycling duty may occur, motors shall be capable of 40 starts per hour.

37.4 MOTOR WINDINGS

All motor windings shall have Class F or better insulation. The following maximum temperatures as determined by the resistance method may not be exceeded:

Class of Insulation	Altitude					
	0 – 1000m	1200m	1400m	1600m	1800m	2000m
.....	150°C	112.6	111.2	109.8	108.4	107

.....	120°C	118.4	116.8	115.2	113.6	112
.....	140°C	138	136	134	132	130
.....	165°C	163.7	162.5	161	160	158.7

The above figures comply with BS 2613 and SABS 948 for a maximum cooling air temperature of 40°C. Where higher ambient temperatures occur (particularly in cases where heaters are installed), the above temperatures shall be reduced in accordance with BS or SANS specifications.

All windings shall be varnished and baked. The insulation shall provide protection against dust, oil and high humidity as well as aggressive vapours and gases where these are specified.

End-windings shall be carefully wrapped and supported to prevent movement and prevent mechanical damage due to vibrational stresses.

37.5 **MOTOR PROTECTION**

37.5.1 Motor protection shall be provided as follows:

Type of Protection	Application
Thermal overload	all motors
Magnetic overload	only for short circuit protection When acting on circuit breakers with sufficient rupturing capacity
Thermistor over-temperature	All motors of 25 kW and more.
Single phasing	All 3-phase motors without thermistor over-temperature protection
Earth fault	Only when condensation in motors can take place,
Phase reversal	All
Under voltage	as specified.
Over-temperature	Auto-transformer starters, liquid starters and resistor starters.

Bearing Temperature Dial-type bearing thermometers with adjustable alarm and cut-out contacts, shall be provided as required. Where such thermometers are also provided on the pump, they shall be of the same type and manufacture.

Temperature Detectors	as Specified.
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- 37.5.2 All the protection specified in the detailed Technical Specification and the Standard electrical specification shall be supplied.
- 37.5.3 Motor overload (O/L) protection shall be provided in accordance with BS 587. O/L protection shall be provided by means of thermal trips or relays actuating contactors, manual motor starters or circuit breakers. **HRC fuses are not acceptable for this purpose.**
- 37.5.4 On motor starters on which the overload protection forms an integral part of the starter the protection shall be by means of temperature compensated bimetal thermal O/L trips indirectly heated by separate heating elements in each phase and connected in series with the load. The O/L trips shall be adjustable within the range of approximately 75% to 120% of the rated current of the motor.
- 37.5.5 Where motors are used frequent repetitive cycles or for inching operations, magnetic overload protection with time delays may be used provided the motor is suitably rated for the duty.
- 37.5.6 Single phasing protection where provided shall be inherent in the overload protection unit in the case of integral motor starters. Protection schemes depending solely on the excess current drawn by the motor during the single phasing are not acceptable.
- 37.5.7 Magnetic over current trips or relays for short circuit protection may never be allowed to actuate contactor starters and may only operated on suitably circuit breakers.
- 37.5.8 Short circuit protection shall be provided by means of suitably rated circuit breakers.
- 37.5.9 Thermistor over-temperature protection shall be installed. The thermistor control units shall where possible be integrated with the motor starter (VSD). Care shall be taken to select units with sufficient current rating to operate the contactor coil.
- 37.5.10 **Thermistor protection may not be provided in lieu of over current protection.**
- 37.5.11 Motor protection shall be "ENGLISH ELECTRIC" type "CMM" OR "P & B GOLDS" type "M", or other approved, for all motors where preferred. Thermal (or magnetic if required) overload, single phasing (or phase unbalance) and earth fault protection relays as well as auxiliary relays where required, shall be included. The relays shall be housed in a panel mounted unit in a withdrawable case.
- 37.5.12 Motor protection relays shall not be allowed to operate on metering current transformers, but shall be connected to separate protection class current transformers matched to the motor full load current and the relay power consumption.
- 37.5.13 In all cases where protection relays are used, "CHAMBERLAIN AND HOOKHAM", or other approved, test blocks type shall be provided to facilitate remote testing or relay operation, current transformers, etc.
- 37.5.14 Proven electronic protection relays are acceptable.
- 37.5.15 Where motors which are not described in BS specifications, e.g. semi-hermetic compressor motors, etc. are used, protection shall comply with the manufacturer's requirements.
- 37.5.16. Special attention shall be paid to motors driving high inertia loads to ensure that motors are adequately protected against sustained over currents but do not trip unnecessarily during starting.

- (a) Shorting of the over current protection during starting is not acceptable.
- (b) Increased overload settings on protection units are not acceptable.
- (c) Connecting the overload relay in the delta loop in star-delta starting applications thus providing no protection during starting, is not acceptable.

Saturable core current transformers providing a normal over current characteristic up to 120% of full load current may be used provided they are properly matched. Alternatively, separate starting and running over current protection units shall be used. For star-delta starting methods, the latter can be achieved by connecting the starting over current unit in the main supply line to the motor and the running over current unit in the delta loop. For other starting methods, a change-over arrangement is required to switch from the starting to the running after the starting time has lapsed. For motors larger than 50 kW electronic integrating type relays with individually adjustable time/current characteristics shall preferably be used. Whichever protection method is used, a safe discrimination between “safe locked rotor time” and “starting time” shall be maintained.

37.6

MOTOR PROTECTION – THERMISTORS

All motors with ratings of 25 kW and higher and all motors with a rating of 15 kW and more that are subjected to run-up times in excess of 15 seconds shall have thermistors for over-temperature protection installed in the stator windings.

Three thermistors, one per phase, shall be installed in single wound motors and 6 thermistors shall be installed in double wound motors.

All motors between 50kW and 150kW rating, shall have embedded in their starter-windings, one PTC thermistor per phase, suitable for Class B temperature rise. All motors rated 150kW and larger, shall have embedded in their stator windings and bearings, one platinum RTD of type PT/100 per phase and per bearing. The bearing detectors shall touch the outer bearing race, shall be spring-loaded and shall be of the screw type. The characteristics of these temperature detectors shall match the thermal limitations of the motor electrical installation.

Where thermistors are installed in the end-winding, the “Curie Point” shall be 5°C above the temperature. Where thermistors are installed in the winding “hot spot”, the Curie Point shall be 15°C above the temperature values stated.

