

Section F Mechanical Building Services Specifications for Upgrade Works

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Quality Assurance

The Contractor will be deemed to have included for the supply, delivery, hoisting, erecting, commissioning, testing, handing over in a complete working order, ready for immediate use, as well as the subsequent upholding during the Defects Notification Period, of all plant and equipment, necessary for the successful completion of the installation as described in this specification and on the accompanying drawings, schedules and BOQs.

Ensure that the construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation shall be exposed.

Ensure that the whole installation complies with all relevant standards.

If any clause or statement is not possible or conflicts with the drawings and other information, the Contractor is to immediately bring this to the attention of the Engineer.

Additional Documentation

This section of the Specification relates to the manufacture, delivery to site and installation of the above ground foul drainage and ventilation pipes. To ensure a fully coordinated installation, this Specification is to be read in Conjunction with all of the following documents:

- Below ground foul drainage information
- Above ground foul drainage information
- HVAC system information
- Fire reticulation system information
- Fire signage system information
- Relevant Section of the Project or system BOQ
- ALL ARCHITECTURAL LAYOUTS AND SANITARYWARE SCHEDULES

PB 001: FIRE PROTECTION INSTALLATION

1.1 General Requirements for the Contractor

This Specification covers supply, install, clean, test and commission of the complete Fire protection and reticulation system for the **SRSS: Leeuwkuil Scheme in Gauteng**. All work shall be carried out to the complete satisfaction of the Employer and Engineer.

All equipment shall meet the performance criteria as detailed in this Specification, and the relevant schedules, Drawings and BOQs. All equipment is to be priced as per the schedules and BOQs but options on equal and approved suppliers and equipment can be provided.

The design of the Fire protection shall meet the Building Regulation SANS 10400 part T & W as well as comply with the requirements of the Employer. The Fire Fighting equipment, installations and fire protection system shall be installed properly as to be ready for their purpose at all times.

The fire water system shall be installed using the minimum pipework, will be free of contamination and will be free flowing as required. To insure fittings and accessories necessary to be able to carry and supply water quickly, quietly and with freedom from nuisance or risk to health.

All pipelines shall be identified in accordance with Building Regulations.

Removable access panels shall be co-ordinated with the valve locations to enable maintenance.

Pipework shall be installed true and supported in accordance with SANS 10252-1 and the manufacturer's recommendations.

All parts and equipment used with portable and non-portable fire extinguishers shall be in accordance with Codes SANS 810-1985, SANS 889-1973, SANS 1151-1977 and SANS 0105-1971.

Markings and signage shall comply with the requirements of SANS 10114-2 with regard to the maximum viewing distance of the sign in proportion to the vertical dimension of the sign.

All visible fittings and fixtures, such as mounting brackets, fire extinguisher cabinets (where specified), labels etc. shall be approved by the Engineer.

The Contractor shall submit identified duplicate samples of all manufactured items. One sample of each item will be signed by the Engineer and handed to the Contractor, who will keep it on site available for inspection.

1.1.1 Contractor Responsibility and System Coordination

The Contractor shall be responsible for the supply, installation, testing, commissioning and upholding during the Defects Notification Period of the installation detailed in this Specification and on the accompanying Drawings, Schedules and BOQs.

The Contractor shall provide all materials, equipment, labour and services necessary for the complete, safe and efficient operation of the installations in accordance with the intent of this Specification and Drawings.

This Specification and accompanying layouts, schedules and BOQs detail the requirements of the Contractor in terms of the Fire protection Services installation. Coordination of the relevant elements of the installation that interface with the various other installations (HVAC, Power, Lift, Wet services etc.) is the responsibility of the Contractor.

Due to the nature of this Construction Project, the Contractor is to ensure all interfacing elements have been priced for..

Specific areas (but not limited to) to verify:

- Fixtures and Fittings.
- Builders work Required
- Concealment of pipework and equipment Required

Should any of these and any other requirements be lacking, the Contractor is to inform the Employer.

1.2 General Specification

1.2.1 General Description

The purpose of the fire protection system is to provide the building with measures that extinguish a fire or allow persons to extinguish a fire that is small and manageable. The system is also to allow for the escape of all persons from the building safely and quickly.

This specification covers the supply, delivery, installation, testing, commissioning and handing over of the complete Fire protection System specified below and as indicated on the Drawings, which form part of this Specification. All the work shall be carried out to the complete satisfaction of the Employer and Engineer.

The Drawings indicate the sizes of pipes and the manner in which the various systems of piping are to be run.

All pipes, fittings or any materials used shall be new, suitable for the said operating and test pressures and conform to the specification.

1.2.1.1 Principal items of work

Principal items of work include, but are not limited to, the supply and installation of:

- Fire extinguisher, Hose reels, signage and Booster connection.
- Fire Pipework Installation.
- All control panels and monitoring equipment necessary for the complete working of the system.
- All necessary supports, hangers, brackets and accessories to complete the installations.
- Commissioning and testing of the installations.
- Upholding of the installation during the Defects Notification period.

1.2.2 Design Parameters

Fire Protection services installation will comply with all the requirements of the following:

- SANS 10252-1:2012
- SANS 10400 XA
- SANS 10400 T
- SANS 10400 W
- All other relevant guides and building regulations

1.2.3 General System Requirements

1.2.3.1 Fire Protection Water Supply and reticulation

The Employer shall provide a single, metered water connection to each building facility (site) separating into domestic water and manual fire fighting systems, if applicable (one water meter per site).

The Employers fire main reticulation shall be external to the building, including external fire hydrants and a fire booster connection at the site entrance, and shall enter and terminate within the building with a minimum of a flanged 100 mm diameter galvanized steel pipe.

In the event of galvanized steel piping being used underground, all such underground steel piping and fittings shall be treated with Rapid bond in accordance with the manufacturer's

specification/recommendations, and to the Engineer's approval, in order that the piping and fittings are fully protected against external corrosion.

SANS part T states that a building of 250m² or greater per floor area shall be provided with a fire hose reel for each 250m² that is able to reach the furthest corner of the building, therefore for fire-fighting purposes hose reels shall be installed in the building as per SANS requirements.

A twin booster set and suction line will be installed after the municipal meter and from this point the rest of the fire water reticulation will move into the building. A non return valve will be installed between the suction line and the booster to ensure the municipal line is not pressurised should a booster truck need to connect.

The fire water supply will run to the fire tank located in the plant room and from here will be pressurised and pumped to the building.

Generally pipework should run within service and back of house zones and push through to the required areas where possible.

1.2.4 General Equipment Requirements

1.2.4.1 Fire Hydrants

Fire hydrants shall be supplied in accordance with SANS 10400 "Part T" of the National Building Regulations, with a Building Occupancy of D2 Medium Risk Industrial (Process Area), J2 Medium Risk Storage (Storage Area) and G1 (Offices)

- fire hydrants shall be provided within the buildings, at the rate of one (1) per 1000 m² or part thereof, together with the requisite number of hoses, couplings and 16 mm diameter nozzles. Pipework feeding fire hydrants shall not be less than 75 mm diameter.
- all pipework shall be hydraulically sized in accordance with the relevant South African National Standards documentation.

1.2.4.2 Fire Hose Reel

Fire hydrants shall be supplied in accordance with SANS 10400 "Part T" of the National Building Regulations, with a Building Occupancy of D2 Medium Risk Industrial (Process Area) and / or J2 Medium Risk Storage (Storage Area), i.e.:

- fire hose reels shall be provided within the buildings, at the rate of one (1) per 500 m² or part thereof, mounted at 1500 mm (to centre of the appliance) above finished floor level, 30 m x 20 mm internal diameter rubber hose and nozzle, pressure gauge, brass water way and gland, stopcock, pipework etc. all in accordance with the relevant South African National Standards documentation.
- any piping feeding any single fire hose reel is to be a minimum of 25 mm diameter galvanized pipe in accordance with the relevant South African National Standards documentation.
- all pipework shall be hydraulically sized in accordance with the relevant South African National Standards documentation.

Hose reel installed in building shall comply with the requirements in SANS 543, shall be installed in accordance with SANS 10105-1 and SANS 10400-W, and shall be maintained in accordance with the requirements in SANS 1475-2.

Hose reels shall be red enamelled type of all steel construction, and provided with wall mounting bases, spindles and glands and shall be securely fixed to the wall with suitable "rawl" bolts and plate washers.

Hose reels shall be fitted complete with supply pipe, nozzle cock and hose guide in conformity with SANS 543 and bear the SANS mark. Fire hose shall be reinforced rubber 25 mm nominal bore, having 28 mm outside diameter and shall be in 30 m lengths.

Any hose reel installed shall be positioned to ensure that the end of the hose will reach any point in the area to be protected.

1.2.4.3 FIRE EXTINGUISHERS

Portable fire extinguishers installed in a building shall comply with the requirements in SANS 1910, and shall be installed, maintained and serviced by competent persons in accordance with SANS 1475-1 and SANS 10105-1.

Such portable fire extinguishers shall bear a certification mark from an accredited Certification body and shall bear the SABS mark of approval.

All portable fire extinguishers shall be supplied complete with quick release brackets and fixings for wall mounting. The brackets are to be fixed to the structure with rawl bolts.

All fire extinguishers shall be supplied in the charged condition.

All fire extinguishers shall be fitted with means to provide visual indication that the unit has been partially or wholly discharged. Each extinguisher shall be marked with operating instructions, and markings shall conform to SANS requirements. Each extinguisher shall be stamped with the design pressure, test pressure and test date.

All fire extinguishers shall be painted red with their labels colour coded or the cylinder itself is colour coded to indicate its contents. The colour coding shall be:

Dry Chemical Powder	:	Blue
Halon 1211 (BCF)	:	Green
Water	:	Red
Foam	:	White
Carbon Dioxide	:	Black

1.2.4.4 Valves

Valves will be required as per the installation requirement as well as the following not indicated:

- Valves shall be suitable for the pressure duty required, and shall be of a suitable pressure Class, depending on the mounting location.
- Valves shall be sealed or locked in the correct position by means of an approved lock and chain.
- Hose reel valves shall be 25 mm bronze shut off valves, globe type with threaded ends.
- Valves shall be suitable for PN16 with non-shock water and shall be clearly marked with an arrow and the words open in red.
- Valves shall be suitable for the installation of an approved sealing device.

