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DEPARTMENT OF PUBLIC WORKS

STANDARD SPECIFICATION

FOR

STEAM BOILER INSTALLATIONS

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STANDARD SPECIFICATION

FOR

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SECTION 1

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STANDARD SPECIFICATION
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SECTION 1

1.0 GENERAL REQUIREMENTS

1.1.0 NOTICE

1.1.1 This standard specification forms part of, and is to be read in conjunction with the Department's Supplementary Technical Specifications for Steam Boiler and Steam Piping Installations as applicable.

1.1.2 In so far as the conditions herein contained are at variance with anything contained in the Supplementary Specifications, the contract shall be in terms of the Supplementary Specification for each particular service.

1.1.3 Where reference is made to "Contractor" or "Sub-Contractor", it shall be read to mean the successful Tenderer appointed to execute the contract specified in the Supplementary Specification.

1.2.0 STANDARD MEASURES

1.2.1 The dimensions, weights, etc., shown on the drawings and mentioned in the specifications shall be taken as the Republic of South Africa's legal standard weights and measures.

1.3.0 MATERIALS AND WORKMANSHIP

1.3.1 All work is to be executed with materials of the best quality and in the most substantial manner under the inspection and to the entire satisfaction of the Department.

1.3.2 The entire installation shall be in accordance with the following:

a) The National Building Regulations and Building Standards Act No. 103 of 1977 as amended in 1984 and all amendments thereafter.

b) The latest revision of SABS 0400: The Applications of the National Building Regulations, as amended.

c) SABS Code of Practice for the Wiring of Premises No. 0142 of 1981,as amended.

d) The Machinery and Occupational Health and Safety Act No. 85 of 1993.

e) The Atmospheric Pollution Prevention Act 45 of 1965 as amended.

f) Any other relevant by-laws of local or other authorities.

1.3.3 All apparatus, components parts, fittings and materials supplied and/or installed whether especially specified herein or not shall conform in respect of quality, manufacture, tests and performance with the requirements of the appropriate current South African (SABS) or British Standard Specifications (BS) and Addenda thereto, except where otherwise required by this specification or permitted by approval of the Department in writing. All materials and workmanship

which may, in the opinion of the Department, be inferior to that specified for the work will be condemned. All condemned material and workmanship must be replaced or rectified as the case may be, to the satisfaction of the Department.

1.3.4 No second hand equipment of any description may be offered for supply or installation.

1.3.5 If so required the Department may call for samples of material and equipment for approval. Such samples shall be submitted within 14 days of the request and if judged necessary by the Department may only be returned after completion of the installation in order to ensure that the quality of the installed product is the same as that of the approved sample.

1.3.6 Any fitting or item of equipment not specifically mentioned but obviously necessary for the successful completion of the installation is to be included so as to form a complete working installation.

1.4.0 DRAWINGS

1.4.1 The tender drawings issued with the Supplementary Technical Specification are schematic and do not necessarily purport to show the exact position, size or details of construction of equipment.

1.4.2 Tenderers must satisfy themselves that the equipment offered by them can be accommodated in the available space and positioned in such a way that access for maintenance, repairs or removal is not obstructed.

1.4.3 Contractor's drawings

Where indicated in the Supplementary Specification these drawings are to be prepared by the Contractor at his expense in accordance with this document and shall be on a scale of not less than 1 : 50.

These drawings shall at least consist of:

a) Builder's work drawings

These shall indicate all work to be done by others (bases, foundations, holes in concrete and masonry, etc.) as well as the sizes, capacities and positions of service connections (electrical, water, drainage, etc.) to be provided by others, all in accordance with the supplementary specification.

b) General arrangement drawings

These shall indicate all equipment, distribution systems, testing and inspection requirements as well as instrumentation positions and access requirements.

During their preparation, the Contractor shall take cognisance of all relevant architectural, structural, electrical and other services drawings in order to properly co-ordinate his layout. These drawings can be obtained via the Department. The drawings shall be amended as required during the contract period, and up to date copies kept on site for reference purposes.

1.4.4 Positions and sizes of sleeved openings through reinforced concrete beams and slabs, etc., as indicated on the tender drawings shall be adhered to as far as possible. Amendments will only be considered if absolutely unavoidable.

c) Shop drawings

These shall be based on the General Arrangement drawings, and shall show in detail the construction of all the parts of the works, method of assembly where applicable, erection and construction, materials and connections, welds, gaskets, sealants, fastenings, reinforcing

and all other necessary detail.

d) Electrical drawings

Electrical drawings shall comprise complete control and power wiring diagrams, as well as front and side elevations giving major dimensions of control panels as well as instrumentation and switch position layouts.

e) As-Built drawings and wiring diagrams

These are up-to-date approved drawings at the completion of the contract. Tenderers shall allow in their price for submitting to the Department a sepia of each of the up-to-date general arrangement drawings, shop drawings, as well as electrical drawings together with the O&M manuals specified herein.

1.4.4 Submission of contractor's drawings

Drawings shall be submitted to the Department in orderly fashion commencing within the following time limits or as determined by the main contract programme (where applicable):

Builder's work drawings	:	within 2 weeks of tender acceptance.
General layout drawings	:	within 4 weeks of tender acceptance.
Shop drawings	:	within 6 weeks of tender acceptance.
Electrical drawings	:	within 6 weeks of tender acceptance.
As-built drawings	:	at completion before first hand-over.

By submitting drawings, the Contractor represents that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, or will do so, and that he has checked and co-ordinated each of his drawings with the requirements of the works and the contract documents, taking into account drawings of all other relevant disciplines.

At the time of submission the Contractor shall inform the Department in writing of any deviation in the Contractor's drawings from the requirements of the supplementary documents.

After scrutiny the Department may at it's discretion and depending on the number of discrepancies, require amendment and resubmittal prior to approval. Drawings shall be resubmitted until approved prior to any portion of the works related to the drawings being commenced.

Should the Contractor, during drawing amendment, alter any portion of his drawings not specifically required by the Department, he shall point this out in writing when resubmitting the drawing.

Approval of the Contractor's drawings in no way indemnifies him from being responsible for the correctness of the drawings and satisfactory operation of the installation.

1.4.6 If the Tenderer wishes to submit alternative proposals, differing from the Department's design, drawings indicating such proposals comprehensively shall be submitted with his tender.

1.5.0 SITE CONDITIONS

1.5.1 It is the responsibility of the Tenderer to visit the site during the tender phase and to familiarise himself with conditions related to it. If the location of the site is not indicated in the Supplementary Specification, it can be obtained from the Department. No claim for additional payment related to ignorance of site conditions will be accepted. By submitting a tender it is accepted that the Tenderer is fully aware of all site conditions as well as the access to it, and has allowed for this in his tender price.

1.6.0 DEVIATIONS FROM TENDER DOCUMENTS

1.6.1 No deviations or alterations from that of the specification, schedules or drawings shall be made without first obtaining the written approval of the Department.

1.7.0 PROGRAMMING OF WORK

1.7.1 The contract works shall proceed concurrently with the building construction or in accordance with an approved programme in all respects.

1.7.2 It is essential that the Contractor programmes his construction and all other work in conjunction with the Main Contractor and the main contract programme in order to avoid possible delays or clashes of trades.

1.7.3 For direct contracts the Contractor shall submit a detailed programme in the form of a bar chart based on the contract period and the various activities and components of the installation. This programme shall be submitted to the Department within two weeks of site hand-over.

1.8.0 MANUFACTURER'S RATINGS

1.8.1 All equipment such as motors, control valves, fans, compressors, cooling towers, pumps, etc., shall be selected to be operated well within the manufacturer's ratings. Equipment offered for use beyond these limits will not be considered.

1.8.2 Tenderers must submit manufacturer's ratings of all equipment offered. Ratings shall be given in the SI system.

1.9.0 NOTICES

1.9.1 The Contractor shall supply and install all notices and warning signs that are required by the appropriate laws or regulations and by these documents.

1.10.0 GUARANTEE

1.10.1 The 12 month guarantee called for in the Supplementary Specification, shall apply to all items of plant such as chillers, etc., delivered to site and/or erected. It is the responsibility of the Contractor to negotiate with his suppliers in order to secure their equipment guarantee on this basis.

1.10.2 The date of acceptance shall be that appearing in the acceptance certificate issued by the Department and shall define the start of the guarantee period and free maintenance period (where applicable).

1.10.3 No Claims for extended guarantee or otherwise from Suppliers, Principals etc., will be considered even if equipment is required on site long before acceptance date.

1.11.0 LUBRICATION

1.11.1 All bearings must be packed with approved grease or filled with the correct oil, and all gearboxes and sumps must be filled with the lubricant specified by the manufacturer. The Contractor will be responsible for the supply of all lubricants required for the initial fill. All lubricants must be new and supplied in sealed drums or containers.

1.12.0 COMMISSIONING AND TESTING

1.12.1 Commissioning Engineers

The Tenderer shall allow in his tender price for the services of approved and expert Commissioning Engineers, as may be appropriate for the individual specialised sections of his contract, as well as a competent Engineer in overall control of the installation. Testing and commissioning shall be carried out by these Engineers.

Should undue problems be encountered at any time, the Contractor may be requested by the Department to obtain the services of a representative of the manufacturer of specified items of equipment, at no cost to the Department.

1.12.2 Notice of Testing and Commissioning

The Department shall receive not less than two weeks advance notice of any tests to be witnessed by the Department.

1.12.3 Failure of Works, Site or Commissioning Tests

Should the Department be notified to attend official tests as laid down, and should the equipment fail the test for any reason whatsoever, such that the Department is required to re-witness the test, the time, transport and disbursement by the Department in so doing will be for the Contractor's account, which amount may be deducted, at the option of the Department, from monies due to the Contractor.

1.12.4 Quality Testing of Equipment

The Department reserves the right to arrange for testing of any piece of equipment at will, to check on compliance with the relevant specifications. Should the particular piece of equipment pass the test, the cost of such testing will be borne by the Department. However, should it fail the test, the cost of the test, rectification of the shortcomings, re-testing and repetition of the same test on the remaining like items will be for the Contractor's account.

1.12.5 Inspection during Manufacture

The Contractor will advise the Department when the items to be supplied are in the course of manufacture. The Department reserves the right to inspect any items during the course of manufacture, and witness any performance tests that may be required thereon. The Contractor shall give the Department at least two weeks advance notice of works tests.

1.12.6 Testing

The Contractor shall be responsible for carrying out all tests laid down in the specific sections elsewhere in this document, in addition to those listed hereafter and in the Supplementary Specification.

Testing and balancing shall not begin until the system has been completed and is in full working order.

The plant shall be tested and operated to meet the performance figures and duties specified.

All safety features and interlocks will be tested.

The Contractor will be responsible for all costs incurred in the testing, including the supply, calibration and use of all instruments and tools, but not the supply of water or power on site.

All instruments and test equipment used shall be provided by the Contractor, and shall be accurately calibrated and maintained in good working order. All test instruments used for tests to be witnessed

by the Department's Representative shall be provided with calibration certificates, which must be available to the Department's Representative.

Specific attention is drawn to the fact that calibration certificates will be required for the following:

Watt meters, ammeters, voltmeters, frequency meters, pressure gauges, flow meters, orifices plates, temperature gauges and dynamometers.

All instruments shall be of above standard grade, and test pressure gauges shall not be less than 150mm in diameter. The maximum scale of the instrument shall not exceed 1,5 times the full test requirement.

It is essential that the Contractor inspects and tests all equipment before requesting the Department to inspect or witness acceptance tests thereon.

All acceptance tests, whether in the manufacturer's works or on site, must be carried out in the presence of the Department's Representative.

Should the Department wish to verify the calibration of any instruments, the Contractor shall make the necessary arrangements for the instrument to be re-calibrated by a recognised authority. Should the instrument prove to be correctly calibrated, the cost of the re-calibration test will be borne by the Department. Should the instrument prove to be in error, the cost of the tests will be borne by the Contractor.

Two copies of the complete test reports shall be submitted to the Department, prior to the first delivery of the project. Reports shall cover all tests carried out on individual sections, including such works tests as may have been conducted. All reports shall be neatly typed.

1.12.7 Commissioning

The Contractor shall carry out all tests and commissioning of the systems installed by him, in a co-ordinated and properly organised manner.

Steam installations shall be commissioned in accordance with the following Codes or such other recognised commissioning procedure or code approved by the Department:

a) Control Systems:
CIBS : Commissioning Code : Series C : Automatic Controls.

b) Hot Water and Steam Boilers:
CIBS : Commissioning Code : Series B : Boiler Plant.

c) Water Distribution Systems:
CIBS : Commissioning Code : Series W : Water Distribution Systems.

Should the tests be carried out over an area outside the range of normal speech, it is required that the Contractor make available at least four battery powered, two-way radio sets, to facilitate communications.

The testing procedures shall be sufficiently comprehensive to prove the correct functioning of each and every piece of equipment, and it’s suitability for the application.

After all systems and equipment have been tested and commissioned to the satisfaction of the Department, a detailed demonstration of all functions of the system shall be carried out in the presence of the Department's Representative, so as to allow him to become fully acquainted with the operation of the system.

The commissioning tests shall include the tests laid down under the specific sections hereafter, and

a full operational test of all plant, pumps, compressors, fans control gear, etc. in all modes of operation.

The Contractor shall allow for the replacement and cost of any materials and fuel used for testing purposes, as part of the contract.

The demonstration to the users shall include a repeat of the operational tests above.

The planning of this demonstration shall take place in collaboration with the Department.

A certificate of completion will not be issued until all tests have been satisfactorily completed, and the plant has operated successfully, to the complete satisfaction of the Department.

1.13.0 PERFORMANCE TOLERANCE

1.13.1 All performance figures obtained during testing and commissioning must be within -5% and +5% of the specified performance figures given in the supplementary specification. Should the plant fail to comply with these figures after it has been tested and operated for a period of seven days, then the Contractor shall have a further four weeks to meet the requirements of the specification, after which the Department shall have the right to reject the plant and recover all monies paid to the Contractor for the rejected plant.

1.14.0 TEST CERTIFICATES

1.14.1 The Contractor shall ensure that copies of all relevant test certificates, inspection reports, materials analysis certificates and similar data as may be required under various sections of this specification, or by Government Licensing and Inspection Authorities or Local Authorities, shall be provided before handing over the plant. Acceptance of the plant will be delayed if such certificates are not available. In particular, attention is drawn to pressure vessel and boiler construction and materials test certificates.

1.15.0 APPLICATION FOR INSTALLATION

1.15.1 The Contractor shall allow for the submission of the necessary forms, fees and drawings to the Inspector of Machinery or other relevant Authorities to obtain permission to install equipment where this is required. He shall also, in co-operation with the Department make any arrangements that may be required for Government Inspectors or other relevant Inspectors to carry out prescribed tests.

1.16.0 POWER, WATER AND DRAIN CONNECTIONS

1.16.1 Power, water and drain points in the plant room will be provided by and at the expense of the Department.

1.16.2 All plumbing between equipment and water and drain points shall form part of the contract.

1.16.3 The exact details of terminal points will be set out in the Supplementary Specification.

1.17.0 QUALITY OF MATERIALS

1.17.1 Only new materials of high quality shall be used throughout and shall be subject to the approval of the Department.

1.17.2 All materials, where applicable, shall conform in respect of quality, manufacture, tests and

performance, with the requirements of the SABS standards or, where no such standards exist, they shall conform with the appropriate current specification of the British Standard Institution. Materials manufactured in South Africa shall be used wherever possible.

1.17.3 Imported materials shall comply with the requirements of the relevant SABS or British Standard Specifications, although these materials need not necessarily bear the SABS mark.

1.17.4 All materials shall be suitable for the particular site conditions. These conditions shall include weather conditions as well as prevailing conditions during installation and subsequent permanent use.

1.17.5 Should the materials or components not be suitable for use under temporary site conditions, where applicable, the Contractor shall provide at his own cost, suitable protection until these unfavourable site conditions cease to exist.

1.18.0 SERVICE ACCESS

1.18.1 Where equipment such as pipes, fans, dampers, etc. are installed above ceiling the Contractor shall ensure that access will be possible for maintenance purposes after installation.