The thermistors shall comply with the following:

- (a) Only Positive Temperature Co-efficient (PTC) thermistors shall be used.
- (b) Thermistors installed in motors connected to supply voltages up to 600 V shall be flash tested at 2 kV r.m.s. Additional insulation shall be provided on higher voltage machines.
- (c) A varnished Terylene or glass fiber sleeve shall be fitted around those parts of the thermistor leads, which are embedded in the winding for mechanical protection of the leads. Care shall be taken that the sleeve does not cover the thermistor bead.
- (d) The thermistor shall be inserted in the winding in such a way to ensure best thermal contact with the adjacent conductors of the winding.

- (e) All leads from thermistors to the protection control units shall be twisted pairs to minimise stray voltage pick-up. Screened cables shall be used where the control units are far from the motor.
- (f) All the thermistors acting on one control unit shall be connected in series.

Where thermistors are installed it is essential that relay panels be safeguarded against high voltages in case of a short circuit between sensor and motor windings. Isolation transformers are recommended for this purpose.

37.7

MOTOR CONSTRUCTION

The housing, end-shields and feet of totally enclosed surface-cooled motors shall be of cast iron to BS 1452. Standard protected, internally cooled motors may be of welded steel construction. A condensation hole shall be provided at the lowest point in the motor frame.

It is essential that the correct mounting type is selected for each application.

Motor terminals shall be clearly marked, U, V, W or U1, V1, W1 and U2, V2, W2. An earth terminal shall be provided at a convenient position on the motor frame. Vulcanised rubber insulation shall not be used for the connection from windings to the terminals.

When viewed from the drive shaft end, the motor rotor shall rotate in a clockwise direction when the R-W-B supply leads are connected to the U-V-W motor terminals.

All terminals shall be totally enclosed in a waterproof box sealed with gaskets and shall be complete with nuts, locknuts, lugs, etc. Cable boxes for PILCA cables shall be complete with tinned brass wiping gland and armour clamps. PVC cables shall be terminated using compression glands with shroud. Cables shall be provided with a means of support to remove the weight of the cable from the gland. All terminal boxes shall be large enough to ensure proper termination of the cables and connection of cores without exceeding the allowable bending radius. All terminal boxes shall be capable of being rotated through 360°. Where condensation may form on motor terminals, e.g. certain centrifugal refrigeration compressors, terminal boxes shall be hermetically sealed and filled with silica gel.

Motors shall as far as possible have pre-lubricated and sealed ball or roller bearings. Unsealed bearings shall be loaded conservatively in order that the grease need not be renewed at intervals of less than one year. Bearings shall be suitable for flat or V-belts drives where these are indicated without the use of outrider support bearings. Belt pulleys and couplings shall be balanced.

Bearings shall be protected against possible shaft eddy current and shall be suitable to withstand vibrations caused by reciprocating or unbalanced loads.

Anti-condensation heating elements shall be provided in the motor windings for the following motor applications:

- (a) Close-coupled motors and pumps in chilled water systems.
- (b) Standby motors in refrigeration installations where the ambient air surrounding the motor may drop below the dew point.

- (c) Pumps installed in damp areas where the pumps will not run continuously.

The heating elements shall be arranged to prevent terminals and exposed connections becoming damp. As an alternative to heating elements, a low voltage transformer (approx. 50V) can be switched into the circuit when the motor is stationary to provide a continuous circulating current in the motor windings.

Where requested copies of type test certificates for routine and performance tests in accordance with SABS 948, BS 2613 or BS 170 shall be submitted before delivery of the motors. In additions the Manufacturer's guarantee that the motor will comply with the duty as described in this specification, shall be submitted. Curves of Torque/Speed and Current/Speed shall be provided on request.

The client reserves the right to witness all routine or performance tests and shall be notified in writing 14 days before the commencement of such tests.

Motors that have become damp shall be dried out before connection to the supply. Damaged motors resulting from non-compliance with this requirement, shall be rectified by the Contractor at his cost.

38. **VALVES**

38.2 **GENERAL**

For valve sizes referred to in this specification are nominal bore sizes. The Tenderer should check the requirements of drawings and supporting documentation and specifically in those where with phrases such as "unless otherwise specified" are used in this specification.

"Knife" valves will not be acceptable as either shut-off or modulating valves.

Lifting lugs are to be fitted on all valves which have a mass in excess of 50kg.

Each valve shall have a plate securely fixed to the body on which the following information shall be stamped:-

The Manufacturer's name
Size of valve
Class of valve
Arrow indicating the direction of flow
The contract number

38.3 **GATE VALVES**

Gate valves shall be constructed according to the stipulations of the following Specifications:

SABS 664

For valves operating under working pressures up to 1 MPa and of diameter up to 350mm. These valves shall be constructed of cast iron.

Gate valves subject to working pressures up to 1,6 MPa and of diameter over 350mm, but not exceeding 600mm, shall be of cast iron and shall comply with the relevant requirements of SABS 664.

SABS 191

Valves operating under working pressures over 1 MPa and of diameter exceeding 600mm, shall be of cast steel and shall comply with the material and construction requirements of this specification.

The definitions as contained in SABS 191 and 664 are applicable to this specification.

All valves shall have double flanged ends.

Unless otherwise stated the valves are to be the non-rising spindle type.

The valve shall be provided with a handwheel, unless otherwise specified.
Handwheels for Classes 10 and 16 valves, shall be manufactured from cast iron and for Classes 24, 40 and 100, from cast steel.

The direction of closing shall be clockwise.

Channel-guides and shoes shall be fitted to valves falling within the following pressure and size ranges:-

- Class 10 500mm and above
- Class 16 300mm and above
- Class 25 250mm and above
- Class 40 150mm and above
- Class 100 all sizes

The valves shall be capable of being easily operated by one man, against the maximum, unbalanced pressure, and in order to comply with the above requirements, it has been found that the following is normally necessary :-

CLASS	VALVE SIZE	DRIVE
10	250mm and above	Ball thrust
16	200mm and 250mm 300mm and above	Ball thrust or 2,5:1 spur-gear Both ball thrust and 2,5:1 (or greater) spur-gear
25	200mm 250mm and above	Ball thrust or 2,5:1 spur-gear Ball thrust and 3:1 (or greater) spur-gear
40 and 100	All sizes	Ball thrust and spur-gear

The Tenderer shall state the spur-gear ratio offered and whether the valves are fitted with ball thrust bearings, together with a maximum torque required to operate the valves against the working pressure.

