PART 1

PROPOSED NEW POLICE STATION FOR SOUTH AFRICAN POLICE SERVICES (SAPS) - SAMORA MACHEL, CITY OF CAPE TOWN, WESTERN CAPE

AIR-CONDITIONING AND VENTILATION INSTALLATION

STANDARD SPECIFICATION

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I N D E X

PART 2

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STANDARD SPECIFICATION

1. PART OF THE SPECIFICATION

The Standard Mechanical Specification covers the general technical requirements of the mechanical installation. These specifications shall be read in conjunction with the document in its entirety. If the conditions and/or specifications contained herein are at variance with anything contained in the detail specification, the latter shall take preference, otherwise these Standard Mechanical Specifications shall apply as if duly included.

2. MINIMUM REQUIREMENT

The conditions and/or specifications in this section shall be regarded as the absolute minimum requirement. More stringent similar conditions and/or specifications stated in the detail specification shall take preference to those in these Standard Mechanical Specifications.

3. PROPRIETARY MATERIALS

The Tenderer's attention is drawn to the Detail Specification and Bills of Quantities generally which forms an integral part of the specification, specifically to the following clauses:

Where the term "or other approved" is used in connection with proprietary materials or articles, it is to be understood that approval shall be at the discretion of the Principal Agent.

Where brand or trade names are referred to in the Detailed Specification and Bills of Quantities, these shall indicate the quality and type of material or fitting required and no substitution of materials so specified will be permitted unless the authority of the Principal Agent has been obtained in writing before tenders close.

4. STANDARD TYPE AND MAKE OF EQUIPMENT

Once installation has commenced with the appropriate approvals for using any type and make of article or equipment, the same type and make of article or equipment shall be used throughout the project for that specific application unless otherwise specified.

5. STANDARD OF WORKMANSHIP

The workmanship under this contract shall be of a high standard and to the satisfaction of the Principal Agent.

6. STANDARD OF MATERIALS

All materials and equipment supplied and/or installed under this contract shall be new and the best of their respective kinds and shall comply with the requirements laid down in the latest editions of the relevant SANS or BS and their amendments and with the requirements of this specification.

7. VARIATIONS

The Principal Agent reserves the right to instruct the Contractor to carry out variations to the contract in accordance with the conditions of contract.

8. CONSTRUCTION, PLANT, ETC.

Tenderers shall include in their prices for the supply of all scaffolding, hoisting, ladders, trestles, dust sheets and everything necessary for the proper performance of the contract, for clearing and removal of all rubbish due to the work, for the protection of the work from damage due to the building operations, other contracts and the weather. In existing buildings Contractors shall in particular take adequate precautions to the satisfaction of the Principal Agent to prevent damage to existing apparatus during erection operation.

9. MATERIAL, OFF-LOADING AND STORAGE

Tenderers must make due allowance in their tenders for the off-loading of materials and the storage and safe custody thereof according to manufacturer's specifications on or off site until such can be accommodated or is required on site.

10. ACCESS TO BUILDING

Workmen are to be identified to security and issued with access/identity cards. Identifiable uniforms must be worn by workmen and supervisors on site.

11. INSPECTION OF LOCALLY MANUFACTURED SUPPLIES

Where locally manufactured plant or materials are offered, the Principal Agent reserves the right to inspect such plant or goods during manufacture and to reject items that do not conform to the Employer's requirements. Where a number of units are ordered, the Contractor shall notify the Principal Agent when one unit has been completed so that the Principal Agent may inspect and approve it.

12. ORDERING MATERIALS

The Contractor is warned to place all orders for materials or special articles as early as possible as he will be held solely responsible for any delay in the delivery of such goods.

13. PACKING

The Contractor will be held responsible for packing all plant and other goods in such a manner as to ensure freedom from any loss or damage in transit. Unless otherwise specifically agreed upon, receptacles will not be returned or paid for and no additional charges will be allowed for packing or packing materials.

14. SAMPLES FOR TEST

The Contractor shall furnish, without delay, such samples for testing, or other purposes, as called for, or may be called for, by the Engineer, who may reject all materials or workmanship not corresponding with the approved sample.

Notwithstanding that samples and approved brands of materials, etc. are exhibited or included in classified lists at the offices of the Principal Agent, the Engineer may retest any samples, brands of materials, etc. included in the contract and reject articles and materials, etc. that do not strictly comply with the specification.

15. DAMAGE TO BUILDINGS AND THE MISUSE OF FACILITIES

Any damage done to the buildings, roads and landscaped areas by the Contractor, or his men, shall be made good by the Contractor. Should the Contractor, or his personnel, be granted leave by the Principal Agent to utilise on-site facilities and such facilities be misused or damaged, the facilities shall be cleaned and/or repaired to the satisfaction of the Principal Agent (It should be understood however, that the provision of facilities (toilets, etc.) in terms of the Preliminaries costs called for in the tender document, are the responsibility of the Contractor).

16. PROTECTION OF EMPLOYER'S EQUIPMENT

The Contractor shall ensure that any computers or other valuable equipment of the Employer is sufficiently protected against work or dust by means of temporary coverings or sealed-off partitions.

17. INSPECTIONS, TESTING, COMMISSIONING AND HANDING OVER

The Contractor shall provide all tools and instruments required for inspections, testing and commissioning of the works as detailed in the detail Technical Specification.

First Offer for Acceptance (First Inspection)

Once the Contractor has completed the total installation, written notice shall be given to the Principal Agent in order that a mutually acceptable date may be arranged for a joint inspection. During the course of the inspection the Engineer, in collaboration with the Principal Agent, will compile a list of items (if any) requiring further attention. These items shall be identified by checking each and every clause in the contract (all specifications and drawings) in relation to the offered installation.

A copy of this list of outstanding items will be provided to the following:

(a) Principal Contractor – for action.

(b) Contractor – for action.

(c) Principal Agent – for information.

Subsequent and/or final offer for Acceptance (Subsequent and/or final Inspection)

The Contractor shall similarly provide written notice that he is ready for an inspection of the remedial work done on the offending items. If the installation is accepted as complete at this stage, by both the Engineer and Principal Agent, the Principal Agent may certify the works as completed. If at this stage there are still outstanding items requiring attention, irrespective of whether those items were identified during prior inspections or not, the procedure will continue until the entire installation has been correctly completed to the satisfaction of the Principal Agent.

Tests

In addition to the above, the Contractor shall have the complete installation tested and the correct operation of all plant demonstrated to:

(a) Engineer, and/or

(b) The Principal Agent.

Subsequent to the above testing and approval, the Contractor, in the presence of the Engineer, shall test the works as per the Detail Technical Specification.

First Delivery

First delivery (See conditions of contract) may only be proceeded with after final acceptance and testing have been completed successfully.

18. CONTRACTOR'S LIABILITY IN RESPECT OF DEFECTS (Maintenance Period)

The Contractor shall make all adjustments necessary for the correct operation of the plant for a period of 12 (twelve) months after the date of first delivery of the Principal Building Contract. The Contractor shall make good any defects due to inferior materials or workmanship that may arise during this period. If, during this period, the plant is not in working order for any reason for which the Contractor can be held responsible or if the plant develops defects, the Contractor will be notified and immediate steps shall be taken by him to remedy the defects or to make any adjustments required.

Should such defects occur so frequently as to become objectionable or should the equipment otherwise prove unsatisfactory during the abovementioned period, the Contractor, if called upon by the Engineer, shall replace at his own expense the whole, or such parts thereof, as the Engineer may deem necessary, with apparatus to be specified by the Engineer.

The contractor shall within 8 hours of callout report to site, investigate and carry out the necessary minor repairs. Major repairs shall be done within 24 hours.

19. ARRANGEMENTS WITH SUPPLY AUTHORITIES

The Contractor shall apply for and complete all the formalities necessary for compliance with any statutory requirements as necessary. He shall also make himself available for all statutory authority inspections in order to complete all the formalities and tests. Inspection fees shall be allowed for in the tender.

20. COMPLIANCE WITH REGULATIONS

The entire installation shall be carried out in accordance with the latest revision and amendments of the following:

(a) The Code of Practice for the Wiring of Premises issued by the South African Bureau of Standards, SANS 10142-2003.

(b) The Occupational Health and Safety Act.

(c) The municipal by-laws and any special requirements of the supply authorities of the area and district concerned.

(d) The local fire-brigade regulations.

(e) The applicable SABS specifications, or the BS specifications where no SABS specifications exist.

No claims for extras in respect of failure by the Contractor to comply with any of the above regulations will be considered.

Where conflict exists between any of the above regulations and the specification, the said conflict must be referred to the Principal Agent in writing for his ruling.

The Contractor shall be responsible for serving all notices and paying all fees due in terms of the laws and regulations mentioned.

21. TAKING RESPONSIBILITY FOR THE INSTALLATION (For normal electrical or electrical within mechanical installations)

Before any inspection or hand over of the electrical installation or part thereof takes place, the Electrical Contractor (employed by the Mechanical Sub-contractor) will present a Certificate of Compliance of the electrical installation or part of the installation to be handed over as defined in the regulations of the OSH Act of 1993, as amended.

With first delivery, the Contractor shall accept in writing the responsibility for the total installation as installed by him by certifying the correctness of the installation in accordance with and on the certificates of compliance of the work as per the Specification.

22. ELECTRICAL INSTALLATION

SUPPLY

A single and three phase, 50 Hertz electrical supply will be provided by others at the points shown on the drawings. This tender shall include for the supply points and all other cabling, conduits, cable racks, trays, switchgear, panels, distribution boards, etc., necessary for the satisfactory operation of every part of the installation as well as for the connection of the supply cable into control panels, etc.

