ADDITIONS AND ALTERATIONS TO EXISTING OFFICE BUILDING

AIRCONDITIONING & VENTILATION SPECIFICATIONS

NAME OF TENDERER: .....

CLIENT

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in association with

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PART 1: STANDARD SPECIFICATION

STANDARD SPECIFICATION

INTRODUCTION

This Standard Specification applies to and is to be read in conjunction with the detailed Technical Specification Part 2 which covers the equipment, materials and operational methods required. In so far as the conditions herein contained are at variance with anything contained in the detailed technical specification or the drawings, the contract shall be interpreted in terms of the detailed technical specification and the drawings for each particular service.

Furthermore as the standard specification covers all sections of mechanical works of the building services, certain sections may not apply if these services are not covered in the detailed technical specification.

The drawings issued with this specification are generally schematic and do not purport to show the exact position, size or details of construction of all equipment as the Tenderer has the right to investigate and offer alternatives which if equal in performance and construction may be approved by the Engineer and incorporated into the workshop or construction drawings produced by the successful Tenderer.

Also where in these documents the word 'Contractor' is used this shall be taken to mean the person, firm or company who shall be accepted as the successful Tenderer and installer of the contract works described in this specification and shall include his or their legal representatives, administrators, successors and/or assigns who shall be deemed to have entered into a contractual agreement with the Builder.

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SECTION ONE

PIPEWORK INSTALLATION

1.1.1 GENERAL

The Contractor shall supply, deliver and erect all interconnecting pipework complete with all brackets, fittings, unions, valves, etc., necessary for the operation of the plant as shown on the drawings.

The pipework and fittings shall conform to the current relevant SABS specifications or British Standards and where applicable installed to the relevant Code of Practice.

All pipework runs shall be properly spaced from each other and from walls, floors and ceilings, as indicated on the tender drawings.

The arrangement and sizes of the pipework shall be generally as portrayed on the enclosed drawings.

1.1.2 SLEEVES AND FLOOR PLATES

Where pipes pass through walls, floors, partitions or ceilings, the Contractor shall supply and hand to the Builder sleeve pipes of suitable size and material for building in. After installation of the pipework, the Contractor shall caulk the sleeve with asbestos rope, or alternatively, foam in the space around the pipe. Pipes shall pass concentrically through wall sleeves to maintain an even thickness of insulation. Each sleeve shall project beyond the finished surface sufficient enough to allow the application of a continuous vapour seal where required. Any pipe passing through a water-proofing retaining wall or slab shall pass through a sealed puddle flange.

1.1.3 RELEVANT CODES OF PRACTICE AND CLASS OF TUBING

The Contractor shall refer to the specific service clauses of this specification to establish which materials are to be used for the pipework installation.

a) Black mild steel pipework shall comply with B.S. 1387/SABS 1182 - Heavy Quality, Screwed and flanged fittings shall be manufactured in accordance with B.S. 143/SABS 1123.

b) Galvanised mild steel pipework shall comply with B.S. 1387/SABS 763 - Heavy Quality, Screwed and flanged fittings shall be manufactured in accordance with B.S. 143/SABS 1123.

c) Stainless steel pipework shall comply to B.S. 4127/SABS 965 for piping up to 50mm NB and thereafter shall be Grade 316 longitudinally (seam) welded. Fittings shall be capillary pattern to B.S. 864.

d) Medium gauge copper tube shall be manufactured to the requirements of B.S. 2871, Part I, Table X, by Yorkshire Imperial Metals Ltd, or SABS 460.

e) Light gauge copper tube shall be manufactured to the requirements of B.S. 2871, Part I, Table Z by Yorkshire Imperial Metals Ltd., or SABS 460.

f) Polythene tube shall comply with B.S. 3284, Class D, for sizes up to and including 25mm, and Class C for 32mm and above. All fittings shall be compression pattern to B.S. 864, or SABS 533.

Pipework shall also be installed to the following Codes of Practice: -

a) Domestic Water Services: British Standard Codes of Practice, CP 310 and CP 99.
b) Gas Services: British Standard Codes of Practice, CP 331.

1.1.4 PIPEWORK ERECTION AND JOINTING

Bends on black mild steel and copper pipework shall be formed in pipe lengths by machine bending when this is the accepted practice. The internal radius of the bend shall not be less than two pipe diameters.

Galvanised pipework, lightweight copper tube to Table Z, and stainless steel tube shall not be bent with a bending machine. Fittings shall be used throughout the installation in these instances.

Only in exceptional cases will the use of elbows be permitted and only with the written approval of the Engineer. Alterations to the cross sectional area of the pipe or rippling of the throat of a bend will make such a bend unacceptable for installation.

All galvanised mild steel pipework shall be protected against damage and corrosion prior to and during installation.

All horizontal services shall be laid to a slight fall so that the system is self-draining to all low points, drain cocks and drain plugs.

Where screwed joints are used, bushings or long screw connections and back nuts will not be accepted.
The amount of flux and paste used in jointing shall be kept to a minimum and all excess shall be removed.

Care shall be taken to ensure fittings are not excessively tool marked. If in the opinion of the Engineer any fitting or pipe length is unacceptably marked, the Contractor shall replace the condemned section with new material.

This section will be installed to the Engineer's satisfaction.

Piping when cut, shall be carefully reamed out to restore the bore and the Sub-contractor shall allow for disconnecting and refixing any joint the Engineer may select to demonstrate that this has been done.

Before any part of the installation is commissioned, the pipework shall be cleaned of any accumulated dirt and debris by washing or blowing through the pipework at least twice. The Contractor shall allow for dismantling the pipework at the bottom of each riser to ensure that all debris is removed from the system.

All screwed joints shall be clean threaded and pulled up tightly. No caulking shall be permitted.

Vertical lines shall be dropped plumb; all multiple lines shall be parallel and must be spaced to permit coverings as specified under the insulation clause of this specification.

All black pipework and all welded joints shall be painted two coats of red oxide after tests have been completed.

All flanged copper joints shall be made with corrugated full face rings.

All black mild steel pipework in floor duct, chases, ceiling void and service shafts shall be welded. Flanged or screwed connections shall be made at valves, items of plant and elsewhere as specified.

For steel pipework, all pipe fittings 50mm diameter and below where exposed may be screwed pattern B.S. 143/SABS 1123.

All steel pipework 65mm and above shall be flanged to Table H, except for connections to items of plant where flanges to Table E shall be used.

All copper and stainless steel pipework up to and including 25mm bore shall be assembled with Delcoh capillary fittings. Fittings shall comply with B.S. 864.

Copper and stainless steel pipework 37mm bore and above, shall be assembled by capillary or approved compression
fittings. Cast Brass fittings shall be manufactured from non-dezinctifiable alloys. All copper pipework 76mm bore and above shall be flanged, faced and drilled to B.S. 10. Table D/SABS 1123.

Polythene pipework shall be assembled with compression fittings, strictly in accordance with the manufacturer's recommendations.

For all piped services, union or flanged connections shall be provided at adequate intervals to facilitate disconnection for maintenance purposes.

All service connections to fixed points shall be made with an approved union connector.

The Contractor shall provide between all galvanised and copper pipework, connectors that will minimise electrolytic reaction between the materials.

Hot pressed or duplex brass fittings will not be permitted.

Unless detailed otherwise on the drawings, all external services pipework shall run at a minimum of 1m below ground level.

1.1.5 ANCHORS AND SUPPORTS

The Contractor shall supply and erect all anchors and brackets necessary to support and control the movement of the pipes.
Where there are more than two pipes installed next to each other, the Contractor shall supply and install galvanised mild steel channel or angle support. Pipework may be either supported by the steel or hung from it using 'U' bolts or single ring clips.

Where services are grouped together and are supported from a common channel, the spacing shall be as for the smallest diameter service pipe.

Detailed drawings for the pipework supports shall be approved by the Engineer prior to fabrication.

Exposed services shall be supported by the Solar 2000 Pipe Support System or an equal and approved system.

1.1.6 MAXIMUM SPACING OF PIPE SUPPORTS

TYPE OF PIPING	SIZE OF PIPE IN mm	SPACING FOR HORIZONTAL RUNS RUNS IN mm	FOR VERTICAL IN mm
Cold Water Pipes			
Polythene (Type 32)	up to 25	12 x o.d. of pipe	24 x o.d. of pipe
	over 25	8 x o.d. of pipe	24 x o.d. of pipe
Polythene (Type 50)	9.5	600	1200
	12-25	700	1500
	32-38	900	1800
	50	1200	400
UPVC	19-25	900	1800
	50-75	1200	2100
	100-125	1500	2400
	150	1800	3000
Hot and Cold Water Pipes and Gas Pipes			
Lead	all sizes	600	900
Copper (Light gauge)	12	1200	1800
Stainless steel	15-28	1800	2400
	35-42	2400	3000
	54	2700	3000
	76-133	3000	3600
	159	3600	4200
Steel to BS 1387	10-15	1800	2400
and copper	20-25	2400	3000
(Heavy gauge)	32	2700	3000
	40-50	3000	3600
	65-80	3600	4500
	100-125	4000	4500
	150	4500	5400
Cast or spun iron	50	1800	
	75-100	2700	
	150	3600	

TYPE OF PIPING	SIZE OF PIPE IN mm	SPACING FOR HORIZONTAL RUNS IN mm	FOR VERTICAL RUNS IN mm
Soil and Waste Pipes			
Cast iron	all sizes	2000	3000
Copper	as for water pipes		
Steel to BS1387	as for water pipes		
Lead (single tacks)	up to 50	600	
	50 & over	900	
Lead (double tacks)	all sizes	-	1200
Pitch fibre	75	600	3000
	100	900	3000
	150	1200	3000
UPVC	32-38	500	1200
	50	600	1200
	75-100	900	1800
	150	1200	1800
Polythene (type 32)	32-38	500	900
	50	600	1200
	63	800	1500
	75-100	900	1800
Polythene (type 50)	32-38	900	1800
	50	1200	400
	62	1500	3000
	75-100	1800	3700

SECTION TWO

PIPING ISOLATION

1.2.1 GENERAL

All ceiling suspended and floor supported piping that is connected to mechanical equipment shall be isolated from the building structure throughout its run in the following manner: -

The first four hangers located adjacent to mechanical equipment shall be capable of supporting the piping at a fixed elevation during installation, regardless of load changes. The mountings shall consist of a steel spring in combination with a neoprene in shear element. The minimum static deflection shall be 32mm. The hanger shall also incorporate an adjusting device to transfer the load to the spring.

Ceiling suspended piping shall be isolated by a combination spring and neoprene in shear element having a minimum static deflection of 32mm.

Floor supported piping shall be isolated by mountings free standing, laterally stable without housings, snubbers or guides, and complete with 6mm ribbed acoustical neoprene pad cold bonded to the underside of the base plate. All mountings shall have bolt holes in the base plate and be provided with adjusting bolts for levelling and attachment to the equipment. Horizontal and vertical spring constants shall be equal so as to ensure the same protection from horizontal disturbances as from vertical. Mountings shall have an additional 50% capacity beyond the rated load.

Floor supported piping in the main plantroom and condenser water piping shall be supported by mountings as described above except that mountings shall incorporate a resilient vertical limit stop to prevent spring extensions during weight changes. A minimum clearance of 13mm shall be maintained between the steel springs and the limit stop housings and around the restraining bolts so as not to interfere with normal spring performances.

When piping passes through walls or floors, furring sleeves which contain isolating material should be used.

SECTION THREE

VALVES STOPCOCKS AND FITTINGS

1.3.1 GENERAL

The Contractor shall install valves and stopcocks in the positions indicated on the drawings, on the flow and return connections to each branch circuit, at each item of apparatus and to each group of sanitary fittings.