1.19.0 STANDARD SPECIFICATIONS

1.19.1 Unless otherwise specified in the supplementary specification, the following standard specifications (including amendments) of the organisations indicated shall form part of this specification.

a) SABS 0140-1978; Identification colour marking

b) SABS 0139-1981; The prevention, automatic detection and extinguishing of fire in buildings.

1.19.2 Tenderers shall indicate in their tender submission whether their tender and/or equipment as applicable complies with any of the above or other SABS specifications or carries the SABS mark.

1.20.0 MONTREAL PROTOCOL

Tenders for equipment utilising chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) or hydrofluorocarbons (HFCs), to be supplied and installed shall be within the constraints and schedules of the Montreal Protocol and the Copenhagen Agreement and such amendments thereto as may be made by the international community.

Where tenders are submitted for equipment not complying with this Protocol it shall be clearly indicated, in writing, in the tender submission.

SECTION 2

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SECTION 2

2.0 MAINTENANCE AND SERVICING

2.1.0 GENERAL

2.1.1 Unless otherwise specified in the Supplementary Specification, the Contractor shall be responsible for all maintenance and servicing of the installation for the full 12 month guarantee period. During this period, the Contractor shall make good any defect due to inferior materials or workmanship and maintain all plant and equipment in perfect operating condition.

2.1.2 The Contractor shall be entirely responsible for carrying out regular inspections at intervals not greater than 1 month, unless otherwise specified, and for full servicing of all components of the installation in accordance with the manufacturer's instructions. For this purpose, the Contractor shall prepare a detailed inspection and service report in the form a check list and log sheet showing all functions to be carried out at each inspection and service. Copies of these service reports shall be regularly submitted to the Department after each service.

The Contractor shall also 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 temperatures and pressure readings etc.

2.1.3 The Contractor shall allow for all expendable materials necessary for servicing such as lubricating oils, grease, refrigerant and cleaning materials.

Replacement filters, if required, will be provided by and at the expense of the Department.

2.2.0 MAINTENANCE INSTRUCTION OF OWNER'S STAFF

2.2.1 Tenderers shall make proper allowance in their tender price for instruction of the Department's staff in the maintenance, repair and adjustment of all the equipment. Allowance must be made for the proper hands-on tuition of the owner's personnel at the appropriate time to enable them to take over operational duties.

2.3.0 SPARE PARTS AND AGENCIES

2.3.1 Where Tenderers offer plant embodying units of manufacture other than those of their principals and for which they are not accredited South African agents, and for which they do not stock spare parts, they should state in the tender the name of the accredited South African agents from whom spare parts for such units are obtainable.

2.3.2 In all cases, Tenderers should furnish an undertaking from agents to the effect that they are prepared to carry the necessary stock of spare parts for their particular units

2.3.3 Tenderers are also required to furnish the same undertakings as regards the spares for units manufactured by their own principals.

2.3.4 During adjudication of tenders, consideration may be given not only to the cost of the plant offered, but also to the cost of the spares.

2.4.0 TOOLS

2.4.1 All special tool required, i.e. tools specially designed for the particular equipment offered, must be supplied and listed in the tender offer and included in the unit price. In the case of a number of identical items of plant being supplied it will only be necessary to supply two sets of tools covering all units, and not one set for each unit.

2.4.2 It is the responsibility of the Contractor to ensure that all tools are handed over to the Department on completion of the contract, in brand new condition. No damaged tools will be accepted, and the contract will not be considered complete until such tools are satisfactorily received. Tools handed over shall be suitably mounted on a wallboard or supplied in a high quality metal box or other container as may be agreed to by the Department.

2.5.0 OPERATING, MAINTENANCE INSTRUCTIONS, WIRING AND CONTROL DIAGRAMS

2.5.1 The Contractor shall prepare and supply comprehensive manuals for the successful operation and maintenance of the installation. A draft of the manual shall be submitted to the Department after commissioning, for approval. The draft shall then be corrected, if required, and THREE sets of the manual shall be submitted before first acceptance of the plant will be considered.

2.5.2 Manuals shall be prepared in the same language as the contract document unless otherwise required by the Department. These manuals shall be bound in hard file covers with clear titles and indices and shall contain the following information as a minimum, in the sections indicated:

SECTION 1 : System Description

A comprehensive description of the system, including schematic diagrams.

SECTION 2 : Commissioning Data

The results of all checks and measurements as recorded during the commissioning period, shall be compiled in such a manner that every check and measurement is clearly defined.

SECTION 3 : Operating Instructions

1. Plant running check list and frequency of servicing.
2. Safety precautions to be taken.
3. Manual and automatic operation.
4. Operator's duties.
5. Lubricating oils and service instructions.
6. Pre-start checklist for each system.
7. Starting and stopping procedures.

SECTION 4 : Mechanical Equipment

1. Description of all major items of equipment with the make, model number, names, addresses and telephone numbers of the Supplier, Manufacturer or their Agents.
2. Design capacities of all equipment including selection parameters, selection curves, capacity tables, etc.
3. Manufacturer's brochures and pamphlets.
4. Schedule of spares with part numbers recommended to be held in stock by the Department.

SECTION 5 : Maintenance Instructions

1. Schedule of maintenance particulars, frequency of service and replacements.
2. Troubleshooting guide.
3. Part number of all replacements items and spares.
4. Capacity curves of pumps, fans and compressors.
5. Serial number of main items of equipment.

SECTION 6 : Electrical Equipment

1. Schedule of equipment indicating manufacturer, type, model number, capacity and address and telephone number of supplier.
2. Maintenance instructions.
3. Manufacturer's brochures and pamphlets.
4. Complete "as-built" circuit diagrams and diagrammatic representation of inter-connections of electrical equipment.

SECTION 7 : Instrumentation and Control

1. Description of each control system.
2. Schedule of control equipment indicating make, type, model number, rating, capacity and name, address and telephone number of supplier.
3. Maintenance instructions.
4. Manufacturer's brochures and pamphlets.

SECTION 8 : Drawings

1. Paper prints (reduced if so desired) of all "as-built" mechanical and electrical Contractor's drawings.
2. Wiring diagrams, framed behind glass shall be mounted adjacent to each relevant control panel.

SECTION 3

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3.0 TECHNICAL REQUIREMENTS - GENERAL

3.1.0 ERECTION OF EQUIPMENT

3.1.1 Tenderers shall allow for a complete installation, including the provision of mobile cranes, air compressors, lifting tackle, measuring equipment, precision levels, and all other special or regular tools and equipment that may be needed to complete the entire installation in accordance with the specification, and to the satisfaction, of the Department.

3.1.2 The Contractor will be responsible for any damage caused to buildings, equipment, etc. during the course of the erection of his equipment.

3.2.0 EQUIPMENT PLINTHS

3.2.1 Plinths as specified hereunder shall not be confused with any form of inertia or anti-vibration base. Unless otherwise specified in the Supplementary Specification, equipment plinths shall form part of the steam boiler installation contract.

3.2.2 Plinths shall be provided for all mechanical and electrical equipment. Plinths cast on concrete surfaces shall protrude at least 100mm above floor levels and depending on the position of the vibration mountings, shall be at least 300mm wider or longer than the inertia bases mounted on top. (Where applicable)

3.2.3 Plinths for equipment which do not need inertia bases or plinths for inertia bases with recessed vibration mountings, shall be of the same size as the equipment or bases mounted on top. Plinths shall consist of 1,6mm thick channel or angle iron formers with 10mm thick reinforcing bars located at 150mm pitch in each direction and filled with concrete. The top surface of the concrete shall be floated to an even and smooth finish to allow for not less than 25mm and not more than 50mm of suitable cement or epoxy grout under the equipment base frame. A 25mm 45º chamfer shall finish off all grout corners.

3.2.4 Plinths as specified above shall also be provided for field assembled plenum chambers and other equipment.

3.2.5 Where cooling towers are on the same floor level as cooling water pumps, the towers shall be mounted on concrete or masonry walls high enough to ensure a flooded suction at all times.

3.2.6 Pumps for feed water, condensate and hot water systems shall be installed to ensure an acceptable NPSH with due regard for fluid temperature and vapour pressure to ensure cavitation free operation.

3.3.0 HOLDING DOWN BOLTS AND BOLTS FOR EQUIPMENT

3.3.1 The Contractor shall be responsible for the supply of all necessary holding down bolts for the machines supplied by him. He shall also supply all bolts necessary for assembling all the equipment supplied by him.

3.3.2 Holding down bolts shall preferably be cast into concrete bases when the bases are being cast. All bolts shall, in this instance, be provided with galvanised sheet metal sleeves approximately three times the diameter of the bolt, and projecting a minimum of four-bolt diameters below the surface of the concrete. This sleeve must be kept free of concrete until the final grouting takes place.

3.3.3 Under exceptional circumstances, the provision of suitably sized pockets for the holding down bolts will be permitted.

3.3.4 Where galvanised bolts are called for, they shall be fully galvanised all over. No re-cutting of threads will be permitted after galvanising. All nuts must run freely on the threads.

3.4.0 BEDPLATES

3.4.1 All bedplates shall be of fabricated mild steel with surfaces on which the pump, motor, gearbox, fan etc. is mounted.

3.4.2 All bedplates shall be stress relieved after welding but before machining. Each bedplate shall be provided with approximately eight horizontal jacking screws with locknuts for each unit mounted thereon to assist in aligning the pumps and motors, etc.

3.4.3 All bedplates shall be thoroughly cleaned, prepared and painted with one coat of Anodite red oxide primer to finishing coats being applied.

3.4.4 It will not be necessary to dowel equipment in place, provided the jacking screws specified above are fixed and locked.

3.5.0 COUPLING SHAFT AND VEE-BELT GUARDS

3.5.1 All couplings, vee-belts, shafts and moving parts and components shall be fitted with adequate guards which comply in all respects with the Machinery and Occupational Health and Safety Act. They shall be fabricated from sheet and flattened expanded metal, and be so arranged that the couplings or belts are completely visible through the guard.

3.5.2 All guards shall be painted as specified.

3.5.3 Guards for fluid couplings shall be so constructed as to completely enshroud the coupling, and completely contain 110% of the full volume of oil contained in the coupling. In the event of an oil discharge, no oil must be thrown about or leak onto the floor.

3.6.0 COUPLINGS

3.6.1 High speed (Above 750 r/min)

Couplings between motors and driven equipment shall be Fenaflex tyre type couplings or approved, and shall comply with the following requirements:

i) They should be designed and selected for severe duty and 24 hours per day operation. In no case shall a "service factor" of less than 25% above that given in the Fenner Catalogue be used.

ii) All tyre couplings must be fitted with taper lock bushes.

iii) All couplings shall be of synthetic oil resisting rubber.

3.6.2 Low speed (Below 750 r/min)

These couplings shall in general be of a flexible type, which shall be approved by the Department.

Couplings shall in all cases be designed and selected for severe duty and 24 hours per day operation. In no cases shall a "service factor" of less than 25% above that given in the maker's catalogue be used.

Where possible, all couplings shall be fitted with taper lock bushes.

3.6.3 Hydraulic Couplings

These shall be of the Crofts, Voith or Vulcan Sinclair manufacture or as approved.

Where possible, couplings shall be fitted with taper lock brushes for both input and output shafts.

All couplings shall be adequately rated for the full power and torque rating of the motor to which they are coupled, plus 15% safety margin.

All fluid couplings must be offered with a temperature safety device, which will safely release the oil in the event of the coupling overheating.

3.7.0 MECHANICAL DRIVES

3.7.1 Vee-belt drives

Where used vee-belts shall be standard sections and lengths conforming to the latest edition of CKS 332 - 1972, "Specifications for industrial vee-belts".

Belt drives shall be designed and selected assuming direct-on-line starting of a squirrel cage motor and heavy duty operation for 24 hours per day. Design and selection shall be in accordance with the Fenner Power Transmission design manual or equivalent. Design shall be based on at least 8 starts per hour for all applications. The power rating of the drive shall be based on full rating of the drive motor.

Pulleys shall be fitted with taper lock bushes. No pulley shall have a diameter smaller than that recommended by the belt manufacturer with minimum diameter being 100mm, and no non-standard pulley will be accepted.

No drive above 1kw rating shall have less than two belts.

Pulley size and centre distance shall be designed to ensure a belt contact arc over the smaller pulley of not less than 120º.

Pulleys shall be manufactured from close-grained cast iron with grooves matching belt sections and properly machined with smooth edges and wear surfaces.

Inward and outward adjustment of the drive motor and pulley combination shall be possible with proper locking mechanisms to enable correct belt tensioning and ease of replacement of belts.

All belt tensions shall be checked within 24 hours of first delivery and again one week later and adjusted as necessary.

Belt speeds exceeding 15 m/s and speed ratios greater than 7:1 are not acceptable.

3.7.2 Chain Drives

To facilitate maintenance, spares inter-changeability and standardisation, chains where selected, shall be standard stock roller type precision drive chains of reputable manufacture.

The axial and angular alignment of wheels and chains shall be carefully checked to very close tolerances to ensure maximum life and trouble free operation.

The amount of adjustment possible to take up chain wear shall be not less than 2 pitches or 2 percent elongation above nominal chain length, whichever is the greater. Chains shall be lubricated in accordance with manufacturer's recommendations.

3.8.0 PACKING OF EQUIPMENT

3.8.1 All base plates and steel work shall be suitably packed with steel packs to ensure that they are true to level, line and grade. The thickness of packing shall be such as to allow for not less than 25mm, and not more than 50mm of grout under all base plates or steel work. Packings shall be of suitable size to support the base plates and one pack must be situated immediately on each side of each holding down bolt as well as in such other positions as may be directed by the Department in order to adequately support the base plates and it’s superimposed load.

3.8.2 All packs shall be as near as possible to the exact height in one thick piece. Thinner shims may be used for final adjustments, but large piles of thin shims will not be accepted. All packs must be of parallel shims. Taper packs or wedges will not be accepted. Packs must be bedded on a flat and smooth area on the surface of the concrete foundation. Packs resting on rough concrete will be rejected.

3.8.3 After final levelling and lining up, it is essential that all packs are tight. Loose packs will be rejected.

3.8.4 No shims will be permitted between a machine base and plate and the machine's feet except as mentioned hereinafter.

3.9.0 ALIGNMENT OF EQUIPMENT

3.9.1 Bedplates

Where equipment is delivered completely assembled on a bedplate, these items of equipment shall be removed from the bedplate prior to installation. The bedplates shall first be installed, levelled, lined up and packed to ensure that there is no twist or distortion therein. The machines shall then be installed on their bedplates and the final alignment carefully checked and adjusted until it is to the

entire satisfaction of the Department.

Minor corrections to the alignment of machines may be carried out using thin shims between the machinery feet and the machined surface of the bedplate. This applies particularly to electric motors. A maximum level error of 20 seconds of arc, or as decided by the Department, will be allowed.

3.9.2 Couplings

The alignment of all couplings must be carefully checked for both the parallelism and eccentricity of their shafts. Alignment must be carried out to the maker's tolerance and to the entire satisfaction of the Department.

In any event, a misalignment of more than 0,05mm will not be permitted for either parallel or eccentric misalignment as measured at the periphery of the couplings. It is essential that a dial micrometer is used to set the final alignment, which must be witnessed by the Department.

3.9.3 Vee-belts and chain drives

The alignment of vee-belt drives and chain drives shall be carried out with a precision steel straight edge in the case of short centre drives, or by means of a nylon line in the case of long centre drives. The Contractor must ensure that all belts and chains are correctly tensioned in accordance with the maker's instructions.

3.9.4 Gearboxes

All gearboxes shall be carefully checked for level and twist. No twist in the gearbox casing will be permitted. After final levelling and bolting down, the gear teeth shall be marked with Engineer's blue, and the meshing and bearing of the teeth checked and corrected to the satisfaction of the Department.

3.10.0 ASSEMBLY OF COMPONENTS

3.10.1 It is essential that all mating components such as couplings, taper lock bushes, machined faces, etc., be thoroughly cleaned with a suitable solvent before assembly. All surfaces must be free from burrs or irregularities, which may prevent the correct mating of the surfaces.

3.10.2 A molybdenum-disulphide lubricant similar or equivalent to Mobil-grease Super shall be used on the threads of all bolts and between the mating surfaces of all parts closely fitted together, such as shafts and couplings, keys and base plates. PTFE tape shall be used in all screwed pipe connections.