1.2.5 Fire Protection Pipelines

Generally, the following pipework materials will apply to the Fire Protection pipework, unless detailed or specified otherwise.

1.2.5.1 Galvanised Steel

The fire appliance ring main within the factory/building shall be galvanized steel to relevant South African Standards, and shall include red bands every 6 m lengths. The dropper pipes to relevant fire

hydrants/fire hose reels shall be cleaned, primed and painted with red oxide and signal red enamel paint on completion of installation.

All piping shall be hydraulically pressure tested in sections. The testing thereof shall be witnessed by the Engineer and the relevant pressure test certificates shall be prepared by the Contractor and submitted to the Engineer.

All pipe-work is to include galvanized/stainless steel hangers/fittings and must be adequately and neatly supported in both the horizontal and vertical direction.

Welded sections of piping shall have flange/coupling joints at suitable intervals to facilitate removal. All fittings shall be groove type systems in accordance with SANS 1109/BS21 and ASIB.

Galvanised Steel pipes and fittings shall be manufactured in accordance with SANS. The tubes shall be straight, smooth, of true cylindrical bore and free from all flaws.

The pipes and fittings shall be jointed by screw fit or flanged connection with PN of 16 Bar to suit the pipework material and/or the fitting being connected to. Generally connections will be flanged for all pipes 50 mm in diameter or greater with screwed connections for smaller pipes.

Galvanised will only be used where specifically stated. This is generally confined to all major supply pipework above ground.

All pipework 50 ND or less will be screwed

All pipework greater than 50 ND will be either welded or shoulder ended to allow for specialist coupling of the pipework (Klambon/Klamflex) or similar. Pressure ratings of joints must comply with the maximum working pressure of the system

1.2.5.2 HDPE

HDPE pipes and fittings shall be manufactured in accordance with SANS. The tubes shall be straight, smooth, of true cylindrical bore and free from all flaws.

The pipes and fittings shall be suitable for a PN of 16 Bar.

1.2.6 Fire Protection Pipe Routes

Ensure pipe routes are shortest practicable, with the minimum number of bends, unless indicated otherwise. Pipe routes are indicate don the drawings and the contractor is to follow these routes as far as is practicable

HDPE will be used for all major water runs below ground if required for Fire Protection pipelines.

1.2.7 Fixing and Jointing

Pipes supplying the hose reels will be supported as follows (or as per manufacturer's minimum recommendation – whichever is more robust):

Size of pipe	Spacing for Horizontal (m)	Spacing for Vertical (m)
15-28	1.8	2.4
28-40	2.7	3.0
40-50	3.0	3.6
65-150	4.0	4.5

Install pipes, fittings and accessories in accordance with Building Regulations and manufacturer's recommendations.

Where horizontal pipes are installed in excess of 300 mm from the soffit of the supporting slab adequate supports shall be provided to prevent lateral movement.

Install adequate restraint couplings to ensure that the system is capable of withstanding all likely accidental static water pressures.

1.2.8 Marking and signposting

Escape routes shall be clearly marked and signposted to indicate the direction to be travelled in the case of any emergency. Such signage may be of the internally or externally illuminated, or photo luminescent type and shall comply with the relevant requirements of SANS 1186-1, SANS 1186-3, SANS 1186-5 and SANS 1464-22.

Marks or signs which are not of the illuminated type shall be illuminated to an intensity of not less than 50 lx. Internally illuminated signs shall comply with the luminance requirements of SANS 1186-3. Photo luminescent signs shall comply with the luminance requirements of SANS 1186-5.

The system, which is based on international standards, is briefly described as follows:



Informative, Fire Fighting: square in shape with a white background and red border. The symbol must be in red and placed in the centre of the sign. Typical examples of such signs are the location arrow, fire extinguisher, fire hose, etc.



Informative, General: square in shape with a green background and white symbol centrally placed. Typical examples of such signs are those for first aid equipment, general direction arrows, direction to escape route, etc.



Mandatory Sign: round in shape with a blue background, with the symbol placed centrally and in white. Typical examples of such signs are those advising that certain pieces of protective clothing must be worn (e.g. goggles, respiratory protection, hand protection, etc.).



Prohibition Sign: round in shape with a white background and a circular band and diagonal bar in red. The symbol must be black and placed in the centre of the sign without obliterating the cross-bar. Typical examples of such signs are those prohibiting smoking, fire and open flames, the use of cell phones, etc.



Warning Sign: triangular in shape with a yellow background and black triangular band. The symbol or words must be black and placed in the centre of the sign. Typical examples of such signs are those warning of the danger of explosion, electric shocks, slippery walking surface, etc.

1.2.9 Builders work

The Contractor shall be responsible for providing all small openings in brick walls for pipework etc. and for providing the necessary flashing, support brackets for pipework ductwork etc.

The Contractor shall be responsible for providing all Builders' Work Drawings. Full details of all large openings for pipework in the roofs, slabs and brick walls, details of concrete bases, etc are to be included on these drawings which are to be submitted to the Engineer for approval in good time to comply with building program.

The Contractor shall also check the positions and sizes of all these openings, bases, etc.

The Contractor shall provide all waterproofing and making-good.

1.2.10 Fire Safety

Provide and install protection of openings and fire stopping in accordance with the Building Regulations.

Provide and install on all plastic pipework passing through fire compartment floors or walls and exceeding 40mm internal diameter an intumescent fire sleeve in accordance with Building Regulations – SANS 10400 Part T: Fire Protection. The fire sleeve shall have a fire rating compatible with the floor, wall or cavity barrier to which it is fitted.

1.2.11 Earthing and Bonding

All new metal pipework systems shall be continuity bonded and tested to ensure earth continuity. These shall all be tied into the buildings main earthing system, whether it is rebar or other system being employed.

Carry out equi-potential bonding and tests of the foul drainage system (above ground) to prove the effectiveness of the earthing system. All tests shall be fully recorded and included within the operating and maintenance manuals.

1.2.12 Workmanship

Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds. Failure to undertake this will result in the requirement for CCTV inspections to be carried out to the entire system, to prove that the system is free from debris.

Handle, store and securely fix all products and accessories in accordance with manufacturer's recommendations.

All pipework and fittings shall be properly cleaned, where necessary following completion of the installation.

1.2.13 Testing and Commissioning

TESTING AND COMMISSIONING SHALL BE UNDERTAKEN IN LINE WITH THE CIBSE COMMISSIONING CODES AS WELL AS BELOW. THIS IS IN LINE WITH THE GREEN STAR RATING SPECIFICATION

The Contractor shall be responsible for testing and commissioning of the complete plant and allow for inspections by the Engineer as required.

After the Contractor has completed his testing and commissioning and is satisfied that the plant is ready for the Tests on Completion he shall notify the Engineer so that the Tests on Completion can be arranged.

1.2.13.1 Commissioning Schedule

The Contractor shall submit to the Engineer a complete commissioning schedule at least 1 month before commissioning commences. The commissioning schedule shall contain all commissioning activities, all equipment to be tested and all variables of all equipment to be checked. The following tests and measurements are to be included and recorded:

1.2.13.1.1 Mechanical Tests and Measurements

- Capacity of the systems.
- Operation of control, safety and alarm devices.
- Noise levels.
- Any other tests that may be required for the particular system.

1.2.13.2 Commissioning is to be carried out as follows:

The Contractor will be responsible for the supply of all test equipment necessary to carry out all tests. Performance tests shall be carried out in the presence of the Contractor, the Engineer as agreed and, if required, the local Fire Department.

The method of checking and testing the operation of the system shall generally be as follows (or as more specifically detailed elsewhere in this specification):

- (1) The pressure and flow test through the fire hose reel and hydrant, assuring that the minimum requirements set by SANS are met.
- (2) Fire Brigade Signalling
 - a. The activation of the alarm at the Station must be checked for correct operation with the energising of the water flow switch.
- (3) Every fire hose reel and hydrant shall be checked for operation, prior to the Municipalities seal being fixed.

Once the schedules have been completed they are to be forwarded to the Engineer for approval, signature and for record purposes.

1.2.14 Contractor General Requirements

1.2.14.1 Contractor Information, drawings and samples

The Contractor shall within a period of two weeks of receipt of documentation verifying his appointment submit to the Engineer all drawings and samples as requested by the Engineer. The drawings shall be submitted within two (2) weeks in an orderly sequence so as to cause no delay to the works.

The Contractor shall be responsible for providing the following Drawings pertaining to the Fire Protection Installation for the execution of the project.

- Fire Protection Services Drawings
- Builder's Work Drawings
- Shop Drawings
- As Installed Record Drawings

By preparation and submission of this information, the Contractor shall be deemed to have determined and verified all field dimensions, materials, catalogue numbers etc. In terms of the project programme, the Contractor shall allow the Engineers adequate time for review of drawings.

The Contractor shall submit electronic copies of all drawings to the Engineer for approval before commencement of work.

No portion of the work requiring approval of shop drawings or samples shall be commenced without the necessary approval of the Engineer.

1.2.14.1.1 Samples Required:

- Galvanised pipework jointing sample
- Example of pipe hanger

1.2.14.2 Variations and additional works

Corrections, comments, amendments or approval of shop drawings and samples are not to be assumed as acceptance of variations in the cost of work.

Should such approval, comments, etc, in the opinion of the Contractor involve additional cost, the Contractor shall notify the Engineer in writing within the time periods stipulated in Clause 8 and 20 of the Contract of receipt of such approval, comments, etc.

Variations in costs shall be calculated in accordance with the labour and material rates, indicated by the Tenderer in the Bill of Quantity.

1.2.14.3 Operating and maintenance manuals

Operating and maintenance manuals are to be prepared by the Contractor for all the systems and installations for which they are responsible. This will include (but is not limited to):

- General Description of the systems

- Operating manuals for all equipment
- Maintenance requirements for all equipment and systems
 - Including lists of all spares that should be kept on hand
- Record Drawings of all system installations.
 - Including floor layouts, sections, and details of all installed equipment, plant, cables, etc. Enough detail must be provided to allow the facilities team to be able to pinpoint all the services.
 - Must include equipment numbering and all labelling

Manuals must be submitted to the Engineer at least 1 week prior to the system commissioning start date.