In addition to the isolating valves, regulating valves shall be provided on the return connection of each branch circuit.

All valves up to and including 50mm shall be screwed to BSPT. Valves 65mm and above shall be flanged to B.S. 10, Table M/SABS 1123.

Valves shall be as follows or equal and approved:

ALL VALVES MUST HAVE CAST METAL HANDWHEELS - PRESSED METAL WHEELS MUST NOT BE USED.

1.3.2 BALL VALVES

Ball valves to the water storage tanks shall be of the equilibrium pattern complete with silencing tube. Ball valves shall be approved by the Water Supply Authority.

1.3.3 GATE VALVES

Use for isolating and shut off of equipment only. Up to and including 75mm Nominal Bore. Bronze Body, screwed bonnet, internal screw and yoke, non-rising spindle bronze wedge.

Screwed Newman Hattersley - Fig. 33X
Flanged Newman Hattersley - Fig. 35F

Above 75mm Nominal Bore. Cast iron body, bolted bonnet, flanged ends, external screw and yoke, bronze trim, rising spindle.

Newman Hattersley - Fig. 552E

Above 150mm Nominal Bore. Cast steel body, bolted bonnet, flanged ends, external slide action, spring loaded, renewable stainless steel disc and screwed-in renewable stainless steel seats.

Newman Hattersley - Fig. 7767J

1.3.4 GLOBE VALVES

1.3.4.1 Use on balancing of systems, on bypass and all return headers. Up to and including 50mm Nominal Bore, Bronze Body, screwed BSP ends, rising stem screwed bonnet, renewable stainless steel disc and seat.

Newman Hattersley - Fig. 16

Over 50mm Nominal Bore, Bronze Body, flanged ends, Table H, outside screw and yoke, renewable stainless steel disc and seat, rising spindle.

Newman Hattersley - Fig. 18H

1.3.4.2 Commissioning sets - From 15 to 50mm - Newman Hatterley Bronzed Body Type CV 2432 screwed. From 50 to 300mm - Newman Hatterley cast iron body type CVM 2733 PN16 flanged.

1.3.5 CHECK VALVES

Use on parallel pump discharge and all pulsating services.

Up to and including 50mm Nominal Bore, Bronze Body, screwed bonnet, screwed ends BSP, spring loaded, renewable composition fibre disc and bronze seat air check valve.

Newman Hattersley - Fig. 1213 up to 50mm
Newman Hattersley - Fig. 1017F. over 50mm

1.3.6 WATER STRAINERS

Water strainers shall be of the pot or angle type. Strainers of 38mm size and smaller shall have bronze or iron bodies, with screwed connections and 50mm strainers and larger shall have iron bodies and flanged connections. Strainers shall be designed for not less than 1035 Kpa working pressure.

Screens shall be bronze monel metal or stainless steel with perforations as follows:

Strainer Size	Perforation Size
20mm to 50 mm inclusive (NH807)	0,8mm
55mm to 150mm inclusive (NH810-E)	1,6mm
200mm to 300mm inclusive (NH810-E)	3,2mm
Over 300mm	6,4mm

The free area of each screen shall be not less than three times the area of the strainer inlet pipe. Each strainer shall be provided with 20mm valved drain, with hose connection and unless the strainer design is devoid of air pockets, a 15mm vent cock.

A strainer shall be installed at the suction side of each water pump or as shown on the drawings. The filter medium shall be readily removable for cleaning purposes, without draining the system.

All closed circuit water lines including chilled and hot water shall have dirt pockets with 20mm gate valve and hose connection at bottom of vertical runs to permit drainage.

1.3.7 RELIEF VALVES

Relief valves shall be of the screwed connection type, spring loaded, and shall have seats of non-corrosive metal.

The discharge shall be fitted with a pipe connected approximately 300mm from the safety valve and run to discharge over the nearest tun dish.

All relief valves must be locked and sealed in their preset blow off pressures. Steam NH Fig. 1319L.

1.3.8 PRESSURE REDUCING VALVES

Pressure reducing valves shall be single seated, tight closing internal spring loaded with spring suitable for the proper pressure differential.

Valves shall be flanged ends all bronze construction, and springs shall be phosphor bronze. Adjusting screws shall be protected with tamper proof caps. All internal parts shall be replaceable and adjustable without removing the valve body from the line.

All pressure reducing valves shall have a strainer on the inlet side, an isolating gate and pressure gauge on each side, and a relief valve on the outlet side. (BAILEYG4)

1.3.9 STEAM SEPARATORS

Install steam separators in the steam supply line before each steam pressure reducing station. Steam separators shall be Spirax with screwed connections up to 25mm and flanged 40mm and over.

1.3.10 AUTOMATIC AIR VENTS

Automatic air vents shall be bronze body, brass ball, stainless steel valve and seat. They will be installed at all high points in the water systems as shown on the drawings (BRAUKMANN EA122).

Automatic air vents on steam lines shall be of the balanced pressure thermostatic type with brass body and brass cap, stainless steel seat similar or equal to SPIRAX SARCO AV14 OR AV21.

1.3.11 PRESSURE GAUGES

Pressure gauges shall be installed where required and where indicated on the drawings. All pressure gauges shall be of the dial type with a diameter not smaller than 100mm. All pressure gauges shall be complete with stopcock and syphon pipe and shall be graduated to 50% above the working pressure. The accuracy of all gauges shall be 2%.

1.3.12 THERMOMETERS

All thermometers to be 100mm dial flush mercury in steel type dial thermometers with pressed steel casing, black crackle finish with chrome plate brass trim. Scale range of the thermometers shall be selected so that the nominal operating temperature falls at or near midscale.

1.3.13 THERMOMETER WELLS

Thermometer wells shall be made of heavy brass with portions surrounding the bulbs not over 1,6mm thick.

They shall be approximately 150mm long, shall project 50mm into the pipe and shall have dust excluding caps with gaskets and chains. Pipes smaller than 65mm in size shall be enlarged at the points where the wells are installed. Wells shall be set vertically or at an angle, so as to retain oil.

1.3.14 VACUUM BREAKERS

Vacuum breakers shall be installed on all liquid storage vessels. They shall be constructed of a brass body with stainless steel valve disc and seat with a stainless steel enclosed operating spring. Minimum size to be 25 mm.

1.3.15 STEAM SIGHT GLASSES

Install a combined steam sight glass and non return valve after all trap sets as indicated on the standard steam trapping drawing. The sight glass/non-return set shall be SPIRAX HILLS or equal and approved having a gunmetal body and toughened glass tube. They shall be utilised in systems with up to 3, 5 bar working pressure. Above this pressure a cast iron body suitable for working pressures of 21 bar shall be used such as SPIRAX SARCO type PMO or equal and approved. The sight glass is to be installed at least 1 m from a steam trap outlet and followed by a check valve.

1.3.16 CONDENSATE CHECK VALVES

Non return valves shall be of the swinging disc type (mushroom seating types are not acceptable). The body and disc shall be bronze similar and equal to SPIRAX SARCO WCVI.

SECTION FOUR

PIPE LINE IDENTIFICATION

1.4.1 GENERAL

Pipelines identification banding shall be used to identify all pipelines (insulated and uninsulated), concealed in ducts, voids and spaces above false ceilings. It shall be self-adhesive cellulose tape laminated with a layer of transparent ethyl cellulose tape.

The contents of the pipeline shall be readily identified by an adhesive band of the appropriate ground colour detailed in B.S. 1710/SABS 0140(111) with an explanatory text approved by the Engineer, printed upon it in a contrasting colour detailing the contents of the pipe.

All colour bands shall be 300mm wide and spread at approximately 5m centres. Where pipes are installed in under floor ducts, colour bands etc., shall only be provided where access covers occur.

1.4.2 VALVE LABELS

The Contractor shall provide chain and brass labels for all valves, stopcocks, etc., with engraved lettering to indicate their purpose, as directed by the Engineer.

Provide approved ceiling tile markers in areas where removable ceilings or access panels occur to indicate location of valves or other devices.

SECTION FIVE

WELDING

1.5.1 GENERAL

All welding is to be carried out in accordance with recommendations contained in 'Recommended Practice' for Oxy-Acetylene Welds in Mild Steel Pipelines for Pressures up to 250 p.s.i.g/1725 Kpa and/or Temperatures up to 218 degrees Celsius. (425 degrees Fahrenheit)(Hereinafter referred to as the 'Recommended Practice') published by the Association of Heating, Ventilating and Domestic Engineering Employers, Millbank House, 2 Great Portland Street, London SW1 or SABS 044.

15.2 WELDING RODS

Electrodes shall be kept in a dry place in sealed container as supplied by the manufacturer. All sif-bronze welding in copper pipelines shall be carried out in accordance with B.S.I. Standards. Only welding rods of 'Silfos' or 'Silbraloy' shall be used.

For all purposes of the contract, the Engineer will be regarded as 'Competent Authority'.

4.5.3 X-RAY EXAMINATION

THE CONTRACTOR SHALL ALLOW IN HIS TENDER PRICES FOR X-RAY EXAMINATION OF 10% OF ALL WELDS.

1.5.4 DEFECTIVE WELDS

Should any of the welds prove to be defective, the Contractor will be required to cut out and renew a portion of all the completed welds as directed by and to the satisfaction of the Engineer.

1.5.5 CERTIFICATION

Only welders holding a Certificate of Competency shall be permitted to perform any welding on site. The names of such welders shall be submitted to the Engineer before any welding is executed on site and the appropriate certificates must be submitted for the approval of the Engineer at the time. Their certificates will be renewed after inspection.
Each welder having completed a weld shall stamp the number of his Certificate of Competency on the pipe adjacent to the weld.

Any welding which is found to have been performed by the welder whose name has not been previously approved, shall be removed and the pipeline rewelded by an approved welder at the expense of the Contractor.

SECTION SIX

COMPLETION

1.6.1 FLUSHING THE SYSTEM

The completed pipework system shall be filled with water and then run to waste until the system is free of dirt, oil, cuttings, and weld splatter. On steam systems remove all steam traps and strainers and provide temporary connections as required prior to flushing out. Replace all traps on completion.

1.6.2 VALVE GLANDS

All valve glands shall be inspected on completion and the gland nuts shall be systematically tightened as necessary and replaced if required.

1.6.3 PROVISION OF TOOLS

Three complete sets of all necessary spanners, keys and wrenches as required for maintenance shall be provided. These shall be placed in a suitable labelled container and handed to the Clients representative.

1.6.4 WATER TREATMENT PLANT

General

The chemical treatment programme for all water systems shall perform the following functions:

Inhibit Corrosion

Inhibit formation of scale

Protect system against algae growth

Protect system against sludge formation

Chemicals shall comply with the Local Health Authority regulations and shall be compatible with all materials forming part of the piping system.

Chemicals shall be readily available from a recognised supplier. Chemicals shall be selected so as to not interact with or neutralise each other.

Concentration of chemicals in pipe systems shall be in accordance with suppliers recommendations.

Service vists by the supplier of teh water treatment systems with water analysis tests and recognised corrosion tests shall be conducted at monthly intervals during the twelve (12) month maintenance period. Reports on the above shall be sent to the engineer.

The Subcontractor shall provide sufficient chemicals for twelve months operation.

Closed Systems

Systems shall be filled and the water circulated sufficiently to flush the entire system before draining and filling with clean water, after which corrosion inhibitors shall be added.

The Subcontractor to provide a dosing pot to facilitate addition of the inhibitor.

SECTION SEVEN

DUCTWORK INSTALLATION

1.7.1 FAN GUARDS

Fan inlets and outlets in exposed positions shall be fitted with wire guards.