CONTROL PANEL

A motor control and switchgear board shall be supplied and installed in each plantroom at the position indicated.

Each board shall be fitted with the following:

a. A main isolator.

b. A set of copper busbars of adequate size, if the peak current on the board exceeds 50 amperes per phase.

c. Individual motors shall be supplied through a circuit breaker and suitable D.O.L., automatic Star-Delta, or slip ring starter.

d. All other equipment shall be supplied through a circuit breaker.

e. In the case where the rupturing capacity of a circuit breaker is lower than the rupturing capacity of the electric feed system at the specific point, the circuit breaker shall be protected by H.R.C. fuses of adequate size.

f. Phase rotation protection.

g Over/under current protection.

All starters shall be equipped with auxiliary contacts, which shall be brought to an easily accessible terminal block for the purpose of remote control (if specified). An ammeter with suitable scale shall be fitted to each motor above 7, 5 kW output on at least one phase, and shall be installed in the panel next to the relevant switchgear.

Switchgear panels and boards shall be factory pre-wired so that the only "on site" connections to be made will be the main connection, the supply to each motor, and the control system connections to the terminal block.

Each item on the board, switches, instrument control, etc., shall be clearly labelled in white print on black, hard plastic labels, which shall be neatly glued onto the back panel of the Board.

All switchgear and distribution boards shall be of the metal clad surface type, with a framework, which is electrically continuous and properly bonded to earth.

The boards shall be equipped with hinged steel doors adequately braced each with a flush lock and two keys.

All boards shall be treated with two layers of rust inhibiting paint.
Switches, push-buttons, and indication lamps and gauges shall be so installed that they remain fastened to the doors when doors are opened.

The layout of each board as well as the wiring diagrams and details of the switchgear provided shall be approved by the Consulting Engineer before any manufacture is commenced.

All wiring in distribution boards shall be labelled to ease the later tracing of circuits, these shall correspond to drawing labelling.

WIRING

All boards which are to be mounted outdoors shall be weather proof and guaranteed by the manufacturers for such outdoor operation.

The wiring of the plant shall be carried out by the contractor in surface work in the plantrooms and concealed work in all finished spaces. Wiring shall be done by means of solid drawn or lap-welded screwed tubing and PVC insulated copper conductors, or in multicore PVC/SWA/PVC cable. The main runs of conduit or cable shall preferably be carried out at high level (if possible in false ceiling spaces). Distribution shall be vertically down to the required points. All electric conduit and conduit fittings must be thoroughly inspected for defects before installation, and all sharp edges and burrs removed. Bushes and locknuts are to be used where conduit enters switch boxes.

The proposed location of tubing and cables shall be approved by the Consulting Engineer before commencement of work.

Conduit to be installed under plaster finish shall be installed in good time so as not to delay the Building Contractor or cause finished plaster to be chased.

All electrical cables shall be fastened to cable racks or shall be laid in cable ducts. Cables carried in racks shall as far as possible be laid parallel and shall be neatly installed. Descents shall be firmly secured with provision for the swinging of flexible tubing or cables where attached to moving machines and electrical motors.

Sizes of conduit, conductors and cables shall be at least equal to those laid down in the relevant tables of the Code of Practice.

Flexible conduit and cables shall be provided wherever it is necessary to avoid transmission of vibration. No joints in cables or wires will be permitted in a conduit. The ends of cables shall be properly made off. Terminal lugs shall be used wherever special clamp-washers or sleeve terminals are not provided on equipment. Conductor strands may not be cut away or reduced in size, and care must be taken to select switchgear, etc., with terminals of adequate size for looping, etc., where necessary.

No open wiring will be permitted at any point in the system, with the exception of the copper bus-bars in the switchgear boards. These shall be taped up with PVC tape with the relevant phase colours.

BOXES

Where boxes are used in concrete or masonry, approved removable cover plates shall be supplied. For 100 mm x 100 mm boxes, standard blank metal switch-type cover plates may be used, but for larger boxes, removable cover plates of metal or other approved material must be supplied with bevelled edges and must be neatly painted.

Cover plates shall be large enough to overlap and cover any gaps between the draw box and the masonry or concrete, and must be finished off to match the surroundings so as not to mar the architectural appearance of the building.

WIRING IN CONDUIT

No joints shall be allowed and all looping must be done through approved connectors at fitting points.

The live phase shall be connected at the switching point. All wiring in conduit shall conform to the requirements of SANS 10142 (Table 4 of SABS 0142-1981 as amended). Not more than one circuit shall be accommodated in one circuit unless special permission is obtained from the Engineer. Before any wires are drawn into the conduit, a swab is to be drawn through to clear any water, dirt etc.

PVC INSULATED CABLES

LT cables with PVC insulation must conform to the requirements of SANS 1574 (SABS 150 of 1970 as amended), and must be laid according to the requirements as set out in the Electrical Specification of this document.

SOLID CONDUIT

All conduit shall be of heavy gauge steel, screwed and conform to SANS 61386 (SABS 162 of 1987 as amended). No conduit shall be less than 20 mm in diameter.

All joints shall be screwed and all outlets fitted with rustproof iron boxes. Conduit must be both screwed and lock-nutted on both sides, bushed on the inside of the box or board to which it is attached.

The whole conduit system shall be electrically and mechanically continuous over all joints by means of screwed couplings, well bonded and efficiently earthed by means of earthing terminals and earth continuity conductors. The contractor must keep in touch with the builder and install all conduit so as not to delay his work and to ensure the closest co-operation. Every effort must be made to avoid running conduit in "U"-form, but where this is unavoidable, provision should be made, if possible, to drain the conduit.

All chasing of brickwork, etc., for conduit shall be carried out under this contract.

MINIATURE CIRCUIT BREAKERS

All miniature circuit breakers of the single and double pole type shall be 250 volt grade, and triple pole breakers shall be 600 volt grade. Circuit breakers shall be of the Heinemann, F.W. or other approved make. MCBs may be secured directly to the front panel in which case this panel shall be hinged and wiring taped together to allow for easy movement of the panel. Preferably the MCBs shall be mounted on a metal frame attached to the board casing, access being given to the MCBs and connections by a removable or hinged panel, suitably slotted for toggles, etc.

FUSES

Where circuits are scheduled to be fed through fuses, these shall be mounted directly on the panel. All rewireable fuses shall be of the porcelain bridge type, of approved manufacture, connected through bushed insulated holes in the panel. An I.C. fuseboard unit may be used instead of separate fuses. Connections shall be made through the back of the panel so that no surface wiring results. Tinned copper fuse wire shall be fitted to suit the loading indicated in the schedules, where rewireable fuses are used, and cartridge fuses shall be fitted with the appropriate cartridges.

CHASING OF CONCRETE COLUMNS, BEAMS AND SLABS

The Contractor must take particular care that all pipes, boxes etc., in columns, beams or slabs are fitted before the concrete is cast. Where, however, through unforeseen circumstances it becomes necessary to chase columns, beams, or slabs, the permission of the Engineer must first be obtained. Where this is not done, the Contractor will be held responsible for any damage to the structure which may result.

EARTHING

The whole installation shall be efficiently earthed to the satisfaction of the Engineer, the Inspector of Factories, the Supply Authority, and strictly in accordance with the Code of Practice for the Wiring of premises. Any points proposed as earthing points by the Contractor shall first be approved by the Engineer before connection.

FLEXIBLE CONNECTIONS

Flexible connections shall be of "Kopex" manufacture or approved type. All flexible connections shall be properly earthed to ensure earth continuity.

CABLE TRAYS AND LADDERS

The contractor shall supply and install all cable trays or ladders as specified or as required by the cable routes including the necessary supports, clamps, hangers, fixing materials, bends, angles, junctions, reducers, T-pieces, etc.

Metal cable trays shall be manufactured from perforated rolled steel. Only the following metal cable tray types may be used:

(a) Less than 250mm wide 1,6mm minimum thickness with 12mm minimum return.

(b) 250mm and wider equivalent to trays supplied by "PERFORATION AND CONDIDURE", or other approved, manufactured from 2mm thick steel with folded over returns and a minimum up stand of 50mm.

(c) 250mm and Wider 2,4mm minimum thickness with 76mm minimum return as alternative to (b) above.

The return of trays shall not be perforated and the top of the return shall be smooth. The same cable tray type shall be used in long parallel tray runs.

Metal cable ladders shall be of the "CABSTRUT CL76 series" and shall consist of a 76mm high side rail of 2mm minimum thickness. Cross pieces shall consist of P3300 "CABSTRUT", or other approved. Cross pieces shall be spaced at maximum intervals of 250mm. Where $10mm^2$ cables are to be installed the cross pieces shall be spaced at 125mm centres. Cables shall be clamped in position by means of purpose made cable clamps that fit into the cross pieces. Alternatively with prior approval of the Principal Agent on vertical runs against walls cross pieces consisting of slotted metal rails which accommodate plastic or metal cable binding bands, may be used. These cross pieces are not acceptable in horizontal cable runs and CABSTRUT CL76 cable ladder is to be used.

Rigid unplasticised PVC trays are acceptable. Only the following tray types may be used:

(a) Less than 50mm 3,0mm minimum wide and 40mm minimum return.

(b) 250mm and wider 4,0mm minimum thickness and 60mm minimum return.

Metal cable trays and ladders shall be finished as follows:

(a) In coastal areas (for all applications): Hot-dipped galvanised to SANS 121 and SANS 32 or epoxy powder coating.

(b) False ceiling voids: Electro-galvanised or epoxy powder coating.

(c) Vertical building ducts: Hot-dipped galvanised to SANS 121 and SANS 32.