After approval of the manuals by the Engineer, the Contractor shall provide the Engineer with bound copies as well as soft copy CD ROMs/flash drives of all MS Word, Excel and AutoCAD files as well as all manufacturers information.

Manufacturer's catalogue information shall be scanned and saved to disc in "JPEG" format at a rate of compression to be clearly legible.

The CD ROM copy shall read as a catalogue with drawing files separated and all files properly indexed.

The Works will not be taken over by the Employer, until these documents have been supplied, complete and to the satisfaction of the Engineer.

The Contractor shall include for professional assistance in preparation of the above if necessary.

1.2.14.4 Guarantee and maintenance

The entire installation shall be upheld during the Defects Notification Period.

The Contractor shall service and maintain the installation during the Defects Notification Period.

The various items of equipment shall be serviced and maintained in strict accordance with the requirements of the respective suppliers of the equipment.

Tenderers shall include, in their tender prices, for travelling, labour, consumable, oils, lubricants, chemicals, tools, etc. necessary for the successful implementation of the maintenance programme.

Tenderers shall allow for at a minimum monthly maintenance visits during the Defects Notification Period.

The Contractor shall implement and maintain maintenance/servicing register for the duration of the Defects Notification Period.

A record of each maintenance visit shall be submitted to the Engineer within one (1) week after each visit.

At the end of the Defects Notification Period the Contractor shall hand over to the Employer a full set of any special tools or instruments required for the continued maintenance of the installation.

1.2.14.5 Labelling and Painting

All labels shall be in English as per Clause 1.4.

1.2.14.5.1 Equipment

All items of equipment and plant shall be labelled. Labels shall be of engraved aluminium be securely fixed by screws or rivets. Lettering shall be block capitals in a minimum size of 8 mm. 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.

1.2.14.5.2 Pipework

1. All surface to be thoroughly cleaned with a detergent chemical solution in accordance with SABS 064 Code of Practice for the Preparation of Steel Surfaces for Coating.
2. One coat of self etching primer to SABS 723 (Wash Primer)/(Metal Etch Primer).
3. One coat of zinc chromate paint to SABS 679 (Zinc Chromate Primers for Steel) Type II, Grade I.
4. One coat Signal Red oleo-resinous, micaceous iron oxide paint.
5. Two coats pure acrylic emulsion exterior paint to SABS 634.

All paints used shall be by the same and approved manufacturer and the Contractor shall ensure that the various paints are compatible one with the other.

Surfaces exposed on galvanised material through cutting, drilling and/or pipe grips shall be painted with Galvalloy or similar.

1.2.14.6 Intumescent painting

All services penetrations shall be fire sealed.

The Contractor shall identify, on drawings, where his services penetrate floor slabs.

The Contractor will caulk in all services.

Once services have been caulked in a specialist contractor other than the Contractor shall apply intumescent paint to ducts, piping etc. where such passes through floor slab and fire barriers.

Before requesting the Engineer to carry out an inspection the Contractor shall satisfy himself that all penetrations relating to his installation have been caulked and fire sealed with intumescent paint.

1.2.14.7 Danger notices

The Contractor is to allow for all danger notices in terms of the relevant regulations.

1.2.14.8 Closing in of work

The Contractor shall give the Engineer due notice of inspections required.

No work shall be closed in without it having been inspected and approved by the Engineer.

Failure by the Contractor to request the Engineer to carry out inspections may result in the Contractor bearing the cost for uncovering of concealed work and subsequent making good.

PB 002: HVAC INSTALLATION

1.1 General Requirements for the Contractor

This specification covers the supply, install, clean, test and commission the complete HVAC system for Pumps stations on the SRSS Leeuwkuil WWTW systems. All work shall be carried out to the complete satisfaction of the Employer and Engineer.

All equipment shall meet the performance criteria as detailed in this Specification, and the relevant schedules, drawings and BOQs. All equipment is to be priced as per the schedules and BOQs but options on equal and approved suppliers and equipment can be provided.

The design of the HVAC system shall be to meet the requirements the Building Regulations SANS 10400. The HVAC system will be designed such that fresh air is provided to the occupants of the facilities as well as any and all heat output generated from the equipment stored, would be extracted. The HVAC system will be designed to ensure adequate cross-flow and prevent overheating of Mechanical equipment.

The system shall be installed using the minimum ductwork, fittings and accessories necessary to ensure a complete and working air distribution system.

All ducts shall be identified in accordance with Building Regulations SANS 10400. All ducts shall be designed for installation without designated ceiling voids.

1.1.1 Contractor Responsibility and System Coordination

The Contractor shall be responsible for the supply, installation, testing, commissioning and free maintenance during the Defects Notification Period of the installation detailed in this Specification and on the accompanying Drawings, Schedules and BOQs.

The Contractor shall provide all materials, equipment, labour and services necessary for the complete, safe and efficient operation of the air conditioning and ventilation installations in accordance with the intent of this Specification and Drawings.

This specification and accompanying layouts, Schedules and BOQs detail the requirements of the Contractor in terms of the HVAC installation. Coordination of the relevant elements of the installation that interface with the various other installations (Drainage, Power, etc.) is the responsibility of the Contractor. The Contractor is to ensure that all interfacing elements have been priced for.

Specific areas to verify (but not limited to):

- Power Supply to all mechanical Control Panels and Control Systems:
- Builderswork Required
- Fire Sealing Required

1.2 General Specification

1.2.1 General Description

The purpose of the HVAC installation is to safely, quickly and without excessive noise remove all stale/hot air from the building as well as provide fresh air to all occupied spaces.

This specification covers the supply, delivery, installation, testing, commissioning and handing over of the complete HVAC system as specified below and as indicated on the drawings and schedules, which form part of this specification. All the work shall be carried out to the complete satisfaction of the Employer and Engineer.

The system will be installed to ensure that the minimum requirements of the relevant regulations are met. The system will be efficient in terms of installation of ductwork as well as energy use.

The HVAC system that will be installed will provide the following:

- **Extract systems for buildings which house mechanical equipment which build up heat and create an un-inhabitable space.**
- **Fresh air supply systems to ensure that fresh air is provided**
- **Controls Panels and control requirements for the HVAC system to ensure energy efficient operation.**
- **Links to fire system to ensure fire compliance**
- **Fire dampers for all ducting on the face of or penetrating fire barriers, fusible link normally open.**

1.2.1.1 Principal items of work

Principal items of work include, but are not limited to, the supply and installation of:

- Fresh Air Supply Fans to facility including, louvres, ductwork, filters, grilles, etc.
- Attenuation to building fresh air supply fans to reduce noise generated by the system.
- Extract System from the buildings, including fans, ductwork, attenuators, controls, etc.
- Mechanical Plant Control panels.
- Electronic temperature control systems.
- Fire Dampers fusible link normally open required for generator space.
- Any other Control Panel and Links to machines and fire systems
- Site wiring between control panels and extract/ventilation equipment
- Galvanised sheet metal ducting including fittings, dampers and other accessories as detailed and required
- All necessary supports, hangers, brackets and accessories to complete the installations as specified
- All necessary conduit, tray and basket required to support cables and pipework as well as fittings and fixings required.
- Commissioning and testing of the installations
- Provision of maintenance for 12 months from date of entire works Practical completion.
- Generating of O&M Manuals

1.2.2 Design Parameters

The following general parameters have been used for the design of the systems

Ventilation:

Areas	Rates	Noise Levels [NR]
Pump Station		
Pump Room	Temperature rise based with a dT of 5°C	50 dBA
Toilets	10 air changes	45 dBA
Offices	2 air changes	45 dBA

Ventilation:

	Requirements
Design Fresh air flow rate	2 to 6 air changes
Noise Levels [NC] in the space	45 dBA
Coverage – amount of extract areas	1 extract grille spaced at 2m to 5m around the area
Face velocity – extract grilles	2 to 4m/s
Face Velocity - fresh air intake louvres	1.5m/s
Face Velocity - exhaust louver	4m/s

Ductwork Max velocity – Branch Run	4m/s
Ductwork Max velocity – Final Run to fan	6m/s
The Fan will be designed to meet these requirements at 60% of capacity.	

Air Conditioning

External Conditions	
Temperature [°C dB]	30°C
Temperature [°C DB]	20°C
Internal Conditions	
Temperature [°C dB]	22.5°C
Humidity [%]	50% (design condition only – not controlled)

The HVAC system is to be designed and installed to meet all the requirements of the following:

- Building Regulation SANS 10400 Part O
- Building Regulation SANS 10400 Part T
- All other relevant SANS regulations
- SANS 10400 The Application of the National Building Regulations
- OHS Act Occupational Health and Safety Act No 85 of 1993 (as amended), including Regulations
- NFPA Standards applicable to air conditioning and ventilating systems
- SANS 10142 The wiring of premises
- SANS 1238 Air conditioning ductwork
- SANS 10140 Colour coding for pipelines
- All other technical manuals and guides that may be applicable.

1.2.3 General System Requirements

The Ventilation systems for the buildings comprise of several systems that are standalone. Each is discussed below:

1.2.3.1 Supply Air Systems

Fresh air supply required to the offices and other spaces will be supplied primarily by use of fresh fans mounted in or near the area.

The supply fans will be inline fans and shall either be a Silent Series type fan, or an axial extract fan including two of 1.5 D sound attenuators for a quiet running system (45db). They will have full inverter speed control unless otherwise specified to ensure that the fans run only at the required duty point or at multiple speeds based on the requirements.

A minimum 40% free area weather louvre with insect mesh will be installed on the intake duct. Louvers shall be natural anodized aluminium weather louvers (color-coded to Principal Architect's specification).

Filter boxes with two filters will be installed on the intake duct before the fan to ensure that the air is filtered prior to be supplied to the space.

Galvanised steel ductwork will be used to direct the air from the fan to the required supply fixture point with flexible being used for the final connection to the fitting/fixture.

Supply air fixtures are room dependant but will generally be via diffusers that are designed and selected to ensure even distribution on the space as well as appropriate mixing of air.

1.2.3.1.1 Power and Controls

Power to the fans and all control elements will be supplied from an electrical panel / isolator situated adjacent to the fans.