3.11.0 WELDING

3.11.1 Welding shall be carried out in accordance with the current edition of SABS 044 Parts I to VII where applicable.

3.11.2 All welded filler or 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.

3.11.3 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.

3.11.4 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 fillet welds and with reinforcement of not more than 3mm in the case of butt welds.

The weld face shall be uniform in appearance throughout it’s length.

3.11.5 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 SABS 455.

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

3.11.7 All welds must show proper fusion.

3.11.8 Where welding is contemplated in pipework systems, Tenderers 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 Department and tested. Should faulty welding be discovered, all other joints shall be X-ray tested by the SABS or an approved body, all at the expense of the Contractor.

3.12.0 GALVANISING

3.12.1 Unless otherwise specified in the Supplementary Specification the following items shall always be galvanised:

Fabricated mild steel sections exposed to the weather.

Steel grilles and louvres exposed to the weather.

3.12.2 Where hot dip galvanising is called for, items to be galvanised shall be entirely pre-fabricated and then dismantled in sections for galvanising. No cutting of threads or welding will be accepted after galvanising.

3.12.3 All hot dip galvanising shall be carried out in accordance with SABS 934 and SABS 763 where applicable, including preparation for galvanising.

3.12.4 Mild steel plate and sections shall be of good commercial quality, or higher grades, best suited for galvanising. The materials shall be free from slag or coarse laminations, fine fissures and rolled-in impurities.

3.12.5 Castings shall be sound, dense and clean, and free from distortion, porosity, carbon and slag enclosures, blowholes, and other injurious conditions.

3.12.6 Welding flux shall be chipped away and all welds wire brushed before galvanising.

3.12.7 The surface to be galvanised shall be free from paint, oil, grease and similar impurities.

3.12.8 All exposed surfaces including welds shall be thoroughly sand blasted prior to galvanising.

3.12.9 The Department reserves the right to inspect all steel components before galvanising, and shall have the right to reject or ask for remedial treatment of any material which is considered to be unsuitable. This applies particularly to welds.

3.12.10 The galvanising coating shall be smooth, adherent, continuous and free from black spots or flux stains.

3.12.11 Globular extra-heavy deposits of zinc which interfere with the intended use of the material will not be acceptable. Excessively protuberant lumps and nodules shall be removed by hot wiping or by the skilful application of mechanical means, however there shall remain a sufficient minimum thickness of unbroken zinc coating. Flaws on small parts and working surfaces shall be repaired only by stripping and re-dipping.

3.12.12 Repairs to galvanised coatings will not be accepted. Items damaged will need to be re-galvanised.

3.12.13 Coating thickness shall be as per table 1 of SABS 763 unless otherwise specified in the

supplementary specification.

3.12.14 The SABS requirement for uniformity shall apply.

3.12.15 Galvanised surfaces specified with paint finishing shall not be passivated.

3.13.0 PAINTING

3.13.1 The entire installation, other than aluminium or stainless steel pipe cladding, shall be painted, unless otherwise specified in the Supplementary Specification.

Hot surfaces shall be painted with appropriate heat resisting paints.

3.13.2 Painted items shall include plantroom floors, equipment plinths and bases.

3.13.3 Before any painting is applied, the surfaces shall be prepared according to SABS 064, Code for Preparation of Steel Surfaces for Painting. All surfaces shall be moisture free, clean and properly prepared.

3.13.4 During painting, the Contractor shall ensure that all the necessary fire prevention and fire-fighting precautions have been taken.

3.13.5 Name plates, labels and notices on equipment shall not be painted.

3.13.6 Items which do not require painting such as diffusers and grilles, shall only be installed after the paintwork on the plant, ceiling or walls have been completed.

3.13.7 Painted surfaces on proprietary manufactured items shall be adequately protected. Equipment on which the paintwork has been damaged during installation shall be repainted before first delivery of the plant will be considered.

3.13.8 Unless otherwise specified in the Supplementary Specification the installation shall be painted in accordance with Table I at the end of this Specification. Colour code bands and arrow indicators as indicated shall be as per SABS 0140 of 1978, and the basic colour shall cover the full length and circumference of pipes and ducts.

3.13.9 Plastered surfaces inside plenums shall be painted with a suitable alkali resistant primer to SABS 1414-1987 followed by a universal undercoat with a final coat of high gloss enamel paint to SABS 630, Grade I. The colour of the final coat shall be white.

3.13.10 Lagged and plastered ductwork and plastered surfaces outside plenums shall be painted with a suitable alkali resistant primer to SABS 1414 of 1987 followed by one undercoat to SABS 681, type II and one coat high gloss enamel paint to SABS 630, Grade 1 or PVA exterior type emulsion paint to SABS 634 of 1974 as top coat.

3.13.11 Ferrous casings of cooling towers, evaporative condensers and sprayed coils including galvanised iron casings, sumps, fans and ductwork connected to outlets of cooling towers or evaporative condensers, shall be internally painted with two coats of epoxy-tar paint to SABS 801, type II.

Angle iron framework shall be similarly painted with epoxy paint before side covers are fitted. All steel surfaces shall be cleaned and painted with a wash primer or zinc chromate primer (ungalvanised iron) before the epoxy paint is supplied.

3.13.12 Exposed and unlagged galvanised piping shall be painted with one coat wash primer (self etch primer) to SABS 723 followed by one undercoat to SABS 681, type II and one coat gloss enamel paint to SABS 630, Grade 1 as top coat.

3.13.13 Unlagged black piping, flat iron, angle iron, rods, etc., for supports, brackets, frames, duct stiffeners, etc., shall be painted on all sides with a zinc chromate primer to SABS 679 type 1, followed by one coat universal undercoat and one finishing coat of enamel paint to SABS 630 Grade 1.

3.13.14 Where specified in the supplementary specification, aluminium shall be painted with a wash primer to SABS 723 followed by a zinc chromate primer to SABS 679, type I and one coat universal undercoat to SABS 681-1972 type II and one final coat of enamel paint to SABS 630, Grade 1.

3.13.15 Where specified in the supplementary specification, steel surfaces shall be cleaned and then treated with the hot phosphate process to a minimum weight of 1,6 g/m5 coating followed by two coats of backing enamel to SABS 783 type I.

3.13.16 All galvanised surfaces requiring painting other than those covered in 3.13.17 below shall be thoroughly degreased. In case a detergent is used, the surface shall be well rinsed and dried. It shall then be painted with one coat wash primer (self etch primer) to SABS 723. When dry, the surface shall be painted with one undercoat to SABS 681 type II and one coat universal undercoat and one coat high gloss enamel paint to SABS 630 Grade 1 as top coat.

3.13.17 All galvanised surfaces inside air handling plenums and external within 50km of the coast, or as specified in the supplementary specification, shall be cleaned with a galvanised iron cleaner until a water break free surface is achieved. After drying one primer coat of "Galvo-Grip" or approved paint shall be applied followed by one coat of universal undercoat paint. A final coat of gloss enamel to SABS 630, Grade I shall then be applied.

3.13.18 For air handling units the entire unit casing, including galvanised iron eliminators, sumps, drip pans, fans etc., shall be painted internally with two coats of epoxy-tar paint to SABS 801, type II. The white rust preventative compound on galvanised iron shall be removed as specified above before the paint is applied. Angle iron framework shall be similarly painted with epoxy paint before side covers are fitted.

3.13.19 Exposed piping with canvas covered insulation shall be painted two coats of bitumen aluminium paint to SABS 802 followed by the colour coding basic colour as per table 1.

3.14.0 BEARINGS

3.14.1 Anti-friction

Anti-friction bearings shall include all bearings, which provide rolling contact between one or more sets of hardened steel balls or rollers and hardened steel rings or raceways.

Anti-friction bearings shall be of approved manufacture and available throughout South Africa.

To facilitate maintenance, spares interchangeability and standardisation, anti-friction bearings of standard design and manufacture shall be employed. All anti-friction bearings shall be provided with greasing facilities in accordance with manufacturer's requirements.

3.14.2 Bushed bearings

Only where specifically stated in the Supplementary Specification and in the case of low velocities and light loads in moisture free conditions will bushed bearings be accepted. All bushed bearings shall be made of an approved bearing metal composition, which has good anti-friction qualities and is capable of withstanding severe usage in the specific application.

All bushed bearings shall be provided with lubrication facilities to ensure adequate lubrication and shall be properly grooved to distribute the lubricant uniformly over the bearing surfaces. Grooves shall not be cut into the journal, but always into the surrounding bush. The edges of all chambers and grooves shall be rounded to avoid sharp corners and to facilitate the introduction of the oil or grease between the journal and the bearing metal.

3.14.3 Self-lubricating or oilless bearings

Self-lubricating or oilless bearings shall only be used on application of light and low velocities in moisture free and low humidity conditions and where access to bearings is difficult and likely to be neglected during servicing.

The type of bearing metal composition used shall have frictional and wear resistant properties akin to those of grease lubricated bushed bearings.

3.15.0 NOISE AND VIBRATION CONTROL

3.15.1 General

Unless otherwise specified in the Supplementary Specification the design, manufacture and installation of all the mechanical and electrical equipment shall be such as to ensure compliance with the relevant sections of SABS 0103 of 1983 "The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communications", as amended.

Any installation where the measured residual sound level exceeds the maximum desired residual sound level as per SABS 0103 shall be rectified to comply with SABS 0103 at the Contractor's own expense.

In all plantroom applications where airborne noise cannot be limited or comply with the set standards, provision shall be made for acoustical treatment of the equipment involved or, alternatively, total enclosure thereof with acoustical panelling to comply with requirements laid down in this specification.

Such provisions shall be included in the tender price and no claims for payment to comply with this requirement will be entertained.

3.15.2 Vibration Isolation

Proper provisions shall be made in the foundations and mountings of all equipment capable of transmitting vibration forces to it's environment, whether local or remote, (As is the case with pipes) for vibration isolation.

The following table of recommended isolation efficiencies for critical areas applicable to heavy mass concrete floor slabs serves as a guide only:

Critical Areas			Transmissibility	Isolation Efficiency
1.	a)	Centrifugal compressors and chillers.	0,5%	99,5%
2.	a)	Centrifugal fans larger than 15kW.		
	b)	Reciprocating compressors larger than 40kW		
		Pumps larger than 4kW	1%	99%
3.	a)	Axial flow fans larger than 20kW		

	b)	Centrifugal fans up to 15kW		
	c)	Reciprocating compressors up to 40kW		
	d)	Pumps up to 4kW		
	e)	Unit air conditioners		
	f)	Fan coil units	3%	97%
4.	a)	Axial flow fans up to 20kW		
	b)	Air handling units	4%	96%
5.	a)	Pipes		
	b)	Electrical connections, conduit cabling etc.	8%	92%
6.	a)	Boilers, steam and central heating, larger than 20kW		4 to 7Hz

The following table of recommended isolation efficiencies for general areas applicable to heavy mass concrete floor slabs serves as a guide only:

Critical Areas			Transmissibility	Isolation Efficiency
1.	a)	Centrifugal compressors and chillers.	5%	95%
2.	a)	Centrifugal fans larger than 15kW.		
	b)	Reciprocating compressors larger than 40kW		
		Pumps larger than 4kW	8%	92%
3.	a)	Axial flow fans larger than 20kW		
	b)	Centrifugal fans up to 15kW		
	c)	Reciprocating compressors up to 40kW		
	d)	Pumps up to 4kW		
	e)	Unit air conditioners		
	f)	Fan coil units	10%	90%
4.	a)	Axial flow fans up to 20kW		
	b)	Air handling units	15%	85%
5.	a)	Pipes		
	b)	Electrical connections, conduit cabling etc.	20%	80%
6.	a)	Boilers, steam and central heating, larger than 20kW		8 to 15Hz

Selection of vibration isolation equipment and in particular, mountings for equipment and machines, shall be done with due regard to the forcing frequency of the driven machinery and the mounted natural resonant frequency of the machine.

In the case of installation of equipment on upper floors, suspended floors, roofs etc. it is of prime importance that floor stiffness, floor, deflection and natural frequency of the floor be taken in to consideration to ensure that resonant conditions cannot occur.

Driven machinery and isolator deflections shall be carefully selected in these applications.

Equipment selection schedules shall be submitted to the Department for approval and shall contain full details regarding the forcing frequency, the natural mounting frequency, the static deflection and all other relevant information to evaluate vibration isolation equipment.

Should added mass inertia blocks be required to comply with these vibration isolation requirements, proper provision shall be made at tender stage for the provision of such.

3.15.3 Damping

Where static deflections in excess of 8mm are indicated, steel springs shall be employed incorporating acoustic sound pads in series with the spring.

The horizontal stiffness of the springs shall not exceed that in the vertical, in particular for systems mounted at vertical frequencies below 5Hz.

Low frequency mounts shall incorporate rubber snubbers to accommodate extreme horizontal or vertical motions such as can occur near resonance during start up.

The snubbers shall however not be relied upon to provide the necessary horizontal stability of the machine in normal operational conditions.

Spring layouts and inertia blocks shall be employed to avoid this situation.

For static deflections below 8mm, rubber in sheer mounts may be used provided the frequency is above 6Hz.

For small static deflections less than 4mm and particularly for high-speed machines and general acoustic isolation, ribbed rubber neoprene composite pads may be employed subject to the specified requirements.

No equipment shall be installed in critical areas without correct and approved vibration isolation.

Sufficient stability and damping shall be incorporated in the mountings to minimise the movement of the machine during start up or changes in the operating conditions.

The selection of mounts shall take proper cognisance of unequal distribution of the mounting weight of equipment and rotational and/or pressure forces acting thereon.

3.15.4 Pumps

All pumps with their motors shall be mounted on a baseframe, which shall be installed on concrete plinths.

In addition it is required that pumps installed indoors and in critical areas shall be installed on anti-vibration mountings with inertia mass bases with mountings selected for correct static deflection.

Bases for pumps in non-critical areas shall be installed on rubber in sheer mounts as a minimum, depending on the pump selection and locality of the pump.

Where required in the supplementary specification, pumps shall be totally enclosed in acoustic panelling to reduce noise breakout to the immediate vicinity and surrounding areas.

3.15.5 Fans

3.15.5.1 Centrifugal Fans

No centrifugal fan shall be selected in a class range other than Class 1 or 2 and the rotating speed of the fan at duty point shall not exceed 1 440 r/min.

Centrifugal fans in critical areas and fans above 7,5kW shall in all cases be mounted together with the drive motor on anti-vibration mountings together with the correct inertia mass.

3.15.5.2 Propeller Fans

Propeller fans shall comply with the criteria already laid down and shall be carefully selected for the highest possible efficiency with due regard for the noise criteria.

Propeller fans in excess of 0,5kW and of rotational speed higher than 800 r/min shall, in addition to the requirements already laid down, be mounted on correctly selected and installed anti-vibration mountings to reduce possible vibration transmission to surrounding structures.

3.15.5.3 Axial Flow Fans

Axial flow fans shall be selected for the highest possible efficiency and comply with the noise criteria specified. In critical areas no fan shall be installed without attenuators on inlet and outlet sides.

In addition it will be required that the fan as a whole be mounted on anti-vibration mountings and where specified in the supplementary specification, it may be required for the fan to be enclosed in acoustic panelling.

No axial flow fan may be installed without anti-vibration mountings to match the fan characteristics and in critical areas it may be required for the axial fan to be provided with inertia mass to match.

Fan rotational speeds specified in the supplementary specification shall not be exceeded.

3.15.5.4 General

No fan may be directly connected to ducting either on the inlet or outlet sides, approved flexible connections shall be provided between the fan and the ducting distributing the air.

Where fan noise characteristics cannot meet the requirements of this specification such fans shall be replaced or other approved steps taken by the contractor at his own expense until the installation meets the requirements.

3.15.6 Piping

3.15.6.1 General

Under no circumstances may any piping be directly connected to noise generating equipment such as pumps, chillers, cooling towers etc.

Connections to such equipment shall be made with correctly selected flexible rubber type connectors of the spherical type.

In critical areas double spherical rubber type isolators immediately adjacent to the noise generating machine will be required.

3.15.6.2 Pipe Penetrations Through Walls

Under no circumstances will pipe penetrations through walls be permitted where the pipe comes in direct contact with the surrounding wall or structure.

Proper sleeves of approved materials shall be fitted at wall penetrations.