Fans installed in roofs shall be provided with bird guards and weather guards as necessary to prevent ingress of rain.

1.7.2 DUCTWORK

Low-velocity, low pressure ductwork (velocities not in excess of 10m/sec) shall be constructed from galvanised sheet metal in accordance with HVCA DW/121.

High-velocity, high-pressure ductwork shall be constructed from galvanised sheet steel in accordance with HVCA DW/132 issued by the ductwork group of the Heating and Ventilation Contractors' Association, or SABS 1238 (1979).

Flexible ductwork shall comprise a liner and cover of tough, Tear-resistant, glass fibre, proofed fabric, reinforced with galvanised spring wire helix between liner and cover, with a helix of glass and fibre cord.

Ductwork is to be true in section. No distortion shall be permitted.

Joints and seams are to be sealed by an initial layer of 'Densyl' paste and covered with a strip of 'Densyl' tape 75mm wide or equal. Sharp edges or corners shall not be permitted.

1.7.3 DUCT SUPPORTS

Ductwork supports are to be galvanised, adjustable, of adequate strength and in accordance with DW/121. Pop rivets, etc. penetrating into vapour sealed insulation will not be allowed.

1.7.4 DIRT PROTECTION

During erection all open ends of ductwork shall be covered to prevent entry of dust and dirt, etc., by means of Hessian canvas or stout bitumen backed paper securely tied in position.

1.7.5 TEST HOLES

Test holes shall have mild steel cover plates secured with gunmetal screws. Any cut edges around holes etc, and wherever galvanising is broken shall be painted with 'Galvanite'.

1.7.6 SITE DIMENSIONS

The Mechanical Contractor is required to check all dimensions on site before preparing drawings for the manufacture of ductwork and will be held responsible for ensuring that all ductwork conforms to the building structure.

1.7.7 EXPOSED DUCTS

Ductwork exposed to the weather shall not be less than 1mm material thickness and shall be painted with two coats of bitumastic solution to approved colour.

1.7.8 DAMPERS

Butterfly dampers shall be of aerofoil design fabricated from two plates of a thickness not less than the duct gauge fixed to each side of a square spindle having brass end bearings which have means of lubrication.
Regulating dampers as at fresh air intakes shall be of the Z'ed section opposed blade type with the linkage provided with a locking mechanism.

1.7.9 FIRE DAMPERS

Fire dampers shall be provided at all positions where ducts pass through a firebreak barrier. These shall have a fire resistance equal to that of the barrier, and shall be equipped with fusible links to operate at 59 degrees Celsius. Access traps shall be provided in the ductwork to permit inspection and replacement of the link.

1.7.10 FLEXIBLE CONNECTIONS

Flexible (canvas) collars shall be provided in connections between fans and ducts or casings, where required to prevent excessive movement of long ducts and wherever ducts cross building expansion joints. Connections for Kitchen exhaust ducts, other ducts operating at temperatures above 38 degrees Celsius and acid resisting ducts shall be made of heavy asbestos cloth or neoprene coated glass fibre weighing approximately 1 kg per square metre. Connections exposed to the weather shall be made of neoprene coated glass fibre.

Collars shall be approximately 200mm long and shall be installed with just sufficient slack to prevent transmission of vibration. Circular connections shall be secured to fans and ducts with 1,6mm thick bands 25mm wide. Rectangular connections shall be secured to ducts and fans with 25mm by 3mm flat bars fastened with screws or bolts at 200mm intervals or with slip joints with the fabric being tightly clamped into the slip joint and the complete joints being fastened with gunmetal screws at 800mm intervals. Flexible connections shall not be painted.

SECTION EIGHT

INSULATION

1.8.1 GENERAL

No insulation work is to commence until piping, valves, ductwork (externally insulated) etc, this is to be insulated, have been tested to the written satisfaction of the Engineer. (See Testing and Commissioning).

Insulation shall be applied on clean, dry surfaces.

Insulation shall be continuous through wall and ceiling openings and sleeves. Extreme care shall be taken to ensure that the vapour barrier where required is unbroken. All joints etc shall be sealed. Where insulation with a vapour barrier terminates, it will be sealed off with vapour barrier being continuous to the surface being insulated. Ends shall not be left raw.

Insulation shall be applied in accordance with manufacturer's general instructions in a neat and workmanlike manner so as to present a smooth, even surface.

Special care shall be taken with the installation of the insulation to prevent sealing compounds, cement, pastes, and other materials from dripping on to the building and/or equipment.

Insulation on cold surfaces where vapour barrier jackets are used shall be applied with a continuous, unbroken vapour seal. Hangers, supports, anchor, etc. that is secured directly to cold services shall be adequately insulated and vapour sealed to prevent condensation.

Inserts shall be installed at hangers. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of equal thickness to the adjoining insulation and shall be provided with vapour barrier where required. Inserts shall be of sufficient lengths to support the weight of the pipe without crushing the insulation.

Where insulation is specified for piping, insulate similarly all connections, vents, drains, condensate drains, and any piping connected to systems subject to heat loss or gain.

1.8.2 PHYSICAL CHARACTERISTICS OF INSULATING MATERIALS

Insulation shall be in accordance with the following British Standards with regard to scope, definitions, physical characteristics method of application and tests for fitness.

a) B.S. 1304: Ready-to-fit Thermal Insulating Materials.
b) B.S. 1334: Pre-formed Thermal Insulating Materials.
c) B.S. 1588: Thermal Insulating Materials (Temperature range 93-232 degrees Celsius).
d) S.A.B.S. : 0173

Where an alternative type of insulation is proposed in accordance with the General Conditions apart from satisfying the requirements of the B.S. regarding thermal conductivity, thickness, etc., the Contractor shall also equate the Mechanical Properties of the proposed insulation. All polystyrene is to be of the self fire extinguishing type.

To ensure that the correct thickness has been applied, the Contractor shall, if required by the Engineer, cut one of the sections from the finished covering, without charge.

If any defects are revealed, the Contractor shall at his own expense, remove the whole of the covering and provide and fix new insulation, to the satisfaction of the Engineer.
Particular attention shall be given to the finished appearance of all thermal insulation, which must present a neat symmetrical appearance, running true in line with pipe layouts. Any rough, irregular or badly finished surfaces shall be stripped down and relagged to the satisfaction of the Engineer.

1.8.3 HEAT EXCHANGERS, CALORIFIERS AND HOT TANKS

Insulate on all exposed fixed surfaces with 40mm thick, 85% plastic magnesia covered with galvanised mesh, 15mm hard setting compound trowelled true and smooth and with canvas scrim worked into surface to give smooth texture.

1.8.4 HOT WATER AND LOW PRESSURE STEAM LINES

Insulate with preformed rigid insulation equal to Fibreglass Ltd., fibreglass "Crown" rigid section, Type FPL/104, with canvas finished secured by aluminium bands.

Insulation thickness shall be as follows: -

15mm-50NB	:	25mm thick
65mm NB and above	:	32mm thick
Flat surfaces	:	40mm thick

1.8.5 CHILLED WATER PIPEWORK

Insulate with fire retardant polystyrene sections, minimum density 24 kilogram per metre cubed.

Insulation thickness shall be as follows: -

15mm - 65mm NB	:	35mm thick
76mm - 150mm NB	:	40mm thick
175mm - 300mm NB	:	50mm thick
Over 300mm NB	:	65mm thick

Apply insulation in two layers, staggered to avoid air bridges. Coat the wire brushed pipework with one layer of Flintcote 5, a synthetic cold bitumen adhesive and await until this is tacky. Apply a coat of Flintcote 5 to the inside of styrene shells taking care to fill all air bubbles and depressions and when tacky place upon the metal surface. Allow to set firmly and repeat for second layer.

When dry, apply final coat of Foster 30-36 or Chemseal 4 onto the outside of the styrene sections and cover with a fibre glass scrim cloth taking care to smooth out all bubbles and wrinkles. When firmly in place apply two further coats of Foster or Chemseal until a smooth finish is achieved. All bends and joints to be purpose made, either moulded or segmented. Round off segmented sections to a neat workmanlike appearance before applying sealer.

Finish with 0,5mm thick snap on aluminium sleeving. All bends to be full aluminium segmented lobster back. Screws to be stainless steel and hidden from view on top of bends.

All work shall be finished completely vapour sealed.

1.8.6 VALVES AND STRAINERS

Minimum thickness in all cases shall be identical with thickness stated for relevant pipe size.

All fittings as specified above shall be enclosed in minimum, 0,29mm thick aluminium fabricated valve box hinged lid for access to valve body for maintenance. Hinges to be heavy duty chrome plated. Provide also a sponge gasket for lid to seat on.

The purpose of valve boxes is to permit access to valves and strainer baskets for maintenance, without having to re-insulate valve each time. Care and thought should therefore be given to see that the valve box fulfils this task.

1.8.7 REFRIGERATION PIPEWORK

Insulate with 25mm 'Armaflex'.

The following areas in the refrigerant piping system should be insulated: -

(a) A liquid line exposed to the direct rays of the sun for a considerable distance.

(b) Piping in boiler rooms or ducts containing heating pipes.

(c) Piping at the outlet of a liquid suction interchanger.

Where liquid and suction lines can be strapped together, a single insulating covering can be used over both lines.

Hot gas lines shall not be insulated.

Suction lines and condensate drain lines should be insulated only to prevent dripping where this causes a nuisance or damage.

1.8.8 INTERNALLY INSULATED DUCTWORK

Generally, all sheet metal ductwork carrying chilled air at velocities up to 10 m/sec shall be insulated internally with 25mm Sonic Liner, securely held with angles and cover strips on all corners and joints streamlined to suit air flow. On circular ducts, hold in position with an inner sleeve of expanded metal having at least 16 divisions per 25mm. Expanded metal to be flat faced, not raised, to prevent any whistling. All split pins and plates etc., shall be manufactured from a rust proof material.

1.8.9 EXTERNALLY INSULATED DUCTWORK AND FITTINGS

Where specifically detailed on drawings or called for in the Detailed Technical Specification.

(a) Exposed in Plantroom

Insulate externally with 50mm fibreglass slabs or lags secured by straps every metre. Wrap 25mm galvanised chicken wire around fibreglass and apply nominal 12mm plaster finish. Cut expansion joints through plaster finish every 1,5mm both longitudinally and vertically. Seal all joints with mastic or suitable foam seal. Finally prime and then epoxy paint all plastered finish to provide a suitable vapour seal.

(b) Concealed

Insulate with 50mm foil backed fibreglass in accordance with Manufacturers written instructions.

(c) Duct Fittings

Whether detailed or not, all plenum boxes and diffuser connections shall be insulated as (b) above.

1.8.10 INSULATION OF BRICKWORK PLENUMS

Built up air handling units are to be insulated internally downstream of all heating and cooling coils.

The Contractor is to ensure that all surfaces to be insulated are to be as smooth as possible with no sharp protrusions. These surfaces are to be primed with two coats of Flintcote 3 or equal applied so as to ensure no bare areas.

Timber battens are to be applied set at suitable centres to suit cladding. These battens should be treated with Flintcote 3 prior to erection.

50mm thick, Grade 16 DU in one layer is to be applied. The polystyrene is to be applied with a suitable adhesive and mechanically fixed where necessary.

22 SWG Galvanised Sheet is to be tied back to the battens to afford protection to the insulation material.

Note that it is not required to insulate under plinths unless specifically required in the detailed specification.

SECTION NINE

PUMPS

1.9.1 PUMP TYPES

Pumps shall be of the non-overloading, centrifugal, volute type. Pumps generally shall be of the horizontally split, double suction type, operating at not over 1500 r.p.m.