The supply fans will be controlled in a number of ways as required in the detail schedule of equipment. These include:

- Occupancy controlled as required
- AC system controlled as required
- Equipment controlled – whereby the fans are on/off or variably speed controlled based on the mechanical equipment being active or not.

This will be achieved using and programmable time switches / network links over the control network or relays located in the main supply panel / isolator or that will be supplied with the fan as part of the standards control package.

Each fan will also be supplied with a proprietary inverter controller that will control the fan speed as well as the on/off operation.

1.2.3.2 Extract systems

The extract systems are designed to extract hot/stale/unfit air from a space and to exhaust it to outside. Make-up air (fresh air) is then pulled into the space through openings or louvres to replace the air that has been exhausted.

Generally the air extract ventilation fans and attenuator installation will be wall or roof structure mounted with the ductwork being run to the areas from which the air will be extracted. The attenuators will be installed on either side of the fan to reduce the in-duct noise generated by the fan to safe and required levels.

The extract systems will also be interfaced with the plant machinery such that they turn on simultaneously. Depending on the system and installation, the fan may be required to run continuously at low speed to ensure a small amount of air is constantly exchanged.

Bird and vermin mesh will be used on any area where birds or vermin could enter the system. This will include open duct ends and the back of weather louvres and grilles

1.2.3.2.1 Louvers

Where low level louvers are required within the space, they shall be vertical, weather, dust-proof louvers as required in the layouts. They will be manufactured from aluminium, with colour specification as per the architect's requirements. The chemical dosing rooms will have plastic louvers.

Each respective intake louvre shall be equipped with an aluminium frame and gasket, including washable filters, all to be sealed for a dust proof environment except the chemical dosing rooms which will be plastic.

The louvers shall be waterproofed and consist of an approved form of back-flashing to counteract rain entering the premises.

1.2.3.2.2 Ventilation System Control Panel

A control panel will be used to operate the fans, as well as any other automated equipment on the extract system. Links to the Fire Alarm panel and any other panel will be from here and will be clearly labelled.

All fans and fire dampers are to be closed / switched off in the event of a fire, via a fire signal from the early warning detection and alarm systems in the building.

The extract fans will be controlled in a number of ways as required in the detail schedule of equipment. These include:

- Temperature controlled on/off or ramping up as the temperature in the space increases as required

- Occupancy controlled as required
- Equipment controlled – whereby the fans are on/off or variably speed controlled based on the mechanical equipment being active or not.
- Gas build-up.

1.2.3.2.3 Power

Power to the fans will be supplied from the ventilation system control panel which will be powered from the nearest distribution board provided and installed by the Electrical contractor. The power supply cable to the control panel will be installed and terminated by the electrical contractor. The HVAC contractor will wire from the control panel to the unit. Any controller that is to be supplied with the extract systems will also be wired by the HVAC contractor and placed as required.

1.2.3.2.4 Conduit / Cable Tray / Trunking

All Cable trays, conduits, connectors, fixings, etc. for the extract systems will be powder coated to the Employer approved colour. Powder coating will be done once the system has been designed and all parts have been bent and worked as required.

No trunking or conduit is to be worked post powder coating. If touch-ups are required, all touch-ups will be done using approved paint and methodology to best match powder coating.

All exposed ventilation conduit is to be installed in conduit with a fire rating of minimum 2-hours to ensure fire compliance.

1.2.3.3 Smoke exhaust

Smoke exhaust systems will generally be roof mounted smoke louvre type installations. The louvres will be mounted on the roof and will open in the case of high levels of smoke. Fusible links will be used that will activate under high temperature and will allow the louvres to open.

The louvres are to be installed such that they are impermeable to rain when closed. The louvres will also be required to be secure against human ingress and must be installed in such a way that people cannot gain access to the installation via the louvres.

1.2.3.4 Air Conditioning systems

The Air conditioning system will be a split type DX systems installed in the offices and in the MCC room.

1.2.3.4.1 External condenser unit/s

The outdoor units shall be factory-assembled units housed in sturdy weatherproof casings constructed from rustproofed galvanised steel panels coated with a baked epoxy powder finish.

The compressor shall be highly efficient with inverter control capable of changing the speed in accordance to the cooling or heating load requirement. The heat exchanger shall be covered by an anti-corrosion resin film.

External condenser units shall have a secondary corrosion resistant protection coating (Blu-chem or similar approved).

The refrigerant circuit shall include liquid and gas shut off valves and a solenoid valves. All necessary safety devices shall be provided to ensure the safety operation of the system. The units shall be fitted with high pressure switch, overload relay, inverter overload protector and fusible plugs as safety devices.

1.2.3.4.2 Internal evaporator units

Indoor units will comprise:

1.2.3.4.3 Ceiling mounted cassette units

Indoor units shall be of the ceiling mounted cassette type. They shall have electronic control valves, which control refrigerant flow rate in response to load variations of the room.

The fans shall be of the multi blade type and statically and dynamically balanced to ensure low noise and vibration free operation.

1.2.3.4.4 Fixed controllers to all wall mount and cassette units

Air-conditioning units shall be controlled by means of hard-wired controllers. The controllers shall be mounted adjacent the light switch position in the respective rooms.

Wired remote type computerized PID controllers shall be used to maintain correct room temperatures and interrogate the system log. Units shall be equipped with a self-diagnostic and logging system for easy and quick maintenance and service.

The LCD (Liquid Crystal Display) remote controllers shall memorize the latest malfunction code for easy maintenance, it shall be able of controlling up to 16 indoor units and change fan speeds individually in the group.

1.2.3.4.5 Further considerations and equipment required

Air conditioning systems will require the following in order to complete the system.

- Drainage – all indoor units will have pumped condensate drainage
- Refrigerant pipework (including insulation)
- Heat Recovery Control Boxes to distribute the refrigerant for simultaneous heating and cooling
- All ancillary systems and supports

The external units will be installed in the locations as indicated on the drawings. All the units will be installed on vibration damping mounts.

1.2.3.4.6 Power and Controls

All power to the system will be supplied from an electrical panel / isolator Control Panel installed adjacent to each unit.

Each room that houses an indoor AC unit will be supplied with a control panel for that unit. The panel will allow temperature control and will indicate a full set of details incl (but not limited to): room temp, set point temp, fan, cool, heat, speed. Each control panel will be wall mounted and hard wired to the unit.

The system must be linked to the fresh air supply system to ensure that the fresh air supply system is activated when the air conditioning is activated.

The system must be linked to the fire alarm to ensure shut down in the case of a fire.

1.2.4 Specific Area Requirements

1.2.4.1 Pump Station

The low level areas of the pump station will potentially accumulate stale air that will be too cold and so will stagnate and sit in the pit. This is not ideal and an extract system will be provided to pull the stale air at low level out of the room.

The pumps will also generate large amounts of heat they will need to be exhausted from the room. To this end the same extract system has been sized to account for the heat gains and will exhaust at a rate to ensure a 5°C temperature difference between inside and outside.

Roof ventilators with a fusible link will also be utilised to ensure that no smoke accumulates at a high level.

The Offices will be supplied with a small fresh air supply fan, attenuators and filter box to provide fresh air to the space. The room will also have a small split type DX AC system with an outdoor and unit and cassette unit inside the room.

The toilets will be provided with a small extract system with a fan and ductwork that will extract air from the space.

1.2.5 Equipment Requirements

1.2.5.1 Schedule of Equipment

The schedule of equipment will be provided on the relevant mechanical layouts and will form a part of the BOQ to be priced.

Contractor is to refer to the schedule of equipment for equipment details over and above those detailed below

1.2.5.2 Ventilation Fans

Unless otherwise stated in the schedules or above:

Details of fan selections and fan curves shall be submitted to the Engineer for approval before purchasing of fans. Fan curves shall show absorbed power, static pressure and static efficiency plotted against air volume. All fans shall be capable of delivering the specified air volumes indicated in the schedules.

Fans shall be mounted on anti-vibration mountings/spring hangers, which shall eliminate all vibration transmissions. Anti-vibration mountings shall be selected from the Mason Industries range.

Fan motors shall be of the totally enclosed fan cooled type and the enclosure shall meet the requirements of IP55 (Standard Protection specifications).

Fan motors shall have a minimum of 10% excess power over peak shaft power drawn under site operating conditions.

All accessories such as mounting feet, mating flanges, inlet and outlet cones, etc shall be proprietary made items and be supplied with the fans.

Fan shaft and bearings where accessible shall be protected from rust by means of protective "tectyl" coatings.

All fans shall be statically and dynamically balanced and be quiet in operation.

Each fan shall fit into the space provided and shall be installed without damage to the building, building equipment or the fan.

Fans shall not be operated for any purpose such as temporary ventilation, testing, etc until the connected ducts have been cleaned and the filters, if any, have been put in regular operating condition.

All finished parts of fans, such as shafts and bearings, where accessible, shall be protected from rust prior to operation by means of wrappings and protecting grease coatings. For chemical dosing rooms, all fans shall be the plastic type.

1.2.5.2.1 Axial Flow Fans

Axial flow fans shall be of the long casing type with terminal boxes.

Impellers shall comprise pressure die cast aluminium hubs and faceplates with either aluminium or injection moulded chemically coupled glass reinforced nylon blades. Impellers shall be fully adjustable. Impellers shall be assembled with high tensile setscrews and self-locking nuts.

Blades shall be cast with an integral aerofoil section.

Impellers shall be tested in accordance with BS848 Parts 1 and 2 for aerodynamic and acoustic performance.

Motors are to be totally enclosed, fan cooled and comply with IP55 requirements.

Motors shall have self-lubricated bearings that will have durability and long life.

Sizes, quantities, types and performances shall be as indicated in the relevant Schedule for the Engineers approval.

1.2.5.3 Sound Attenuators

Unless otherwise stated in the schedules or above:

All fans are to be fitted with suction and discharge attenuators. Circular pod attenuators will be used in circular ductwork. Rectangular Splitter type attenuators will be used in rectangular ductwork

Sound attenuators shall be the product of a firm regularly engaged in the manufacture of sound attenuators and similar products and who publish catalogued selection data. All Attenuators will be one manufacturer's standard size larger than the nominal duct sizes on either side of the fan.

Sound levels in the occupied spaces shall be achieved as stated in the design parameters.