Class 10 and Class 16 valves are to be fitted with back sealing rings in order to permit the re-packing of the gland while the valve is under pressure.

Valve-trim shall be either Type B or Type C. Gate seating rings may be deposited.

Unless otherwise specified, position indicators shall be fitted on all valves of size 100mm and larger and shall show clearly the full open, and closed positions and the quarter, half and three-quarter intermediate open positions.

Supporting feet are to be fitted on all valves of sizes 300mm and larger.

In addition to the marking requirements listed in SABS 191 and 664, one flange edge shall have the following number of 3mm wide by 3mm deep grooves cut across it at top, dead-centre :-

- Class 10 1 groove
- Class 16 2 grooves
- Class 25 3 grooves
- Class 40 4 grooves
- Class 100 5 grooves

The design of the valves shall be such that the cast iron/steel sections are not subject to excessive tension, by the tightening of connecting bolts, as can happen when the faces of the bonnet and the stuffing box flanges are not fully machined for a full-faced gasket.

Bolts must be used to fasten the stuffing box to the bonnet and the bonnet to the valve body. The use of studs and Allen-type screws is unacceptable.

Resilient seal gate valves are acceptable for the application where the water contains undissolved solids. These valves shall be covered in bonded nitrile rubber. The gates shall be able to be replaced without removing the valve body from the pipeline.

38.4 **BUTTERFLY VALVES**

Butterfly valves shall be used on water services for positive shut-off only. This type of valve shall not be used for controlling the flow in any way. The valves shall be manufactured in accordance with BS 5155 (cast iron and carbon steel butterfly valves for general purposes), as far as is applicable. Where conflict exists, the requirements in this specification shall take precedence.

The following criteria for construction shall be met:-

38.4.1 Body

These shall be of the wafer-lug type, with drilled/tapped bolt holes, to allow the valve to be used at maximum working pressures of respectively 20 and 16 bars in terminal positions.

This is to allow downstream pipework to be disassembled with the upstream pipework under pressure.

Bodies shall be one piece casting Ductile Iron, UTS 400 MPa, YP 250 MPa, (elongational 12%) GGG 42 or equivalent for sizes up to 1500mm. Sizes above shall be of cast steel. Bodies shall never be in contact with the fluid conveyed and shall be fully protected internally by the resilient seat.

38.4.2 Disc

Shall be cast or stamped, spherically machined and positively splined or keyed internally to the driving shaft. (Use of plinths or bolts is totally prohibited).

Selection of the disc material shall be made taking into account the aggressivity of the fluid. (Cupro-aluminium or stainless steel 316 or equivalent).

38.4.3 Shaft

Butterfly valve technology shall be such that the shaft will never be wetted. (Dry shaft) Stainless Steel, AISI 420 of high mechanical characteristics shall be used.

It shall be positively splined or keyed to the disc. The upper and lower shaft and tie-bolt, when assembled to the disc, shall give in effect a one-piece shaft/disc assembly. At least three bearing assemblies, consisting of steel outer shell, with sintered bronze inner lining, coated with Teflon, facing shall be used.

The upper shaft shall be carried in two bearings, the lower in one.

38.4.4 Liner

The resilient, synthetic rubber seat shall be easily replaceable (bonded liners are prohibited) and shall entirely cover the inside of the body overlapping over the sides to form the seal between the body and matching pipework.

Where necessary, it shall be keyed to the body with annular grooves in the bore of the valve. The design shall be such as to allow the disc to seal drop-tight to the liner so that there is no ingress of fluid to the shaft area.

38.4.5 General

Valves with "O" Ring Shaft Backup Seals shall not be considered. The Manufacturer shall be able to offer alternative grades to cope with various fluids.

Quarter-turn handles shall be supplied for valves up to and including 150mm nominal diameter. The handle shall be lockable in all intermediate positions and be adaptable to the valves.

For valves larger than 150mm a gear shall be used. The gear operator shall be designed with a worm and nut system. The gear operator shall be irreversible in any position. The gear shall have a handwheel and an indicator protected by plexiglass, showing the position of the disc. If specified, limit switches shall be fitted, mounted in a waterproof and dustproof housing.

U-section wafer-type valves, as described in BS 5155, shall be acceptable, provided that:-

- the valve is suitable for individual bolting of each flange

and

- the dimension between the inside faces of the flanges is not less than 3D, where D is the diameter of the flange bolts as specified in BS 4504: Part 1, or SABS 1123

The use of single flanged and flangeless valves shall be permitted only if provision is made for downstream pipework to be disassembled with upstream pipework under pressure.

The direction of opening of the butterfly blade shall be such that the bottom of the blade moves in a downstream direction.

All handwheels shall be fitted with a suitably sized shear-pin that shall fail before damage can be done to the drive gearing of the valve.

38.5

REFLUX VALVES

Reflux valves shall be double-flanged for horizontal and vertical mounting of robust construction and suitable for the operating head and close drop tight.

The body, cover and door shall be of close-grained cast iron and the door shall be fitted with a zinc-free phosphor-bronze face, closing on a corresponding bronze face in the body.

The valves must be of the “non-slam” type, for horizontal or vertical installation. Valves with a stainless steel perforated cone, or resilient conical diaphragm, are also acceptable.

Wafer type reflux valves shall not be acceptable.

Swing check valves shall not be used in cases where the solids content of water exceeds 5%.

For fluids with a higher solids content, lined cast iron or cast steel reflux valves with a non-return disc, shall be provided. The disc and lining shall be of either rubber, polypropylene or PTFE, depending on the characteristics of the fluid.

38.6

STRAINERS

Strainers shall be provided and installed in all piping installations upstream of water pumps, control valves, etc., where a possibility exists that solid particles of appreciable size will damage the downstream equipment. Strainers shall be of the angle or Y-type. Strainers up to 50mm shall have bronze bodies with screwed ends and bronze screens.

Strainers of 65mm and over shall have cast iron or cast steel bodies, with flanged ends and screens of stainless steel or bronze. Screens shall be perforated as follows:-

STRAINER SIZE	PERFORMANCE SIZE
Up to 50mm included	0,8mm
65 to 150mm	1,8mm
200mm and over	3,2mm

Strainers fitted in pipes larger than 150mm diameter shall be provided with a 15mm blow down globe valve fitted with a quick coupler.