Pumps having discharge connections not exceeding 200mm (Nominal pipe size) and operating at not over 38 metres of water dynamic head may be of the vertically split, single suction type having the casing secured directly to the bedplate and operating at not over 1500 r.p.m. Pumps having discharge connections not exceeding 100mm NB and operating at over 38 metres but not over 72 metres, total dynamic head, may also be of this type and may operate at not over 3000 r.p.m.

Pumps having discharge connections not exceeding 75mm NB may be of the vertically split, single suction type, and may be of the close coupled type in which the impeller is bracket-mounted type in which the casing is overhung from the bearing bracket. Pumps of either type shall operate at not over 1500 r.p.m. except that where the total dynamic head exceeds 18m; speeds not exceeding 3000 r.p.m. will be permitted.

1.9.2 PUMP CASINGS

Casings of horizontally split pumps shall be designed for a working pressure of 8, 5 bar or 1, 5 times the actual discharge pressure, whichever is greater. Casings of vertically split pumps shall be designed for working pressures of 5 bar or 1, 5 times the actual discharge pressure whichever is greater. Pressure classification of flange connections shall correspond to casing working pressures.

All pumps having discharge connections larger than 75mm NB and operating at more than 18m total dynamic head shall be provided with casing wearing rings. Rings shall be of bronze chrome iron, nickel iron or other composition suitable for the individual application.

High points of pump casings shall be provided with air vent cocks. Cocks shall be extended outside of any insulation specified. Low points of casings shall be provided with valved drains and inlet and outlet connections shall be provided with properly located gauge tappings. Each removable casing weighing over 23 kg shall be provided with a lifting eye or lugs of ample strength. Casing brackets of vertically split pumps equipped with stuffing boxes shall be arranged to have drip pockets. A drip pipe shall be run from each drip pocket and terminate with an approved air gap over the nearest drip funnel or floor drain.

1.9.3 PUMP IMPELLERS

Impellers shall be bronze and shall be dynamically balanced. Hot water circulating pumps shall be of an "all bronze" construction.

Impellers of pumps having 38mm and larger discharge connections shall be fully enclosed and hydraulically balanced. Actual impeller size selected shall not exceed 85% of maximum impeller size possible in casing.

1.9.4 PUMP SHAFTS

Shafts for pumps with stuffing boxes shall be stainless steel, monel metal or shall be carbon steel with sleeves of bronze, chrome iron or nickel extending through the stuffing boxes.

1.9.5 PUMP BEARINGS

Bearings for close coupled pumps shall be of the ball or roller type. Bearings for all other pumps shall be either ball or roller bearings or ring oiled or wool packed sleeve bearings with ample oil reservoirs. Thrust bearings shall be either the ball or Kingsbury type. Bearings shall be effectively sealed to prevent loss of oil and entrance of dirt or water.

1.9.6 STUFFING BOXES AND PACKING

Stuffing boxes shall be deep enough for not less than 4 rings of packing and shall have bronze glands. Glands for horizontally split case pumps shall be split. Pumps of 38mm size and larger operating with a suction lift shall be equipped with bronze lantern rings and external or internal water seal connection with needle valves.

Packing shall be suitable in all cases for the service required with proper consideration of water pressure, temperature, temperature changes and sediment carried in water. Mechanical seals may be provided in lieu of stuffing boxes where recommended and guaranteed by the pump manufacturer for the particular service involved.

1.9.7 FLEXIBLE COUPLINGS

All pumps, other than close coupled pumps, shall be provided with suitable flexible couplings which shall impose no restriction on normal end play and expansion.

Each flexible coupled pump shall be provided with a cast iron fabricated steel bed plate of ample size to hold both pump and motor in correct alignment. Pump and motor shall be accurately aligned when running at normal temperature. Bed plates of horizontally split pumps shall have raised lips and drain connections. A drain pipe shall be run from each drain connection and terminated with an approved air gap over the nearest drip funnel or floor drain.

1.9.8 PUMP EFFICIENCY

The efficiency of each pump shall not be less than 70% and not more than 3% below the peak of the efficiency curve for the impeller furnished.

Catalogue data submitted for approval shall include characteristic curves.

4.9.9 PUMP MOTORS

Each pump shall be equipped with an electric motor. The name plate rating of the electric motor shall be not less than the maximum brake horse power required by the pump at any operating head characteristic from zero to shut-off, or as otherwise specified. Electric motors shall be suitable for Star-Delta starting, if larger than 7, 5 Kw, and shall be totally enclosed fan-cooled.

1.9.10 WEATHERPROOF COVERS

Each pump and motor mounted externally to the plant room or building shall be protected by a removable galvanised sheet metal cover. The cover shall be designed to have sufficient space for ventilation of the electric motor.

SECTION TEN

PAINTING

1.10.1 GENERAL

The Contractor shall paint with first quality materials all parts of the installation covered by the work of this contract to the approval of the Engineer, except where such painting is specified as being of others. All work shall be sealed (as appropriate) primed and given two full finishing coats.

1.10.2 DUCTWORK

Ductwork which is exposed to view including in plantroom shall be fully painted externally.

External ductwork shall be given two coats of bituminous paint after the primer, internally and externally.

1.10.3 COWL, GRILLES & WEATHER LOUVRES, ETC

All non-aluminium cowl and grilles etc., shall be hot dipped galvanised after manufacture and shall be primed and painted externally.

1.10.4 PLANTROOMS

All plantroom equipment shall be fully painted. Equipment supplied in finished condition will be acceptable provided the finish is of high standard, acceptable in colour and does not require much touching up. Equipment within conditioner housings shall be finish painted.

1.10.5 PIPEWORK AND FITTINGS

All piping and fittings shall be painted with the exception of operating components (and copper piping and trays).

Turned parts of valves, controls and fittings, exposed copper and bright metalwork, shall be cleaned and polished to approval.

All piping shall have approved identification bands fitted after final painting to denote the type of service and the direction of flow. (Refer also section identification).

1.10.6 PAINTING DETAILS

i) Galvanised metal parts supplied shall be degreased with white spirit and allowed to weather for several months (if possible). One coat of primer shall then be applied from the following: Calcium plumbate: etch primer plus zinc chromate, or zinc oxide primer. One overcoat and one finishing coat of exterior alkyd gloss to an approved colour shall then be applied or Bituminous paint as approved.

ii) Ungalvanised components primed before delivery and erection on site shall be examined when received. Wire brush any areas where the paint is damaged or where rust has appeared and touch up with a suitable primer, paying special attention to all angles, edge rivets and bolt heads. All steel shall be finished complete with two priming coats being red lead, metallic lead, zinc phosphate or calcium plumbate and finished with one undercoat and one finishing coat of exterior alkyd gloss to an approved colour.

iii) All ductwork shall be readily identified by an adhesive band of the appropriate ground colour detailed in B.S. 1710/SABS 0140 with an explanatory text approved by the Engineer, printed upon it in a contrasting colour detailing the contents of the duct.

iv) Colour Schedule

Unless Otherwise indicated, the following colour schedule shall apply:

Plant Description	Colour	Plascon Code
Chilled water expansion tank	Minuet	G124
Chilled Water Pumps	Midnight Blue	G116
Chilled Water Supply	Midnight Blue	G116
Chilled Water Return	Light Blue	G16
Condenser Water Pumps	Midnight Blue	G116
Condenser Water Supply	Olive	G401
Condenser Water Return	Fairy Green	G71
Hot Water Expansion Tank	Aluminium	HRA4
Hot Water Pumps	Midnight Blue	G116
Hot Water Supply	Medium Yellow	G6
Hot Water Return	Sunlight Yellow	G12
Air Handling Units	Minuet	G124
Supply Air Fans	Minuet	G124
Return Air Fans	Minuet	G124
Ducting	Light Blue	G16
Duct Flanges	Black	G2
Air Compressor Receivers	White	NY1
Pneumatic Air Mains	White	NY1
Fan and Pump Guards	Signal Red	G7
Bases	Black	G2
Drain Pipes	Black	G2

SECTION ELEVEN

TESTING OPERATING AND SERVICING

1.11.1 GENERAL

The Contractor shall provide during normal working hours proper facilities and appliances for testing of materials, equipment, and work supplied under the Contract, and shall carry out such tests as may be necessary to satisfy the Engineer that the installation meets the requirements of this Specification.

1.11.2 STATUTORY AND REGULATORY REQUIREMENTS

Further to the above requirements, the Contractor shall perform at appropriate times all tests required by Government and Local Authorities who may from time to time have jurisdiction over the works and shall obtain all necessary certificates of approval. These certificates and details of the tests carried out shall be lodged with the Engineer upon the completion of the works.

1.11.3 PROGRAMMING OF TESTS

The Contractor shall allow for all performance tests to be carried out within twelve (12) calendar months of practical completion of the Contract or at the time of final inspection as determined by the Engineer or, in the event of failure of plant to pass the tests, such extended period as the Engineer may determine.

All tests shall be carefully scheduled and pre-planned. Performance tests of air conditioning system and refrigeration and heating plant shall be conducted during the appropriate seasons and under approved conditions. The procedure, all results, data and instrument readings obtained during each test shall be recorded by the Contractor and the records lodged with the Engineer.

1.11.4 SPECIFIED TESTS

Specific test requirements are stated in other relevant sections of this Specification. Where required, the Contractor shall provide equipment performance data to permit interpolation of test results for non-design conditions.

1.11.5 PRELIMINARY TESTING

In general, prior to final testing the operation of each piece of equipment individually and each completed system as a whole shall be correctly adjusted as required to give satisfactory performance. Control systems shall be adjusted and placed in operation by the manufacturer or, alternatively, by suitable trained and competent employees of the manufacturer's authorised agent.

1.11.6 ABORTIVE TESTS

Should the Contractor notify the Engineer that tests are ready for his inspection and the tests prove faulty or fail to take place through default by the Contractor, the cost of the Engineers wasted time and expense in attending the aborted inspection will be charged to the Contractors account at the rates laid down by the SA Association of Consulting Engineers.

1.11.7 FINAL ADJUSTMENT

Re-adjustments necessary to accomplish the specified results during the Maintenance Period shall be made without cost to the Client. Re-balancing necessitated by partitioning of the building after the specified conditions have been achieved shall be carried out as a variation to the Contract.

1.11.8 CAPACITIES OF EQUIPMENT

Capacities of refrigerating machines, cooling towers, pumps, heating and cooling coils, fans and other equipment shall be determined by operating tests of not less than 4 hours duration after stable conditions have been established.

Test procedures shall be in accordance with applicable portions of ASME and other generally recognised test codes as far as field conditions permit.

1.11.9 REFRIGERATION SYSTEMS

Field assembled refrigerant piping and apparatus, other than centrifugal refrigerating machines, shall be tested with dry carbon dioxide or nitrogen plus a small amount of refrigerant. Test pressures shall be in accordance with the latest edition of the American Standard Safety Code for Mechanical Refrigeration. Field assembled refrigerating equipment, including centrifugal machines and absorption machines, shall be tested under vacuum and shall show no evidence of leakage with an absolute pressure of 0, 68 Kpa mercury gauge, sustained for a period of one hour without pumping.

Leaks in pipe joints shall be corrected by remaking the joints. Caulking will not be permitted. The vacuum test shall follow the pressure test. Charging the equipment with refrigerant shall follow the vacuum test as closely as is practicable to minimise the possibility of air or moisture being returned to the system. After charging and prior to capacity tests, joints in refrigerant piping and apparatus shall be checked with a halide torch or other equally sensitive leak detector. If leaks are found, the system shall be pumped down and the leaks corrected as specified above.