The sound attenuators shall be fitted with sheet metal covers at the ends for protection during transport, handling and storage.

Noise levels generated by the plant shall not exceed 40 dBA when measured 10 metres from the fan.

The Contractor shall ensure that the equipment and sound absorbers comply with this requirement.

For chemical dosing rooms, attenuators shall be the plastic type.

1.2.5.4 Fire Dampers

Unless otherwise stated in the schedules or above:

Fire dampers shall be installed where ductwork passes through fire rated partitions/walls/areas.

Fire dampers shall be UL approved and labelled as conforming to the requirements of NFPA Pamphlet NO.90A.

Damper shall be fabricated from galvanised steel, with galvanised steel sleeves, fusible links, spring latches, and non-corrosive bearings. In addition, fire dampers shall be approved by and shall meet the requirements of the Local Fire Department.

Fusible links shall be UL listed for a minimum 72°C release.

Dampers located in rectangular, circular or oval ductwork shall be shutter type with shutter held out of air stream and having a minimum of 95% free area.

For dampers up to 1 000 mm in width and 600 mm in height, provide 1.6 mm thick galvanised steel sleeves; for larger dampers provide 2 mm thick galvanised steel sleeves around dampers.

Sleeves shall have perimeter iron mounting angles on both sides of wall opening, secured to the wall, and shall extend at least 150 mm beyond mounting angles. Ducts shall be joined to the sleeve such that the sleeve becomes a section of the duct.

Fire dampers shall not be built into the structure.

Dampers mounted in floors or in horizontal positions shall be similar to the type specified for installation in rectangular ductwork except that they shall be provided with stainless steel closure springs.

Access will be provided in all ductwork adjacent to fire dampers to allow resetting of the links after testing.

1.2.5.5 Air Terminals

Unless otherwise stated in the schedules or above:

The Contractor shall verify that the sizes shown on the drawings are correct for the intended air volume, throw and noise level.

Sizes and quantities shall be as indicated on the layout drawings and schedules.

Contractor to verify with the supplier based on the design and materials surrounding the air terminal how the air terminal will be fixed and installed. Any discrepancy or issue in this regard is to be brought to the Engineers attention before purchase.

1.2.5.5.1 Supply Air grilles

Grilles shall be of the double deflection type. Unless otherwise stated grilles will be supplied with opposed bladed dampers. Dampers shall be painted matt black.

1.2.5.5.2 Extract Air Grilles

Extract air grilles shall be of the single deflection, fixed blade type and unless otherwise stated complete with oppose bladed dampers. Epoxy powder coated to a colour of the Architects choice.

1.2.5.5.3 Weather louvres

Whether louvres will be single, double or triple blade as required in the schedule.

Unless specifically stated all-weather louvres will be aluminium and will be powder coated to the requirements of the architects. Chemical dosing rooms shall have plastic type louvers.

Weather louvres that are placed in rooms that are using the room as a make-up louver are to be installed complete with a filter bank on the back of the louver to minimise the ingress of dust due to the forced vent requirement through the louver.

1.2.6 Control Panels

1.2.6.1 Main Extract System Control Panel

The control panel will comprise an IP55 mild steel enclosure with orange powder coated finish. The panel will be installed inside the building and will have a lockable cover. The control panel will have the following indication and control equipment for the system:

- Fan Auto/Run/Off switch
- Indicator lights showing Auto/run/off condition
- Fan speed dial for speed selection under manual
- Fan speed indicator
- System Fault Indicator
- Temperatures of the various temperature sensors
- Gas concentration levels
- Fire Incident Indicator
- Override indicator from external control panel

- Either a network link or mobile link to a BMS or monitoring station. (if needed)

The control panel shall be used to operate the fans, as well as any other automated equipment on the extract system.

Links to the Fire Alarm panel and any other panel will be from here and will be clearly labelled. All fans and fire dampers are to be closed / switched off in the event of a fire, via a fire signal from the early warning detection and alarm systems in the building.

To be supplied with Ethernet IP connector and controller to allow control and feedback to main site BMS system. All elements in the board must be allowed to be displayed and where require modified from the BMS. The Ethernet link must be used to turn the fans off the case that the generator are switched on.

1.2.6.1.1 Control Ethos

The extract fan will be controlled in a number of ways. These include:

- Temperature controlled on/off with ramping up from minimum flow as the temperature in the space increases and ramping down as the temperature decreases.
- Gas concentration controlled on/off with ramping up as the concentration in the space increases as required
- Manual controls required
- Override from the external panel

4 no. temperature sensors will be equally spaced around the floor of the sump. These will feed back to the control panel and be individually displayed. The temperatures will be averaged to provide a temperature set point at which the fan will turn on/off.

Gas concentration sensors will be equally spaced around the floor of the sump. These will feed back to the control panel and be individually displayed. Should any of the gas concentration be over the limit advised, the fan will turn on and ramp up to fresh air rate until the concentration is gone. Should the concentration not drop the fan will further ramp up to max speed.

Should the concentration still not drop an incident alert will be sent to the main panel, external panel and to the BMS/monitoring stations.

Manual switch will turn the fan on and the speed dial will allow for manual speed control of the fan.

1.2.6.2 External Override and indication Control Panel

The control panel will comprise an IP67 mild steel enclosure with orange powder coated finish. The panel will be installed external to the building near the main entrance and will have a lockable cover. The control panel will have the following indication and control equipment for the system:

- Fan Manual Override
- Purge Vent Timer
- Indicator lights showing Auto/run/off condition
- Fan speed indicator
- System Fault Indicator
- Temperatures of the various temperature sensors
- Gas concentration levels

The panel is only used to override and provide purge ventilation. The panel also indicates the current conditions in the space to allow the person entering to decide to purge the space or not.

1.2.6.2.1 Control Ethos

Should the operator decide to press the manual override, the system will ramp the fan to max speed for 15 minutes – after which the fan and controls will default back to auto / manual (as set on the main control panel inside)

1.2.6.3 Smoke control panel

The smoke control panel will control the smoke louvres on the roof to open or close them. The panel will be linked to the fire alarm panel.

1.2.7 Ductwork

1.2.7.1 General Ventilation Ductwork

Ductwork will be galvanised steel and will be a combination of square and round ductwork except chemical dosing rooms which shall consist of plastic ductwork. Generally height will be restrictive and square duct will be used to minimise void heights required.

Spiral Wound Circular duct will be used where possible to connect to final circular spigotted units/grilles/valves etc.

All ductwork shall be fabricated from galvanised sheet metal unless otherwise specified. All ductwork shall be fabricated and installed in strict accordance with SANS 1238:2005.

Where ducting passes through un-air conditioned spaces, particular care shall be taken to seal all joints.

All exposed ducting shall be painted. All concealed ducting shall be left unpainted. All ducting shall be colour coded in accordance with the relevant SABS specification.

Air flow indication arrows and service labels shall be fixed to the ductwork at all branches and wherever ductwork passes through holes in the structure.

Provide 50 mm drain connections with plugged gate valve at the bottom of the duct risers to drain condensate and residue from the ducts at regular servicing intervals.

1.2.7.2 Insulated Flexible Ductwork

Flexible ductwork will be used to make final connections from rigid ductwork to fixtures and fittings. Flexible ductwork will not exceed 1m.

Flexible ducts may be PPG Glass-Flex Thermaflex II type M-KF, or Wiremold type 4K, pre-insulated flexible duct, or other approved.

Insulated flexible air ducts for air connection between air terminals, ductwork, air mixing boxes, regulators, etc shall be factory pre-insulated flexible metal type or spiral reinforced fabric type. The flexible metal type shall be of interlocked spiral construction or zinc-coated steel. The spiral reinforced fabric type shall consist of a steel wire helix or a corrosion resistant flat steel spiral supporting and permanently connected to a coated fabric having a mineral base. The spiral reinforcement shall be zinc-coated unless completely enclosed by plastic or sealed by the fabric.

Flexible ducting shall be supported at regular intervals and shall not be supported by resting on the false ceilings. Supporting brackets and hangers shall not damage the insulation or insulation covering and shall not distort the ducting

1.2.7.3 Hot Dip Galvanising

All exposed metal ductwork in harsh environments including externally mounted, caustic and salty environments, inclusive of supports, brackets, hangers platforms, etc shall be hot dip galvanised AFTER manufacture.

1.2.7.4 Painting

All exposed, ungalvanised, indoor metal work, inclusive of supports, brackets, hangers, platforms, etc. shall be thoroughly cleaned, de-scaled and painted with one coat of zinc chromate primer followed by one undercoat and two finishing coats of gloss enamel.

All exposed, galvanised, indoor metal work shall be thoroughly cleaned with a galvanised iron cleaner and painted with one coat of calcium plumbate primer followed by 1 coat of universal undercoat and two coats of gloss enamel. The pipe paint finishes and colour coding shall be in accordance with SANS

10140 Part III. Flow direction arrows shall be painted onto pipe finishes at all tees, branches, plant connections and where piping passes through holes in the structure.

1.2.8 Duct Accessories

1.2.8.1 General Accessories

1.2.8.1.1 Vibration Mountings:

All HVAC machinery that vibrates will be mounted on anti-vibration mountings/spring hangers, which shall eliminate all vibration transmissions to the structure or mounting. Anti-vibration mountings shall be selected from the Mason Industries range or the approved OEM supplier range.

1.2.8.1.2 Flexible Connections

All fans to ductwork connections will be completed using flexible ductwork connections. These will be no longer than 150mm.

1.2.8.1.3 Filters:

All filters (supply and extract as required) must be installed in accessible ductwork sections with access door to allow easy maintenance and replacement of filters. The filter frame shall be of U-channel form and constructed of 0.5 mm galvanised mild steel. The U-channel edges will be double returned by at least 4 mm in order to give added strength to the frame section and to prevent injury to personnel handling the frame.

The filters will be installed from the side or bottom of the frame depending on the most appropriate access point. Filters will be locked into place to ensure they don't come loose while in use. This can be achieved using doors and rubber material to hold the filters in place.

1.2.8.2 Thermal and Acoustic Insulation

1.2.8.2.1 Ductwork

Except where internal insulation is indicated on the drawings, all air conditioning supply and return air ducting is to be externally insulated with minimum 25 mm thick aluminium foil reinforced mineral wool.