(d) Plant Rooms, Substations, service tunnels or basements: Electro-galvanised or epoxy powder coating.

(e) Damp areas, exposed to weather: Hot-dipped galvanised to SANS 121 and SANS 32 or epoxy powder coating.

(f) Undercover industrial applications: Hot-dipped galvanised to SANS 121 and SANS 32 or epoxy powder coating.

The abovementioned finishes shall apply unless specified to the contrary. Hot-dipped galvanised or electro-galvanised trays and ladders shall be cold galvanised at all joints, sections that have been cut and at places where the galvanizing has been damaged. Powder coated trays and ladders shall likewise be touched up at joints, cuts and damaged portions using spray canisters recommended by the manufacturer of the trays and ladders.

Trays shall be supported at the following maximum intervals:

(a)	1,6mm thick metal trays with 12mm return	1,22m maximum spacing
(b)	Metal trays with folded over return and 50mm up stand	1,22m spacing
(c)	2,4mm thick metal trays and 75mm return	1,5m spacing
(d)	Metal cable ladders	1,5m spacing
(e)	3,0mm thick PVC trays with 40mm return	1,0m max. spacing
(f)	4,0mm thick PVC trays with 60mm return	1,5m max. spacing

In addition, trays and ladders shall be supported at each bend, off-set and T-junction.

Joints shall be smooth without projections or rough edges that may damage the cables. The Specialist Controls Contractor will be required to cover joints with rubber cement or other hardening rubberised or plastic compounds if in the opinion of the Engineer, joints may damage cables. Joints shall as far as possible be arranged to fall on supports. Where joints do not coincide with supports, joints shall in the case of trays with single returns be made by means of wrap-around splices of the same thickness as the tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 8 round head bolts, nuts and washers. Splices shall have the same finish as the rest of the tray. Where joints which do not coincide with supports occur in trays with folded over returns, tight fitting metal guide pieces, at least 450mm long, shall be inserted in the folded returns to provide the necessary support to the two cable tray ends. Splices as described above shall be provided if trays sag.

Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened to avoid cables being damaged during installation.

The supports for cable trays and ladders shall in all cases be securely fixed to the structure by means of heavy duty, expansion type anchor bolts. It is the responsibility of the Specialist Controls Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense.

Horizontal and vertical bends, T-junctions and cross connections, shall be supplied by the Specialist Controls Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections of which they are connected.

The radius of all bends shall be 1000mm minimum. The inside dimensions of all horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall have 45° cornices.

Cables shall be installed adjacent and parallel to teach other on the trays with spacings as determined by the current ratings. Horizontal trays and ladders shall in general be installed 450mm below slabs, ceilings, etc. to facilitate access during installation.

22.13 12 All metal trays and ladders shall be bonded to the earth bar of the switchboard to which the cables are connected. Additional bare copper stranded conductors or copper tape shall be bolted to the tray or ladder where the electrical continuity cannot be guaranteed.

23. ELECTRIC MOTORS

STANDARD SPECIFICATION

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

- SANS 1804: "Standard Specification for Three Phase Induction Motors".
- BS 2613: "The Electrical Performance of Rotating Electrical Machinery".
- BS 170: "The Electrical Performance of Fractional Horsepower Electric Motors and Generators".

MOTOR SPECIFICATIONS

(a) Standard Squirrel Cage Motors shall be three phase (or single phase up to THREE kW), continuously rated, screen-protected drip-proof, suitable for direct-on-line or star-delta starting.

(b) High-starting-torque squirrel-cage motors shall be three-phase, continuously rated, screen-protected drip-proof, with a special arrangement of rotor conductors giving high starting torque and moderate starting current and suitable for direct-on-line or star-delta starting.

(c) Slip-ring motors shall be three-phase, continuously rated, screen-protected drip-proof, with continuously rated slip rings and brushers and brushgear suitable for automatic starting.

(d) Fractions kW motors shall be continuously rated, totally enclosed single phase, capacitor-start induction run type, shaded pole of three-phase squirrel-cage where required.

(e) Motors suitable for part-wound starting shall be three phase, continuously rated, screen-protected drip-proof with wound rotor circuits suitably rated to provide continuous full load power when fully switched and to provide starting in graded steps sufficient to overcome the starting load torque without exceeding the specified starting current.

(f) Hermetically sealed motors shall be three phase squirrel cage motors, totally enclosed with suitable internal cooling medium and suitable insulation to provide continuous full load power under the specified ambient conditions.

(g) Pole-changing motors shall be three-phase, continuously rated, screen-protected drip-proof with cage rotor and separate stator windings providing several numbers of poles with various interconnections of the windings. The use of pole-changing motors to alleviate starting conditions shall be limited to 2:1 speed ratios. Additional speed ratios shall only be used where the driven load specifically so requires. Pole-changing rotor circuits are not recommended and shall only be used in exceptional circumstances with the proper approval of the Engineer. Dahlander connections providing a 2:1 speed ratio with variable torque and variable power characteristics of the motor may be used to drive centrifugal fans and centrifugal pumps. Dahlander connections providing constant torque characteristics may be used for high friction loads and connections providing constant power characteristics may be used for constant power loads viz. machine tools.

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

MOTOR RATINGS

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

(a) All motors shall be rated for continuous full load duty.

(b) The Continuous Maximum Rating (C.M.R.) of the motor shall be 20% in excess of the full load running duty of the load in order to withstand the tolerance of 105% - 120% in the tripping characteristics of over-load protection devices allowed in BS 4941 Part 1.

(c) All starting times, irrespective of the load characteristics or the method of starting **shall be limited to 20 seconds** unless prior approval to the contrary is obtained from the Engineer. The safe locked rotor time shall be well in excess of the run-up time to allow protection discrimination.

(d) All motors shall be capable of a **minimum** of three **consecutive** starts per hour with the load connected and employing the method of starting to be installed without exceeding the allowed temperature limits of the insulation. In addition, the motor shall be capable of the numbers of starts per hour for the particular load as may be specified or as may be experienced under normal operating condition.

(e) Unduly over-rated motors resulting in a low power factor and efficiency are not acceptable.

(f) The motor starting torque and speed/torque characteristics shall be carefully matched to that of the load to ensure that the motor does not stall at a low speed. A safety margin shall be allowed to overcome voltage drops and load fluctuations. The maximum torque developed by the motor in its final running condition (i.e. when the motor is switched to its final running configuration in the case of pole-changing motors and all starting devices have been switched out of circuit in the case of assisted starting) shall be 1.6 times the rated full load torque to overcome temporary overloads and voltage fluctuations.

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

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

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

Te	=	equivalent accelerating torque in N-m
T1	=	Maximum accelerating torque in N-m
T2	=	Minimum accelerating torque in N-m
GD^2	=	Moment of inertia of the rotating parts of the load and motor in kg-m^2
N	=	Final speed in r/min.
t	=	Run-up time in seconds

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

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

MOTOR WINDINGS

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

Class of Insulation	Altitude					
	0 – 1000m	1200m	1400m	1600m	1800m	2000m
E……	150°C	112.6	111.2	109.8	108.4	107
B……	120°C	118.4	116.8	115.2	113.6	112
F……	140°C	138	136	134	132	130
H……	165°C	163.7	162.5	161	160	158.7

The above figures comply with BS 2613 and SANS 1804 (SABS 948 as amended) for a maximum cooling air temperature of 40°C. Where higher ambient temperatures occur (particularly in cases where heaters are installed), the above temperatures shall be reduced in accordance with BS or SANS specifications.

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

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

MOTOR PROTECTION

Motor protection shall be provided as follows:

Type of Protection	Application
Thermal overload	All motors.
Magnetic overload	Only for short circuit protection when acting on circuit breakers with sufficient rupturing capacity.
Thermistor over-temperature	All motors of 25 kW and more.
Single phasing	All 3-phase motors without thermistor over-temperature protection.
Earth fault	Only when condensation in motors can take place, e.g. standby close coupled pumps on chilled water system.
Phase reversal	All centrifugal compressor circuits

	and large reciprocal compressors or other circuits where phase reversal can cause damage.
Under voltage	As specified.
Over-temperature	Auto-transformer starters, liquid starters and resistor starters.

All the protection specified in the detailed Technical Specification shall be supplied.

Motor overload (O/L) protection shall be provided in accordance with BS 587. O/L protection shall be provided by means of thermal trips or relays actuating contactors, manual motor starters or circuit breakers. **HRC fuses are not acceptable for this purpose.**

On motor starters on which the overload protection forms an integral part of the starter the protection shall be by means of temperature compensated bimetal thermal O/L trips indirectly heated by separate heating elements in each phase and connected in series with the load. The O/L trips shall be adjustable within the range of approximately 75% to 120% of the rated current of the motor.

Where motors are used frequent repetitive cycles or for inching operations, magnetic overload protection with time delays may be used provided the motor is suitably rated for the duty.

Single phasing protection where provided shall be inherent in the overload protection unit in the case of integral motor starters. Protection schemes depending solely on the excess current drawn by the motor during the single phasing are not acceptable.

Magnetic over current trips or relays for short circuit protection may never be allowed to actuate contactor starters and may only operate on suitably circuit breakers.

Short circuit protection shall be provided by means of HRC fuses or suitably rated circuit breakers.

Thermistor over-temperature protection shall be installed. The thermistor control units shall where possible be integrated with the motor starter. Care shall be taken to select units with sufficient current rating to operate the contactor coil.

Thermistor protection may not be provided in lieu of over current protection.