39. **GAUGES AND FITTINGS**

Each pump shall be equipped with a glycerine filled pressure gauge (120mm diameter) on the delivery and suction side of the pump suitable to handle the delivery pressure of the particular pump.

Pressure gauge installation shall comply in all respects to the standard mechanical specification.

39. **PRESSURE TRANSMITTER DEVICES**

- 39.1 An electronic pressure transmitter devices shall be installed on the outlet piping of the each Booster pumpset.
- 39.2 The transmitter shall be sized to for the span limit that shall correspond with the zero to full working pressure of the Booster pumpset.
- 39.3 The transmitter shall be equipped with both a local pressure display in the pump station and shall interface with each pump VSD PLC. The water pressure will be used to control the speed of the duty pump to ensure a constant pressure as specified is delivered.
- 39.4 The unit shall be extremely robust and shall have a stainless steel housing.
- 39.5 The units shall comply too PED Category III standards and shall have a local zero and span button. The units shall be local configurable with keys on the LCD indicator and also remotely configurable with the PC based software in the control room.
- 39.6 The unit shall have a base accuracy of at least $\pm 0.15\%$ and provide a large turn down ration of up to 20:1. The units shall work on a 4 to 20 mA output signal. The units shall be vibration resistant, shock resistant in accordance with IEC 60068-2-27 standards and shall be able to function in a humid, wet and dust laden atmosphere without malfunctioning.
- 39.7 Each units shall be complete with all the necessary devices and accessories to comply with the specification and shall be of the 2600T Series Pressure Transmitter as supplied by ABB or other approved.
- 39.8 All the software, hardware wiring etc. to complete the installation shall be included and allowed for by the contractor

40. **MOTOR CONTROL CENTRE (MCC)**

40.1 **SUPPLY**

The Contractor shall allow for the supply, installation, testing and commissioning of all a Distribution Board that will act as the MCC and will include all the necessary control equipment to ensure the pumps function as specified in this specification.

The distribution boards shall be made by approved Specialist Manufacturers, who shall also install and fit the switchgear and equipment and carry out all internal wiring.

The Contractor shall install any apparatus, accessories, equipment and systems that may be required by the Supply Authority as part of his electrical contract.

The Contractor shall note the dimensions of the room or openings, in which the panels will be mounted and also the dimensions of the access routes and doors. Panels shall be so constructed that they may be taken through the doors, after doors have been placed in position.

Four copies of working drawings of wiring diagrams, schematic diagrams, general arrangements and construction details of all distribution boards, shall be submitted to the Engineer for approval prior to manufacture. These drawings shall indicate all electrical and mechanical information as well as make and type of equipment, dimensions, ratings and other relevant technical information.

The Contractor shall furnish the Board Manufacturer at the time of tendering and at all other times, with all the necessary information as regards access and the requirements of this standard specification.

The distribution board shall be inspected before delivery to site by the Engineer or his representative and a certificate issued as required by SABS 0142-1, Annexure H or similar.

40.2 **DESIGN**

All distribution boards shall be in accordance with SABS 1473-1.

The following types of board may be required in accordance with this specification:-

- Floor standing boards
- Flush mounted boards
- Semi-flush or partly-recessed boards
- Surface mounted boards
- Flat boards
- Weatherproof boards
- Distribution boards incorporated in other boards.

40.3 **GENERAL**

Boards and all components shall be constructed to be able to withstand fault currents in accordance with any specified or implied values.

All metal work and welds shall be ground smooth and rendered free from blemishes. Self-threading screws may not be used in the construction of boards, nor for fixing of any panels.

All front panels shall be hinged and fitted with flush, square key, operating catches at the other side of the panel.

Space for 30% future expansion on MCCB's and CFS units and 50% future expansion on contactors, time switches and isolators, shall be allowed on all boards unless otherwise specified.

40.4 **DOORS**

Where doors are required, they shall be manufactured of the same gauge material as the remainder of the panels.

Doors shall be suitably braced to ensure stiffness and shall have a smooth, flat finish.

Door hinges shall be heavy duty and shall be constructed to permit easy removal of doors.

All doors shall be fitted with locks unless otherwise specified. Locks shall be Union, Yale or Solid and shall have master key facilities for the entire installation and separate key facilities for each board. Two individual keys shall be provided with each board and four master keys shall be provided for the entire installation.

All the panel doors shall be mechanically and electrically interlocked to ensure that they cannot be opened unless the starter is off and the interior of the panel is safe.

40.5 **REMOVABLE PANELS**

Panels of sheet steel, finished in the colour required, shall be suitably stiffened with machine-punched slots to allow for flush-mounting of equipment.

Blank-offs to consist of dummy MCCB's in vacant MCCB positions and to be firmly secured. Easily removable metal covers to be fixed in all other positions.

All removable front panels shall be secured by means of quick-release fasteners, similar and equivalent to a suitable size DZUS type.

Where panels on any boards are accidentally interchangeable, the fixing, eg locating pins, shall be arranged or staggered in such a way as to make it impossible accidentally to interchange such panels.

Instruments and other equipment which is designed for panel-mounting only, shall be mounted on a hinged front panel and the wiring thereto laced together and having sufficient slack to allow full opening of hinged panel. Slack wiring shall be neatly clipped to back of panel.

In the case of 3-phase boards, two panels shall be fitted side by side with a common bonding tray. One panel shall accommodate all single phase MCCB's and the second panel shall accommodate the main isolator main bus boards and all triple pole circuit breakers. The chassis shall be of rigid channel section, rust-proof steel with clip-on trays for the single pole MCCB's the triple pole MCCB and the main isolator. The main isolator is to be mounted at the bottom of the second panel with the triple pole circuit breakers above.

Unless otherwise specified, motor starters shall have push buttons protruding through the front panel, unattached thereto. However, push buttons, having mechanical push rod operation, may be attached to the front panel, provided the front panel can be freely removed and re-installed.

Equipment shall be chassis-mounted, flush behind a removable front panel. This front panel shall have returned edges to give it greater rigidity and shall be secured to the frame of the board at a minimum number of fixing points by means, other than self-tapping screws. Approved handles or knobs shall be provided on the panel to facilitate removal.