1.11.10WATER PIPING SYSTEMS

Water piping shall be tested with water pressure of not less than seven bars or one and a half times the maximum working pressure, whichever is greater, at the lowest point in the system.

Care shall be taken to avoid putting excessive pressures on mechanical seals, safety devices, etc. The system shall be filled and all air vented at least 24 hours before the actual test pressure is applied. Test pressure shall be applied when water and average ambient temperatures are approximately equal and constant. Test pressure shall be maintained for not less than 30 minutes without appreciable drop after the force pump has been disconnected. Leaks in screwed fittings shall be corrected by remaking the joint. Leaks in welded joints shall be cut out and re-welded. Caulking of leaks will not be permitted.

1.11.11COMPRESSED AIR PIPING

Compressed air piping (except low pressure control piping) shall be tested at not less than 10, 5 bar. This pressure shall be maintained for one hour without pumping. A correction of the final pressure of not more than 12 Kpa for each 2, 70 degrees Celsius change in average ambient temperature during the test will be permitted. Leaks shall be corrected as specified for water piping.

Low pressure temperatures control air piping shall be tested with 200 Kpa air pressure. This pressure shall be maintained for one hour without pumping, during which time the pressure shall not drop more than 7kPa. A correction of the final pressure of not more than 3, 3 Kpa for each 2, 70 degrees Celsius change in average ambient temperature during the test will be permitted. Leaks shall be corrected by remaking the joints. Caulking will not be permitted.

1.11.12BALANCING WATER SYSTEMS

Water circulating systems shall be adjusted, cleaned and balanced so that water quantities circulated through heat exchangers; condensers, coils and similar equipment are as specified. The adjustment of individual coil circuits may be based on return water temperature, provided air or other primary flow adjustment have first been satisfactorily completed.

Temperature control valves shall be fully open during balancing. Regulating valves shall be set so that those on the longest circuits will be nearly fully open and those on shorter circuits closed only enough to balance the longer circuits. If this results in excessive total flow then limited final adjustment may be made by partial closing of pump discharge valves. The Contractor shall allow for adjustments to pump impeller sizes as appropriate. Final settings of all regulating valves shall be permanently marked.

Water quantities shall be measured with calibrated orifice meters.

Water quantities read from pump curves may not be used for determining capacities.

1.11.13BALANCING AIR SYSTEMS

Air flow systems shall be adjusted and balanced so that air quantities at outlets are as directed and the distribution from supply outlets is free from draughts and uniform over the face of each outlet. These adjustments shall be made in such a manner that volume controls close to air outlets will have the least pressure drop consistent with flow requirements.

Additional pressure drop required for balancing of shorter runs shall be obtained by adjustment of dampers at branch take-off points. Adjustable fan drives shall be used for making final adjustments of total air quantities.

Direct reading velocity meters may be used for comparative adjustment of individual outlets but air quantities in all ducts having velocities of 5 m/s or more, shall be measured by means of Pitot tubes which shall be inserted through small test holes with metal covers (see section 7) provided in the ductwork in positions which shall give at least two traverses of the cross section of the duct.

Final settings of all regulating dampers and other volume adjusting devices shall be permanently marked.

Total diffuser volume for low pressure duct systems, measured by means of a velometer, shall be at least 95% of actual fan supply (measured by means of a duct traverse taken with a Pitot tube and Water manometer).

1.11.14SOUND LEVELS

The system design is such that normally acceptable sound pressure levels should be obtained which are generally accepted as:-

(a) Fan plantrooms with a 400mm diameter or less double inlet double width centrifugal fan 85dBA

(b) Air compressor rooms with two reciprocating compressors having up to 75kw motors 90dBA

For desirable noise levels in various occupied areas the following NC levels are acceptable:-

Workshops without heavy metal working	..... NC 60/70
Computer suites	…..... NC 40/45
Gymnasia, swimming pools, sports halls	…..... NC 40/50
Areas with business machines, general offices and cafeterias	…..... NC 40/45
Restaurants, large office areas, retail shops.	.... NC 35/40
Private offices, libraries, classrooms, conference rooms and reception areas	….. NC 30/40
Bedroom, homes and relaxing areas	…..... NC 20/30
Concert and TV or broadcasting studios	…..... NC 20/25

Where telephone booths are installed or phone usage is frequent the background noise from airconditioning systems is estimated at a level of NC 45.

After commissioning of all plant, should the owner complain of noise problems in general, the Contractor shall be requested to make sound level tests over the normal frequency bands to prove the NC ratings in the areas concerned. This shall be done at the Contractors cost.

Should any area have NC ratings or noise levels exceeding those listed above, the Contractor is to fully assist the Consultants in investigating the source of the problem. Should noise emanating from suppliers equipment be cause for complaint, the onus will be upon the Contractor to remedy the fault by replacement of the item or items concerned. Noise attenuation or sound baffles will not be considered as suitable for reduction of excessive noise from plantroom equipment.

1.11.15TEST INSTRUMENTS

All instruments and appliances required for tests shall be furnished by the Contractor for the duration of the tests. The Contractor will be permitted to use for testing purposes the gauges, thermometers and other instruments specified as a permanent part of the installation.

Test instruments shall be checked for accuracy by the manufacturer or an approved laboratory and Certificates showing degree of accuracy shall be supplied to the Engineer prior to site tests.

1.11.16INSTALLATION DRAWINGS (FOUR SETS REQUIRED)

These shall be neatly prepared and photographically reduced if possible to the same size as the Instruction Manual and bound therein or separately in matching cover. They shall be compiled generally in accordance with the following outline and under the following headings:

a) Layout drawings, showing actual duct positions, sizes, location of dampers, and measured air quantities at all fan discharges, air outlets, fresh air inlets, return air inlets and all other items and quantities relevant to the system.

b) Layout drawings showing actual pipe positions, size, location of control and balancing valves, valve size and type and all other items relevant to the system.

c) Schematic drawings of all controls showing differential bands in all cases where applicable, setting of all controls, overloads, cut-outs and all other variable or adjustable features of the system and components.

1.11.17INSTRUCTION MANUAL (FOUR COPIES REQUIRED)

This shall be bound in a durable Vinyl hardback folder with name of job, Contractors and Engineer stamped on the front. It shall be compiled generally in accordance with the following outline and under the following headings:-

(1) Index - In detail.
(2) General Description of Plant.
(3) Plant Operation and Starting and Stopping Procedures.

To include automatic and manual start-up and shut down procedure: end of season shut-down procedure (if applicable), and operation log sample pages.

(4) Automatic Controls and Switches

Description of operating sequences including time clock settings where required, duplicating and supplementary to Instructions in Plantroom.

Functions of all switches, indicator lights, alarm etc.
Instructions for re-setting controls and cut-outs and adjusting same.

(5) Electric Equipment

General description and list of complete motor nameplate data and scale and actual overload settings.

(6) Schedule of Other Equipment

To include supplier's name and telephone number and equipment make, model numbers, etc.

(7) List of Installation Drawings
(8) Copies of Instructions Framed in Plantroom
(9) Maintenance Schedule

Set out item, frequency, materials to be used, etc, as necessary for normal preventive maintenance of the plant installed.

(10) Manufacturers Descriptive Literature

1.11.18 INSTRUCTIONS IN PLANTROOM

Operating instructions where required by the Authorities shall be framed behind glass or transparent plastic and mounted in the plantroom to Engineers approval. Control and wiring drawings shall be photographically reduced and framed behind glass and mounted in the plantroom to Engineers approval. Drawings shall state, where applicable, the normal and abnormal gauge readings, the control points, scale settings, true settings, differential bands, throttling ranges, time delays, overload settings (actual and scale) and other relevant variable and adjustable items to permit checking and adjustment of each instrument, control and motor function.

1.11.19 INSTRUCTION FOR OPERATION OF THE PLANT

The instructions for operation of the plant shall include demonstrations of the correct performance and function of each piece of equipment under both automatic and manual control. If necessary, this service shall be arranged in two parts to adequately demonstrate operation of the plant under Summer and Winter conditions to ensure adequate education of the owners representative.

1.11.20 SPARES AND TOOLS FOR MAINTENANCE

The tenderers shall state in their tenders all necessary spare parts and special tools recommended or required for proper maintenance of the equipment offered by them and shall allow for this equipment in their tender.

1.11.21 SERVICING

During the maintenance period, starting from the date of Certified Practical Completion of the Contract, the Contractor shall carry out regular monthly inspections of the installation and shall be responsible for maintaining all plant and controls in correct operating adjustment.

The Contractor shall include for free replacement of the refrigerant charge and all consumables during the maintenance period unless such charge is lost by reason of wilful damage by others to the plant.

1.11.22 SERVICE ATTENDANCE RECORDS

Service attendance sheets detailing the work carried out on each visit shall be submitted to a Client's representative for signature. A service log book should also be provided on site in each plantroom in which the date of visit, type of service, work done and spares or consumables used together with any general remarks which will assist in future servicing shall be recorded. The serviceman's name should be clearly recorded.

SECTION TWELVE

INSTALLATION OF MACHINERY

1.12.1 ACCESSIBILITY

Install work so as to be readily accessible for operation, maintenance and repair. Minor deviations from drawings may be made to accomplish this, but changes of magnitude which involve extra cost shall not be made without prior approval.

1.12.2 MOVING EQUIPMENT

Investigate each space through which equipment must be moved. Where necessary equipment shall be shipped from manufacturer in crated sections of size suitable for moving through restricted spaces available.

1.12.3 STORAGE OF MATERIALS

In addition to the requirements of the Conditions of Contract, the following shall apply:

1.12.3.1 Materials permitted to be stored within buildings shall be safely stacked and shall not overload the floor construction beyond the legal permissible floor loading.

1.12.3.2 Combustible material shall not be stored on premises longer than the minimum period necessary for the execution of the work. Provide fire protective measures as directed by the Engineer.

1.12.4 FOUNDATIONS

1.12.4.1 Unless otherwise specified or indicated, all rotating equipment and floor standing equipment is to be installed on concrete foundations or plinths.

1.12.4.2 Foundations or plinths are to be not less than 100mm high and extend not less than 150 mm beyond equipment on all sides. The Contractor shall provide galvanised iron forms the size and shape of each foundation or plinth. These forms shall be of suitable strength such that they will not distort when concrete is cast therein.

1.12.4.3 The foundation forms are to be handed to the Building Contractor for placing and casting of concrete.

1.12.4.4 Where holding down bolts are required, these are to be handed to the building Contractor, together with a suitable jig or template for correctly siting the foundation.

1.12.4.5 Shop drawings indicating the required builders work are to be submitted timeously.

1.12.4.6 The Contractor shall provide all the required inserts for supporting equipment in concrete. The inserts shall not be loaded beyond 75% of the maximum recommended loading allowed for any condition of operation.

1.12.4.7 All equipment set on concrete foundations or plinths shall be accurately levelled with shims which extend completely across the underside of the base of the equipment being supported.

1.12.5. DRIVES AND GUARDS

Provide readily removable guards for rotating machinery and moving parts of machinery in accordance with the requirements of the Factories, Machinery and Building Work Act of 1941 as amended. Guards protecting motor drives and rotating equipment shall have covered test openings to permit tachometer readings to be taken without removal of guards.

All unprotected fan openings shall be provided with protective wire guards. The guards shall be expanded metal and shall be suitably braced to prevent drumming in the airstream.

1.12.6 COUPLINGS AND SHAFT GUARDS

1.12.6.1 All high speed couplings, projecting shaft ends and all dangerous moving parts of machinery within normal reach of a person shall be protected by a guard manufactured from not less than 1,6mm mild steel plate.