Motor protection shall be “ENGLISH ELECTRIC” type “CMM” OR “P & B GOLDS” type “M”, or other approved, for all motors where preferred. Thermal (or magnetic if required) overload, single phasing (or phase unbalance) and earth fault protection relays as well as auxiliary relays where required, shall be included. The relays shall be housed in a panel mounted unit in a withdrawable case.

Motor protection relays shall not be allowed to operate on metering current transformers, but shall be connected to separate protection class current transformers matched to the motor full load current and the relay power consumption.

In all cases where protection relays are used, “CHAMBERLAIN AND HOOKHAM”, or other approved, test blocks type shall be provided to facilitate remote testing or relay operation, current transformers, etc.

Proven electronic protection relays are acceptable.

Where motors which are not described in BS specifications, e.g. semi-hermetic compressor motors, etc. are used, protection shall comply with the manufacturer’s requirements.

Special attention shall be paid to motors driving high inertia loads to ensure that motors are adequately protected against sustained over currents but do not trip unnecessarily during starting.

(a) Shorting of the over current protection during starting is not acceptable.

(b) Increased overload settings on protection units are not acceptable.

(c) Connecting the overload relay in the delta loop in star-delta starting applications thus providing no protection during starting, is not acceptable.

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

MOTOR PROTECTION - THERMISTORS

All motors with ratings of 25 kW and higher and all motors with a rating of 15 kW and more that are subjected to run-up times in excess of 15 seconds shall have thermistors for over-temperature protection installed in the stator windings. Three thermistors, one per phase, shall be installed in single wound motors and 6 thermistors shall be installed in double wound motors.

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

The thermistors shall comply with the following:

(a) Only Positive Temperature Co-efficient (PTC) thermistors shall be used.

(b) Thermistors installed in motors connected to supply voltages up to 600 V shall be flash tested at 2 kV r.m.s. Additional insulation shall be provided on higher voltage machines.

(c) A varnished Terylene or glass fibre sleeve shall be fitted around those parts of the thermistor leads, which are embedded in the winding for mechanical protection of the leads. Care shall be taken that the sleeve does not cover the thermistor bead.

(d) The thermistor shall be inserted in the winding in such a way to ensure best thermal contact with the adjacent conductors of the winding.

(e) All leads from thermistors to the protection control units shall be twisted pairs to minimise stray voltage pick-up. Screened cables shall be used where the control units are far from the motor.

(f) All the thermistors acting on one control unit shall be connected in series.

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

MOTOR CONSTRUCTION

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

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

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

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

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

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

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

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

(a) Close-couples motors and pumps in chilled water systems.

(b) Standby motors in refrigeration installations where the ambient air surrounding the motor may drop below the dew point.

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

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

Where requested copies of type test certificates for routine and performance tests in accordance with SANS 1804, BS 2613 or BS 170 shall be submitted before delivery of the motors. In additions the Manufacturer’s guarantee that the motor will comply with the duty as described in this specification, shall be submitted. Curves of Torque/Speed and Current/Speed shall be provided on request.

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

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

STAR-DELTA STARTERS

(a) All star-delta starters including resistors where applicable shall be rated for 15 starts per hour unless automatic time delays are incorporated which will prevent more frequent starts than the starter rating allows. In no case however, shall ratings be less than 3 consecutive starts per hour. Starters for plugging duty shall be rated at 40 starts per hour.

(b) The timers for open transition star-delta starters, shall be a break-before-make, snap acting type with a distinct time delay before make, of sufficient length to quench the arc on the star contactor but short enough to prevent magnetic flux decay in the motor with consequent high transients.

(c) All star-delta starters shall be electrically interlocked via N/C contacts on the contactors.

(d) The timing and control circuit for closed transition star-delta starters, shall be designed to employ only one timer to initiate the star-to-delta changeover. The closed transition switching shall be inherent in the arrangement of the auxiliary contact operation. A “policeman” timer to protect the transition resistance may be added.

(e) An overall “policeman” timer shall be provided on all closed transition star-delta starters in addition to the star-delta changeover timer to disconnect the load if the total allowable starting time is exceeded. The make and principle of operation, e.g. electronic vs. electro-mechanical, shall be different from the star-delta timer. On 2-wire control systems the “policeman” timer must lock out and shall be manually reset in order to prevent recycling.

24. CONTROL EQUIPMENT

GENERAL

The equipment offered must meet the following minimum specified standards. The Trade names only mention the name of a product, which will be acceptable if it is installed. Tenderers can offer another product to the product mentioned in the specification, if it is of similar or improved type and quality and if it has been accepted by the Engineer in writing.

All equipment shall operate from a 24 V supply.

CONTROLLERS

The controllers shall be of the microprocessor based programmable controllers with a fixed operating system.

Each controller shall be composed of the following:

a) Analog input ports

b) Digital input ports

c) Control modules for P, PI, PID and digital control

d) Numerical calculation modules

e) Logic calculation modules

f) Analog output ports

g) Digital (on/off) output ports

h) Dedicated service module socket

i) Updating of readings twice per second

Configuration of the controller shall be carried out in the following ways:

(a) Using a hand held service module.

(b) Using a personal computer with graphic configuration software.

(c) Down loading of a previous up-loaded configuration from a PC or service module.

Each controller shall display the following on an alpha numeric panel with keypads:-

(a) Temperature in ºC.

(b) Relative humidity in % RH.

(c) Pressure in Pa.

The controllers shall be used to read temperature, pressure and relative humidity and to adjust valve and damper actuators proportionally. It shall also be used to reset supply air temperature set points in relation to outside air temperature.

The controller shall be designed to be DIN rail mounted into a standard electrical panel with the face of the controller protruding through the panel front cover. The controller housing shall be manufactured from polycarbonate, blended with ABS.

The controller offered shall be engineered to be used as a stand-alone controller, but must incorporate technology to be connected and to communicate to a supervisory control system through a high speed (RS 485) serial communication bus.

PRESSURE DIFFERENTIAL SWITCHES

Pressure differential switches shall be used as digital inputs to the control system to give dirty filter alarms and fan run stop indication. The switches shall be used to interlock the control system with fan operation, thus ensuring that humidifiers and steam heaters are not activated if the fan is not in operation. The switch point shall be adjustable to suit the specific requirement. In general the following shall apply:

(a)	Pressure differential over roll filter	:	150 Pa
(b)	Pressure differential over bag filter	:	250 Pa
(c)	Pressure differential over hepa filter	:	300 Pa
(d)	Pressure differential in supply air and return air ducts	:	100 Pa

The pressure differential switches must be designed to operate in an environment where the duct pressure can increase to 1500 Pa. The pressure differential switches shall be connected with appropriated PVC tubes, which will be connected on a static pressure probe, which will be mounted on the duct. The pressure probe shall consist of a 50 x 50mm galvanised plate, with a copper tube protruding through it. The plate shall be pop riveted to the duct with the probe protruding into the duct. All piping shall be neatly attached to the duct.

PRESSURE TRANSMITTERS

Pressure transmitters shall accurately measure low differential pressures and shall convert the measurement into a standard proportional 0-10 Volt signal.

The transmitters shall have the following features:

(a) Low zero drift time.
(b) Low sensitivity to ambient temperature change.

(c) Low hystresis.

(d) Good over rangeability.

(e) High accuracy.

(f) Splash proof dust type case.

The pressure transmitters shall be required to measure duct static pressure in low pressure duct systems and shall have a measuring range from 0-600 Pa. It shall be designed to operate in an environment where the duct pressure can increase to 500 Pa.

TEMPERATURE TRANSMITTERS

General

Accuracy

(a)	Duct, emersion, strap-on and outdoor sensors	:	1% accuracy
(b)	Return air sensors	:	1,2% from +10 to + 30°C and 3,5% from to +10°C and from 30°C to +40°C

Protection

Minimum protection to be IP 54.

Ambient Operating Limits

Temperature	:	0 to +50°C
Humidity	:	10 to 90% rh

Emersion or Duct Mounted Type

The temperature transmitters shall provide active sensing of air or water temperature and shall produce a 0-10 Volt DC signal, directly proportional to the sensed temperature. The transmitters shall be used to provide an analogue input to the plant controllers. The temperature transmitters shall use a positive temperature compensation, silicon sensor and shall be available in the following modules:

(a) Emersion/duct mounting.

(b) Return air mounting.

(c) Outdoor mounting.

(d) Strap-on mounting.

The temperature ranges of the various transmitters shall be as follows:

(a)	Chilled water	:	0° to + 40°C
(b)	Cold duct supply	:	0° to 40°C
(c)	Hot duct supply	:	20° to +120°C
(d)	Outdoor air	:	-20° to +40°C
(e)	All other applications	:	0° to +40°C

Room Type

The room type temperature transmitter shall be to the type described for the duct mounted type, with the exception that the control components shall be accommodated in a neatly designed and attractive housing with sufficient openings for room air circulation over the temperature sensing element. The room sensors shall not be equipped with an adjustment facility, or with temperature indication. Room sensors shall be designed for installation on a 50 x 100mm existing electrical box. The temperature range shall be 0°C to +40°C.

25. WELDING

Welding shall be carried out in accordance with the current edition of SANS 10044 Parts I to VII where applicable.

All welded filler of butt joints shall be free from porosity, cavities and entrapped slag. Joints shall be ground smooth, if required for aesthetic reasons only, without effecting weld strength.

The joints in the weld run, where welding has been recommended, shall be as smooth as possible and shall show no pronounced hump or crater in the weld surface.

The profile of the weld shall be uniform, of approximately equal leg length and free from overlap at the toe of the weld. Unless otherwise specified the surface shall be either flat or slightly convex in the case of filler welds and with reinforcement of not more than 3mm in the case of butt welds.

The weld face shall be uniform in appearance throughout its length.