The insulation shall be glued to the ducting and sealed along all longitudinal and transverse overlapping joints with approved adhesive to provide a vapour seal. The overlapping joints shall be approximately 75 mm wide. The edges of overlaps are to be taped down with self-adhesive aluminium tape no less than 50 mm wide.

The use of spikes spot welded to the ductwork is not acceptable.

The insulation shall be strapped with nylon straps at intervals of more than one metre apart. Where necessary, especially at bends, transformation pieces, branches, etc. insulation is to be glued, taped and strapped to ensure that the joints are vapour sealed.

Ducting and equipment exposed to the elements shall be insulated with 50 mm thick 24 kg/m³ density mineral wool insulation, which shall be glued and strapped to the ducting. Insulation shall then be clad with 0.6 mm galvanised sheet metal. All longitudinal and cross sectional joints on the insulation cladding shall be sealed against rain and moisture penetration.

Brackets and hangers for ducting shall be on the outside of vapour seals and shall not crush insulation.

Under no circumstances will damaged and/or patched insulation be accepted.

Any damaged insulation shall be removed and replaced with a completely new section around the entire perimeter of the duct.

1.2.8.2.2 Flexible Ductwork

Flexible duct insulation shall be 25 mm nominal thickness fibreglass of 24 kg/m³ density. The insulation shall encase the flexible duct and shall be sheathed with a moisture barrier having a permeability of not

over 0.02 perm. The duct and insulation components shall have a flame spread of not over 10 with a smoke development of not over 25.

Pressure requirements of external sheathing and vapour barrier will not apply where flexible duct inside of insulation meets all pressure and velocity requirements.

All insulated ducts, exclusive of vapour barrier material, shall have a flame spread of not over 10 with a smoke development of not over 25.

Where insulated flexible ducts join ductwork, air mixing boxes and air terminals, the flexible duct liner shall be secured with a pressure-sensitive vapour seal adhesive tape and secured with a stainless steel clamp applied over the vapour tight joint.

All ends of duct sections to be joined in the field shall be coated, before assembly, with a cementing material that will prevent erosion. Finished flexible ductwork insulation shall not impart loose fibres or odours to the air stream in any manner when the system is operating.

1.2.9 Builderswork

The Contractor shall be responsible for providing all small openings in brick walls for pipework, ductwork etc. and for providing the necessary flashing, support brackets for pipework and ductwork etc.

The Contractor shall be responsible for providing all Builder's Work Drawings for the work to be carried out. Full details of all large openings for ducting, in the roofs, slabs and brick walls, details of concrete bases, etc are to be included on these drawings which are to be submitted to the Engineer for approval in good time to comply with building program.

The Contractor shall also check the positions and sizes of all these openings, bases, etc provided .

The Contractor shall provide all waterproofing and making-good.

1.2.10 Site Wiring

The Contractor shall be responsible for all field wiring between the HVAC control panels and remote items of the plant area.

Generally, field wiring shall be carried out in PVC SWA LSF cable neatly and securely strapped to adequately size cable trays with ½ rated insulated earth wires.

Where field wiring is located within an air plenum wiring shall be installed in screwed, galvanised conduit.

All cable trays, cable trunking, accessories and supports shall be galvanised.

No fixing to a surrounding plant and piping will be allowed without the approval of the Engineer.

All equipment such as extract or ventilation fans, located remotely from their respective control panels shall be fitted with its own lockable, local isolator.

1.2.11 Fire Safety

Where any pipe, conduit, cable or duct passes through a fire-wall assembly, fire stopping is to be allowed around the penetration to impede the spread of smoke or fire in accordance with SANS 10400-T for Fire Protection.

Several methods of sealing such as application of intumescent coating, fire collars or alternative containment products tested under SANS 10177-2:2005 may be utilized.

Before requesting the Engineer to carry out an inspection the Contractor shall satisfy himself that all penetrations relating to his installation have been caulked and fire sealed with intumescent paint. Fire

stopping/sealing is to be done by an approved specialist who is to provide a COC for all seals upon completion.

Fire dampers will be required where any ductwork passes through a rated partition/wall. These will be installed as required by the relevant Consultants layouts.

All HVAC equipment must also be connected to the Fire Alarm and Detection systems to ensure that they will shut down all the Vent and Extract equipment should the fire alarm be triggered.

1.2.12 Earth Bonding

All new metal pipework systems shall be continuity bonded and tested to ensure earth continuity. These shall all be tied into the buildings main earthing system, whether it is rebar or other system being employed.

Carry out equi-potential bonding and tests of the HVAC system to prove the effectiveness of the earthing system. All tests shall be fully recorded and included within the operating and maintenance manuals.

1.2.13 Workmanship

Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers as work proceeds. Failure to undertake this will result in the requirement for CCTV inspections to be carried out to the entire system, to prove that the system is free from debris.

Handle, store and securely fix all products and accessories in accordance with manufacturer's recommendations.

All ductwork, plant, pipework, fixtures and fittings shall be properly cleaned, where necessary following completion of the installation.

1.2.14 Labelling and Marking

All items of equipment and plant shall be labelled. All labels shall be in English. Labels shall be of engraved aluminium be securely fixed by screws or rivets. Lettering shall be block capitals in a minimum size of 8mm.

All ductwork will be labelled with the required arrows showing direction of air flow as well as labels stating the type of air in the duct. Arrows and labels will be stuck to the ductwork at every change of direction, tee-off and otherwise every three meters

1.2.14.1 Powder Coating

All conduit and containment will be powder coated to identify the containment. This includes all conduit, cable tray, cable basket and all other containment that may be used.

1.2.15 Testing and Commissioning

The entire installation shall be commissioned in accordance with the relevant CIBSE commissioning codes and guides.

Carry out all tests and inspections to prove that the installation meets the requirements of the Building Regulations.

Carry out all tests required by the building control officer giving adequate notice. Should the installation fail to hold against any test, identify the location of the failure rectify and re-test at no additional cost to this contract.

The installation shall be tested section by section as the work proceeds and subsequently on completion, to ensure that the installation is free from superfluous matter and obstruction and that all work which is to be concealed, is free from defects before it is finally enclosed.

The ductwork system will be air tested.

Before testing, all ductwork shall be cleaned and prepared thoroughly.

1.2.16 Contractor General Requirements

1.2.16.1 Shop drawings and samples

The Contractor shall within a period of two weeks of receipt of documentation verifying his appointment submit to the Engineer all shop drawings and samples as requested by the Engineer. The drawings shall be submitted with reasonable promptness and in an orderly sequence so as to cause no delay to the works.

By preparation and submission of the shop drawings, the Contractor shall be deemed to have determined and verified all field dimensions, materials, catalogue numbers etc. In terms of the project programme, the Contractor shall allow the Engineers two calendar weeks for scrutiny of drawings.

The Contractor shall submit electronic copies of all shop drawings to the Engineer for approval before commencement of work.

No portion of the work requiring approval of shop drawings or samples shall be commenced without the necessary approval of the Engineer.

1.2.16.2 Variations and additional works

Corrections, comments, amendments or approval of shop drawings and samples are not to be assumed as acceptance of variations in the cost of work.

Should such approval, comments, etc, in the opinion of the Contractor involve additional cost, the Contractor shall notify the Engineer in writing within 7 days of receipt of such approval, comments, etc. In the event of notification of additional costs not reaching the Engineer within 7 days, no claims for such additional costs will be entertained.

Variations in costs shall be calculated in accordance with the labour and material rates, indicated by the Tenderer in the Bill of Quantity.

1.2.16.3 Operating and maintenance manuals

Operating and maintenance manuals are to be prepared by the Contractor for all the systems and installations for which they are responsible. This will include (but is not limited to):

- General Description of the systems
- Operating manuals for all equipment
- Maintenance requirements for all equipment and systems
 - Including lists of all spares that should be kept on hand
- Record Drawings of all system installations.
 - Including floor layouts, sections, and details of all installed equipment, plant, cables, etc. Enough detail must be provided to allow the facilities team to be able to pinpoint all the services.
 - Must include equipment numbering and all labelling

After approval of the manuals by the Engineer, the Contractor shall provide the Engineer with five bound sets and soft copy CD ROM of MS Word, Excel and AutoCAD files.

Manufacturer's catalogue information shall be scanned and saved to disc in "JPEG" format at a rate of compression to be clearly legible.

The CD ROM copy shall read as a catalogue with drawing files separated and all files properly indexed not, as a random assortment of files.

The Contract will not be accepted as complete until these have been supplied, complete and to the satisfaction of the Engineer.

The Contractor shall include for professional assistance in preparation of the above if necessary.

1.2.16.4 Guarantee and maintenance

The entire installation shall be guaranteed against defect or faulty workmanship for the Defects Notification Period.

The Contractor shall service and maintain the installation for the Defects Notification Period. The various items of equipment shall be serviced and maintained in strict accordance with the requirements of the respective suppliers of the equipment.

Tenderers shall include, in their tender prices, for travelling, labour, consumable, oils, lubricants, refrigerants, chemicals, tools, filters, etc. necessary for the successful implementation of the maintenance programme.

Tenderers shall allow for monthly maintenance visits over the Defects Notification Period.

The Contractor implement and maintain a maintenance/servicing register for the duration of the maintenance and guarantee period.

A record of each maintenance visit shall be forward to the Engineer after each visit.

At the end of the guarantee period the Contractor shall hand over to the Employer a full set of any special tools or instruments required for the continued maintenance of the installation.

1.2.16.5 Danger notices

The Contractor is to allow for all danger notices in terms of the relevant regulations.

1.2.16.6 Closing in of work

The Contractor shall give the Engineer due notice of inspections required.

No work shall be closed in without it having been inspected and approved by the Engineer.

Failure by the Contractor to request the Engineer to carry out inspections may result in the Contractor bearing the cost for uncovering of concealed work and subsequent making good.

PB 003 : FIRE DETECTION INSTALLATION

1.1 General Requirements for the Contractor

This specification covers supply, install, clean, test and commission of the complete Fire Detection system for **the SRSS: Leeuwkuil Scheme**. All work shall be carried out to the complete satisfaction of the Employer and Engineer.