The chassis shall be arranged for adjustment in depth and for plumb alignment. No equipment shall be mounted on the front panel, except as provided for elsewhere. The front panels shall be fitted with plastic windows, in front of the kWh meters and other instruments which are arranged for chassis mounting. Time switches shall have hinged flaps to allow ample access for adjustment of time switch and for operation of by-pass switches without the front panel having to be removed.

Where resettable instruments or meters are specified, eg maximum demand indicating, suitable cut-outs shall be provided in the front panel to permit resetting without opening or removing the panel.

40.6 **VERMIN-PROOF**

All distribution boards shall be completely vermin-proof.

40.7 **VENTILATION**

Boards fitted with heat generating equipment shall be arranged to prevent heat building up to a temperature which could damage any of the equipment or cable on the board. Forced ventilation to be installed onto the panels if situated in a chlorine/corrosive gas atmosphere.

40.8 **ACCESS**

Sufficient removable panels shall be provided to afford access to all equipment for maintenance purposes.

Main LV boards shall be arranged for back access as well as front access and shall be installed with a minimum of 1000mm clear access space behind. The back panel shall be of similar construction to the front panels.

40.9 **CLEARANCES**

Sufficient space shall be left inside panels for incoming and outgoing cable connections and for inter-connections and control wiring, taking into account the sizes and quantities of cables and wires involved.

Equipment on distribution boards may be installed abutting. Undue clamping of equipment and wiring shall, however, not be permitted and the following clearances must be maintained:-

- Clearance of not less than 75mm between sides, top and bottom of architrave and any equipment mounted on the chassis.
- Clearance of not less than 75mm between rows of equipment (measured between terminals).

40.10 **BUSBARS**

All boards shall be equipped with copper busbars to SABS 1195.

The main busbars and connections shall be of hard drawn high conductivity copper for low voltage equipment, having a constant cross-section throughout. Unless specified aluminium busbars may not be used.

Copper or brass neutral bars for sub-circuit distribution shall be provided of sufficient size to accommodate a neutral conductor for each way (including spares) specified and conductors shall be connected to bars by means of double grub screws.

Busbars are to be installed in all distribution boards and may be installed either horizontally or vertically, their current rating should not be less than that specified for the main switch or isolator.

Busbars shall be identified for phase and shall be fully insulated. They shall be able to withstand the specified voltage and impulse voltage tests and shall comply with BS 159.

Bolts for supporting or jointing busbars shall be of high tensile phosphor bronze or high tensile plated steel, not less than size M8, provided with wide flat plated washers at each end and spring back washers under the nuts. Connections shall be kept as short and straight as possible and where dissimilar metals are connected, means shall be provided to prevent electrochemical reactions and corrosion.

Spacing of busbars shall be calculated in accordance with SABS 1195, but shall not be less than 50mm.

Busbar supports shall comply with SABS 1195 and shall be mounted on substantial porcelain or other approved insulators. The insulators shall be non-hygroscopic, non-tracking and unaffected by sweating. Their conductors shall be so spaced, that with all clamps, lugs and lead-offs in position, the spacing between any conductor and earth shall not be less than 40mm. In multiple parallel busbar arrangements, the space between bars of the same phase shall be equal to the thickness of each bar.

Current rating of boards shall be not less than that specified for the main switch or isolator. Current ratings for busbars shall be in accordance with the manufacturer's recommended rating multiplied by a de-rating factor of 0,75. Busbar cross-sections may not be reduced without the approval of the Engineer.

Connections to the busbars must be effected by means of the correct clamps or lugs, with soldered connections or with connections crimped with the correct equipment.

All busbars and any other un-insulated connecting links shall be sleeved with heat-shrunk material by the Board Manufacturer, except at joints and take-offs. The latter including cable lugs, shall be taped after installation of boards and connecting of cables thereto. Colour coding of busbars shall be strictly observed.

Where busbars are mounted horizontally, the longer dimensions shall be in the vertical plane. The busbars shall be designed to withstand the mechanical and thermal stresses of any possible short circuit that could occur at that point in the system.

Ratings for busbars shall be in accordance with Tables A1 and A2 of SABS 1195 (as amended), except that current ratings of busbars shall not exceed 1, 5 amps per square mm for copper and 1, 0 amps per square mm for aluminium. Neutral busbar cross-sections may not be reduced without the approval of the Engineer.

The maximum current density in busbars and connections shall be such that in no part of the switchgear equipment including circuit breakers, isolating equipment, busbars,

current transformers, cable boxes and connections, shall exceed the temperature rise values stated in BS 159 and BS 5424 and other relevant British Standards. The temperature rise of operating coils shall not exceed the values specified in BS 5424.

A copper earth bar of not less than 25 x 6mm² for medium voltage switchgear, or 25 x 3mm² for low voltage switchgear or nearest equivalent metric size, shall be provided running the full length of the board. This bar may run externally at the back of the board. If it is broken into short sections within each cubicle, the sections shall be joined together in a substantial way. The steel work of a switchboard and in particular gland plates must be solidly and effectively bonded to the main earth bar. An earthing lug shall be provided. Where withdrawable chassis's are used the method of bonding these shall be to approval. If cable is used for bonding, it shall be not less than 2,5mm². Metal instrument cases shall be bonded to earth. Earth bars shall have sufficient ways for all the earth conductors and 30% spare space shall be provided.

Where small leads are connected directly onto the busbars, such as voltmeters, fuses, etc., they shall be provided with a 20-ampere fuse mounted at the busbar and a 2 ampere fuse at the equipment.

40.11 **PAINTING**

The interior of all switchboard cases shall be painted with two coats of best quality white "arc-free" paint and the outside shall be painted with two coats of paint before delivery to site. Compartments containing telemetry equipment shall have a central brown stripe of 1/3 the cubicle area.

40.11.1 Surface Preparation

All metal parts to be de-greased, rinsed, pickled, rinsed, phosphated, neutralised and then to be thoroughly dried. This process shall be followed up within 48 hours by application of one layer of high quality zinc-chromate primer of minimum thickness 0,04mm.

40.11.2 Baked Enamel Finish

Two coats of a good quality Alkyd-based baked enamel of the required colour. The minimum film thickness of the paint after baking to be not less than 0,06mm. Care to be taken that all edges are properly covered.