3.15.6.3 Pipe Supports

In all critical applications and within the first ten metres of all equipment, it is required that pipe supports shall be of the flexible type, correctly selected for the application and with the correct static deflection.

Depending on the application spring mounting will in all probability be required.

Any other areas and applications at risk of noise or vibration transmission to the surrounding structure similarly require pipe mountings isolated from the structure.

Pipe supports fixed to sensitive building elements will not be permitted.

3.15.7 Sound Attenuators

Where required, in order to comply with the noise and vibration criteria already laid down, or where specified in the supplementary specification, sound attenuators shall be provided for ventilation and all other plant (Duct mounted and/or as applicable).

Primary sound attenuators shall be installed near or in the plantroom.

The attenuators selected shall match the specific fan or plant characteristics to ensure the correct insertion loss to meet the sound criteria laid down.

Unless otherwise specified, sound attenuators shall be installed with flexible connections at the inlet and outlet connections.

The sound attenuators shall in addition be selected to produce the minimum pressure loss across the attenuator coupled to the least re-generated noise level produced by the flow through the attenuator.

Unless otherwise specified, air path sound attenuators shall be manufactured from galvanised sheet steel with the sound absorption material moisture repellent and erosion resistant up to 20 m/s air speed, and preferably flange connected.

Wherever possible attenuators shall be proprietary type supplied by the same manufacturer as the plant manufacturer to ensure complete compatibility.

Where not clearly indicated on the drawings, attenuators shall in all cases be provided at points where supply and return air ducting leaves the plantroom and shall be installed to prevent noise breakout from the plantroom via the ductwork.

The internal free area of sound absorbers shall be not less than the cross sectional area of the connecting duct as indicated on the drawings.

Field fabricated type sound absorbers shall be made as follows:-

All sides of rectangular ducting shall be double walled with the inner walls perforated with 10mm holes at 25mm centres. The space between the two sidewalls shall be divided into 3 unequal sections by means of 25mm thick cement fibre panel strips and filled with glass wool. The lining thickness shall be at least 80mm.

Circular ducts shall be lined as specified above except that the lining thickness shall not be less than 100mm.

3.15.8 Air-Borne Noise

Selection and installation of all items such as valves, traps, grilles, diffusers, dampers, jet outlets, nozzle outlets, transformation pieces, take-offs, etc. shall be carried out in such a manner to ensure compliance with the noise criteria laid down in this specification. Items shall be carefully selected to reduce generated noise levels to accepted levels and with minimum air pressure loss.

Items such as dampers, volume control items etc., shall be carefully selected with due consideration for noise regeneration in all possible positions of such dampers or items to ensure compliance in all positions.

All pipe penetrations through walls and structures shall be provided with a 25mm thick soft neoprene or similar approved material sleeve surround to ensure that no direct contact between the duct and wall occurs. For plastered walls the plastering shall be cut back to the outer edge of this sleeve.

3.15.9 Room Units

Where room units such as fan coil units are used, it is essential that the acoustical characteristics of such units are considered during selection and that they are installed to ensure compliance with the noise criteria laid down.

The sound pressure level from these machines shall be within the set criteria throughout the frequency range.

3.15.10 Noise to the Exterior

Where specified in the supplementary specification, additional measures shall be taken to prevent or reduce noise breakout to the exterior from the plantrooms.

In critical areas it is essential that all possible steps be taken and be allowed for at tender stage to ensure compliance with the requirements laid down.

No allowance shall be made for screening or attenuation with distance in calculating requirements.

3.15.11 Electrical Connections

In critical areas no conduit or armoured cabling may be connected directly to equipment. Flexible connections shall be used in these applications.

In other applications cabling shall be connected to equipment with long radius bends. No sharp corners or bends in cabling may be used.

Electrical connections shall not impede anti-vibration mountings and shall not convey vibrations or sound to the structure or building elements.

In critical areas cabling, trunking etc. shall be supported in a manner to ensure no vibrations are conveyed to the structure. Supporting from sensitive elements of the structure will not be permitted.

Where floating floors, acoustical separating elements etc. are used in a structure, flexible connections, conduit etc. shall be used at all crossover points.

3.15.12 Testing

When called upon to do so by the Department, the Contractor shall provide at his expense, all necessary equipment required ascertaining compliance with noise and vibration elimination in the installation.

The instruments provided shall be calibrated by an approved Authority and shall be capable of measuring sound and vibration levels integrated over a period of time.

The instrument to measure sound pressure levels must be capable of reading sound levels in dBA as well as the sound level at the international octave band centre frequencies of 31,5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz as a minimum.

The instrument to measure vibration levels shall be calibrated in nano m/s over the integration period.

In the event of such tests indicating insufficient provision for eliminating airborne noise and vibration transmission, the Contractor shall at his expense rectify the installation as necessary and the tests shall again be executed until satisfactory results are obtained.

Final approval of the noise and vibration levels shall be at the sole discretion of the Department.

3.16.0 ELECTRICAL EQUIPMENT AND INSTALLATION

3.16.1 Unless otherwise stated in the Supplementary Specification Tenderers must allow in their price for the complete electrical installation and wiring.

3.16.2 All electrical equipment and wiring shall be in accordance with the current issue of the Department's Standard Specification for Electrical Equipment and Installation for Mechanical Services. Copies can be obtained from the Department, Private Bag X65, PRETORIA, 0001.

3.16.3 Power terminal points will be as specified in the Supplementary Specification.

3.16.4 All motors over 5kW shall be provided with an approved electronic type motor protection unit in addition to the protection called for in the Standard Specification for Electrical Equipment and Installation for Mechanical Services.

3.16.5 Clause 1.2.1 (a) of the Standard Electrical Specification shall read "The South African Bureau of Standards Code of Practice for the Wiring of Premises as amended".

3.16.6 The fault level of the steam installation distribution board shall be as specified in the Supplementary Specification.

3.16.7 In the case of small wiring direct from busbars, e.g. voltmeter supply, suitable protection fuses shall be mounted directly onto the busbars.

3.16.8 The possibility of inadvertent contact with live terminals shall be avoided at all cost. All apparatus and wiring behind readily accessible hinged doors or panels shall be protected against finger contact by means of insulating panels (perspex or similar approved material) or other approved method. Busbar mounted voltmeter fuses shall be mounted on insulated back plates to afford complete safety from hand contact with busbars or other conductors in the immediate vicinity.

3.17.0 SELECTION OF EQUIPMENT

3.17.1 All equipment shall be selected with due regard to the installation site conditions, particularly with respect to;

- altitude
- ambient temperatures
- atmospheric conditions

3.17.2 Equipment shall at all times be selected to operate within the limits recommended by the particular manufacturer.

3.17.3 Where equipment will be required to operate at conditions deviating from the manufacturer's standard selection tables, re-rating shall be done strictly in accordance with the manufacturer'smethods.

SECTION 4

CONTENTS

STANDARD SPECIFICATION
FOR
STEAM BOILER INSTALLATIONS

SECTION 4

4.0 TECHNICAL REQUIREMENTS - EQUIPMENT AND MATERIALS

4.1.0 GENERAL

4.1.1 The design, manufacture, installation and operation of the equipment shall comply fully with all the relevant requirements of the Atmospheric Pollution Prevention Act 45 of 1965, as amended, and any regulations promulgated thereunder.

4.1.2 Written permission shall be obtained from the local authority Chief Air Pollution Control Officer for the area where any new boiler is to be installed.

4.1.3 The Contractor shall supply and install all notices and warning signs that are required as set out in the relevant regulations and Acts, and/or by these documents.

4.1.4 The Contractor shall apply in good time to the Department of Labour for permission to erect the boiler/s on behalf of the Department.

All documents, drawings, certificates etc. required under the regulations of the Occupational and Safety Act and by the local authority shall be completed by the Contractor and submitted on behalf of the Department.

Fees payable in this respect shall be allowed for and included in the tender price.

A duplicate set of all documents shall be submitted to the Department's Regional Representative.

Erection of the boiler/s may only proceed after submission to the Department's Regional Representative of the provisional permit issued by the Department of Labour.

Any delay caused to the contract due to late submission of the required documents may result in the relevant penalty clause being applied to the contract by the Department.

4.1.5 It is a condition of tender that Tenderers allow in their tender price, over and above their normal labour force employed on the contract, to be in attendance on the day/s of inspection of the boiler/s by the Inspector of Machinery and to provide all assistance, instrumentation, lighting etc. that will be needed for such inspection.

4.1.6 Boilers shall be rated at MCR (maximum continuous rating) for the pressure and site conditions specified in the Supplementary Specification supplying saturated steam at maximum possible dryness factor.

4.1.7 Boiler rating shall be based on the particular coal grade, size and quality specified in the Supplementary Specification.

Tenderers shall submit written guarantees with their tenders stating maximum specified fuel consumption of the boiler as tendered in kg steam per kg coal at specified MCR.

The MCR and specified fuel consumption must be guaranteed under fully automatic conditions, operating normally in-situ at the specified site and shall be maintained without any sign of priming, foaming or carry over from the boiler into the steam lines.

4.1.8 Boilers shall be subjected to certification by an independent, registered and recognised Inspector Authority and the Contractor shall supply the Department with original certificates issued by the Inspector Authority before first delivery will be considered.

Boilers shall be inspected and passed by the Inspection Authority before leaving the manufacturer's works.

4.1.9 A manhole or manholes shall be provided for each boiler to enable internal inspections (as applicable) and where necessitated by the boiler configuration hand holes shall be fitted to enable proper internal cleaning when necessary.

4.1.10 Boiler chamber volumes, fans etc. shall be suitably sized and matched to suit the site conditions, particularly high altitude applications.

4.2.0 STEAM BOILERS

4.2.1 GENERAL

Steam boilers shall be manufactured, designed and rated strictly in accordance with BS2790 : 1992 "Specification for design and manufacture of shell boilers of welded construction".

4.2.2 HORIZONTAL BOILERS

4.2.2.1 Horizontal boilers shall be of proven design and manufacture, high efficiency, coal fired, wetback, packaged shell and fire tube type.

4.2.2.2 Each boiler shall be complete with at least the following;

- horizontal chain grate stoker/s
- two off electrically driven feedwater pumps with feedwater controls
- feed check valves
- two lockable safety valves piped to outside boiler house
- one pressure gauge with at least 250mm dial and isolating valve
- inspector's test cock with flange
- air release valve/s
- high and low level water alarms with valves and blowdown valves
- blow through drain piping shall be done in copper tubing from the fittings to the blowdown pit
- induced draught fan
- forced draught fan
- instrumentation and automatic controls for combustion and load control
- integral pipework
- blowdown valves with keys, piped to blowdown sump
- steam/water sampling points
- soot blowers with steam stop valves
- ash removal valve and trolley
- feed hopper
- custom made platforms and cat ladders for access to all components, to form an integral part of the boiler construction
- two shielded water level gauges with blowdowns and valves
- control panel
- draught gauges
- crown valve
- grit arrestor/s and stack as specified, complete with interconnecting ductwork
- fittings to function as complete unit

? dual Mobrey or equal water level control with bypass and isolating valves

4.2.2.3 Combustion shall take place under balanced draught conditions in the combustion chamber, under fully automatic controls.

4.2.2.4 The boiler shall be mounted on steel base frames ready to be placed on foundation plinths. Wherever possible boilers shall be supplied fully packaged and complete.

4.2.2.5 An ash discharge port with cast iron swing type valve shall be provided for ash removal from the grate discharge end.

Each boiler shall be provided with it's own matching standard bin trolley for carting ash away. When in position underneath the boiler, the trolley shall seal neatly against a cast iron wedge plate fitted to the ash discharge port.

When the trolley is removed the swing type valve shall seal the port off air tight to maintain set combustion conditions.

Trolley wheels shall be large diameter solid rubber tyre type with the tyres protected with radiation shields.

4.2.2.6 Boilers shall be fitted with at least two soot blowers each, to enable cleaning fine gas passages such as reversed chamber tubeplate and first tube pass to maximise operational time between boiler shutdowns.

Sootblowing must be possible with the boiler on range, fully operational.

4.2.2.7 Access doors shall be fitted to the furnace chamber, front and rear.

The doors shall be refractory lined with proper seals and easily removable.

4.2.2.8 Unless otherwise specified the stack shall be supported off the boiler.

Stack height and material shall be as specified in the Supplementary Specification.

Material thickness shall be not less than 4,0mm (for stainless steel) and the stack shall be anchored with galvanised steel cables.

4.2.2.9 A full set of special tools must be provided to enable maintenance to be done by the Department's staff. The set must include all special tools for the stoker, soot blowers etc., including cleaning brushes and rods. The tools must be neatly mounted together on a steel bracket mounting and fixed to the wall of the boiler house.

4.2.2.10 All ducting between boiler, grit collector and induced draught fan shall be of 6mm mild steel welded construction and flanged with sufficient bolted inspection and cleaning openings.

At least four (4) connection points shall be provided in the ducting, one for temperature readings, one for combustion analysing, one piped to a magnehelic type pressure gauge and the fourth piped and valved for connecting a CO_2 analyser.

4.2.2.11 The stoker shall be of the continuous chaingrate type with electrically controlled speed, infinitely variable over the range of the grate speed as supplied. It is essential that the stoker has a large effective area to allow for effective burning of the coal delivered to site, as is, without loss of output.

A withdrawal frame on large wheels shall be provided for each boiler house to enable easy stoker withdrawal. The stoker must withdraw as a complete unit.

The chain links must be cast-iron and must allow proper and uniform air distribution over the whole of

the grate fire area. Link shafts must be withdrawable to enable replacing of individual links.

Forced draught ventilation through the grate is required with adjustable undergrate dampers. The dampers must be adjustable when the boiler is in operation.

A manually adjustable guillotine door is required to allow varying the thickness of the coal bed on the grate. A radial door must be provided to close off the boiler front when required.

The manufacturer's standard coal hopper shall be provided and must be at such a height and shaped as to allow filling by lashing manually.

The stoker control shall form an integral unit with the boiler controls, efficient combustion must be maintained under all conditions.

4.2.2.12 The induced draught fan shall be mounted on the boiler within the support framework of the stack with access to all service points and ease of removal of motor, bearings and fan shaft and impeller.

The fan shall be of the single inlet centrifugal type with self-cleaning impeller mounted on ball or roller bearing supports. The bearings shall be air cooled without overheating at any load.

The fan casing shall enable removal of the impeller and shaft without removal of any duct work or support structure.

A control damper functioning off the normal boiler controls shall be built into the ductwork between the fan section and the grit collector.

4.2.2.13 A single inlet forced draught fan of the centrifugal type shall be fitted to the stoker for control of stoker airflow and combustion chamber pressure.

Airflow shall be regulated by damper control forming an integral part of the control system.

4.2.2.14 Each boiler shall be provided with 2 soot blowers in the rear second pass tubes and 2 soot blowers in the front third pass tubes.

A stainless steel screw type grit extractor shall be fitted to the rear of each boiler to enable the removal of grit from the return chamber. The extractor must be hand operated and of robust construction suitable for the high temperature application.

4.2.2.15 The following spares shall be provided with each boiler as a minimum;

4	-	Sets of water gauge glasses and cover shields
1	-	Tube brush rod and 2 brushes
6	-	Sets mineral fibre mud door gaskets
2	-	Sets mineral fibre furnace access door gaskets
1	-	Mudhole door spanner
1	-	Furnace door spanner
1	-	Smoke box door spanner

4.2.2.16 Each boiler shall be fitted with at least two draught gauges mounted on the control panel and piped to the boiler.

One photohelic gauge shall measure the pressure difference across the grate and the other magnehelic gauge the pressure between boiler and grit arrestor relative to the atmosphere.

4.2.2.17 Liquid crystal display is required on the boiler control panel indicating stoker speed and damper positions to forced draught and induced draught fans.

4.2.2.18 Where specified in the Supplementary Specification one portable CO_2 analyser complete with spare

chemical charges shall be supplied with each boiler installation.