Filler metal electrodes shall be of an approved type for the material being used and shall be kept in a dry condition. All electrodes shall conform to SANS 455.

Only welders in possession of a valid approved competence certificate shall be employed.

All welds must show proper fusion. Unless otherwise specified in the technical specification, the contractor shall allow for the removal and testing by an approved body of 5% of the welded joints in the system. These will be removed at random as indicated by the Engineer and tested. Should faulty welding be discovered, all other joints shall be X-ray tested by the SANS or an approved body, all at the expense of the Contractor. The expenses involved in the testing of joints shall be included in the tender form.

DUNDEE HOSPITAL

AIR-CONDITIONING & VENTILATION INSTALLATION

BILLS OF QUANTITIES

GENERAL NOTES

1. The bills of quantities form part of and must be read in conjunction with the specifications and drawings which contain the full description of the work to be done and material and equipment to be used.

2. No alteration, erasure or addition is to be made in the text of the bills of quantities. Should any alteration, erasure of addition be made, it will not be recognised but the original wording of the bills of quantities will be adhered to.

3. The priced bills of quantities of the successful tenderer will be checked and the Engineer reserves the right to call for reasonable adjustments to any individual price and to rectify any discrepancy whilst the total tender price, as submitted, remains unaltered.

4. The responsibility for the accuracy of the quantities written into the bills remains with the party who prepared the bills. The tenderer shall be relieved of responsibility of measuring quantities at the tender stage, and the tender sum submitted shall be in respect of the quantities set out in the bills, although he will be required to make his assessment of items such as fixings, etc. from details stated in the bills and shall include in the item prices for such small installation materials as are required for the complete installation in accordance with the specification.

5. The rates contained in this document shall apply irrespective of the final quantities of the different classes and kinds of work actually executed.

6. The quantities in these bills of quantities are not to be used for ordering purposes. Quantities set out in this document are to be regarded as provisional only.

   The work, when completed, shall be remeasured and the final contract sum calculated, using the tendered tariffs and the finally measured quantities.

7. Variations in the scope and extent of the work included in the bills shall be allowed to meet the Employer's requirements.

   The rules governing the extent and valuation of variations shall be those provided for in the conditions of contract.

8. Unless separate rates for the supply and for the installation of any item is specifically called for, the supply and installation costs of any item shall be fully included in the unit price.

   The description of each item shall, unless otherwise stated herein, be held to include making, conveying and delivering, unloading, storing, unpacking, hoisting, setting, fitting and fixing in position, cutting and waste, patterns, models and templets, plant, temporary works, return of packings, establishment charges, profit and all other obligations arising out of the conditions of contract.

9. The quantities and rates included for dayworks shall form part of the tender price, but tenderers shall note that this item must be regarded as indicative and will only be payable to the Sub-Contractor if and when covered by a Variation Order.

10. Tenderers shall price the Preliminaries under one group only: i.e.

    (a) a fixed amount

11. All provisional sums shall be expended as directed by the Principal Agent and any balance remaining shall be deducted from the amount of the contract sum.

12. Provision is made on the final summary for the applicable Value Added Tax to be added.

13. In these bills, the word “supply” shall be deemed to include the acquiring of equipment and materials from suppliers and workshops and the delivery, off-loading and safe storage of the equipment on site.

14. In the bills the word “install” shall be deemed to include the unpacking, hoisting, placing and fixing, suspending or building in an approved position, cutting, connection, commissioning, testing and handing over of plant, equipment and materials.

15. Piping shall be measured in metres, stating the internal or external diameter in accordance with accepted trade usage. The rate for piping shall include cutting, jointing and running joints. The lengths of pipes shall be measured over/through all fittings, but not over valves, pumps and inline instruments such as strainers, site glasses, etc.

    All pipe fittings to pipes exceeding 50mm diameter shall be given separately for each diameter of pipe and each type of fitting. Unions, valves, flanges, etc. shall be given separately for all diameters of pipe. Purpose-made fittings are to include for lining up of fittings. Welded joints, including joints to fittings, shall be measured separately and shall allow for all cutting, preparation of ends and welding.

    Pipe supports and brackets shall be measured separately in number on main piping systems with diameter above 80mm only.

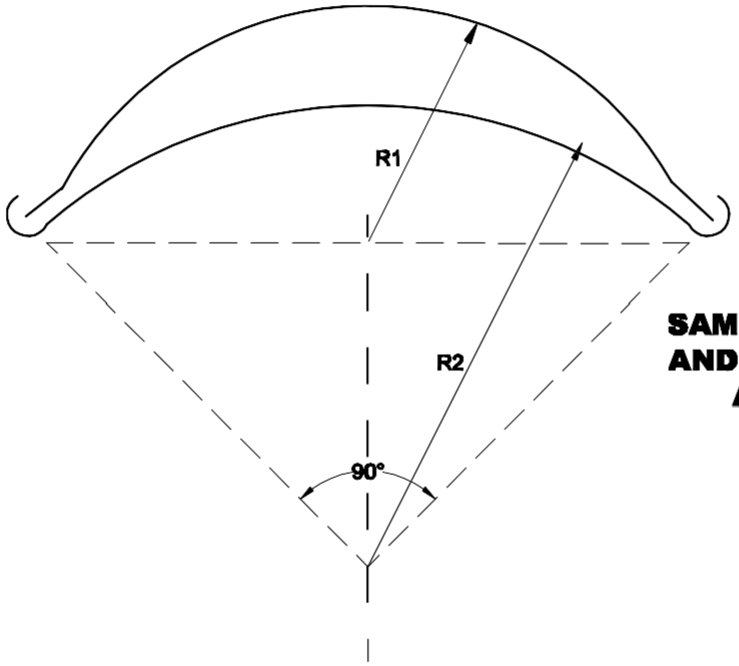
DUNDEE HOSPITAL

AIR-CONDITIONING & VENTILATION INSTALLATION

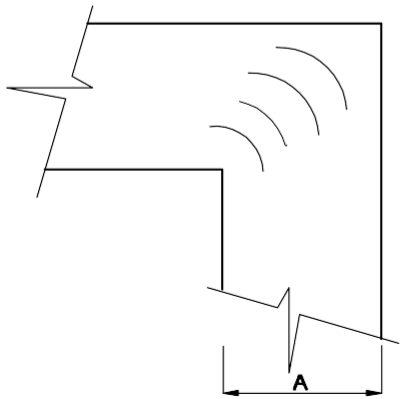
STANDARD AND LAYOUT DRAWINGS

1. The following standard drawings are attached and are to be read in conjunction with the Specification:

STD11	Brackets for ducts.
STD12	Hangers for ducts.
STD13	Brackets for ducts
STD15	Aerofoil type guide vanes for square bends.
STD16	Radiused bends and vanes.
STD17	Flexible Duct Connection.
STD18	Pipe U-bolt and Insulation Pipe Fixing Details.
STD19	Standard Machine Base Tray
STD24	Tee Connections.
STD25	Insulating Fixing Details.



SAME MATERIAL AND THICKNESS AS BEND



A	R1	R2	S
UP TO 600	25	50	55
OVER 600	55	115	80

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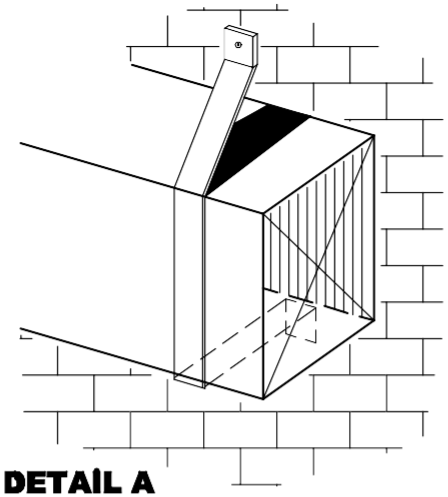
PROJECT:

DRAWING DESCRIPTION:
AEROFOIL TYPE VANES
FOR
SQUARE BENDS

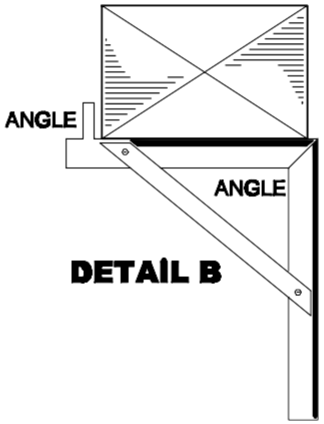
DATE: AUGUST 2005	DIV REF. NO. STD
FILE NO:	DESIGNED BY: W. VENTER
SCALE: N.T.S.	DRAWN BY: L.A.LE ROUX
REV. NO. 0	CHECKED BY: P. MORNET
DRAWING NO: STD 15	



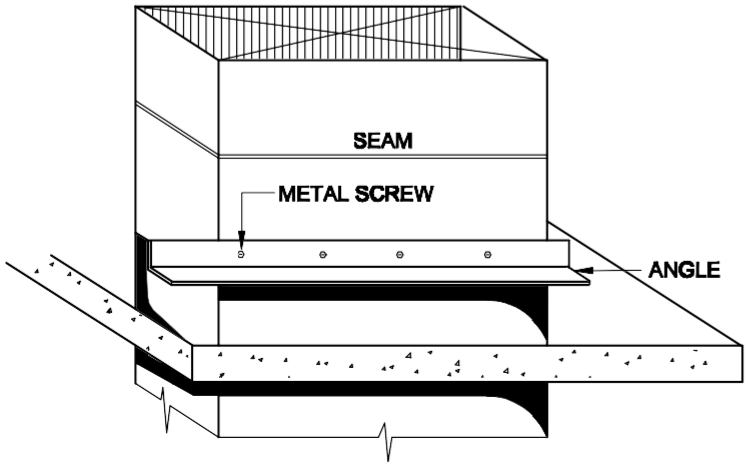
DETAIL A

DUCT SIZE	ANGLE	SPACING
300x450	38x1,6	2400
380x600	38x1,6	2400
450x900	38x1,6	2400