Paint used on boards to have an impact resistance of 5,65J on cold rolled mild steel plate and scratch-resistance to withstand 2kg.

In coastal areas the dry film thickness shall be increased to at least 0,1mm.

All distribution board finishes shall be made good to the satisfaction of the Engineer after final handover.

40.11.3 Powder Coated Finish

Immediately after cleaning the metal part shall be pre-heated and then covered by a micro-structured paint powder applied electrostatically.

The paint shall be baked on and shall harden within 10 minutes at a temperature of 190°C.

The minimum paint thickness after baking shall be 0,05mm. The dry film thickness shall be increased for coastal areas. The paint cover shall have an impact resistance of 5,65J on cold rolled steel plate and a scratch resistance of 2kg.

40.11.4 Colours

Unless otherwise specified, the finishes shall be standard electrical orange colour.

40.12 **WIRING**

All wiring shall be carried out by the Board Manufacturer. The wiring of control and instrument circuits shall be carried out in heavy duty PVC insulated 2,5mm² stranded annealed copper wire or 1,0mm² multi-strand (29/0,21) flexible wire. These circuits shall be marked with numbered ferrules to facilitate circuit identification.

All internal wiring to the board shall be carried out in PVC insulated conductors of adequate size. The insulation colour shall correspond to the phase colour code. Where standard conductors are used, these shall be bound together by means of "Helvin" strap or equivalent, in groups not exceeding 10 conductors and shall be arranged in neat, vertical or horizontal rows. All jumpers between busbars and circuit breakers rated over 200 ampere, shall be solid copper, insulated by means of at least 2 half lapped layers of PVC tape. All wiring shall be ferruled or provided with lug at terminations.

No joints will be allowed in internal wiring and all connections to busbars or earth bars shall be made with tinned copper cable lugs, soldered or crimped to the ends of the conductors and bolted to busbars by means of cadmium-plated high tensile steel bolts and nuts provided with spring washers.

All wiring is to be kept free and away from any exposed terminals or other un-insulated current carrying parts.

Only wires of the same potential shall be grouped or bunched together.

Looping of wiring connections between switchgear phase or neutral terminals is not permitted. All connections and jumpers shall be run individually from the appropriate busbars or neutral bars or neutral terminal box.

PVC trunking with slotted sides shall be used for control wiring.

Wires shall be clearly marked at all termination points, in accordance with the numbering of the Distribution Board Manufacturer's Wiring Diagram, by means of "Critchly" or similar and equivalent markers.

When the board main switch is switched off, no live incoming or other wiring shall be accessible. The incoming terminals must be screened or inaccessible. Where connections are taken from the incoming side of the main switch, they shall be screened by a screen marked "Isolate Feeder before Removing Screen". If any circuits are energised from other sources, clear warning notices to that effect shall be fitted and such terminals shall be clearly marked.

All wiring shall be neatly grouped and laced. Wiring is not to be run at random, but shall follow board construction features as far as possible.

The wiring at feeder terminals, eg. MCB, shall be long enough to allow for current measurement by means of a clamp-on type ammeter.

A common 15-ampere terminal strip shall be provided for the connection of external control wiring. The terminal strip shall be of robust construction, firmly secured to the board and all terminals shall be clearly marked in accordance with the Distribution Board Manufacturer's working drawings and wiring diagrams. The terminals shall be of the shoe-clamping type.

All main and sub-main switchboards, unless otherwise specified, shall be equipped with a test terminal block, of an approved manufacturer. The test block shall be mounted directly below the ammeters and voltmeters on the front panel of the board and shall be wired in series with these instruments.

40.13

LABELLING

All safety warning notices shall be in English and Zulu.

Each distribution board shall be labelled with their name and/or designation of that board.

All circuit breakers on distribution boards shall be properly labelled, indicating number of circuit controlled and location of such circuit.

A legend card, covered by a removable glass or 2mm transparent acrylic plastic ("Perspex") or equivalent panel, shall be installed on the inside of the door of the distribution boards or cubicles and circuits shall be designated on this card. All other equipment to be individually labelled indicating function.

Black letters on white background shall be used for all normal letters and red letters on white or yellow background for danger notices. Labels shall be of sandwich-type, or other approved plastic board, fixed level to the frame panel and neatly by means of blunt-ended screws. Lettering shall be not less than 5mm in height and labels shall be mounted centrally below items of switchgear and generally in approved positions.

The main isolating switch or switches shall be clearly labelled in accordance with the regulations.

Size and origin of supply cables and busbars shall be clearly labelled on all boards, eg "Fed from Main Board with 25mm – 4-core copper cable".

All equipment situated inside the board, eg Contractors, relays, fuses, timers and time switches, shall be clearly marked, indicating function, circuit controlled and fuse rating.

All items of equipment, ie switches, plugs, lighting, isolators etc. shall be labelled as to where fed from, ie LSI-DB6-MCB2-B Phase.

40.14

EARTHING

Earthing shall comply with Clause 4.1 of SABS 1180.

Copper earthbars shall be provided in all boards of cross-sectional area equal to that of the phase busbar, up to a maximum of 160mm². Earth bars must be efficiently bonded to the metal framework of the board and shall be of sufficient size to accommodate a separate earth wire for each circuit requiring one.

40.15

WORKING DRAWINGS FOR APPROVAL

Four copies of working drawings of wiring diagrams, schematic diagrams, general arrangements and construction details of all distribution boards shall be submitted to the Engineer for approval prior to manufacture. These drawings shall indicate all electrical and mechanical information as well as make and type of equipment, dimensions, ratings and other relevant technical information.

The Contractor shall check all details and sizes in respect of location and accessibility and shall ensure compliance with the specifications. Comments made by the Engineer on drawings and layouts shall not relieve the Contractor from any obligation in terms of the specification.

40.16 **INSPECTION**

All distribution boards, upon completion, shall be inspected by the Engineer at the manufacturer's premises prior to them being delivered to site. Seven (7) days notice must be given to the Engineer before the date of such inspection is required. All test facilities and necessary equipment shall be supplied by the manufacturer. No distribution boards will be ACCEPTED ON-SITE without approval in writing by the Engineer. Any costs involved due to failure of this requirement will be the Contractor's liability.

The board must be supplied with a certificate as required by SABS 0142-1, Annexure H or similar.