4.2.3 VERTICAL BOILERS

4.2.3.1 Vertical boilers shall be of the underfeed, coal fired, multi-tube, water-tube or flametube type.

4.2.3.2 Unless otherwise specified in the Supplementary Specification each boiler shall be complete with at least the following;

- Underfeed stoker with feed hopper and forced draught fan induced draft fan
- Two electrically driven feed water pumps
- Extended steel base frame
- Cleaning doors and handholes
- Secondary overfire air
- Instrumentation and automatic controls
- Integral pipework
- blowdown valve/s with key, piped to blowdown sump
- steam/water sampling points
- ash removal tools and trolley
- custom made platforms and cat ladders for access to all components
- two shielded water level gauges with blowdowns and valves
- crown valve
- grit arrestor and stack as specified
- fittings to function as complete unit
- feed check valve/s
- two lockable safety valves piped to outside the boiler house
- one pressure gauge with at least 250mm dial and isolating valve
- inspector's test cock with flange
- air release valve/s
- blow-through drain piping in copper tubing to blowdown sump
- draught gauges
- Control panel

4.2.3.3 Each boiler shall be provided with it's own standard wheeled bin trolley for carting ash away.

The trolley wheels shall be large diameter solid rubber type with the tyres protected with radiation shields.

4.2.3.4 Each boiler shall be fitted with a balanced secondary air system to enhance combustion.

The secondary air installation shall comprise of an independent, floor mounted centrifugal fan, connected to the boiler with steam quality pipe air ducts.

The secondary air piping shall be installed in the space surrounding the stoker retort. It shall be shaped in the form of a ring and shall be fixed to the inner face of the extension skirt. A minimum of three riser ducts shall be welded to the ring.

The secondary riser ducts shall be evenly spaced over the perimeter of the boiler, and shall terminate with specially designed cast-iron nozzles in the combustion chamber.

The nozzles shall be designed to maintain a secondary air jet to penetrate the full width of the combustion chamber.

The ring, risers and cast iron nozzles shall be built into the refractory brick lining.

The nozzles shall discharge at a height of approximately 150mm above the top of the retort.

Tenderers shall submit full details and drawings of the secondary air system offered.

4.2.3.5 At least two heavy duty, cast iron refractory lined hinged de-ashing doors shall be provided in each boiler extension skirt, one to either side of the stoker centreline. Each door shall be at least 300mm high x 450mm wide.

The doors shall be positioned to ensure that the fire can be cleared without drawing tools across the centre of the fire.

4.2.3.6 Adequate space must be ensured around the boiler to enable clinker removal.

4.2.3.7 Where necessary, high altitude application boiler skirt heights shall be raised to achieve correct combustion volume and to improve cleaning facilities.

4.2.3.8 Unless otherwise specified in the Supplementary Specification only underfeed stoker fired units shall be provided with combustion taking place under forced draught conditions in a combustion chamber containing the retort and surrounding refractory brickwork.

4.2.3.9 In the event of a hand-fired unit specified combustion shall take place under natural draught conditions in a combustion chamber containing a fixed grate.

4.2.3.10 The following shall be fitted for inspection purposes;

i) manhole for access to the waterside of the furnace uptake
ii) Fire door for access to the fire side of the furnace
iii) Handholes for every crosstube

4.2.4 BOILER MOUNTINGS AND FITTINGS

4.2.4.1 Boilers shall be provided with mounting pads for all fittings.

4.2.4.2 Boiler fittings shall be of the flanged type and of approved manufacture.

4.2.4.3 The following fittings shall be mounted on each boiler, except where otherwise stated in the Supplementary Specification:-

1. Two sets of bronze or gunmetal water level gauge columns with suitable blow-down cocks or valves, protector frames, safety glass shields and gauge glasses. Blow-down cocks and valves shall be fitted with copper tailpipes, arranged to discharge into a tundish fitted to an independent drain pipe, piped to the blowdown pit in copper tubing.

   The boiler blowdown pipe shall not be used for this purpose. The water level gauges shall be so situated and illuminated, that the water level in the boiler can at all times be readily observed from the operating floor of the boiler house.

2. Each boiler shall be provided with an integral self-contained control panel with vertical facia for the mounting of the switches and control regulators (Unless otherwise specified in the Supplementary Specification).

   Each boiler must be fitted with the manufacturer's standard and proven electric automatic combustion control. The control system shall automatically control the supply of fuel and air as well as the water level and grate stoker speed to maintain a constant steam pressure with load fluctuations as can be expected in this application. The pressure must be maintained without any priming, foaming or carry-over during load fluctuations.

   The feed water control shall be vertical airbreak external type dual control incorporating feed pump stop/start, first low water, water alarm and cut-out and high water alarm. A further

independent external single control operating as a second low water, water alarm and complete boiler lock-out protection shall be fitted.

The combustion control shall be controlled from sensing steam pressure in the boiler drum and controlling the induced draught damper and the furnace flue pressure. Stoker speed control must be suitably linked to the forced and induced draught dampers to maintain the correct fuel-air ratio through the full operating range.

A changeover switch must be provided to enable manual operation when required with all alarms and protective devices in full operation.

All controls must be electrically operated and powered, matching site power.

The controllers shall be of the externally mounted, glandless, electrical type, fitted with float chambers and blowdown valves.

The float chambers shall be manufactured of close grained cast iron, with flanged connections, and float rods of monel metal. Float chamber covers shall be of carbon steel with stainless steel centre tubes.

The control contacts shall be of the air break type, and the water level regulators shall have adjustable differentials. They shall be capable of complete automatic control of the feed water pumps and alarms.

The first controller shall automatically control the selected feed water pump. It shall be fitted with a first low water cut-out and alarm switch.

The second controller shall be provided with high water alarm, as well as a second low water cut-out and alarm switch.

The controllers shall in all respects be compatible with the boilers offered, and shall be fitted to the boilers in strict accordance with the manufacturer's instructions.

The alarm levels and feed pump stop-and-start levels shall be set as prescribed by the boiler manufacturer.

Under normal steaming conditions with the water level in the boiler within the range of the feed pump stop and start positions, a green lamp shall be illuminated on the boiler control panel.

The high level alarm shall be an electric bell, which shall be set off when the water level rises above the set point. A white indicating lamp shall be illuminated simultaneously on the boiler control panel while the green indicating lamp shall be switched off.

The first low level alarm shall actuate an electric hooter fitted with volume adjustment, and illuminate an amber coloured lamp on the control panel.

The final low level alarm shall actuate an electric siren with volume adjustment and higher tone than the first. It shall illuminate a red indicating lamp on the boiler control panel and, at the same time, lock out the automatic stoker.

Muting switches shall be provided for the audible alarms and shall be wired in such a manner as to automatically reset the alarm system when conditions return to normal.

The blowdown valves for the controllers shall be of the flanged, hand operated, sequencing type, suitable for blowdown and isolation of the level controllers. Blowdown of float chambers and water connections shall be effected separately in a pre-set sequence. Ratchet mechanisms shall be incorporated in the handwheels to ensure that once the operation of the valves has started, they cannot be returned to normal working positions without going through

the full sequence of blowdown procedure. Provision shall be made for locking of handwheels.

3. Each boiler shall be fitted with two double spring safety valves. The vent pipes from safety valves shall be run vertically to the outside of the boiler house at high level, above roof line, and suitable drain pipes shall be provided and run to the blowdown pit. Safety valves shall be adjustable and lockable.

4. Each boiler shall be equipped with a main steam stop valve, fitted as close to the boiler as possible. Where more than one boiler is connected to the same steam main a non-return valve shall be provided between each boiler and the range. Alternatively a combined main steam stop and non-return valve (crown valve) may be provided.
Boiler discharge connections to headers/ranges shall be connected to the top of such header/range and not the bottom.

5. Boiler blowdown valves shall be of the key type fitted with a safety device, which shall prevent the key from being withdrawn, unless the valve is fully closed. A separate blowdown pipe shall be provided for each boiler, piped to the blowdown pit.

6. A pressure gauge of not less than 150mm diameter shall be provided on each boiler. The boiler working pressure shall be indicated on the dial face by a permanent red mark. The range of the pressure gauge shall be approximately double the working pressure. The pressure gauge shall be mounted complete with siphon, isolating cock and inspector's test connection.

7. A flanged fitting, complete with stop and non-return valves, shall be provided on each boiler for feed water pump connections.

8. Non-return valves shall be fitted in the feed line from each feed water pump.

9. Isolating valves to soot blowers where specified.

10. Access cat ladders and egg-crate platforms to provide access to all fittings for servicing.

4.2.5 STEEL STACKS

4.2.5.1 General

Steel stacks shall be provided for the boilers where indicated on the drawings.

The stack diameters and heights shall be as specified in the Supplementary Specification. Where no such dimensions are specified, they shall be in accordance with the requirements of the boiler manufacturer and the Local Authority, generally not lower than 20m above boiler room floor level.

Stacks shall be either self-supporting or supported off the boiler, as specified in the Supplementary Specification.

The stack shall be manufactured to it's full height from stainless steel 3CR12 or 304, thickness not less than 4,0mm, or as specified in the Supplementary Specification.

Stacks and supports/stays shall be designed for a wind velocity of at least 260km/h.

4.2.5.2 Boiler supported stacks

Each boiler shall be provided with it's own independent stack.

The stack shall be constructed in sections from welded stainless steel plates, the lower half to be at least 4,0mm thick. The entire mass of the stack shall be carried by the boiler. Where stacks pass through the boiler house roof, the necessary flashing and weatherproofing shall form part of the boiler contract.

A flanged connection shall be provided between the boiler and stack. Each stack shall be provided with a damper of the butterfly type of at least 6mm thick stainless steel plate, arranged for operation from the floor of the boiler house. Dampers shall be accessible for repairs or replacement by means of bolted inspection doors.

A collar with guy ropes and stays shall be fixed to the stack. Stays shall be firmly fixed to the building and ground anchors to the satisfaction of the Regional Representative. Brackets and ground anchors for stays shall form part of the boiler contract.

4.2.5.3 Self-supporting stacks

The stacks shall be of the welded and flanged stainless steel self-supporting type consisting of a conical bottom section and cylindrical top section. The plate thickness of the bottom section shall be at least 10mm and the top section at least 6mm.

The necessary reinforcing or bracing shall be provided where flues enter the stack.

A cleaning door shall be provided at the base of each stack.

An amply reinforced concrete base shall be included in the contract for each stack. The base shall be at least 2000mm deep.

Base design and stack support shall be based on site soil conditions and wind forces and design details shall be certified by a registered professional structural engineer. Contractor to submit engineer's design and report for approval before construction commences.

4.2.6 GRIT ARRESTORS

Each boiler shall be fitted with a suitable grit arrestor as detailed in the Supplementary Specification.

Grit arrestors shall be of the multi-cell or integral cyclone type, and shall conform in all respects with the requirements of the Atmospheric Pollution Prevention Act of 1965, and their efficiencies shall be well above the limit allowed in the Act.

Tenderers shall allow for gas sampling downstream of grit arrestors with the boiler steaming at or close to MCR by an independent authority such as the CSIR who shall submit a written report indicating compliance or not with the Air Pollution Act.

Multi-cell grit arrestors shall be vertical high efficiency type.

Integral type grit arrestors shall be of the low resistance type, using natural draught.

The arrestor shall be installed between the boiler and the induced draught fan or the boiler and stack as applicable and must be accessible for cleaning and maintenance.

The grit arrestor shall be supported off the floor with a structural steel framework.

The grit arrestor shall be manufactured from 6mm mild steel plate or thicker.

Walls of the collector or shells shall preferable be of cast iron with the bottom of the cone section and other erosion susceptible parts to be replaceable.

The arrestor shall be provided with a grit-collecting chute at the bottom with an automatic plate shutter. A matching grit collecting bin on wheels shall be provided for each boiler. The grit trolley must fit under the discharge chute to collect the grit when the shutter is opened without upsetting draught balance.

4.2.7 INDUCED DRAUGHT FANS

4.2.7.1 Induced draught fans shall be provided for all shell type, horizontal boilers and for vertical boilers where specified in the Supplementary Specification. The fans shall be of the multi-vane, centrifugal type, with radially tipped blades. Fans shall be statically and dynamically balanced, and shall be quiet in operation.

4.2.7.2 The fan casing shall be robustly constructed of steel plate and a cleaning door shall be provided in the casing.

4.2.7.3 The impeller shaft shall be carried in ball or roller bearings with cooling arrangements to provide satisfactory operation with gas temperatures over the full range of the application.

4.2.7.4 The induced draught fan shall be mounted on the boiler within the support framework of the stack with access to all service points and ease or removal of motor, bearings and fan shaft and impeller.

4.2.7.5 The fan shall be of the single inlet centrifugal type self cleaning impeller.

4.2.7.6 The fan capacity shall be for the full flue gas flow at MCR at site conditions with sufficient margin to allow for expected foul up between annual services of flue gas passes through the boiler.

4.2.7.7 The fan casing shall enable removal of the impeller and shaft without removal of any duct work or support structure.

4.2.7.8 The fan and motor shall be the standard units normally supplied by the boiler manufacturer with the boiler model offered.

The motor shall be of the T.E.F.C. squirrel cage type with speed not exceeding 1450 rev/min.

4.2.7.9 A control damper functioning off the normal boiler controls shall be built into the ductwork between the fan section and the grit collector.

4.2.7.10 All ducting between boiler, grit collector, stack and induced draught fan shall be of 6mm mild steel welded construction and flanged with sufficient bolted inspection and cleaning openings.

Duct sizing shall be based on a gas velocity of not higher than 7,5m/s and ample provision shall be made for expansion and contraction in the ducting.

4.2.8 AUTOMATIC STOKERS - GENERAL

Unless otherwise specified in the Supplementary Specification, an automatic stoker shall be supplied and fitted to each boiler.

Horizontal boilers shall be fitted with chain grate stokers and vertical boilers with underfeed stokers.

Each stoker shall be sized to provide the rated output of the boiler under normal working conditions, with the flues specified in the Supplementary Specification and at the site conditions specified.

Each stoker shall be driven by an electric motor of the totally enclosed fan cooled type. Motors shall be complete with switchgear for manual and automatic operation.

4.2.8.1 Underfeed type stokers - vertical boilers

Each stoker shall be complete with controls, infinitely variable hydraulic gearbox, hopper, burner, fan, motor, starter and safety devices.

The hopper shall be constructed of sheet steel. The feed screw shall be of alloy steel to resist the effects of abrasion, corrosion and heat, and shall run in a thick steel tube with joints provided between hopper and burner, for easy removal and replacement of the coal screw.

The retort section shall be made up of cast iron tuyeres and corner blocks.

The entire area surrounding the burners and retort shall be bricked up with matching refractory brickwork.

The coal feed tube shall be pressurised with damper adjustable forced draught air.

The stoker speed control shall be arranged to give infinitely adjustable feed control over it's full range of rates of coal feed. The rate of air supply and coal feed shall be mechanically interlocked and arranged for both manual and automatic control.

A shear pin shall be fitted to the final worm shaft. The pin shall be readily accessible for replacement.

Drive mechanism shall be easily removable and provision shall be made for screw removal.

The stoker shall be the standard unit normally supplied by the particular boiler manufacturer.

4.2.8.2 Travelling grate stokers (refer clause 4.2.2.11)

Travelling grate stokers for horizontal boilers shall be installed as complete self contained units. Where two stokers are installed in a double flued boiler the stokers shall be independent of each other.

Grate heat release per square meter grate area shall not exceed industry accepted standards.

The stoker grate shall consist of a series of rows of interlocking links, which shall form an endless chain. The links shall be manufactured from a special grade of cast iron, machined to ensure accuracy. The links shall be so designed as to afford maximum surface exposed to the cooling action of the air and the minimum heat-absorbing surface exposed to the fire bed. The links shall be held in place by means of high carbon steel link rods fitted in such a manner as to eliminate the necessity of any form of securing device for the end links.

The grate shall be driven by a totally enclosed fan cooled motor through an infinitely variable hydraulic gearbox driving the stoker front shaft. The grate speed shall be variable over the range applicable to the boiler size. A safety device shall be incorporated in the drive to safeguard against overloading. The grate must be capable of being hand operated in the event of a power failure.

On - off control will not be accepted.

The chain grate, drive and hopper shall be mounted on a main frame constructed from heavy section side members, substantial stays on the upper side and a bottom plate of ample proportions. The chain tracks shall be manufactured from high carbon steel and shall give continuous support to the grate under the driving links. The rear end of the grate shall be supported and guided by a roller unit fitted with robust screened bearings and revolving on a fixed shaft. The stoker shall be capable of being withdrawn from the boiler as a unit.