1.2.6.2 The guards shall be neatly formed and securely fixed in position.

1.12.6.3 Direct coupling between driven equipment and prime mover shall be by means of a flexible coupling. The coupling shall be "Fennerflex" or equal.

1.12.6.4 The coupling shall be accurately aligned using a suitable clock micrometer.

1.12.6.5 Where a pump set has pipework attached, the pipework shall be removed before aligning the shaft. After alignment, the pipework shall be re-connected with the micrometer in place to ensure that the pipework does not cause misalignment.

1.12.6.6 The coupling shall be fixed to the shafts by means of a taper lock bush which shall be accurately keyed to the shaft.

1.12.7 ALIGNMENT OF MACHINERY

All direct and V-belt driven equipment must be aligned or re-aligned after placing on the foundation. The alignments are to conform to the manufacturers' specifications and must be executed in the presence of and to the satisfaction of the Engineer.

1.12.8 KEYS AND KEYWAYS

All keys and keyways and taper pins shall conform to BS 46 part 1, 1958, or approved equivalent.

1.2.9 LIMITS AND FITS

Limits and tolerances for shafts and holes shall conform to BS 1916 or approved equivalent.

1.12.10 ACCESS PLATFORMS AND LADDERS

1.12.10.1 Provide platforms and ladders where indicated or required for access to equipment in accordance with the requirements of the authorities having jurisdiction.

1.12.10.2 Shop drawings showing details of construction are to be submitted for approval. Platforms shall have bolted or welded structural steel supports cross-braced on all four sides and welded to base plates for anchor bolting to concrete piers. Platforms shall have removable grating, toe plates and hand rails.

1.12.10.3 Ladders shall be of steel construction with ladder width 500mm and 20mm diameter rungs located in 65mm x 65mm side rails securely supported.

1.12.11 SUPPORTS FROM OVERHEAD CONSTRUCTION

Where overhead construction does not permit fastening of supports for the work, provide additional approved framing and/or floor or column supports.

1.12.12 TEMPORARY USE OF EQUIPMENT

Equipment intended for permanent installation shall not be operated for temporary purposes without the written permission of, and in complete compliance with stipulations laid down by the Engineer.

1.13 REFRIGERATION EQUIPMENT FOR COLD AND FREEZER ROOM

1.13.1 MATERIALS

All material shall be the highest quality, and shall comply with the relevant British Standard Specification, the South African Bureau of Standards Specification.

Materials are also subject to the approval of the Engineer to whom samples shall be submitted on his request.

1.13.2 AIR COOLED CONDENSING UNIT

(i) Air cooled condensing units shall be equipped with hermetic, semi-hermatic or open type compressors matching the specified requirements, load and refrigerant.

(ii) Condensing units shall be designed and selected to properly match ambient conditions, refrigerant, room temperature requirements, temperature differences, and compressor operating hours and specified cooling capacity.

(iii) Each condensing unit shall be a complete unit with compressor and motor, air cooled condenser coil, receiver, cooling fans, and controls, high and low pressure protection, discharge and suction valves on serviceable units and high and low pressure indicating gauges complete with shut-off valves.

(iv) Units shall be suitable for permanent outdoor use or indoor use as specified.

(v) Condensing units, including outdoor package units shall be installed on proper bases as specified.

(vi) Compressors with nominal cooling capacity exceeding 7kW must start unloaded.

(vii) Open type compressors shall be directly coupled to the drive motors by means of flexible

couplings and compressor and motor shall be mounted on a single robust bedplate of fabricated steel construction.

(viii) Initial charge of oil and refrigerant shall be provided.

(ix) Internal motor over-temperature protection shall be fitted to hermetically and semi-hermetically sealed compressors together with external over-current protection.

(x) Units with ducted air discharge shall be fitted with centrifugal or axial flow fans.

(xi) Condensing coils shall be seamless copper tubing with copper or aluminium fins depending on the application.

(xii) Interlocks shall be provided between indoor and outdoor units.

(xiii) Outdoor package units where specified shall be completely weatherproof and self-contained with only electrical and refrigerant line hook-up required.

1.13.3 EVAPORATORS

Evaporators, unless otherwise specified in the supplementary specification shall be of the forced convection type, arranged and suitable for intermittent operation of the fan.

The coil shall be finned copper tubing with copper or aluminium fins. The rows of tubes being connected to two headers and the rows being connected as paralleled circuits.

Four row coils will be preferred.

An expansion valve of the thermostatic type shall be provided, and if evaporators are arranged for "flooded" operation, attention must be paid to the return of oil to the compressor.

Compressors should be mounted below the evaporator.

Pipe jointing must be by silver soldering. Soft solder joints will not be accepted.

1.13.4 DRAIN PIPES

Drain pipes from the evaporator units in the freezer rooms, shall be covered with "heater tape" and shall not be covered with "No drip" insulating tape.

1.13.5 REFRIGERATION PIPING

The refrigeration piping shall be of soft drawn copper, annealed, dehydrated and deoxidised with brass flared fittings for sizes below and including 20mm OD.

Above this size hard drawn copper shall be used with sweat type fittings. Soldered with silver solder. Soft solder will not be accepted.

Where necessary flexible sections or suitable coils shall be provided to prevent fracture of tubes due to vibration.

All valves shall be packless type in brass and a liquid indicator, strainer and dehydrator shall be fitted on the liquid line, and arranged for easy removal for cleaning.

Pressure gauges shall be isolated by shut off valves. Horizontal runs shall be sloped from the fixture towards the compressor at a slope of minimum 1 in 200 wherever possible.

All refrigerant lines connected to the condensing units shall be looped when using tubing up to 16 mm.

All lines above 16 mm in diameter shall be fitted to condensing units with vibro-absorbers.

1.13.6 INSULATION OF ROOMS

The insulation to be used in the panels shall be pressure foamed polyurethane with a density of 40 to 45 kg/m^3 and is to be of "fire retardant" quality, or it shall be virgin grade expanded polystyrene conforming in all respects to the accepted S A Standard for thermal insulation and the SABS Report on Polystyrene No. 0711/8687/E53/1971/04/06.

The insulation shall be foamed in place under conditions of controlled temperature and humidity in such a way so as to form a permanent bond with the inner and outer "skins" of metal. Panels foamed on site will not be acceptable under any circumstances.

A high standard of workmanship is to be maintained throughout, and the insulation is to be guaranteed for a period of 5 (five) years against any defects, cavities, deterioration or loss of insulating properties.

1.13.7 PANEL OUTER SKINS

The internal and external cladding on the panels may be of aluminium, stainless steel, PVC coated galvanised steel, plain galvanised steel with baked enamel finish, depending on the requirements of the Supplementary Specification.
The finish may be smooth or embossed, as called for in the Supplementary Specification.

1.13.8 PANEL THICKNESS

TEMP OF ROOM	POLYURETHANE THICKNESS	POLYSTYRENE THICKNESS
Down to + 5° C	50 mm	75 mm
Down to 0° C	70 mm	100 mm
Down to -20° C	110 mm	150 mm
Down to -45° C	150 mm	250 mm

The above thicknesses have been decided upon, based on the thermal conductivity factor of 0,023 W/m° C for polyurethane and of 0,033 W/m° C for polystyrene. Bidders are required to guarantee that this figure will be maintained for a minimum period of 5 (five) years, and that this value applies to an overall installation, including panel joints, etc, and not to a single panel.

1.13.10 PANEL SIZE

Standard panels should be used where possible. These should be such that Cold Rooms can be extended by increments of at least 300 mm in order to obtain a large variety of sizes. Standard Panel heights should be a minimum of 2 300 mm internal. Maximum heights may vary as called for in the Supplementary Specification.

1.13.9 ROOF PANELS

Foregoing references also apply to roof panels. Roof panels should be available in sizes to ensure “overlapping” of the joints between wall panels. Under no circumstances should joints between roof panels occur at the same place as joints between wall panels.

Roof panels should be capable of spanning a distance of at least 4,25m without additional support, but provision should be made to enable the panels to be supported from above or below, should it be necessary. Each roof panel is to be secured to the wall panels in at least one place in each touching wall panel by means of a coach screw or equal positive method. Wood blocks may be foamed in the panel to receive the screw.

1.13.10 PANEL JOINTS

Joints between panels should be positive, 100 per cent air-tight, non-corrosive and not permanent. Gaskets of suitable insulation material are to be designed so as to provide complete vapour barrier once locked in place. Panels should be able to be dismantled and re-assembled without damage to the joints. Detailed drawings and information concerning the joints and method of providing the vapour barrier should be submitted to the Engineer for approval before erection.
After erection, each joint shall be sealed with an approved silicone based sealer to prevent the ingress of dirt into the cracks, and shall provide a continuous smooth finish between panels.

1.13.12 FLOOR INSULATION

The floor may be installed in one of the following ways: (as called for in the Supplementary Specification)

a) Raised above the general floor level
b) Resting on the existing floor
c) Fitted into a recess in the existing floor

1.13.11 RAISED FLOOR

The cold room shall rest on a solid plinth or pad and prefabricated floor panels shall be used. Under no circumstances are gaps to be left between Cold Room floors and the existing floor, by use of bearers or other supports.

The floor panels may have an aluminium checker plate finish or if heavy loads are envisaged, a mesh reinforced concrete screed shall be used.

A ramp shall be provided for easy access to the doorway.

1.13.13 LEVEL FLOOR

The same shall apply as for raised floors, with the exception of the plinth.

1.13.14 RECESSED FLOOR

The prefabricated floor panel must rest on the recessed concrete slab with no space beneath, and the floor of the Cold Room must be raised by means of a screed to bring the finished floor level up to the same level as the outside floor.

1.13.15 GENERAL

Where no mesh reinforced concrete floor screed is provided the floor panel shall be covered with aluminium checker plate on top. For cold rooms with internal temperatures above 0^{o} C, the floor shall be installed un-insulated unless specifically stated and specified insulated.

In all cases, sharp corners shall be sealed off with Silicone based sealer to prevent the accumulation of dirt.

1.13.16 DOORS

Doors may be hinged or sliding. The insulation in the doors shall be at least as thick as that in the wall panels and the outside finish should be the same.

Stainless steel doors may be used with other types of panel finish with the approval of the Engineer.

Hardware shall be stainless steel or chromium plated, and the door locks shall be fitted with safety release handles on the inside operable even when the doors are locked.

Doors shall be fitted with sealing gaskets to provide an air-tight seal when the door is closed. Doors on deep freeze store shall be fitted with heater elements in the door frame and the elements shall be easily renewable or repairable.

1.13.17 SLEEVES

Sleeves used for refrigerant pipes and electric cables shall be of non-conductive, con-corrosive material such as plastic or nylon, and shall be fitted in the panel in such a way that the outside diameter forms a complete seal with the insulation to prevent vapour from entering the panel. The annular space between the pipe or cable and sleeve shall be fitted with a suitable insulating material after installation.

1.13.18 SUPPORTS FOR INTERNAL FITTINGS

All internal brackets shall be supported from the panels in such a way so as to provide a rigid structure. Flimsy supports or pop-rivetting to metal cladding will not be accepted. Where bracket bolts go through the whole panel, special care should be taken as to the sealing of the holes into the panels around bolts and other support fixtures. Plated or stainless steel fasteners only shall be used.

Evaporator coils shall be supported in such a way that easy access is available for maintenance.

Holdover plates, if required, shall be mounted on suitable and rigid floor standing galvanised steel framework.

Where coach screws or similar fastenings are used, wooden blocks may be foamed in place in the panels to take the screws.

1.13.19 SEALING OF GAPS

Gaps shall be sealed, preferably by foaming in place with polyurethane or polystyrene. The sealed gap shall be finished off with suitable cladding where applicable.