40.17 **TYPES OF BOARD**

40.17.1 **FLOOR MOUNTED DISTRIBUTION BOARDS**

Floor-standing boards shall be of the free-standing, pedestal type, with or without doors as required and shall be made up in sections which shall be assembled on-site. The boards shall be so designed as to enable the board to be extended without undue difficulty.

The distribution/switchboards shall be constructed of 2mm sheet steel, suitably stiffened and reinforced by angle-iron framework and shall be complete with all equipment, internal wiring and labelling.

A suitable gland plate for mounting cables shall be provided for termination of cables. Cables and busbars can enter the leave boards from both above and below, as required.

Gland plates shall be bolted down in sections not wider than 600mm. Any gland plate shall be removable without interfering with the adjoining gland plates.

Gland plates shall be a minimum of 375mm from cable terminals.

40.17.2 **FLUSH MOUNTED BOARDS**

These shall be of the adjustable architrave type to SABS 1180, comprising a wall mounted bonding tray of 1,6mm (min) galvanised sheet steel with edges returned for additional rigidity and over which is fitted a 1,6mm architrave frame formed to provide a rebate for front panels and doors and suitable for the fitting of doors at any time. The architrave shall overlap the wall tray by at least 25mm on all sides to cover rough plaster edges around the bonding tray and shall be so fixed to the tray as to allow for adjustment in depth and plumb alignment. Trays which take up the full depth of walls

shall be fitted with expanded metal sheeting welded to backs of trays, having an overlapping border 75mm all round, to provide a bond for plaster.

40.17.3 WEATHERPROOF BOARDS

Where these are specified they shall always be of the surface mounted type, but installed either flush or on surface as specified. Lockable doors shall in all cases be provided. In addition weatherproof boards shall be so constructed as to prevent any ingress of water and shall be made hose proof. A sloping canopy shall be fitted along the top of the board to divert any water falling on the board.

40.18 INSTALLATION

All distribution boards shall be installed at a convenient height, with the top edge of the tray not exceeding 2300mm above finished floor level. The maximum height of any switchgear handle, meter or instrument face, shall be limited to 2000mm. The Electrical Contractor shall level, fix and grout all distribution boards to the satisfaction of the Engineer.

The Electrical Contractor shall note sizes and positions of cable trenches and vertical shafts and shall include in his tender all supporting steel work to straddle trenches and vertical shafts to support distribution boards securely.

The Electrical Contractor will be required to balance the load as equally as possible across multi-phase supplies. Balancing of loads across the three phases must be finally approved by the Engineer after commissioning.

41. GROUND STORAGE TANKS-PREFABRICATED STEEL TANKS

The contractor shall supply 1, 112 kL water storage tanks. The tank shall be similar or equal to SBS steel tanks. The tanks shall be constructed on concrete foundations. The structure and foundations shall form part of a supply and design installation. The completed works shall be supported by a Certificate issued by a Professional Engineer to the effect that the tank, structure and foundations are structurally stable and satisfactory for use under the conditions listed in the Certificate.

41.1 Type of tank

The ground storage tanks shall be similar or equal approved to SBS steel tanks. The storage tank shall be circular in construction, bolted, roofed high tensile steel panel tank with multi-layer woven scrim base liner.

The tank diameter shall be 4 780 mm and 6 280 mm high. The roof structure shall be domed with a centre height not less than 200mm above the tank wall and the roof sheets shall overhang the tank walls by 100mm nominally, unless otherwise specified.

41.2 Construction materials

The tank panels shall be fabricated from high tensile, G300 Zincalume steel sheets or sheet laminates from steel sheet conforming to SANS 9364. Roof Trusses, ladders, and other steel components shall, where applicable, be of carbon steel that complies with the relevant requirements of SANS 1431. Fabricated items, without exception will be hot dipped galvanized in accordance with SANS121:2011 after fabrication, no items will be welded on site. Ladders and tank connectors shall be fabricated in stainless steel in accordance with SANS 10162-4.

The tank liner material shall comprise of multiple layers fabricated from a heavy duty, approved non-toxic food grade material such as PVC, polyethylene, polypropylene or a combination of such materials, and shall have a multi-filament base scrim, of no less than 8 x 8 threads per cm². Liners for consideration of use must be factory fabricated,

and welded by means of radio frequency welding or hot air/wedge welding process. The operational temperature range of the liner should be -30°C to +70°C. Steel sheeting used for roofs shall be fabricated from high tensile steel sheets conforming to SANS 9364, profiled to an approved profile, and with a minimum thickness of 0.47mm.

41.3

Panels

The nominal size of each panel shall suit tank dimensions.

The panels shall be profiled to an approved profile, and shall be factory pre-curved by the manufacturer for each tank model /size. The profiling of the panels shall be such as to comply with deflection limits. (Bulging shall not cause the material to stretch beyond its elastic limit/ yield).

The steel grade shall be G300 AZ150 minimum with single panel thickness not less than 0.8mm. The panels shall be designed and tested to withstand all anticipated applied loadings including wind and earthquake in conjunction with the associated vertical stiffeners. Vertical stiffeners (wind girts) will be of minimum 2.4mm galvanized material and formed into a suitably engineered profile to withstand bending. Panels shall be increased in thickness and/or laminated to provide the sufficient strength to cater for hydrostatic pressure increases proportional to tank height increases in nominal 1.1m steps to the maximum tank height of 9 390mm.

The minimum wind speed and earthquake loadings must comply with SANS 10160. The minimum design wind speed shall be 40m/s. External tank pipework shall be installed so as not to impose additional loading on the tank. If inlets or outlets greater than 150NB are required by the engineer, either the panel thickness must be increased and/or extra panels must be laminated at that position to safely support the connector. Panels shall be overlapped in both the horizontal and vertical planes. The vertical panel edge overlap shall be sufficient so as to include 2 rows of bolt holes. These bolt holes must be spaced a maximum of 60mm apart in the vertical plane, and no more than 45mm apart in the horizontal plane.

A galvanised strengthening rib (wind gird) shall be used at the vertical panel edge joints and bolted as an integrated part to the panel overlap using the same bolts utilised for joining the panels. The tank design shall be such that the vertical strengthening rib from the panel immediately above shall overlap the lower panel and form part of the lower panels bolted panel join. The overlap section must be no less than 180mm and must 'join' with no less than 6 bolts being common to both vertical strengtheners/wind girts

Panels shall be joined to the panel above in the horizontal plane by means of a continuous panel overlap of at least 115mm, and shall be bolted together at a minimum of 5 equispaced points along this overlap. The panel bolt holes shall be of a diameter at least 1.5 mm larger than the nominal bolt size.