An even distribution of air across the width of the grate is essential and the necessary dampers and controls for regulating the supply of air through the length of the bed shall be provided and arranged for convenient operating at the firing floor level

4.2.9 AUTOMATIC CONTROL

4.2.9.1 In addition to the water level controllers specified boilers shall be equipped with reliable combustion

control units (where specified in the Supplementary Specification).

Each boiler shall be provided with an integral self-contained control panel with vertical facia for the mounting of the switches and control regulators.

Each boiler shall be fitted with the manufacturer's standard and proven electric automatic combustion control. The control system shall automatically control the supply of fuel and air as well as the water level and grate speed to maintain a constant steam pressure with load fluctuations. The pressure must be maintained without any priming, foaming or carry-over during the load fluctuations.

4.2.9.2 The combustion control shall be controlled from sensing steam pressure in the boiler drum and controlling the induced draught damper and the furnace flue pressure. Stoker speed control shall be suitably linked to the forced draught damper to maintain the correct fuel-air ratio through the full operating range.

A changeover switch shall be provided to enable manual operation when required with all alarms and protective devices in full operation.

All controls shall be electrically operated and powered.

4.3.0 HOTWELL TANK AND STAND (FEEDWATER)

Hotwell tank and stand as specified in the Supplementary Specification shall be provided and installed in the boiler house in the position indicated on the drawing.

The tank shall be fabricated from 6mm mild steel plate suitably stiffened. The tank shall be mounted on 150mm x 100mm rolled steel joists. Where the tank is to be elevated it shall be mounted on a tubular or rolled steel joist stand which shall be suitably braced and stiffened. The height of the elevated tank will be indicated on the drawings.

The interior of the tanks shall be thoroughly cleaned and prepared and then painted with approved anti-corrosion paint.

The hotwell tank shall be complete with all fittings and outlets as on the drawings including the following;

i) A 460mm x 460mm hinged access door immediately above the ball valve shall be provided in the top of the tank for inspection and maintenance purposes.

ii) A cold water supply connection, located 300mm below the top plate, controlled by a ball valve, to discharge at least 300mm below the normal water level.

iii) 40mm Valved drain and overflow connections, with pipelines complete with water traps, to be run outside the building to the nearest gulley or drain-point.

iv) A 100mm vent pipe to be taken straight up through the roof of the boiler house. Suitable flashing and weatherproofing shall form part of the boiler contract.

v) Suction pipes of the sizes specified, complete with valves and strainers, shall be provided at the bottom of the tank, and connected to the suction side of feed pumps.

vi) Condensate return connections of the size or sizes specified shall be manifolded near the top of the tank with the manifold arranged to discharge near the bottom of the tank. The manifold shall be provided with it's own vent pipe separate of the tank vent, to outside.

vii) A shielded glass water gauge column, complete with isolating and drain cocks, shall be provided for water level indication. The diameter of the glass column shall be not less than 15mm o.d. and shall

be clearly visible from the firing floor.

viii) The stand support shall be of structural steel as per drawing and painted as specified.

4.4.0 WATER TREATMENT PLANT

4.4.1 General

1. Water treatment equipment shall be provided and installed close to or beneath the hotwell tank as indicated on the drawings.

   Tenders shall arrange for a water sample to be taken of the water available at the site and to have same analysed, prior to tendering.

   Water treatment plant tendered shall be based on actual site water quality.

2. The water softening and dosing plant shall be capable of achieving the following feed- and boiler water conditions under all operating conditions:

   i) Expected maximum make-up 60% of MCR (or as specified)

   ii) Feed water analysis required:

Hardness	-	5mg/l as $CaCo_3$
Alkalinity	-	preferably due to Caustic Soda, 100ml sample to give pink colour to phenolphthalein with 0,15ml of 0,1 Nitric acid
Oxygen content	-	not more than 0,05mg/litre

   iii) Boiler water analysis required with normal periodic blowdowns;

Hardness	-	Nil
Total Alkalinity	-	10 - 15% of T.D.S.
Phosphate	-	100 - 170mg/l as $Na_3 PO_4$
T.D.S.	-	not more than 3000mg/l

   Above shall serve as a guideline and final requirements shall be in accordance with the boiler manufacturer's specifications and the Supplementary Specification.

3. The water treatment shall provide corrosion protection to all parts of the boiler and the total steam system in contact with steam, boiler feed water and condensate.

   No priming, foaming or carry-over of any kind of the boiler shall be allowed and boiler water level shall remain stable under all operating conditions.

4.4.2 Water Softeners

1) A fully automatic base exchange water softener/s for the external treatment of boiler feed water make up water shall be provided to match site water and boiler feed water quality and hardness requirements.

2) Each independent feed water/ hotwell system shall be provided with it's own water softener in the make-up water.

3) Capacity of water softeners shall be based on 60% of boiler/s served MCR or as specified in the Supplementary Specification.

4) Each water softener shall be capable of operating for at least 24 hours before having to be regenerated, and shall be designed to suit the site water pressure.

If a water pressure booster pump is required it shall be allowed for in the tender price.

5) The softener shall function fully automatically and provision shall be made to eliminate the bypassing of hard water during generation. The unit shall be complete with at least the following:

a) Brine tank of polypropylene or fibreglass with lid with stainless steel type propeller mixer, all on 150mm raised platform.

b) Synthetic high capacity cation exchange resin.

c) Inlet, outlet pressure gauges.

d) Integrating water meter.

e) Test kit and operating instructions.

f) Isolating valves and all integral pipework.

The cycle control shall be from a twin measuring cell and not time clock or flow controlled. The twin-measuring cell shall be in continuous contact with the resin bed and the controls set for optimum salt consumption and minimum use of regeneration water.

Inlet and outlet pressure gauges as well as a integrating water meter similar and equal to Kent is required.

A test kit and a full set of operating instructions shall be provided.

All equipment shall be manufactured from corrosion resistant materials such as fibreglass and/or polypropylene.

4.4.3 Chemical dosing

1) Chemical dosing of the boiler feedwater is required. It is required that as a minimum oxygen scavenging shall take place at the point of dosage and with effective carbon dioxide neutralising in the condensate return system to protect condensate pipes, traps, valves etc.

2) Chemical dosing shall be done with packaged variable dosing units.

It shall comprise a 200l (min) polythene or fibreglass dosing tank, metering pump/s, tank and pump base, combined electrically driven propeller mixer/stirrer with stainless steel shaft and propellers, tank lid, metering pumps with capacity range variable to match possible tank concentrations for the required chemicals. Dosing shall be in to the feed pump suction main and the dosing pumps shall be suitable for use with corrosive chemicals.

3) The dosing pumps shall be interlocked with the boiler selected for operation as well as the particular feed pump operating at any moment of time to ensure that it stops and starts with the feed pump in operation so that dosing only takes place when a boiler feed pump is in operation. The dosing pump range shall be in the order of 2 to 50l/hour, matching boiler capacity and chemical feed rates.

4) The dosing unit shall be complete with all necessary piping, valves, electrical protection etc., and it shall be possible to service all parts and components with the boilers in normal

operation.

5) The chemicals tendered for use shall be the manufacturer's standard formulation for this type of application and must be freely available in standard concentrations and containers.

6) One set of chemical dosing equipment shall be provided for each boiler.

7) Automatic blowdown or controlled bleed off is not desired unless absolutely necessary and the treatment applied must be suitable for an operation controlled blowdown programme.

4.4.4 Chemicals and salt

1) A full supply of chemicals, salt, etc., to enable 3 months of continuous use of the dosing and softening plant shall be supplied to the Department upon successful commissioning of the plant. The chemicals shall be handed to the Department in sealed containers and a signed receipt must be obtained from the Department's representative.

2) Steam will be used for various processes, including the preparation of food. The chemical treatment must, therefore, be suitable for use with such processes and approved as such.

3) The chemical treatment shall provide protection against corrosion of boiler metal, steam and condensate reticulation systems and shall inhibit caustic embrittlement. Precipitation of sludge is not desirable and all solids shall remain in suspension.

4) The chemical solution shall contain softening agents, oxygen scavengers and corrosion inhibitors.

5) The chemical/s shall be injected into the pump suction lines and shall be arranged for individual dosing to each boiler.

4.4.5 Chemical Control Tests

1) It is a condition of tender that the supplier of the dosing equipment enter into a separate service contract with the Department for the regular maintenance of the dosing plant only, dosage rate adjustment and for the chemical control analysis of the boiler water.

2) Chemical control tests shall be conducted at least once per month and the results thereof submitted to the Department.

Included in the monthly reports shall be recommendations on concentrations, dosage rates and blowdown operations.

3) Tenderers must indicate in their tenders whether the suppliers of the dosing equipment are able to provide such a service and indicate the cost of the service on the schedule of particulars.

4.5.0 STEAM FLOW METER

1) Where specified in the Supplementary Specification one combined steam flow and pressure recorder shall be installed in the position indicated on the drawings.

2) The flow and pressure ranges shall match the specified boiler requirements and expected total steam flow.

3) The recorder shall be mounted on the boiler house wall in a clearly visible and accessible position. Isolating valves shall be provided at the orifice plate tapping and at the recorder.

4) The complete installation shall be strictly in accordance with the manufacturer's requirements.

5) Charts and ink shall be provided for 3 months continuous use.

4.6.0 BOILER FEED PUMPS

1) Each boiler shall be provided with two electrically driven multistage centrifugal pumps. It must be possible to select any one pump without interrupting the automatic control.

2) Pump capacity shall be at least 10% in excess of the boiler MCR at specified operating pressure with a non-overloading characteristic.

The pump motor shall be rated for all possible load conditions with an excess of at least 10% above the expected maximum pump load.

3) Pump and motor shall be mounted on a common baseplate on the boiler support framework.

4) A pressure gauge with range 10% in excess of feed pump shut-off head shall be fitted in the common feed line from the feed pumps in a conspicuous position. The pressure gauge shall be provided with an isolating cock.

5) The pump impeller shall be of machined phosphor bronze or equal. Pump casing to be of cast iron and pump shaft stainless steel.

6) Pumps shall be fitted with non-return and isolating valves to enable servicing any pump with the boiler in use.

4.7.0 TRAINING OF EMPLOYER'S STAFF

4.7.1 Construction phase

It will be the intention of the Department to have two employees (future plant operators) nominated by the Department, working with the Contractor's staff during the construction phase on site to enable them to gain a working knowledge of the installation as well as familiarise them with the various sections and elements.

It will be expected of the Contractor to utilise and develop their skills and instruct them from day to day as if they were his own employees. Salaries of the two employees will be paid by the Department.

4.7.2 Commissioning phase

The Contractor shall within reason involve and train the operating and maintenance staff of the Department during the commissioning phase to enable them to do commissionings after future maintenance shut downs.

4.7.3 Training in Operation

After the successful commissioning of the plant and it being used on a regular basis it is required that a suitably qualified employee of the Contractor shall spend 7 consecutive working days of 9 hours each in full attendance training the staff in the day-to-day operation and attendance and minor adjustments necessary to operate the installation successfully and efficiently.

4.8.0 PERFORMANCE TESTING

4.8.1 General

The testing of each boiler and all equipment forming part of this installation forms part of this contract. All testing shall be done by the Contractor at his expense in the presence of the Department's representative. The Contractor shall supply all materials, equipment, labour, instruments etc. to facilitate the full and comprehensive testing required.

4.8.2 Boilers and Ancillary Plant

The following tests will have to be carried out on each boiler:

a) Hydraulic pressure test and internal inspection as required and arranged with the Inspector of Machinery.

b) Testing of all automatic and safety apparatus and equipment.

c) Hydraulic pressure test on all steam and condensate lines in the presence of the Department's Representative. Tests to be conducted at 150% main steam pressure and the whole system inspected for leaks.

d) All traps, strainers and condensate returns for proper functioning.

e) Proper functioning of combustion controls with special regard to efficient burning in the range 40% to 100% of continuous rating.

f) A continuous performance test of duration long enough to satisfy the Department's Representative during which period the steam flow and coal consumed must be accurately measured. Instrumentation will also have to be provided to accurately measure the temperature and pressure of the steam and feedwater. Two representative coal samples will also be taken with proper airtight containers one of which shall be sent to a independent laboratory for analysis at the Contractor's expense. The other sample will be kept by the Department for control purposes. A full analysis report in writing on the official letterhead of the sampling laboratory must be submitted to the Department within 10 days of the test.

4.8.3 Water treatment plant

After commissioning and during the training period water samples shall be taken to establish the correct functioning of the water treatment in clean, clearly labelled bottles;

a) Water after softener (make-up)

b) Water after dosing and before boiler

c) Condensate return from plant at entry to hotwell

d) Boiler water

The samples shall be taken twice daily and sent to an independent laboratory for analysis.

During the sampling period a close control shall be kept on blowdowns. All blowdowns, number and duration shall be properly recorded and submitted with the analysis report.

4.9.0 STEEL PLATFORMS, WALKWAYS AND CAT LADDERS

1) Additional platforms, walkways ad cat ladders where specified in the Supplementary Specification, shall be installed in accordance with the arrangements shown on the drawings.

2) Platforms shall consist of lattice type grating cut to size and bolted on to strong angle iron frames, which shall be free standing or supported off the walls of the boiler room.

3) The platforms shall be provided with tubular guard rails, not less than 1m high.

4) Cat ladders constructed of 40mm x 13mm mild steel flat sides and provided with 300mm long x 16mm mild steel rungs, riveted or welded into holes in sides at 230mm centres, shall be provided where shown on the drawings.

4.10.0 COAL-HANDLING EQUIPMENT

4.10.1 General

Where specified in the Supplementary Specification, coal-handling equipment shall be provided, as shown on the drawings.

Suitable connection chutes shall be provided between conveyors, elevators and hoppers and chutes.

4.10.2 Coal Elevators (En Masse Conveyors)

The handling capacity of the coal plant shall be compatible with the boiler capacity/capacities and the particular coal size and quality to be utilised on site, with particular reference to fines and duff content.

1) The coal elevator shall consist of a pressed steel casing of robust construction through which the coal is moved by an endless chain of appropriately shaped case hardened links. The casing shall consist of two separate ducts with the chain/links dragging the coal through the full half and the chain return through the empty side.

   The casing sections shall be correctly aligned and shall be dust proof. Hardened wear resisting plates shall be provided at all bends on the inside of the coal duct and along the chain/link travel and slides.

2) The elevator shall be driven by a fixed speed totally enclosed fan cooled motor, through a reduction gearbox and a final chain drive with machined hardened sprocket. Provision shall be made to prevent the mass of the coal in the vertical casing from driving the unit in reverse when the driving motor is switched off. The elevator shall have shearpins for protection. A speed sensing control unit shall be provided to trip the driving motor whenever stoppages occur due to a mechanical fault. Motor coupling to gearbox shaft shall be of the hydraulic type.

3) A robust, manually operated cut off slide with handwheel and drive sprocket shall be provided at each bunker discharge opening, where applicable.

4) Each elevator shall be provided with a discharge chute, which feeds directly into the choke of the matching screw conveyor or boiler hopper, where applicable.

4.10.3 Screw Conveyors

1) Screw conveyors shall consist of an electrically driven Archimedean screw in a steel or cast iron tube. The tube diameter shall be not less than 150mm. The tolerance between screw and sides shall be suitable for the type of coal to be used.

2) Where a screw conveyor is connected to an elevator, the capacity of the conveyor shall be greater than that of the elevator.

3) Screw conveyors shall be fitted with shearing pins for protection against mechanical faults and provision shall be made for access to the screw and shear pin when the conveyor becomes clogged or pin sheared.

4) The conveyor shall be manufactured in practical sections with easy access and screw removal.

4.10.4 Control of Coal Handling Plant

1) Each elevator/conveyor combination (where applicable) shall be controlled from high and low coal level limit diaphragm type micro or proximity switches situated in the chute and stoker hopper respectively. Each conveyor/elevator combination shall be provided with manually operated emergency overriding switches, which can be used in the event of high or low-level micro switch failure.

2) Combination conveyor and elevator motors shall be electrically interlocked to prevent conveyor operation when the elevator has stopped due to a mechanical fault and vice versa. Conveyor and elevator motors shall be started and stopped in sequence.

4.11.0 PIPEWORK AND FITTINGS FOR WORKING PRESSURE UP TO 1000kPa

4.11.1 General

1) Steam, condensate and feed water piping complete with all valves and fittings shall be provided and fixed in accordance with the layout shown on drawings, as well as standard drawing ME 700S/9 to ME 700S/22 which are bound into this standard specification.