All equipment shall meet the performance criteria as detailed in this specification, and the relevant schedules, drawings and BOQs. All equipment is to be priced as per the schedules and BOQs but options on equal and approved suppliers and equipment can be provided.

The design of the Fire Detection system will meet the requirements of the Installer as well as the relevant SANS requirements and the requirements of the Employer. The Fire detection system installations shall be installed properly as to be ready for their purpose at all times.

The fire Detection system shall be installed using the minimum cabling.

Markings and signage shall comply with the requirements of SANS with regard to the maximum viewing distance of the sign in proportion to the vertical dimension of the sign.

All visible fittings and fixtures, such as mounting brackets, heads, beacons etc. shall be approved by the the Engineer.

The Contractor shall submit identified duplicate samples of all manufactured items. One sample of each item will be signed by the Engineer and handed to the Contractor, who will keep it on site available for inspection.

1.1.1 Contractor Responsibility and System Coordination

The Contractor shall be responsible for the supply, installation, testing, commissioning and upholding during the Defects Notification Period the installation detailed in this Specification and on the accompanying drawings, schedules and BOQs.

The Contractor shall provide all materials, equipment, labour and services necessary for the complete, safe and efficient operation of the installations in accordance with the intent of this Specification and Drawings.

This specification and accompanying layouts, schedules and BOQs detail the requirements of the Contractor in terms of the Fire detection installation. Coordination of the relevant elements of the installation that interface with the various other installations (HVAC, Power, Lift, Wet services etc.) is the responsibility of the Contractor.

Due to the nature of this Construction Project, the Contractor is to ensure all interfacing elements have been priced for.

Specific areas (but not limited to) to verify:

- Fixtures and Fittings.
- Builders work Required
- Concealment of cabling and equipment Required

Should any of these and any other requirements be lacking, the Contractor is to inform the Employer.

1.2 General Specification

1.2.1 General Description

The purpose of the fire detection system is to provide the building with measures to warn occupants that there is a fire and to shut off equipment, alert the relevant authorities and activate and shut down systems as required. The system is also to allow for the escape of all persons from the building safely and quickly.

This specification covers the design verification, supply, delivery, installation, testing, commissioning and handing over of the complete Fire detection system specified below and as indicated on the drawings, which form part of this specification. All the work shall be carried out to the complete satisfaction of the Employer and Engineer.

The drawings indicate the proposed system and locations of equipment. The Contractor is to verify the design to ensure compliance with the relevant regulations. Any and all potential non-compliance should be sent to the Engineer.

All equipment, cabling etc., or any materials used shall be new, suitable for the said operating requirements.

1.2.1.1 Principal items of work

Principal items of work include, but are not limited to, the supply and installation of:

- Fire Detections systems
- Fire detection control panel
- Fire detection repeater panels
- Heat Detectors
- Smoke Detectors
- Beam Detectors
- Cabling
- Containment
- Powder coating of containment
- All necessary supports, hangers, brackets and accessories to complete the installations.
- Commissioning and testing of the installations.
- Upholding during the Defects Notification Period.
- Appointed contractor to have valid SAQCC certification.

1.2.2 Design Parameters

Fire Detection installation will comply with all the requirements of the following:

- SANS 10400: T
- SANS 10139
- All other relevant guides and building regulations

1.2.3 General System Requirements

The facility shall be equipped with an early warning detection and alarm installation, in accordance with the relevant South African National Standards documentation, comprising of:

- An L1 category fire detection system for all pump stations

The panel will be an analogue addressable control panel (Ziton to match existing systems), for the Facility. The contractor will supply and install early warning detection devices (smoke sensitive, heat sensitive, combustion gas sensitivity and light emitting diodes), alarm sirens / sounders, break-glass units, fire retardant (PH120) cable, door magnets, door sequential closers, etc. as required

Communication links and cabling to be provided from the fire detection control panel to the central alarm system.

In the event of a fire the early warning detection and alarm installation shall send a signal to the following electrical and mechanical systems:

- Air-conditioning and ventilation systems to close / switch off
- Fire doors to close and alarms/evacuation alarms to sound
- Smoke ventilation systems to close/switch off

The main control panel shall be placed within the office area of the respective pump station, and a mimic panel placed within the main guard house.

All fire related conduit / cable tray / trunking shall be galvanized yellow powder-coated, including bushes, locknuts, couplings, galvanized saddles, etc.

1.2.4 General Equipment Requirements

Manual call points should comply with the requirements of SANS 50054-11 for Type A ("single action") manual call points, will be installed at every exit from the building and at every entrance into an emergency route as well as in all stairwells at every level.

Point heat detectors should comply with the requirements of SANS 50054-5 for Class A1 or A2 detectors, unless the foreseeable maximum ambient temperature in the protected area is 40 °C or above, in which case a Class B-G detector should be used as appropriate (see clause 9)

Point smoke detectors should comply with SANS 50054-7

Flame detectors should comply with SANS 50054-10

Optical beam smoke detectors should comply with SANS 50054-12.

Carbon monoxide fire detectors should, in the absence of any relevant SANS or international standard, be capable of detecting a fire within 60 s if the carbon monoxide concentration exceeds 60 ppm, and should have a fire sensitivity (in combination with any other sensors within the fire detector) sufficient to pass TF5 of SANS 50054-20 where the detector is declared to be suitable for installation instead of a smoke detector, or TF2 and TF3 of SANS 50054-20 where the detector is declared only to be suitable for detecting smouldering fires. Any restrictions in the use of the detectors declared by the manufacturers should be taken into account in the system design.

Control and indicating equipment should comply with SANS 50054-2

Audible fire alarm devices should comply with SANS 50054-3 and the measured sound pressure level at any point within the building should be 65dB(A) or 5dB(A) louder in any area where the background noise is 61dB(A) or greater.

Power supply equipment should comply with SANS 50054-4

Cables should comply with the recommendations of 8.19.

Those functions of the system that are recommended in this standard, for which the storage of programs and data is necessary to control the fire detection and alarm system, should comply with the additional design requirements for software controlled control and indicating equipment in SANS 50054-2

Where a PC is used as a user interface, for example in networked systems, it should be considered as a supplementary interface and there should be control and indicating equipment complying with SANS 50054-2 mounted adjacent, as it is unlikely that a PC would meet the requirements of SANS 50054-2

Aspirating smoke detectors should comply with SANS 50054-20.

1.2.5 Cabling

The electrical characteristics of all cables, such as voltage drop for the extra low voltage supply from an external power supply text, current carrying capacity, impedance and, where appropriate, ability to transmit data, should be suitable for the system.

Cabling will generally be enhanced fire resisting cables should meet the PH 120 classification when tested in accordance with SANS 50200 and the 120 min survival time when tested in accordance with BS 8434-2.

Cables should be installed without external joints wherever practicable. All terminations and other accessories should be such as to minimize the probability of early failure in the event of fire. Other than in the case of joints at or within system components such as control equipment, manual call points, fire detectors and sounders, terminals used to joint cables should be constructed of materials that will withstand a similar temperature and duration to that of the cable. All joints, other than those within system components, should be enclosed within junction boxes, labelled with the words "FIRE ALARM" to avoid confusion with other services.

All conductors should have a cross-sectional area of at least 1 mm².

All fire alarm cables should be red in colour, to enable these cables to be distinguished from those of other circuits.

All fire alarm cable outer sheaths should be marked in order to identify the cables. Markings should include the following:

- 1) the manufactures name, trade name or trademark;
- 2) the year of manufacture;
- 3) the cable description;
- 4) the fire rating of the cable along with the test method used; and
- 5) the batch number.

Markings should be legible and be 550 mm apart. Characters of maximum height 13 mm, and minimum height, 3 mm. Smaller characters may be used where cable diameters are less than 6 mm.

1.2.6 Containment

Methods of cable support should be non-combustible and such that circuit integrity will not be reduced below that afforded by the cable used, and should withstand a similar temperature and duration to that of the cable, while maintaining adequate support.

To avoid the risk of mechanical damage to fire alarm cables, they should not be installed within the same conduit as the cables of other services. Where fire alarm cables share common trunking, a compartment of the trunking, separated from other compartments by a strong, rigid and continuous partition, should be reserved solely for fire alarm cables.

1.2.7 General Installation

The entire system should comply with the requirements of SANS 10142-1. In general, the recommendations of this standard supplement, but do not conflict with, these requirements. Where any such conflict is considered to exist, the recommendations of SANS 10142-1 should take precedence.

Cables which are directly fixed to surfaces should be neatly run and securely fixed at suitable intervals, in accordance with the recommendations of the cable manufacturer. Cables should not rely on suspended ceilings for their support.

Where new conduit, trunking or tray is installed, its capacity should be in accordance with the recommendations given in SANS 10142-1.

Where a cable passes through an external wall, it should be contained in a smooth-bore sleeve of metal or other non-hygroscopic material sealed into the wall. This sleeve should slope downwards towards the outside and should be plugged with a suitable non-hardening waterproof compound to prevent the entry of rain, dust or vermin.

Where a cable passes through an internal wall, a small clearance hole should be provided. If additional mechanical protection is necessary, a smooth-bore sleeve should be sealed into the wall.

Care should be taken to ensure that the ends of any sleeves are free from sharp edges which might damage cables during installation.

Where cables, conduits, trunking or tray pass through floors, walls, partitions or ceilings, the surrounding hole should be as small as reasonably practicable and made good with fire stopping materials that ensure that the fire resistance of the construction is not materially reduced. Spaces through which fire or smoke could spread should not be left around the cable, conduit, trunking or tray.

If cables or conduits are installed in channels, ducts, trunking or shafts that pass through floors, walls, partitions or ceilings, barriers with the appropriate level of fire resistance should be provided within the channels etc. to prevent the spread of fire unless, in the case of ducts and shafts, the construction of the duct or shaft affords equivalent fire resistance to the structure penetrated; in the latter case fire stopping need only be provided where cables pass into, or out of, the duct or shaft.

1.2.8 Builders work

The Contractor shall be responsible for providing all small openings in brick walls for pipework etc. and for providing the necessary flashing, support brackets for cabling and containment.

The Contractor shall also check the positions and sizes of all openings.

The Contractor shall provide all waterproofing and general making-good. Should fire stopping be required, this will be completed by the Contractor

1.2.9 Earthing and Bonding

All new metal systems shall be continuity bonded and tested to ensure earth continuity. These shall all be tied into the buildings main earthing system, whether it is rebar or other system being employed.