DUCT SIZE (WIDTH)	ANGLE	SPACING
UP TO 450	38x38x3,2	2400
460x760	38x38x3,2	2400
761	38x38x3,2	2400



DETAIL B



DETAIL C

DUCT SIZE	ANGLE
900x450	38x38x3,2
1200x600	38x38x3,2
1520x750	38x38x3,2
1520	51x51x4,8

NOTE:
OVER 1520mm INCREASE
ANGLE SIZE AS REQUIRED
FOR SPACING AND DUCT SIZE

REFERENCE DRAWINGS

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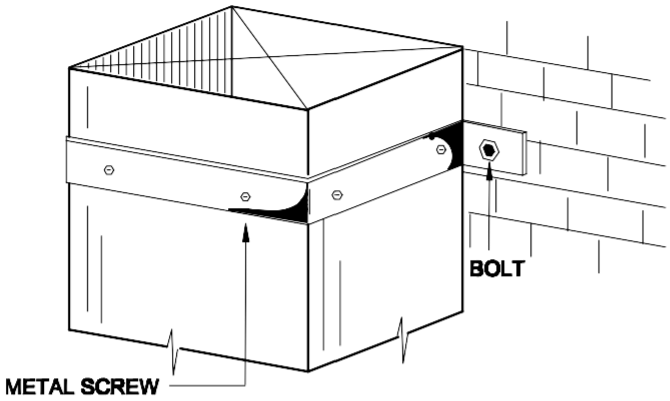
PROJECT:

DRAWING DESCRIPTION:
BRACKETS
FOR
DUCTS

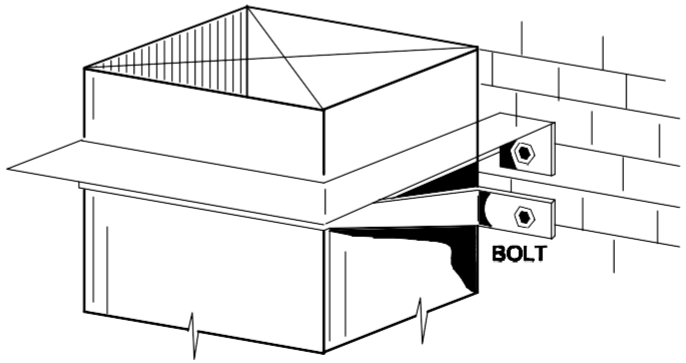
DATE: AUGUST 2005	CSV REF. NO. STD
FILE NO:	DESIGNED BY: W. VENTER
SCALE: N.T.S.	DRAWN BY: L.A.LE ROUX
REV. NO. 0	CHECKED BY: P. MORNET
DRAWING NO: STD 11	



DETAIL A

DUCT SIZE	ANGLE	SPACING
460x300	13x1,6	3660
600x380	13x1,6	3660
600x500	13x1,6	3660

DUCT SIZE	ANGLE	SPACING
760x300	25x25x3,2	3660
900x460	25x25x3,2	3660
1066x600	32x32x3,2	3660
1200x760	32x32x3,2	3660



DETAIL B

REFERENCE DRAWINGS

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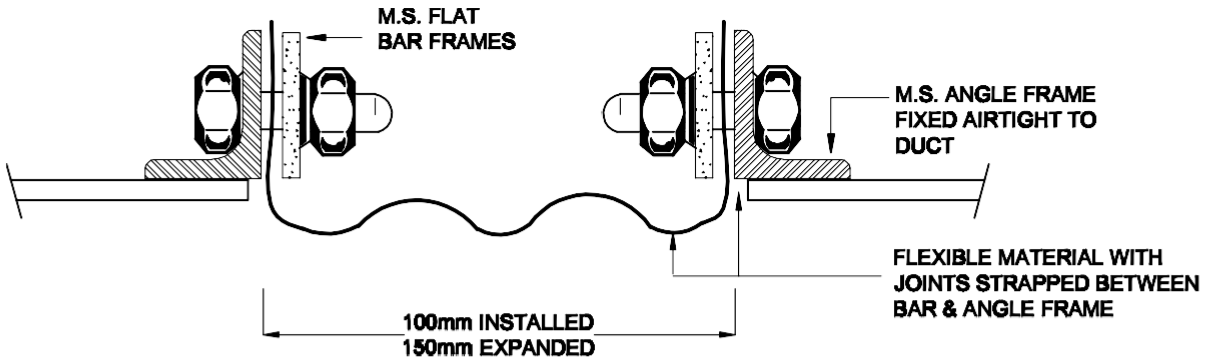
PROJECT:

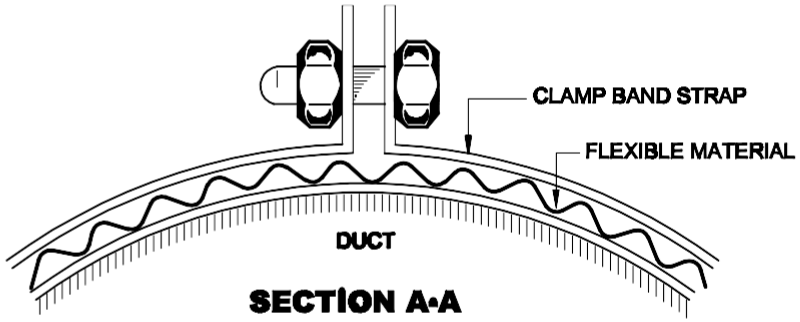
DRAWING DESCRIPTION:
BRACKETS
FOR
DUCTS

DATE: AUGUST 2005	DSV REF. NO. STD
FILE NO:	DESIGNED BY: W. VENTER
SCALE: N.T.S.	DRAWN BY: L.A.LE ROUX
REV. NO. 0	CHECKED BY: P. MORNET
DRAWING NO: STD 13	

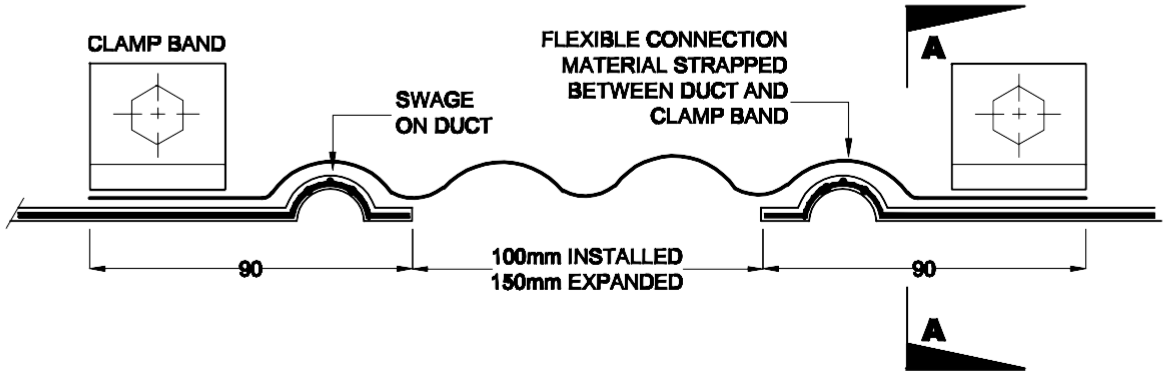


SECTION THROUGH FLEXIBLE CONNECTION FOR RECTANGLULAR DUCTS

FLEXIBLE CONNECTION IS NOT TO BE DRAWN TIGHT



SECTION A-A



SECTION THROUGH FLEXIBLE CONNECTION FOR ROUND DUCTS

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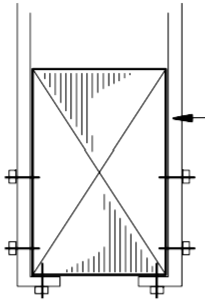
PROJECT:

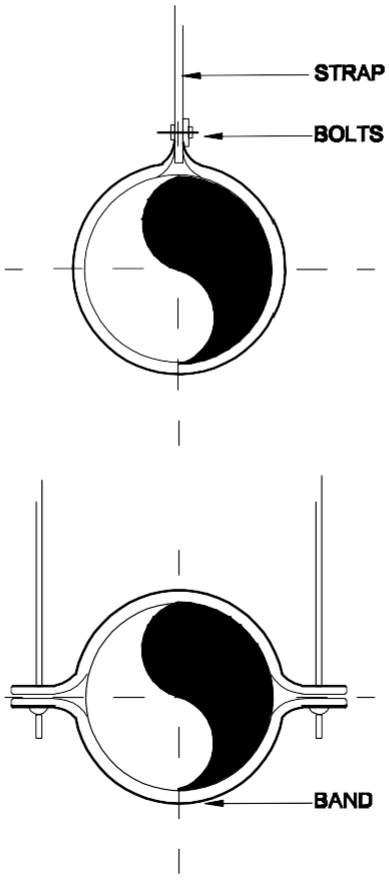
DRAWING DESCRIPTION:

FLEXIBLE DUCT CONNECTIONS

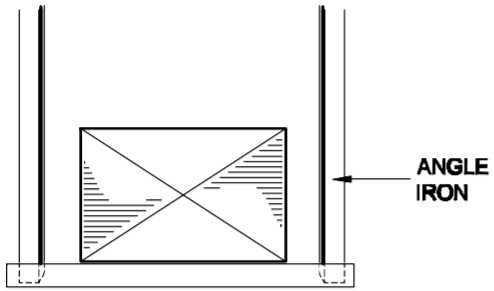
DATE: AUGUST 2005	CSV REF. NO. STD
FILE NO:	DESIGNED BY: W. VENTER
SCALE: N.T.S.	DRAWN BY: L.A.LE ROUX
REV. NO. 0	CHECKED BY: P. MORNET
DRAWING NO: STD 17	

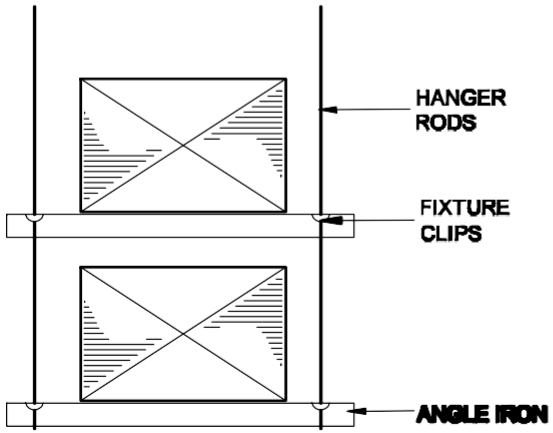
STRAP HANGERS





TRAPEZE HANGERS





NOTE:
HANGERS FOR HOT
OR COLD DUCTS

REFERENCE DRAWINGS

REV:	DATE:	DESCRIPTION	SIGN:
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0		FIRST ISSUE	

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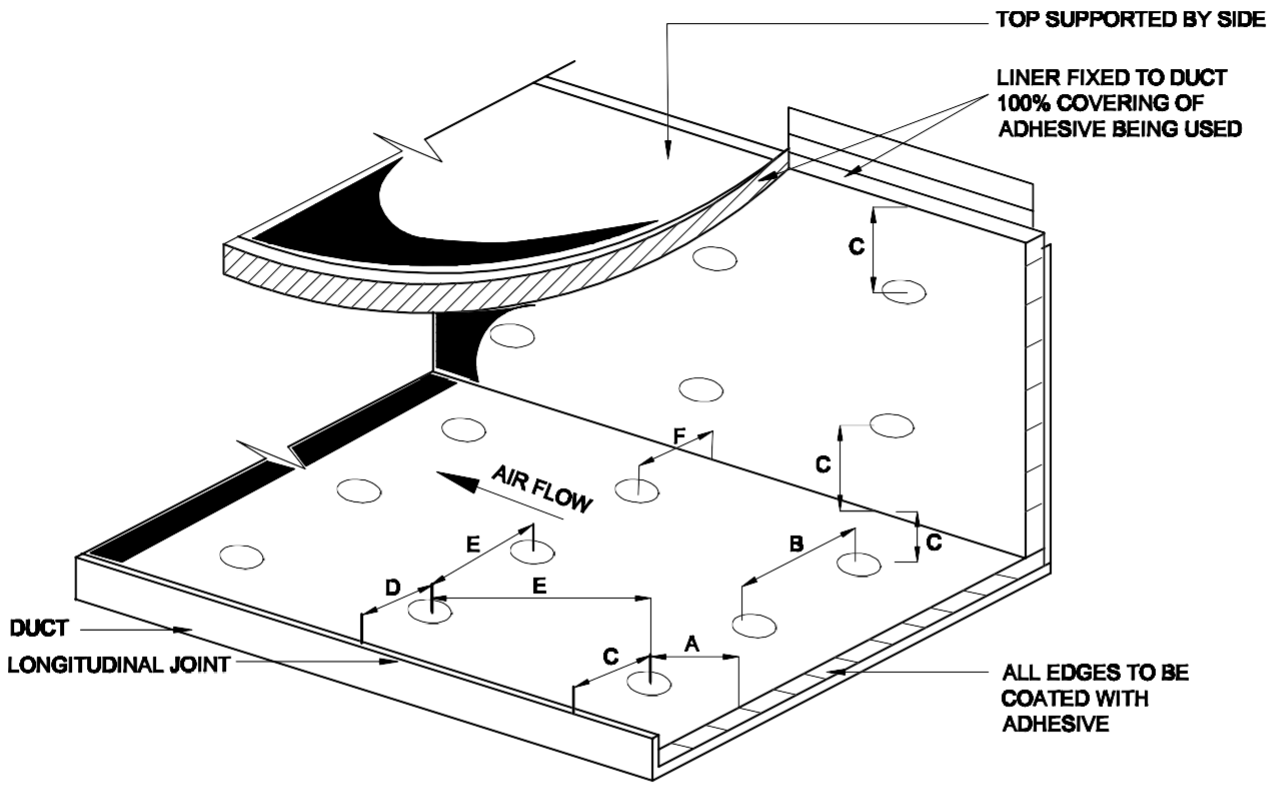
Practical Innovation

PROJECT:

DRAWING DESCRIPTION:
HANGERS
FOR
DUCTS

DATE: AUGUST 2005	CSV REF. NO. STD
FILE NO:	DESIGNED BY: W. VENTER
SCALE: N.T.S.	DRAWN BY: L.A.LE ROUX
REV. NO. 0	CHECKED BY: P. MORNET
DRAWING NO: STD 12	



FASTENING OF RIGID INTERNAL INSULATING MATERIAL

	SPACING OF MECHANICAL FASTNERS (mm)					
DUCT SYSTEM	A	B	C	D	E	F
LOW PRESSURE	75	400	400	400	400	400
MEDIUM PRESSURE	75	400	400	400	400	400

REFERENCE DRAWINGS

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DRAWING DESCRIPTION:
INSULATION
FIXING DETAILS

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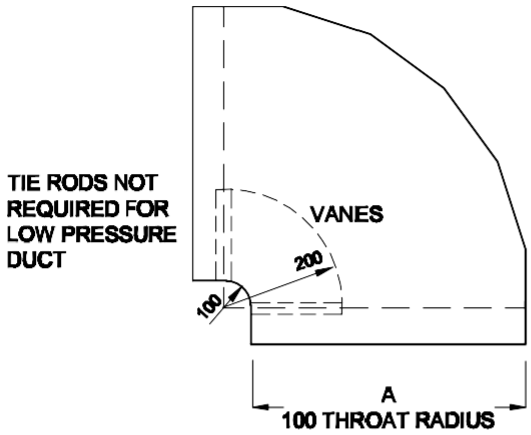
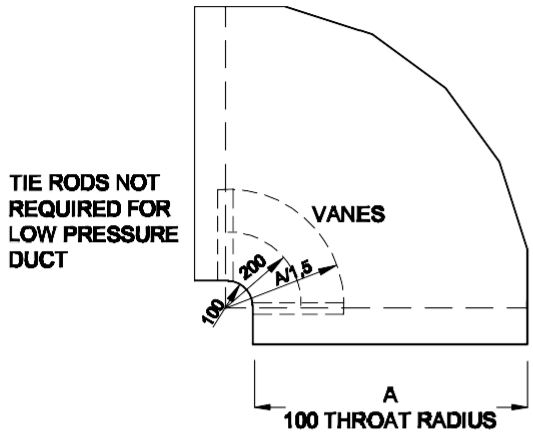
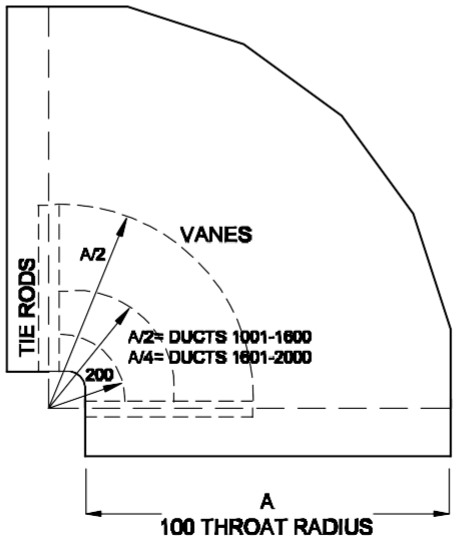


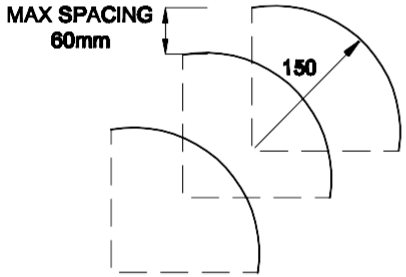
A 301 to 500 WIDE



A 501 to 1000 WIDE



A 1001 to 2000 WIDE



GUIDE VANES IN SQUARE BENDS FOR LOW PRESSURE DUCTING

NO. OF RODS (NOT FOR L.P. DUCTS)
301 - 500 = 1
501 - 1000 = 2
1001 - 1600 = 3
1601 - 2000 = 4

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RADIUSED BENDS & VANES

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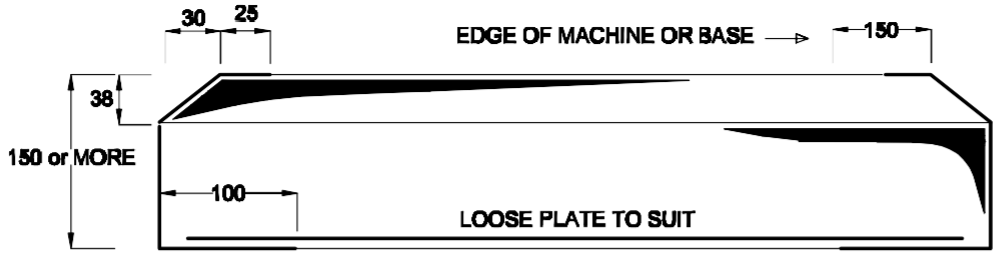
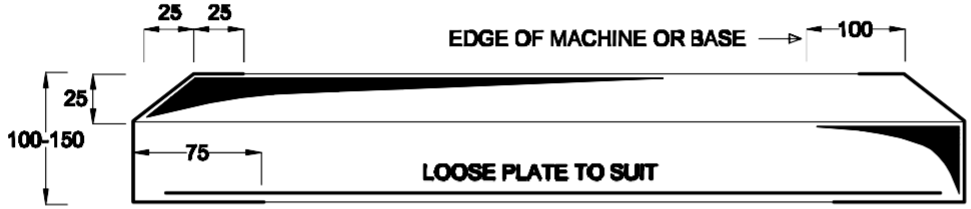
DRAWING NO: STD 16	