2) Pipes shall be neatly run and properly supported. Where beams, stanchions, etc., interfere with the straight running of pipes, suitable offsets shall be provided so that pipes may follow the line of the walls both vertically and horizontally. Tenderers should make themselves conversant with complete drawings of the buildings concerned in order to ascertain the number and positions where such offsets will be required.

3) Horizontal pipes passing through partitions and walls, shall be provided with sleeves made of medium class black steel pipe, large enough to leave a clearance not less than 6mm around the pipe and covering, if any. In new constructions, sleeves shall be built in.

4) Vertical pipes passing through floors shall be provided with sleeves of medium class galvanised steel piping. Sleeves shall be of proper length to pass through the entire floor construction, including fill, and shall provide the same clearance as above. Sleeves in concrete work shall be flanged at the bottom or provided with temporary centring caps and securely nailed or screwed to forms before the concrete is cast.

5) Exposed pipes passing through floors or walls shall be provided with floor, ceiling and wall finishing plates. Plates shall allow for expansion and contraction and shall be securely fixed to the sleeves.

6) Expansion loops and scale pockets with steam traps shall be provided where shown on the drawings and at such other positions as may be required. (See attached drawings)

7) As an alternative to the expansion loops, bellows type expansion joints may be offered, but these shall be subject to approval by the Department's Representative.

8) Bellows type expansion joints where approved, shall have internal and external sliding sleeves and shall be subjected to cold draw as recommended by the manufacturer.

Expansion bellows shall be manufactured from 18/8 stainless steel and shall be designed to withstand the test pressure of the system.

All expansion bellows shall be provided with external protection where exposed to damage.

All bellows expansion joints shall be capable of withstanding without damage, expansion movement of not less than 150% of the predicted maximum in the location for which it is intended. Bellows expansion joints which are strained during tests due to being wrongly located etc., shall at the Department's Representatives discretion, be replaced by the Contractor at not extra cost to the Department.

Each bellow expansion joint shall be fitted with a clearly inscribed plate showing maximum working pressure, maximum and minimum operating lengths and direction of steam flow. They shall be installed strictly in accordance with the manufacturer's recommendations.

4.11.2 Steam Piping

1) All steam piping shall be ungalvanised throughout and shall comply with ASA Schedule 40, seamless class or steam class to SABS62 or BS 1387, as specified in the Supplementary Specification.

2) All piping shall be entirely free from defects and rust or millscale and shall be factory coated with a suitable red oxide primer. All piping shall be suitable for a working pressure of 1000kPa with saturated steam.

3) Piping up to 50mm nominal bore may be screwed, while larger than 50mm nominal bore must be welded and flanged. All piping to be welded, shall be suitably prepared and bevelled for welding.

4.11.3 Steam Fittings

1. General

All fittings shall be of the highest quality ungalvanised steam fittings.

All fittings of 50mm diameter and under may be screwed. The larger fittings shall be flanged. Where fittings are used sufficient unions or flanged joints must be provided to permit easy removal of equipment.

2. Screwed Fittings

Where screwed fittings are used, these shall be of heavy steam quality wrought steel fittings, which shall comply with BS 1740. These shall be threaded to BS 21. Malleable iron fittings may not be used.

Screwed fittings shall have their thread cut accurately square to the axis of the fitting to ensure straight and square pipework.

3. Welded Fittings

These shall be seamless carbon steel butt-welded fittings, and shall comply with BS 1640 Schedule 40.

4. Bends

All bends shall be of the long radius type, elbows may only be used on small pipe sizes where the special requirements are such as to render the use of bends impractical. All bends shall comply with BS 1640 Schedule 40. Elbows shall comply with BS 1740.

5. Reducers

Where reducers are used, these shall be either eccentric or concentric as appropriate. It is essential that, where reducers are used, the invert of the pipe is straight and free of any

untrapped pockets or steps, which could accumulate condensate.

6. Tee Pieces

Screwed tee pieces shall comply with BS 1740. Welded tee pieces shall comply with BS 1640 Schedule 40. Tee pieces may be equal or reducing. The latter are preferred where a smaller branch is taken from a main.

7. Nipples

Only tapered thread nipples made from heavy grade steam pipe may be used. Nipples may be long, short or hexagonal. Nipples will only be accepted up to 40mm nominal diameter pipe size.

8. Unions

All unions shall be of the wrought steel conical bronze seat type of steam union and shall comply with BS 1740. Malleable iron or flat face unions will not be accepted.

9. Flanges

All flanges shall be raised face machined steel flanges, which shall comply with BS 10 Table F. All flanges shall be suitable for welding in sizes above 50mm nominal bore, while screwed flanges may be used on pipes of 50mm nominal bore and smaller.

10. Gaskets

Gaskets shall either be metallic joint rings or they shall be made from graphited compressed mineral fibre with a minimum thickness of 1,6mm.

11. Valves

Steam valves for a working pressure up to 1500kPa and temperature up to 200ºC shall be of the globe valve type. Over and above this temperature and pressure, parallel slide valves shall be used.

For up to 1500kPa pressure and 200ºC steam temperature, valves of 50mm diameter and smaller shall have a bronze body, spindle of manganese bronze, seat and valve of 316 stainless steel which must be fully replaceable and a handwheel of pressed steel with a heat insulating insertion fitted. The screw-on bonnet shall contain a mineral fibre gland packing.

Valves larger in diameter than 50mm shall have a steel body, with a stainless steel seat, valve and spindle. The handwheel shall have a heat-insulating insert and may be of cast iron.

All valves shall be embossed indicating the make, manufacturer, working pressure and temperature.

12. Steam Strainers

Strainers shall be of the Y-leg type with bronze body up to and including 50mm diameter, and cast iron body above 50mm. Strainers shall be fitted with stainless steel or monel metal screen mesh size 100 with screw on or bolted cap. The total free area of the screen shall be equivalent to at least twice the area at the entering port. All strainers larger than 25mm shall be fitted with a blowdown cock.

13. Pressure Reducing Valves

All pressure reducing valves shall be pilot valve operated and capable of handling steam quantities ranging from 10% to 100% of the total load, and with an operating pressure of ±25% of the nominal supply steam pressure. Downstream steam pressure shall not vary more than 1% over the range of 10% to 100% capacity. Pressure rise under dead-end conditions shall not exceed 1% downstream. The valve shall be embossed indicating make, manufacturer and operating conditions. The valve shall be flanged with flanges drilled to BS 10

Table F.

Valves on dead-end legs must shut off tightly.

All wearing parts such as valve seat and valve diaphragms shall be made of stainless steel.

Means for adjustment of the pressure reduction shall be provided without the steam pressure on the reduced side fluctuating out of specified range.

All reducing stages shown on the drawings shall be in accordance with the standard stage shown on drawing ME 700S/19 attached.

14. Pressure Relief Valve

Pressure relief valves shall be of the adjustable spring loaded pop type. The body shall be bronze and suitable for the specified working pressure. The valve seat, and valve shall also be bronze or stainless steel. The spring shall be cadmium-plated steel, with spindle and spring plate being bronze. The valve shall be selected for the maximum possible flow and pressure allowing for a 15kPa pressure drop over the valve. The valve shall operate on 10% variation of the controlled pressure on full opening. The final setting of the pressure shall be locked by means of a padlock. The safety valve discharge shall be piped to a safe position outside buildings, where applicable.

Combined pressure reducing and safety valves are not acceptable.

15. Pressure Gauge

All pressure gauges shall not be less than 100mm diameter Bourdon Tube dial type gauges to BS 1780. All gauges shall be supplied with siphon and cock to suit the pipe to which they are fitted.

All gauges shall have an error of not greater than ±2% as calibrated against a dead weight tester over the complete range of operation.

All gauges on a particular installation shall be of the same manufacture and shall be calibrated in kPa and shall be graduated to 50% above the working pressure.

16. Steam Traps

All steam traps are to be similar and equal to Hopkinson, Armstrong, or Spirax Sarco. Traps shall be suitable for the specified working pressure.

All steam traps used on a particular site are to be of the same manufacture. Steam traps are to be suitably chosen for their duty and submitted to the Department's Representative for approval prior to ordering.

Steam traps shall be of the float, inverted bucket or thermostatic type as specified in the Supplementary Specification and shall have the capacities specified under the conditions at which they have to operate.

Float or bucket traps shall have bodies of cast iron or stainless steel, float and buckets of non-ferrous alloy, and replaceable stainless steel valves and seats. Thermostatic traps shall have bodies of non-ferrous alloy, bronze bellows (or bimetal elements) and replaceable stainless steel valves and seats. All traps of the float or inverted bucket type, shall be fitted with automatic air relief valves.

Traps shall be installed in accordance with maker's recommendations. A pipe line strainer shall be provided before each trap.

A shut-off valve shall be provided before and after each steam trap and the trap shall be mounted between unions or flanges to facilitate easy removal, as shown on drawing ME 700S/15 and -/16.

17. Sight Glasses

Sight glasses shall be made of bronze or gunmetal body, with glass window embedded between two mineral fibre graphite washers, of at least 60mm diameter free viewing area.

The sight glasses shall be installed downstream from traps and shall be suitable for the working pressure of the system.

The bezel shall be readily removable for easy cleaning.

18. Check Valves

Check valves shall be of the swing or lift type. The body, disc and seat shall be made of bronze. The disc and seat shall be machined to allow for positive closing of the valve on backpressure. The valve shall be suitable for the specified working pressure.

19. Combination Sight Glass/Check Valve

A combination sight glass/check valve can be used in lieu of the single items as detailed above. This combined unit shall be of approved manufacture and shall be designed for the specified working pressure.

20. Steam Separators

Steam separators shall only be of a well-proven and approved manufacture. Units made up in the contractor's or other works will not be acceptable.

21. Scale Pockets

Scale pockets shall be provided before all line traps as shown on drawings ME 700S/15 and -/16.

Scale pockets shall in all instances be of the same pipe diameter as the steam main, with a minimum length of 700mm extending below the branch-off to the line trap.

4.11.4 Pipe Joints

1. General

The ends of all pipes are to be cleaned from burrs and rough edges before jointing.

2. Threaded Joints

All pipe threads shall be right-handed Whitworth standard taper pipe threads and shall comply

with BS 21 or ISO-R7. Threaded pipe joints shall be made with either an approved steam pipe jointing compound or PTFE Tape.

All surplus compound or tape shall be cleaned off the joints before painting or finishing-off.

3. Welded Joints

All welded pipe joints shall be of a high standard and carefully prepared for welding.

All edges and holes shall be correctly bevelled and shaped. Where flame cutting is carried out, the surfaces shall be thoroughly cleaned by grinding, and all slag and oxidised material removed before welding commences.

Welded joints shall be thoroughly cleaned after welding and all slag and other foreign material removed before installation.

All welding shall fully comply with SABS 044 as amended.

Where pipes are welded, Tenderers shall allow for one in ten welded pipe joints (chosen by the Department's Representative) to be cut out for examination purposes. Tests of specimen welds are to be carried out in accordance with the test procedures of the above specifications. After removal of these joints, the piping shall be made good by the Contractor. Should any of the welds prove unsatisfactory, the Contractor will be called upon at his own expense to have all welds examined by X-Ray and to have X-Ray plates examined by the SABS or other approved Authority. All welding proven unacceptable shall be put right at the Contractor's expense.

All flanges shall be welded both internally and externally.

Where called for in the Supplementary Specification, only welders coded by the SABS may be used.

Where, in the opinion of the Department's Representative, a welder is not competent, the Department's Representative shall have the authority to ask that such person be replaced with a competent person.

4.11.5 Running of Pipes

1. All steam pipes shall be installed with a fall towards the steam traps of not less than 1 in 400. Pipes shall be so arranged that the piping can drain completely and no pockets of condensate shall be formed at points other than the trap points.

2. Offsets shown on the drawings should be strictly adhered to as the complete layout is designed to take up the natural expansion in the offsets instead of expansion loops etc. Where it is necessary to install devices to take up pipe expansion, expansion loops of the ALYRE type are preferred.

3. Expansion bellows shall only be used where specifically indicated on the drawings.

4. Sleeves for pipes passing through the walls shall be packed with fibreglass or mineral fibre material in accordance with the local fire regulations.

5. Sleeves passing through outside walls must be rendered watertight by means of suitable caulking and flashing.

6. All pipes shall be provided with sufficient unions and flanges to permit the easy dismantling of equipment, and unions or flanges shall be provided adjacent to every branch connection and at all valves.

On straight pipe runs, flanges or unions shall be provided at intervals not exceeding 14 metres.

7. Piping shall be so arranged that it will not obstruct other equipment.

8. All steam piping shall be given sufficient cold draw at offsets etc. during construction to allow pipelines to return to their normal suspension position when in use and hot.

9. Piping shall be connected to equipment in such a way as to permit the easy removal of the equipment with the minimum of dismantling of pipework.

   Unions may only be used in piping sizes up to and including 50mm nominal bore.

   Flanges and/or unions are not usually indicated on the drawings and Tenderers must make proper allowance to comply with this requirement as no claims will be entertained on site stemming from this requirement.

   All pipelines shall be provided with adequate full-bore trap pockets at trapping points. These trap pockets shall be provided with a 15mm blowdown globe valve.

4.11.6 Piping Support

Supports shall be provided as indicated on the drawings. Details of pipe loads and stresses due to expansion, resulting anchor loads etc. have to be submitted for approval by the Department.

Additional support shall be provided at places where concentrated loads will occur due to valves, control valves, reducing stations, traps, strainers, etc.

Only supports, hangers, anchors of approved quality backed up by manufacturer's recommendation, and experience will be accepted. "Unistrut" or equal supports are preferred.

Overhead supports shall be constructed as shown on the drawings. Where poles are specified these shall be made of high quality steel, hot dipped galvanised after manufacture and painted in accordance with this specification (where specified in the detailed specification).

Clearance of 4300mm between finished ground and lowest point of pipelines shall be maintained unless otherwise detailed on the drawings.

Vertical piping on outside walls of buildings shall be supported at intervals not exceeding 2m.

Horizontal piping within buildings shall be supported as indicated on the relevant drawings.

Horizontal piping in roof spaces shall be supported as indicated on the relevant drawings.

Generally horizontal piping shall be supported at intervals as listed below, unless otherwise indicated on the relevant drawings.

Diameter of Pipes mm	Maximum Span Supports m
15 o 20	2,0
25 to 32	3,0
40 to 50	3,5
65 to 80	4,0
100 to 125	5,0
150 to 200	6,5

4.12.0 THERMAL INSULATION

4.12.1 Steam Piping

All steam mains shall be insulated with preformed insulation units. Valves, reducing valves, unions, drip pockets, trays and separators are to be left exposed, but adjacent insulation should have the ends weatherproofed or sealed, as applicable. The thickness of insulation shall be based on heat losses in watts per lineal metre and shall not be less than that stated for economical thickness as set out in BS 1988 : 1949.

All insulation shall be applied after the erection of equipment and pipework and after all pressure tests have been completed.

Insulation materials shall be chemically inert in their wet or dry state and shall comply with BS 1588 and BS 3708. The mechanical strength of the insulation together with it's finish and supports shall be such that sagging or other deformation does not occur under the conditions of use.

Guide to Thickness of Insulation

1.

SIZE OF PIPE	THICKNESS OF PREFORMED SECTIONS
Up to 65mm diameter	25mm
80mm to 150mm diameter	40mm
Over 150mm diameter	50mm

Recommended thickness based on the above shall be stated by the Tenderer. Heat losses and thermal conductivities of the proposed material shall be given by the Tenderer so that the merits of insulating material can be assessed. Surface temperatures of insulation shall not exceed 40ºC.

Mineral wool shall be at least 224kg/m^3 density and fibreglass 95kg/m^3.

Mineral fibre insulation shall not contain more than 3% by mass of phenolic resin binder.

NOTE : Preformed fibreglass sections are preferred.

2. These preformed units shall be suitable for application to hot surfaces and the sectional insulation shall be strapped in position with 10mm wide galvanised sheet metal bands and prior to applying sheet metal cladding, where sheet metal cladding is required.