Carry out equi-potential bonding and tests to prove the effectiveness of the earthing system. All tests shall be fully recorded and included within the operating and maintenance manuals.

1.2.10 Workmanship

Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds.

Handle, store and securely fix all products and accessories in accordance with manufacturer's recommendations.

All equipment and fittings shall be properly cleaned, where necessary following completion of the installation.

1.2.11 Testing and Commissioning

TESTING AND COMMISSIONING SHALL BE UNDERTAKEN IN LINE WITH THE CIBSE COMMISSIONING CODES AS WELL AS BELOW. THIS IS IN LINE WITH THE GREEN STAR RATING SPECIFICATION.

The Contractor shall be responsible for testing and commissioning of the complete plant and allow for inspections by the Engineer as required.

After the Contractor has completed his testing and commissioning and is satisfied that the plant is ready for the Tests on Completion Inspection he shall notify the Engineer so that the Tests on Completion can be arranged.

1.2.11.1 Commissioning Schedule

The Contractor shall submit to the Engineer a complete commissioning schedule at least 1 month before commissioning commences. The commissioning schedule shall contain all commissioning activities, all equipment to be tested and all variables of all equipment to be checked.

1.2.11.2 General Recommendations

All installed cables with a manufacturer's voltage rating suitable for mains use should be subject to insulation testing at 500 V d.c. Prior to this test, cables should be disconnected from all equipment that could be damaged by the test.

Insulation resistance, measured in the above test, between conductors, between each conductor and earth, and between each conductor and any screen, should be, at least, 2 MΩ.

Earth continuity and, for mains supply circuits, earth fault loop impedance, should be tested to ensure compliance with SANS 10142-1.

Unless there is specific agreement that the following tests will form part of the commissioning process, the tests should be carried out on completion of the installation work:

- 1) where maximum circuit resistance for any circuit is specified by the manufacturer or supplier, measurement of the resistance of every such circuit;
- 2) any other tests specified by the manufacturer of the system;
- 3) check correct polarity of circuits where this is required for correct monitoring (to ensure operation of any manual call point while all detectors on a circuit are removed).

1.2.11.3 Commissioning

At commissioning, the entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular:

- 1) all manual call points and automatic fire detectors function correctly
- 2) if the specification requires labelling or other means of visual identification of manual call point automatic fire detectors, fire alarm devices or ancillary devices, this has been carried out
- 3) every manual call point and automatic fire detector, on operation, results in the correct zone indication, and, in the case of addressable systems, correct text display, at all indicating equipment;
- 4) where an optical beam detector uses a combined transmitter/receiver unit in conjunction with a reflector, care should be taken to minimize the effect of reflections (e.g. from surfaces close to the transmitter/receiver unit) from dominating the received signal. Unless the equipment has specific features to compensate for such effects, at commissioning, the installed unit should be tested by partial obscuration of the beam near to the reflector;
- 5) sound pressure levels throughout all areas of the building comply and, where appropriate for voice alarms, an acceptable level of intelligibility is achieved
- 6) any facility for remote transmission of fire alarm signals (and, where appropriate, fault signals) to an alarm receiving centre operates correctly;
- 7) any "cause and effect" requirements of the designer (e.g. in respect of staged alarms or initiation of operation of other fire protection systems and equipment, and safety measures) are fully satisfied;
- 8) all alarm, control, indicating, printing, and ancillary functions of the system operate correctly and are adequately labelled or identified;
- 9) no changes to the building since the time of original design have compromised the compliance of the system with this standard (e.g. by erection of new partitioning that affects the adequacy of siting of fire detectors or the effectiveness of warning devices);
- 10) a suitable zone plan is displayed
- 11) mains power supplies are inspected as far as is reasonably practical

- 12) standby power supplies comply and the system's actual load currents in all circumstances are close to the predictions used by the designer to determine the specified battery capacity;
- 13) as far as it is reasonably practicable to ascertain, the specified cable type has been used in all parts of the system
- 14) there are no other obvious shortcomings in compliance
- 15) in radio-linked systems, radio signal strengths are adequate throughout all areas of the protected premises to ensure reliable operation of the system;
- 16) adequate records of insulation resistance, earth continuity and, where appropriate, earth loop impedance tests exist;
- 17) all fault indicators and their circuits should be checked, where practicable, by simulation of faults conditions;
- 18) all relevant documentation has been provided to the user or purchaser.

Labels, visible when batteries are in their normal position, should be fixed to batteries, indicating the date of installation.

On completion of the commissioning, a certificate signed by a competent person in accordance with the model given in G.3 of SANS 10139, should be issued.

1.2.12 Contractor General Requirements

1.2.12.1 Contractor Information, drawings and samples

The Contractor shall within a period of two weeks of receipt of documentation verifying his appointment submit to the Engineer all drawings and samples as requested by the Engineer. The drawings shall be submitted with reasonable promptness and in an orderly sequence so as to cause no delay to the works.

The Contractor shall be responsible for providing the following drawings pertaining to the Fire Protection Installation for the execution of the project.

- Fire Detection Drawings
- Builder's Work Drawings
- Shop Drawings
- As Installed Record Drawings

By preparation and submission of this information, the Contractor shall be deemed to have determined and verified all field dimensions, materials, catalogue numbers etc. In terms of the project programme, the Contractor shall allow the Engineers two calendar weeks for scrutiny of drawings.

The Fire Detection Contractor shall submit electronic copies of all drawings to the Engineer for approval before commencement of work.

No portion of the work requiring approval of shop drawings or samples shall be commenced without the necessary approval of the Engineer.

1.2.12.1.1 Samples Required:

- Each of the equipment pieces

1.2.12.2 Variations and additional works

Corrections, comments, amendments or approval of shop drawings and samples are not to be assumed as acceptance of variations in the cost of work.

Should such approval, comments, etc, in the opinion of the Contractor involve additional cost, the Contractor shall notify the Engineer in writing within 7 days of receipt of such approval, comments, etc. In the event of notification of additional costs not reaching the Engineer within 7 days, no claims for such additional costs will be entertained.

Variations in costs shall be calculated in accordance with the labour and material rates, indicated by the Tenderer in the Bill of Quantity.

1.2.12.3 Operating and maintenance manuals

Operating and maintenance manuals are to be prepared by the Contractor for all the systems and installations for which they are responsible. This will include (but is not limited to):

- General Description of the systems
- Operating manuals for all equipment
- Maintenance requirements for all equipment and systems
 - Including lists of all spares that should be kept on hand
- Record Drawings of all system installations.
 - Including floor layouts, sections, and details of all installed equipment, plant, cables, etc. Enough detail must be provided to allow the facilities team to be able to pinpoint all the services.
 - Must include equipment numbering and all labelling

Manuals must be submitted to the Engineer at least 1 week prior to the system commissioning start date.

After approval of the manuals by the engineer, the Contractor shall provide the Engineer with bound copies as well as soft copy CD ROMs/flash drives of all MS Word, Excel and AutoCAD files as well as all manufacturers information.

Manufacturer's catalogue information shall be scanned and saved to disc in PDF format at a rate of compression to be clearly legible.

The CD ROM copy shall read as a catalogue with drawing files separated and all files properly indexed.

The contract will not be accepted as complete until these have been supplied, complete and to the satisfaction of the Engineer.

The Contractor shall include for professional assistance in preparation of the above if necessary.

1.2.12.4 Guarantee and maintenance

The entire installation shall be guaranteed against defect or faulty workmanship for the Defects Notification Period.

The Contractor shall service and maintain the installation the Defects Notification Period.

The various items of equipment shall be serviced and maintained in strict accordance with the requirements of the respective suppliers of the equipment.

Tenderers shall include, in their tender prices, for travelling, labour, consumable, oils, lubricants, chemicals, tools, etc. necessary for the successful implementation of the maintenance programme.

Tenderers shall allow for monthly maintenance visits over the Defects Notification Period.

The Contractor shall implement and maintain maintenance/servicing register for the duration of the Defects Notification Period.

A record of each maintenance visit shall be forward to the Engineer after each visit.

At the end of the guarantee period the Contractor shall hand over to the Employer a full set of any special tools or instruments required for the continued maintenance of the installation.

1.2.12.5 Labelling and Painting

All labels shall be in English

1.2.12.5.1 Equipment

All items of equipment and plant shall be labelled. Labels shall be of engraved aluminium be securely fixed by screws or rivets. Lettering shall be block capitals in a minimum size of 8mm. 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.

1.2.12.5.2 Pipework

6. All surface to be thoroughly cleaned with a detergent chemical solution in accordance with SABS 064 Code of Practice for the Preparation of Steel Surfaces for Coating.
7. One coat of self etching primer to SABS 723 (Wash Primer)/(Metal Etch Primer).
8. One coat of zinc chromate paint to SABS 679 (Zinc Chromate Primers for Steel) Type II, Grade I.
9. One coat Signal Red oleo-resinous, micaceous iron oxide paint.
10. Two coats pure acrylic emulsion exterior paint to SABS 634.

All paints used shall be by the same and approved manufacturer and the Contractor shall ensure that the various paints are compatible one with the other.

Surfaces exposed on galvanised material through cutting, drilling and/or pipe grips shall be painted with Galvalloy or similar.

1.2.12.6 Intumescent painting

All services penetrations shall be fire sealed.

The Contractor shall identify, on drawings, where his services penetrate floor slabs and fire barriers.

The Contractor will caulk in all services.

Once services have been caulked in a specialist contractor other than the Contractor shall apply intumescent paint to ducts, piping etc. where such passes through floor slab and fire barriers.

Before requesting the Engineer to carry out an inspection the Contractor shall satisfy himself that all penetrations relating to his installation have been caulked and fire sealed with intumescent paint.

1.2.12.7 Danger notices

The Contractor is to allow for all danger notices in terms of the relevant regulations.

1.2.12.8 Closing in of work

The Contractor shall give the Engineer due notice of inspections required.

No work shall be closed in without it having been inspected and approved by the Engineer.

Failure by the Contractor to request the Engineer to carry out inspections may result in the Contractor bearing the cost for uncovering of concealed work and subsequent making good.