1.13.20 REFRIGERANT

The refrigerant used shall be a fluorinated hydrocarbon and shall be non-inflammable and non-toxic.

1.13.21 TESTING

All systems shall be leak tested with refrigerant or other inert gas. When gas tight at 1 250 Kpa (minimum), or at least 300 Kpa above highest operating pressure, the system shall be dehydrated, evacuated, and then charged with the correct working charge. Expansion valves must be protected from damage during high pressure tests, also compressor seals and low pressure gauges.

1.13.22 PAINTING

The plant shall be painted in accordance with SABS Code of Practice 0140 Part I - III - 1978 and section 10 of Part 4.

1.14 REFRIGERATION PIPING AND ACCESSORIES

1.14.1 GENERAL

As most refrigeration systems will be designed to use R22 refrigerant the following parameters will apply.

The suction line total pressure drop should be 21 Kpa (3PSI). Horizontal piping should pitch down towards the compressor and have a gas velocity sufficient to carry compressor oil back to the compressor. Vertical piping should have a velocity at least twice the velocity in the horizontal pipes.

The hot gas line total pressure drop should be 42 Kpa (6 PSI). Horizontal piping should pitch away from the compressor and have a velocity sufficient to carry compressor oil with the gas flow. Vertical piping to have at least twice this velocity. To preclude noise in the gas lines the maximum gas velocity should not exceed 18m/sec.

1.14.2 LIQUID RECEIVERS

Liquid receivers for field assembled systems shall be welded steel, conforming to the requirements of the latest edition of Mines and Works Act or the Machinery, Factories and Building Work Act and Regulations, covering pressure vessels. Each receiver shall have sufficient capacity to hold all refrigerant in the system to which it is connected, except that in plants having two or more separate refrigerant circuits, cross connected by pump out piping, the receiver shall have sufficient capacity to hold all refrigerant in the largest circuit. Receiver capacity shall be based on not over 85% of its internal volume being occupied by liquid. Receivers shall be equipped with supporting saddles, gauge glasses and valved inlet – and outlet, purge and drain connections and safety valve. Gauge glass guards shall be as specified for water coolers.

1.14.3 HEAT EXCHANGERS

Heat exchangers for field assembled systems shall be the standard products of a reputable manufacturer. Field fabrication of heat exchangers will not be permitted.

Heat exchangers for field assembled systems shall be of the shell and tube, shell and coil, or double tube type. Tubes shall be seamless copper, plain or with integrally formed fins. Shells shall be welded steel, conforming to the requirements of the latest edition of the Mines and Works Act or the Machinery, Factories and Building Work and Regulations, covering pressure vessels. Gas passages shall be arranged so as to prevent trapping of oil. Liquid-gas heat exchangers for Refrigerant 12 shall have sufficient surface to ensure heating the gas to not less than 18,5^{o} C at the outlet.

Liquid pressure drop shall not exceed 20,7 Kpa and gas pressure drop shall not exceed 3,45 Kpa.

1.14.4 REFRIGERANT DRIERS

Refrigerant driers for field assembled systems shall be of the angle type with removable cartridges that can be renewed without disturbing pipe connections. Driers shall have brass or steel bodies and solder joint connections. Bonnets shall be flanged and bolted. Cartridges shall be charged with dry silicagel or activated alumina, held securely in place without restraining normal expansion, and provided with suitable means for distributing the refrigerant evenly through the charge.

Unless otherwise indicated, driers shall be installed in liquid lines close to the receiver outlets and shall be provided with valves on the inlet and outlet connections.

Valved by-passes shall also be provided unless the driers are of a type guaranteed by the manufacturer to operate indefinitely without dusting of the desiccant or appreciable increase in pressure drop.

A liquid sight glass and moisture indicator of the colour-change type shall be installed in the liquid line, close to each drier.
Each drier shall be so selected that the pressure drop through the drier shall not exceed 13, 8 Kpa when operating at full connected evaporator capacity.

Drier cartridges shall not be installed until after pressure and vacuum tests have been completed and immediately prior to charging.

1.14.5 DIRECT EXPANSION COILS AND WATER COOLERS

In field assembled systems, each direct expansion water cooler and each circuit of each direct expansion coil shall be provided with a thermal expansion valve of the gas charged type. Valves shall have external equaliser connections, external superheat adjustments with seal caps and solder joint or flanged pipe connections. Valves shall require not over 2,22^{o}C superheat change to move from fully open to fully closed. Superheat setting shall be 5,56^{o}C at full load. Each valve shall be provided with an external strainer, regardless of any internal strainer that may be incorporated in the construction. Strainers shall be as hereinafter specified under "Refrigerant Strainers".

1.14.5 FLOODED WATER COOLERS

Each flooded water cooler in a field assembled system shall be provided with a float controlled expansion valve of the pilot operated type. A strainer, as hereinafter specified under "Refrigerated Strainers" shall be installed ahead of each valve.

1.14.6 RECIPROCATING COMPRESSORS

Each reciprocating compressor connected to a flooded cooler or having suction or liquid mains more than 15m long, shall be equipped with a discharge line oil separator. Separators shall be made of welded steel and shall have and effective impingement type separating element, an oil sump and a float operated return trap connected to return oil to the compressor automatically.

1.14.7 COPPER TUBING

Unless otherwise specified, Refrigerant piping assembled in field shall consist of copper tubing and recessed solder joint fittings. Tubing shall be Type K, hard drawn. Fittings shall be wrought copper or tinned cast brass. Where required for connection to gauges and control devices, tubing not larger than 10 mm O D may be type K, soft (Annealed) with flared tube or double ferrule compression fittings suitable for high pressure. Solder shall be silver solder. Tubing shall be protected against oxidation during silver soldering by use of dry nitrogen flowing through the tubing.

1.14.8 STOP VALVES

Refrigerant stop valves generally shall be of the back seating, key operated, steel cap type. Valves which must be opened and closed in regular operation shall have hand wheels and shall be of the packless type.

Valves connected to copper tubing shall have solder type ends or flanged ends and soldered flange adapters.

1.14.9 STRAINERS

Refrigerant strainers shall be of the angle type, cleanable without disturbing pipe connections, 38mm strainers and smaller shall have brass bodies and solder joint connections and 50mm strainers and larger shall have brass or rust proofed steel or iron bodies and flanged connections. Bonnets shall be flanged and bolted.

Screens shall be bronze or monel metal with perforations not larger than 0,25mm for liquid lines and 0,5mm for gas lines. The free area of each screen shall be not less than 5 times the area of the strainer inlet pipe.

PART 2: DETAILED TECHNICAL SPECIFICATION

2 DETAILED TECHNICAL SPECIFICATION

2.1 GENERAL

Scope of Works

The Principle items of work are as follows;

Supply, installation, testing and commissioning of the complete air conditioning and ventilation systems as follows;

Building

The building is an existing two story building, comprising of ground floor, and first floor with a new ablution addition. The main VRF condensers will be placed at ground level.

Airconditioning system

The airconditioning system selected is the Samsung DVM S Air cooled heat recovery systems or equal and approved. If an alternate system is proposed, the AC Contractor must first price the tender as is, then offer an alternate price.

IF AN ALTERNATE PRODUCT IS OFFERED THE TENDERER MUST ALLOW FOR A SUM OF R 45,000 EXCL VAT TO THEIR TENDER PRICE TO ALLOW FOR THE CONSULTANT TO RE-DESIGN THE SYSTEM ON THE ALTERNATE PRODUCT OFFERED.

The system shall be made up of internal ceiling cassette type airconditioning units connected to central Outdoor condensing units located at ground level.

The airconditioning system will have both heating and cooling capabilities with full heat recovery thus allowing heating and cooling to different zones at the same time. The refrigerant pipes will be reticulated as per the drawings and will be neatly placed in cable trays/ baskets as indicated mounted in their respective zones and spaces on the various floors. Fresh air will be provided via low pressure ducting connected to fans and filters, these fans will be on timers and turn on as programmed to do so. The condensate from each airconditioning unit must be trapped and run to gradient and fall neatly and uniformly to the nearest drain point.

Co- ordination:

All mechanical services i.e. refrigerant pipes, condensate pipes, supply and fresh air ductwork must run in allocated spaces in the ceiling void as determined by the Architect. Allowance must be made for co-ordination with other services as no variation orders will be entertained for removal and re-installing due to clashes with other services.

Note:

(i) All existing equipment removed must be handed over to client maintenance staff, the items are to be scheduled and receipt of equipment to be signed off. These documents to be produced when requested.

2.2 RESPONSIBILITY OF AIRCONDITIONING CONTRACTOR

a) Supply, Installation, Testing and Commissioning.

b) Co-ordination with all professionals, electrical, structural, mechanical, security, sub-contractors and main contractor.

c) Provision of builders work drawings.

d) Provision of installation drawings.

e) Provision of as built drawings and operating and maintenance manuals. **(4 Copies + USB)**

f) 12 month maintenance and guarantee period.

g) Attendance on domestic sub contracts.

2.3 DESIGN CRITERIA

EXTERNAL DESIGN CONDITIONS

Altitude : 1400 m
Outside Summer Conditions : 33ºc DB & 23ºc WB
Outside Winter Conditions : 2ºc

INTERNAL DESIGN CONDITIONS

General Air conditioned Areas : 22.5ºc ± 1º
: 50% RH

2.4 SYSTEM CRITERIA

a) Fresh Air : Each Air-conditioning system must have fresh air introduced at 10 l/s per person

b) Extract Ventilation : All toilets and kitchens, must be mechanically ventilated by extracting air at 15 air changes per hour- ducted systems for internal areas.

c) Air Balance : The total fresh air input must be balanced with the total extract ventilation.

d) Sound Levels : NC 35 must be achieved in all proposed system.

2.5 SYSTEM DESIGN

All work to comply with the Latest SABS / SANS Regulations and the OSH Act.

2.6 DRAWINGS

The works shall be carried out in accordance with the relevant drawings as appended to this document.

2.7 PROGRAMME

The total project completion is to be arranged to suit the Main Contractor's Programme. Exact dates are to be determined for delivery of major equipment in order to meet the key installation dates.

2.8 DRAWINGS TO BE SUPPLIED BY CONTRACTOR

The Contractor shall produce and co-ordinate the following drawings of all services included in this contract.

a) Design and Installation Drawings

b) Builders Work Drawings
c) As Built Drawings

The drawings shall include full details of builders work requirements and hole details necessary to carry out the works, and as required by the Engineer.

The drawings shall be based upon a design, supply and installation basis and shall be submitted in duplicate progressively prior to the programmed commencement of work, to the Engineer for approval including all relevant design information.

The Contractor is responsible for co-ordinating all site works under the contract to suit the programme.

All alterations to working drawings, whether due to co-ordination or otherwise, shall be carried out by the Sub-Contractor and, after final approval has been obtained, the Sub-Contractor shall make final issue to all parties concerned with 3 copies to the Engineer.

The Sub-Contractor shall allow for preparing such drawings sufficiently in advance to give the respective parties adequate time for approval of drawings, and to suit the programme. The Sub-Contractor is to obtain written approval of his builders work drawings.

The Sub-Contractor is to provide full detailed wiring diagrams for all electrical components supplied and installed with required connection to main supply. Any work caused by inaccuracy of marking out or other default of the Sub-Contractor shall be paid for by the Sub-Contractor. Such unnecessary work may include repairing, replacing, making good, taking down and rebuilding of any part of the building plant and other as may be effected by such work.