The vertical joint bolt sizes must be proportional to the height and model of the tank and must be equal to the bolts used on the corresponding vertical stiffener joints. All bolts used in the tank wall panel construction shall be grade 8.8, hot dipped galvanized with serrated face flanged head nuts to match. All fasteners must be of traceable origin with test certificates to support chemical composition and grade.

41.4

Roof trusses

The roof trusses and/or truss sections shall be fabricated from hot rolled first class weld able steel square tube or angle iron. Square hallow sections will be of minimum grade / type S355. All joints shall be welded and the completed truss shall be hot dipped galvanised 150g/m² to SANS 121 (ISO 1461) after fabrication. Trusses fabricated from sheet metal which is folded and then riveted or screwed or bolted together to form a truss member will not be acceptable.

Where bridges and/or bracing between truss members are used, these items shall be bolted to the main truss members at both ends and at all intersecting points. Truss to wall attachment plates shall be of a fixed mating angle type allowing for correct and accurate alignment of trusses. At point of attachment the truss must be bolted to the tank body with a minimum of four grade 8.8 M10 bolts. The truss attachment should also have a strengthening plate bolted to it externally measuring no less than 200mm x 70mm

Loading of the roof shall be provided for by suitable structural design and shall comply with the relevant requirements of SANS 10160. The roof shall be designed to prevent the accumulation (or ponding) of water on its surface. Steel used in the truss manufacture shall have minimum yield strength of 355MPa. All bolts used in the truss assembly shall be grade 8.8 with nuts and washers to match.

41.5 **Top and Bottom Hoops**

The tank shall be provided with strengthening hoops at the upper outer edge of the top panel and lower outer edge of the bottom panel. These hoops shall be fabricated from steel rectangular tube, pre-curved to suit the tank diameter and hot dipped galvanised 150g/m² to SANS 121 after fabrication.

The hoop sections shall be joined together with galvanised joiners inserted into the hoop sections. There shall be a minimum of 100mm overlap in two adjacent sections and the joiners shall be securely fixed to the respective hoop sections. These hoops must be securely fixed to the top and bottom of the tank.

41.6 **Tank Hold-Down Brackets**

The tank shall be secured to an engineer designed and approved steel reinforced concrete ring beam or slab base by means of original manufacturers' equipment suitable steel hold down brackets. These brackets shall be designed taking into account all anticipated loadings on the tank.

The hold down brackets shall be bolted to the tank wall at the panel joins at the base of the tank by no less than 6 x M12, 8.8 grade hot dipped galvanized bolts and nuts, and provision shall be made to allow for fixing to the concrete base by means of suitably approved sleeve anchors / expansion bolts.

For tanks of different sizes there should be a range of different sized brackets used to ensure proportional loading through the brackets in accordance with the tank model. Provision shall be made in the bracket design to allow for expansion and contraction of the tank.

41.7 **Liner**

The liner shall be comprised of multiple layers fabricated from a heavy duty, approved non-toxic food grade material such as PVC, polyethylene, polypropylene or a combination of such.

The liner material must be internationally certified by a recognised authority or testing body for use in contact with drinking water. All liners must be 'supported' by way of an internal central layer / scrim. No unsupported liners will be acceptable. The liners shall be factory fabricated in a controlled environment with all seams homogenously welded by means of an RF or hot air/wedge welding process under controlled conditions to form a watertight seal.

Suitable stiffening shall be provided around the top perimeter of the liner to provide an adequate base for the fastening of the liner to the tank wall. Reinforced attachment straps fabricated from the same material as the liner shall be welded at suitable intervals to the outer face of the liner complete with eye-lets to allow fastening to the panel joint bolts.

If required by the procuring body, the liner material must demonstrate that the seams will not leak or permanently deform by undergoing a flume test using a tube made up of the relevant liner material and with a standard welded seam along its length. The

sample must withstand a constant pressure of 3 bar for 30 minutes without evidence of leaks/weeping or permanent deformation.
The completed liner must be provided with a non-leak guarantee backed by the manufacturer for a minimum of ten years. The liner material must be capable of being easily repaired on site in the event of damage.

42. **SCHEDULE OF EQUIPMENT OFFERED**

Fire Extinguishers

Make
Country of Origin
Date of Manufacture
Approved by

Fire Hose Reels

Make
Country of Origin
Date of Manufacture
Approved by

Fire Hydrants

Make
Country of Origin
Date of Manufacture
Approved by

Fire Blankets

Make
Country of Origin
Date of Manufacture
Approved by

Fire Storage Tank

Make

Country of Origin

Date of Manufacture

Approved by

Fire Booster Pumps

Make

Country of Origin

Date of Manufacture

Approved by

43. **SPECIFICATIONS**

The specifications to be used in the design of the mechanical service are as follows:

No	Description	Document Number
1	Flange Specification	SANS 1123
2	Identification Colour Markings: Pipe Marking	SANS 10140: Part 3
3	The application of the National Building Regulations: General Principles and requirements	SANS 10400: Part A
4	The application of the National Building Regulations: Lighting and ventilation	SANS 10400: Part O
5	The application of the National Building Regulations: Stairways	SANS 10400: Part S
6	The application of the National Building Regulations: Fire Protection	SANS 10400: Part T
7	The application of the National Building Regulations: Fire installation	SANS 10400: Part W
8	Fire testing of materials	SANS 10177- Part 2-4
9	Fire hose reels (with semi-rigid hose)	SANS 543
10	Components of underground and above-ground hydrant systems	SANS 1128: Part 1

11	Hose couplings, connectors, and branch pipe and nozzle connections	SANS 1128: Part 2
12	Symbolic safety signs: Standard signs and general requirements	SANS 1186: Part 1
13	Symbolic safety signs: Photo luminescent signs	SANS 1186: Part 5
14	Safety of luminaires: Luminaires for emergency lighting	SANS 1464: Part 22
15	Fire detection and alarm systems for buildings — System design and installation.	SANS 10139
16	Automatic sprinkler installations for fire-fighting purposes	SANS 10287