SECTION OF BASE TRAY - 150mm OR DEEPER



SECTION OF BASE TRAY - 100mm TO 150mm DEEP

MAX. LENGTH OF SIDE	S/M THICK
UP TO 1220	1.6mm
1220 AND OVER	2.0mm

WEIGHT OF CONCRETE IN BASE TRAY TO EQUAL 1,5 WEIGHT OF EQUIPMENT RESTING ON IT.
WEIGHT OF CONCRETE=2403kg/m³ (150lbs/cu ft)

MATERIAL: GALVANISED SHEETMETAL (SEE TABLE)

CONSTRUCTION: WELDED CORNER JOINTS

FINISH: WELDS WERE BRUSHED & GIVEN 1 COAT ZINC OXIDE PAINT & ONE FINAL COAT GLOSS ENAMEL TO BE APPLIED ON SITE WITH COLOUR TO SUIT

POLYSTERENE BLOCKS IN APPROX.MTG POSITION TO BE PROVIDED FOR FIXING BOLTS TO BE GROUTED IN.

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DRAWING DESCRIPTION:
STANDARD MACHINE BASE TRAY (PLINTH)

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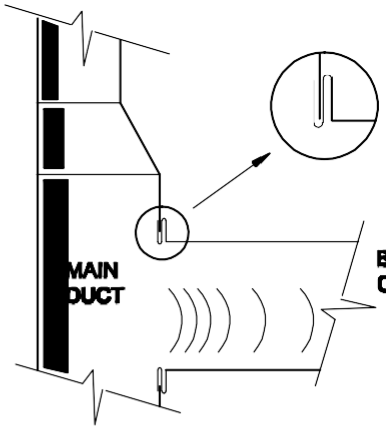
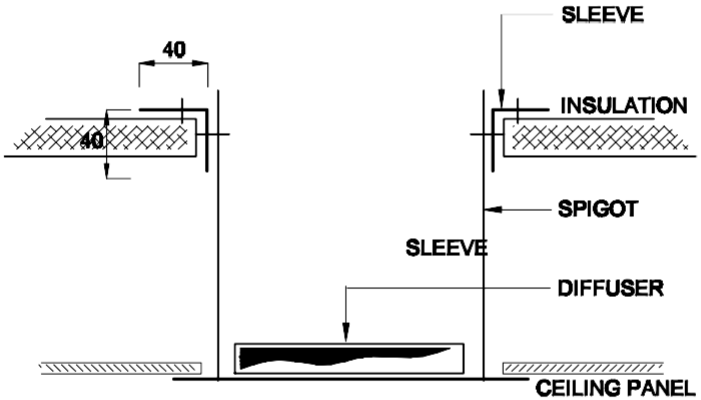
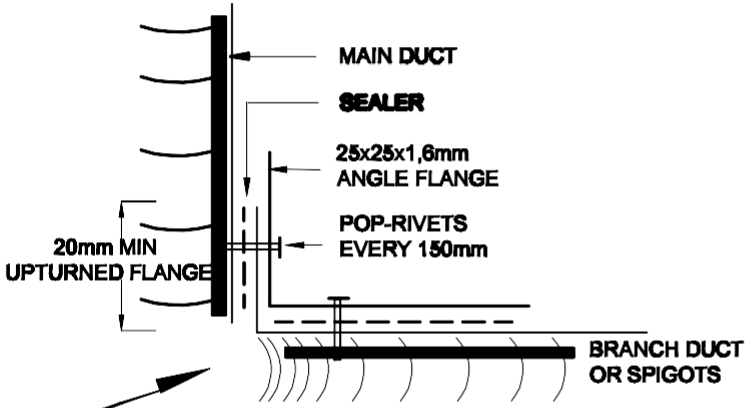


CLINCH LOCK DETAIL

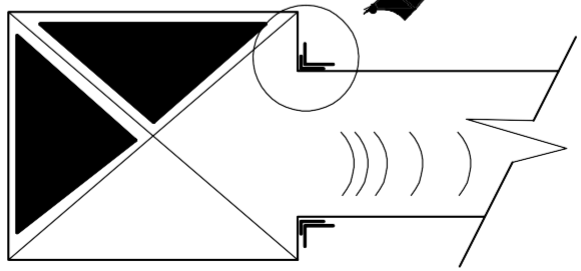
CLINCH LOCK CONNECTION



DETAIL OF SPIGOT FIXING FOR DIFFUSERS



DETAIL OF BRANCH DUCT & SIDE WALL OUTLET SPIGOT CONNECTIONS



FLANGE CONNECTION

THIS DRAWING REFERS TO
LOW PRESSURE DUCTS ONLY.
FOR MEDIUM & HIGH PRESSURE
DUCTS REFER TO SABS 1238–1979

'MEZ' FLANGES ARE TO BE USED
FOR ALL THESE CONNECTIONS
WHEN 'MEZ' HAVE BEEN QUALIFIED
FOR USE ON THE DUCTING SYSTEM.

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TEE CONNECTIONS

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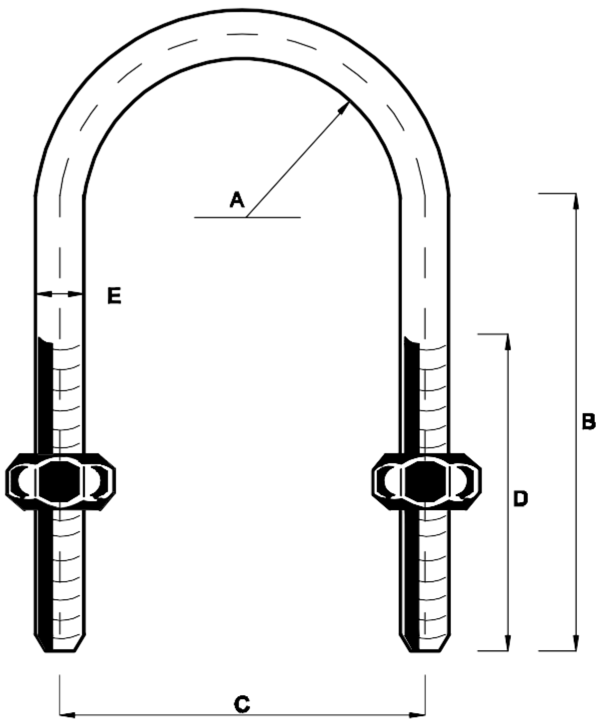
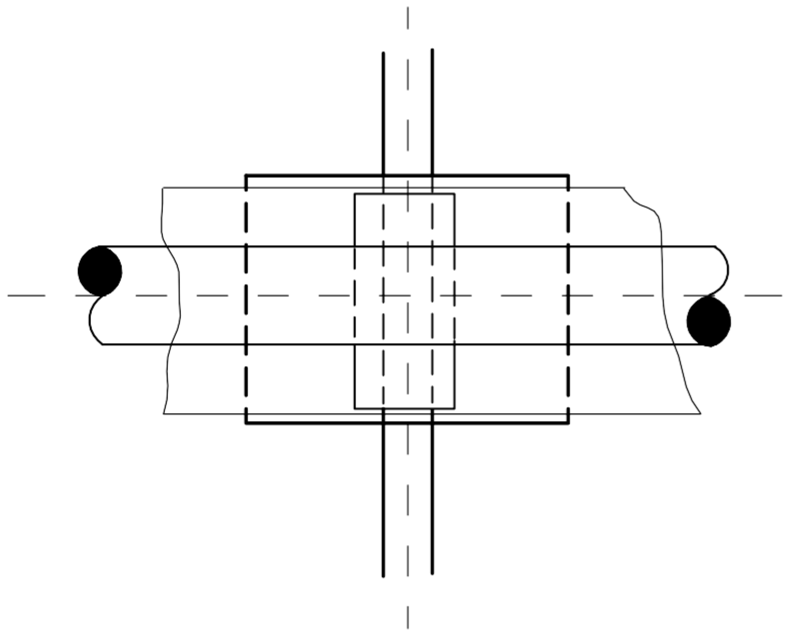
DRAWING NO: STD 24



U-BOLT DETAIL

MATERIAL: MILD STEEL ROUND BAR



THESE SIZES ARE FOR PIPES WITHOUT INSULATON. ALLOWANCE MUST BE MADE TO THE LENGHTS AND RADIUS OF THE U-BOLTS WHERE INSULATION ON PIPING IS TO BE USED.

PIPE BORE	A	B	C	D	E
25	19	64	45	50	6
32	22	64	50	50	6
38	25	67	59	50	8
50	32	75	73	50	8
64	41	75	90	50	8
75	48	86	103	50	8
100	60	100	129	50	8
127	73	110	154	50	8
150	86	127	179	50	8

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DRAWING DESCRIPTION: PIPE U-BOLT & INSULATION PIPE FIXING DETAILS

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