The Engineer's approval of drawings submitted by the Sub-Contractor shall not in any way relieve the Sub-Contractor from his responsibility in respect of the accuracy of all such drawings nor from his responsibility to provide equipment suitable in dimension, construction and finish for the location in which it is to be installed. Any modification or amendments to these drawings requested by the Engineer in order to ensure that they fulfil the contract conditions shall not involve the Client in extra expenditure.

When submitting any drawings, the Sub-Contractor shall advise the Engineer if, in order to avoid delay in completion of the works, early approval is necessary.

Any unnecessary work carried out by the contractor adjudged by the Engineer to be caused by inaccuracy of marking out or other default of the Sub-contractor shall be paid for by the Sub-contractor.

All detailed drawings submitted for approval shall be to a reasonable scale, and the Engineers decision as to what constitutes a reasonable scale shall be final. All important dimensions shall be given and the material of which each part is to be constructed shall be indicated. All dimensions marked on the drawings shall be considered correct, although measurement by scale may differ there from. Detailed drawings shall be regarded as correct where they differ from the general arrangement drawings. A graphical scale shall be incorporated on all drawings.

2.9 ITEMS

The installation shall include everything necessary and installed to the approval of the Engineer. The design, supply and installation of equipment required for adherence to the
Standards and Codes may not have been indicated in detail in the specification, but will nevertheless be considered included in the contract value.

The same make and type of apparatus shall be used for similar items throughout the installation.

2.10 TOOLS AND SPARE PARTS

The Sub-Contractor shall include for the supply of all special purpose tools necessary for performing normal maintenance operations on all plant and equipment supplied and installed under the sub-contract.

2.11 MANUALS

Before completion of the contract works the Sub-Contractor shall hand, free of charge to the Engineer, four copies of a service manual for all the plant covered by the works.

2.12 DUCTWORK

Low-velocity, low pressure supply and return air ductwork (velocities not in excess of 10m/sec) shall be constructed from galvanised sheet metal in accordance with HVCA DW/121, and externally insulated with 25mm thick FRK.

High-velocity, high-pressure ductwork shall be constructed from galvanised sheet steel in accordance with HVCA DW/132 issued by the ductwork group of the Heating and Ventilation Contractors' Association, or SABS 1238 (1979).

Flexible ductwork shall comprise a liner and cover of tough, Tear-resistant, glass fibre, proofed fabric, reinforced with galvanised spring wire helix between liner and cover, with a helix of glass and fibre cord.

Ductwork is to be true in section. No distortion shall be permitted.

Joints and seams are to be sealed by an initial layer of 'Densyl' paste and covered with a strip of 'Densyl' tape 75mm wide or equal. Sharp edges or corners shall not be permitted.

2.13 DUCT SUPPORTS

Ductwork supports are to be galvanised, adjustable, of adequate strength and in accordance with DW/121. Pop rivets, etc. penetrating into vapour sealed insulation will not be allowed.

2.14 DIRT PROTECTION

During erection all open ends of ductwork shall be covered to prevent entry of dust and dirt, etc., by means of Hessian canvas or stout bitumen backed paper securely tied in position.

2.15 TEST HOLES

Test holes shall have mild steel cover plates secured with gunmetal screws. Any cut edges around holes etc, and wherever galvanising is broken shall be painted with 'Galvanite'

2.16 SITE DIMENSIONS

The Mechanical Contractor is required to check all dimensions on site before preparing drawings for the manufacture of ductwork and will be held responsible for ensuring that all ductwork conforms to the building structure.

2.17 FLEXIBLE CONNECTIONS

Flexible (canvas) collars shall be provided in connections between fans and ducts or casings, where required to prevent excessive movement of long ducts and wherever ducts cross building expansion joints.

Collars shall be approximately 200mm long and shall be installed with just sufficient slack to prevent transmission of vibration. Circular connections shall be secured to fans and ducts with 1,6mm thick bands 25mm wide. Rectangular connections shall be secured to ducts and fans with 25mm by 3mm flat bars fastened with screws or bolts at 200mm intervals or with slip joints with the fabric being tightly clamped into the slip joint and the complete joints being fastened with gunmetal screws at 800mm intervals. Flexible connections shall not be painted.

2.18 VARIABLE REFRIGERANT FLOW SYSTEMS

General

The air conditioning system shall be air cooled, split type multi-system consisting of one outdoor unit and multiple indoor units, each having capability to control independently to suit the requirements of the rooms. The equipment shall be Samsung DVM S or equal and approved.

The systems shall comprise of outdoor units connected via interconnecting refrigeration pipe work to multiple indoor units. The systems shall be complete with all the necessary electronic controls and control wiring to maintain the design room conditions

The refrigeration compressor in the outdoor unit shall be equipped with inverter controller and capable of changing the rotating speed to follow variations in cooling or heating load.

The refrigerant used shall be R410A. The refrigerant piping shall be capable of being extended up to 150m with 100m level difference without any oil traps.

The system shall be capable of operating continuously at ambient temperatures between -5°C and 43ºC.

Both indoor and outdoor units shall be assembled, tested, and charged with refrigerant at the factory. Additional refrigerant for the different systems shall be added as indicated by the equipment supplier.

Outdoor Units

The outdoor units shall have inverter driven compressors electronically controlled and capable of changing speed linearly to follow the variation in cooling and heating requirements.

The capacity control of the outdoor units will be inverter controlled and shall be determined electronically by sensing operational temperatures, pressures and ambient temperature and monitoring requirements for the indoor units.

The units shall be complete with electronic expansion valve(s), oil separator(s), high pressure switches, fan motor safety devices, over current relay, inverter overload protection, fuses, necessary solenoid valves, refrigerant shutoff valves, re-cycling guard timer and all necessary sensors for a safe and trouble free operation
The condenser must have an automatic back up function and a Black Box function. Should the evaporators need to be replaced, the system must be able to collect the refrigerant into the condenser in order not to lose the refrigerant charge. The system must also be able to pump out the refrigerant into the slave condenser and evaporators should there be a problem with the master condenser.
Addressing of the outdoor unit to the indoor units must be done automatically by the press of a button.

Indoor Units

Ducted hideaway type

The ducted hideaway shall have the following functions
1. Sleep mode Auto operation
2. Healthy dehumidification
3. Auto restart
4. Hot start
5. Child lock function
6. Soft dry operation mode
7. Weekly program
8. Low standby power
9. Two thermistor control
10. Group control

Ceiling cassette type

The ceiling cassette shall have the following functions:

1. Jet cool
2. Sleep mode auto operation
3. Healthy dehumidification
4. Auto restart
5. Hot start
6. 4 way air deflection
7. Child lock function
8. Soft dry operation mode
9. Weekly program
10. Low standby power
11. Two thermistor control
12. Group control

The decoration panel shall incorporate the return air grille and supply air louvers. A facility shall be provided to automatically swing the supply air louvers or lock them at a desired angle between to ensure even distribution of the airflow.

A condensate lift pump shall be provided within the unit and shall be capable of discharging at a height of at least 700 mm above the drain outlet.

Control

Computerised control shall be used to maintain a correct room temperature either at the fan coil or from a sensor in the remote controller. The system shall be equipped with a self-diagnostic feature for easy service and maintenance. The master LCD remote controller shall be able to control all indoor units as a group.

Standard remote controller

The remote controller shall perform the following functions:

a) Operating mode on / off control/ fan speed / mode / temp
b) ON / Off LED
c) Room Temp
d) Fan / Plasma / Swirl / Heater.
e) Vane control / Auto Swing / Fan auto
f) Malfunction indication code display for ease of servicing and maintenance.
g) Timer function - 7 day time clocking
h) E.S.P. Function
i) Reservation – weekly
j) Max 2 hrs electric failure compensation

2.19 CONTROLS INSTALLATION

The Entire AC System is to be controlled/ Monitored by the “Samsung MCM-A300N” touch type central controller. This includes all indoor and outdoor units

2.20 VENTILATION FANS

Ventilation fans shall be in accordance with the Schedule of Fans and as shown on the drawings.

Fans shall deliver the specified air quantities against the system resistance.Fan motors shall be suitable for single-phase or 3 phase, 50 cycle electrical supply.Fan motors shall be totally enclosed fan cooled and shall be suitable for star-delta starting if larger than 7,5kW.

The motors shall have nameplate ratings of not less than 20%, or otherwise specified, above the actual fan power required at specified capacities and system resistances.

Axial flow fans shall be supported on anti-vibration mountings to the written recommendation of the manufacturer. Suspended units shall generally be supported from hangers Type 30N as manufactured by Mason Industries Inc. or equal and approved.

Roof mounted fans shall be provided with fibreglass cowl and soaker sheet to suit the roof profile.

2.21 ELECTRICAL EQUIPMENT AND WIRING

GENERAL

The complete electrical installation and all electrical equipment and materials covered under this contract shall comply with the latest edition of the "SABS 0142 - 1978" for the Wiring of Premises, the Factories, Machinery and Building Act of 1941, Local Supply Authorities Regulations and relevant SABS Specifications.

A 380 volt 3 phase 50 Hz supply will be provided by others. The final connection to each control panel or isolator shall be carried out as part of this contract.

The control panels to be either floor or wall mounted in accordance with Part 2 of the Standard Specification.

The "Normal supply" equipment must be rated at 10 Ka rupturing capacity.

All instruments etc, to be provided on these panels are described in the Standard Specification.

Power factor correction capacitors must be fitted for all motors above 5 Kw if the power factor is below 0.8 at the absorbed current. If power factor correction is required, the PF is to be corrected to at least 0.95 at the operating load current and the cables connecting the capacitors to the motors shall be rated at 150% of the KVAR rating capacitors. The capacitors shall be rated for 400 volts and size be selected so that the KVAR does not exceed 85% of the no load KVA of the motor. The capacitors shall be connected into the circuit by means of contactors, which will ensure that power factor correction is applied when the motors are in the delta or running mode.

STARTING CURRENT

Any motors in excess of 7.5kW shall be started by star delta starters and have necessary facilities for anti single phasing.

MOTORS

Motors shall generally be totally enclosed fan cooled unless specified otherwise. Motors shall conform to SABS 948 with regard to dimensions or performance or equivalent BS specification and shall be continuously rated for on site conditions.

2.22 MAINTENANCE AND SERVICING

The successful Sub-contractor shall be responsible for all maintenance and servicing of the installation for the full 12-month maintenance and guarantee period. During this period the successful Sub-contractor shall make good any defective work, replace any defective parts and maintain all plant and equipment in perfect operating condition.

The successful Sub-contractor shall be entirely responsible for carrying out regular inspection at intervals not greater than one month and for full servicing of all components of the installation in accordance with the manufacturers instructions. For this purpose the successful contractor shall prepare a detailed inspection and service report in the form of a check list showing all functions to be carried out at each inspection. Copies of these service reports shall be regularly submitted to the Client.

The successful Sub-contractor shall maintain a plant log book on site in which he shall record, sign and date all work carried out at each inspection as well as log all temperature and pressure readings. The successful Sub-contractor shall allow for all expendable materials, necessary for servicing such as lubricating oils, grease, refrigerants, cleaning materials etc.

PART 3: PRICED BILL OF QUANTITIES

REFER MAIN BILLS OF QUANTITIES

PART 4: SCHEDULE OF DRAWINGS

AIRCONDITIONING & VENTILATION LAYOUT

LSG DRAWING NO.	TITLE
M-1000	Ground Floor - Airconditioning & Ventilation Layout
M-1001	First Floor - Airconditioning & Ventilation Layout
M-1010	Ground Floor – VRF Refrig. Piping Layout
M-1011	First Floor – VRF Refrig. Piping Layout
M-1012	Ground Floor – Airconditioning Condensate Piping Layout
M-1013	First Floor – Airconditioning Condensate Piping Layout