3. Where specified in the detailed specification, flanged joints, valves, reducing valves, strainers etc. shall be separately covered by preformed insulation flange boxes "muff covers" held in position by removable metal bands and finished similarly to the lagging on the length of pipe.

   Where valves etc. are not insulated, the adjacent insulation shall have it's ends properly sealed and weatherproofed as applicable.

   The insulation boxes shall be capable of removal without damage to any other portion of the insulation.

4. Generally all steam pipes exposed to the weather or where the insulation is likely to be

damaged or where visible inside buildings and plantrooms, are to be provided with a covering of 0,8mm galvanised sheet metal over the insulation and adequately secured by means of 10mm wide stainless steel metal bands at intervals of not more than 500mm. Bands shall be capable of easy removal and painted as specified.

The sheet metal covering shall be applied with the longitudinal overlap joints in a continuous straight line and automatically water shedding. Butt overlapping shall be at least 40mm.

Piping not sheet metal covered, may be insulated with plain preformed sections strapped as above for the cladding. 200mm wide preformed cladding shall however be applied at intervals of approximately 15 metres generally and both sides of wall penetrations, etc. to enable direction of flow arrows and colour coding to be applied.

5. Pipes exposed to the weather shall be insulated and clad in such a manner that no moisture or rainwater may penetrate the insulation.

   Support bracket hangers, etc. shall be external to the insulation and cladding and no cutouts will be permitted.

6. Condensate pipes shall not be lagged.

7. All insulation to be of the same manufacture.

8. Where preformed insulation sections for bends are not available, bends are to be insulated with plastered hard setting moulded plastic fibrous lagging strengthened with galvanised wire netting and trowelled to a smooth finish of the same diameter as the sheet metal covering. The insulation shall be finished with 4 coats silicated soda and then neatly bound with black scotch tape and painted as specified. Weather-tight sheet steel lobster back-insulated bends may also be tendered.

4.12.2 Boiler and vessel insulation

1. Boilers, calorifiers and hot water vessels shall be insulated with insulating mattresses and covered with cladding of galvanised or stainless sheet steel (as specified).

   The mattresses shall be made up in sections to suit the area to be covered. They shall be cut accurately to ensure even coverage. Loose infill pieces will not be acceptable.

2. Each boiler or vessel shall be insulated with 50mm thick insulation with density not less than 120kg/m^3. Insulation must be neatly fixed to the vessel shell and held in position with galvanised steel straps or wiremesh. Insulation shall be clad with 0,6mm thick stainless steel 430 sheeting with at least 40mm overlapping for boilers and 0,8mm thick galvanised steel for other vessels. The insulation and cladding shall be fixed in a workmanlike manner and any sign of irregularity in or damage to the surface will cause same to be rejected and to be replaced at Contractor's expense. No pop riveting will be allowed.

   Exposed hot surfaces of ducting, grit collector and stack inside the boiler house shall be similarly insulated with 40mm thick insulation protected with 0,8mm galvanised sheet metal cladding.

   The sheet steel covering shall be neatly formed to the shape of the area to be covered. All inspection openings or places where fittings protrude from boilers and vessels, shall be fitted with neat surrounds and beading to completely cover the mattresses.

3. All joints in the sheet steel cover shall be fitted with steel bands of the same material. The bands shall be at least 50mm wide and fixed to the cover plates by means of self-tapping screws to allow easy removal of any plate.

4. All rivet seams on boilers etc., are applicable, shall be separately lagged to facilitate inspections.

5. On externally mounted vessels, the seams of all sheet steel covers shall be rendered watertight with an approved sealant.

4.13.0 CONDENSATE PIPEWORK

4.13.1 Straight Tubing

Condensate tubing shall be copper tubing to SABS 460 : 1085 as amended. Copper shall be drawn, annealed and pickled and suitable for capillary connections and supplied in straight lengths. The tubing shall be suitable for a working pressure of 1000kPa. The tubing shall be free from defects, faults, grease etc. and shall be to the sizes indicated on the drawings.

In general tubing shall be Class 2 medium or as specified in the Supplementary Specification.

4.13.2 Fittings

All fittings such as couplings, elbows, laterals, adapters, unions etc. shall be manufactured from cast gunmetal, bronze or copper, all in accordance with BS 864. All joints shall be silver soldered capillary joints throughout. Connections to equipment shall be of the flare type of connection to permit dismantling.

Brass fittings will not be accepted.

4.13.3 Supports

All supports and hangers shall be of approved manufacture. Care shall be taken that the tubing and the material do not form a galvanic element. Supports and hangers shall be lined with non-abrasive and heat-resistant material such as plastic or fibre liners.

4.13.4 Valves

All valves on condensate lines and after steam traps shall be bronze gate valves with a working pressure rating of 1000kPa and suitable for a working temperature of 100ºC. The valve spindle packing shall be so arranged that it can be repacked while the plant is in operation.

4.13.5 Running of Piping

Pipe runs shall be as indicated on the drawings.

Gravity condensate lines shall be laid to a fall of a minimum of 1:200 towards the discharge end.

Pumped condensate lines shall have a minimum fall of 1:400 towards drain points.

Automatic air vents shall be installed at high points as required or as indicated on the drawings.

The open ends of tubing shall be protected during erection to prevent the ingress of dirt and foreign matter.

Ample unions and couplings shall be provided to enable pipework to be easily dismantled and equipment removed for maintenance and repair.

All valves and other equipment shall be mounted in accessible positions.

Sufficient offsets or expansion loops shall be provided to cater for the natural expansion and

contraction of the pipework.

Where condensate pipes pass through walls or floors, suitable sleeves as for steam piping shall be provided.

Condensate lines supported off steam mains shall be installed with due regard to cold draw requirements for steam lines and relative expansion/construction that will occur between the two lines.

4.14.0 CONDENSATE TANKS

Condensate tanks shall be supplied as indicated on the drawings and shall be either round or square with the capacity indicated.

Condensate tanks shall be manufactured from not less than 3,5mm stainless steel 3CR12 or 6mm mild steel plate as specified in the Supplementary Specification and shall be of welded construction.

The tanks shall be supplied complete with overflow, drain, float type level control, heater, suction connection for the condensate pump, manhole, vent and supports. All pipe connections shall be provided with stub flanges.

4.15.0 CALORIFIERS

4.15.1 Calorifiers shall be of the type and capacity specified in the Supplementary Specification.

Steam calorifiers shall be similar or equal to those of the mild steel type manufactured by Royles, with capacities and ratings as indicated on the drawings. All water spaces and exterior mild steel shall be hot dip galvanised or corrosion protected as specified.

4.15.2 Calorifiers for central heating applications shall be of the vertical non-storage type.

4.15.3 Calorifiers for hot water applications shall be vertical non-storage type or horizontal or vertical storage type as indicated in the Supplementary Specification.

4.15.4 All calorifiers shall be of approved make and shall comply in all respects with BS 853, 1960 mild steel type.

4.15.5 The heating surface shall consist of a number of indented copper tubes arranged in battery form. The battery as a whole shall be withdrawable and individual tubes replaceable.

4.15.6 Calorifiers shall be suitable for the steam and water pressures of the individual installations.

4.15.7 Vertical calorifiers shall be mounted on cast iron or fabricated steel supports and horizontal calorifiers on two or three cast iron or fabricated steel cradles.

4.15.8 Calorifiers shall have the capacities at the conditions specified in the Supplementary Specification.

4.15.9 The calorifiers shall have steam spaces tested to 1700kPa gauge and water spaces tested to 800kPa gauge minimum or twice the working pressure on site, if higher, as applicable.

4.15.10 The thermostats shall be of the Horne's type. The "Bowstring" type will not be accepted. This valve shall be protected by a steam strainer upstream of the valve.

4.15.11 A steam gauge with a 100mm diameter dial shall be fitted complete with siphon tube to the steam space.

4.15.12 The copper tube battery shall be tin coated.

4.15.13 A relief valve shall be fitted on top of the water space and set to cut out at 70kPa above working water pressure. This relief valve shall be at least the size of the steam supply line feeding the calorifiers.

4.15.14 The calorifiers shall be provided with a 100mm diameter dial thermometer, fixed to the main water flow outlet. The necessary flow, return, cold water outlets and drain valves must be provided. Connections to these valves from the calorifier body shall be of the flanged or screw type as applicable.

4.15.15 Calorifiers shall be insulated and clad as specified herein for boilers and vessels.

Nameplate, calorifier inspection test plate, etc. must be unlagged with metal beading framing these areas.

4.15.16 Calorifiers shall be mounted by means of a cradle fixed to the calorifier, so that the lowest point of the calorifier is not less than 300mm above the bottom of the cradle and then mounted on a concrete plinth not less than 75mm thick.

4.15.17 A brass plate shall be fixed to the calorifier in accordance with the MOSH Act indicating the test pressures.

4.15.18 The steam battery shall be easily removable as a whole for cleaning or inspection purposes. The access to the heater battery shall be ample and must not interfere with adjacent pipe work.

4.15.19 Unless otherwise specified in the Supplementary Specification all calorifiers shall be internally corrosion protected with flanged replaceable magnesium anode rods.

4.16.0 HOT WATER STORAGE CYLINDERS

4.16.1 Where specified in the Supplementary Specification hot water cylinders of the sizes indicated shall be provided. The hot water cylinder shall be constructed of mild steel plate or copper with dished ends.

Vertical cylinders shall have the top convex and the bottom concave.

4.16.2 The capacity of cylinders shall be as specified in the Supplementary Specification. Cylinders of more than 180 litres capacity shall have a manhole of suitable dimensions fitted with external stiffening ring 13mm thick with internal door secured by two bridges and bolts. Cylinders up to 180-litre capacity shall be provided with suitable hand holes for cleaning. The jointing rings shall be three-ply rubber insertion or other approved material.

4.16.3 The cylinders shall be insulated and clad in accordance with this specification for boilers and vessels.

4.16.4 Unless otherwise specified cylinders shall be manufactured as pressure vessels in accordance with the MOSH Act.

4.16.5 Mild steel cylinders shall be hot dip galvanised or internally corrosion protected as specified.

4.17.0 ELECTRODE BOILERS

4.17.1 Electrode boilers shall be of the capacity and pressure rating as specified in the Supplementary Specification and installed as indicated on the drawings.

4.17.2 The boilers shall be of compact size and design and shall comply with the Machinery and Occupational Safety Act.

4.17.3 Each boiler shall be complete with all necessary fittings, electrical control equipment, feed pump and feed water/ condensate tank and shall require only a steam, drain, power, water connection.

4.17.4 Each boiler shall be fitted with a properly shielded gauge glass with blowdown cock and inspectors pressure gauge test cock.

4.17.5 Boilers shall operate fully automatically and independent of other boilers and shall be provided with stepless modulating load control to maintain steam pressure with the absolute minimum of fluctuations.

4.17.6 Boiler controls shall be designed to enable capacity to be adjustable and limited between 40 - 100% of full load amperage. The initial setting will be determined on site.

4.17.7 Automatic conductivity control with motorised blowdown valves shall automatically adjust blowdown in proportion to steam generated to maintain boiler water conductivity within limits.

4.17.8 A solenoid valve shall automatically discharge all the water from the boiler shell in the event of a power failure.

4.17.9 Boilers shall be fitted with electric earth leakage protection and a high-level protection probe.

In addition over-current control shall be fitted as standard protection.

4.17.10 Only boilers of proven manufacture shall be considered.

The fittings shall include all necessary safety features such as, pressure release valves, solid state pressure control switch and solid state electrical and water level control.

A valved manual blowdown connection shall also be fitted.

4.17.11 One spare electrode set shall be supplied with the installation.

4.17.12 The boiler complete with it's control panel, feed water tank, feed pump and interconnecting pipework shall be a factory built and tested packaged unit, ready for delivery to site and hooking up.

4.17.13 The boiler shall be welded steel construction suitable for 1000kPa working pressure to BS 1894 and hydraulically tested to 2200kPa.

4.17.14 The electrodes shall be cast from close grained iron alloy and supported from the top plate with porcelain insulators.

4.17.15 The control panel shall be designed and built to the fault level specified in the Supplementary Specification and shall be complete with main isolator switch, ammeter, indicating lamps, controls, protection circuits etc. Front access with top cable entry is required.

4.17.16 All distribution boards with a symmetrical fault level of 20kA or higher shall be either subjected to a fault withstand test by an approved Authority, or shall be built to a tested and proven design. In both cases the Contractor may be required to submit copies of test results and the relevant drawings. Tests relating to main busbars only are not acceptable, but shall included all busbars, cabling and wiring from the main incoming terminals to the input side of all supply switches, fuse gear and other apparatus.

In case of small wiring direct from busbars, e.g. voltmeter supply, suitable protection fuses shall be mounted direct onto the busbars.

The possibility of inadvertent contact with live terminals shall be avoided at all cost. All apparatus and wiring behind readily accessible hinged doors of panels shall be protected against finger contact by means of insulating panels (Perspex or similar approved material) or other approved method. Busbar

mounted voltmeter fuses shall be mounted on insulated back plates to afford complete safety from hand contact with busbars or other conductors in the immediate vicinity.

4.17.17 Automatic water softening and chemical dosing of the boiler feedwater is required to the boiler manufacturer's specification, for each boiler separately and independently.

It shall comprise a base exchange softener as specified herein, a polythene dosing tank, tank and pump base, tank lid, metering pump with capacity range variable to match possible tank concentrations for the required chemicals. Dosing shall be in to the feed pump suction main and the dosing pump shall be suitable for use with corrosive chemicals.

Dosing shall act as an anti-corrosion oxygen scavenging media and proprietary chemicals shall be used.

The dosing pumps shall be electrically interlocked with the boiler to ensure that it stops and starts with the feed pump so that dosing only takes place when a feed pump is in operation.

The dosing unit shall be complete with all necessary piping, valves, electrical protection etc., and is shall be possible to service all parts and components with the boilers in normal operation.

The chemicals tendered for use shall be the manufacturer's standard formulation for this type of application and shall be freely available in standard concentration and containers.

4.17.18 The following items of equipment shall be inter-connected by means of a correctly sized copper earth conductor suitably lugged at neither end, neatly supported or laced along the entire length of the conductor to achieve a neat appearance;

a) Transformer to substation on earth bar (by others)

b) Substation earth bar to Boiler DB (by others)

c) Boiler DB to each boiler separately

d) Boiler DB to any additional racking or cable supports supplied under the steam contract.

4.18.0 WATER FLOW METERS

4.18.1 Water flow meters shall be provided where specified in the Supplementary Specification.

4.18.2 The water meters shall be of the helical type, having a flanged, cast iron body and working parts of bronze or other non-corrodible alloy.

4.18.3 The dial shall have a pointer moving over a scale graduated to 500 litres in 1 litre divisions. The remainder of the register to be of the cyclometer type, reading up to six figures.

4.19.0 STEAM HEATED BASEBOARD HEATING UNITS

4.19.1 Baseboard heaters shall be provided and installed as indicated in the Supplementary Specification.

4.19.2 The tube shall be 25mm diameter steam pipe, conforming to SABS 62/1971 or BS 1387. The fins shall be of 0,560mm mild steel, spirally wound around the above tube, mechanically bonded, and hot dipped galvanised after construction.

4.19.3 No joints will be allowed in the finned sections.

4.19.4 The minimum outside diameter of the finned portion of the tube shall be 60mm diameter or 60mm x

60mm square with ± 160mm fins per metre of tube length.

4.19.5 The baseboard enclosure shall be constructed of 1,6mm thick powder coated mild steel with rounded corners, approximately 150mm high and 80mm wide. The housing shall be constructed in one piece for extra rigidity.

4.19.6 A closed cell rubber sealing strip shall be formed to the back of the top of the enclosure extending over the full length of the baseboard enclosure so as to form an airtight seal between the finished wall and the unit.

4.19.7 The front of the enclosure shall be provided with slots equally spaced to provide an adequate flow of hot air through the unit.

4.19.8 The heater shall be mounted at least 80mm above the finished floor level so as to provide sufficient air inlet space and cleaning space.

4.19.9 Dampers, where used, shall be made of 0,71mm thick galvanised mild steel, installed where required and located above the spiral tube to control complete or partial restriction of the outlet area.

Dampers shall be controlled by means of insulated handles, placed on each damper, thus allowing individual control.

4.20.0 <u>STEAM HEATED FAN CONVECTORS</u>

4.20.1 The fan convectors shall be suitable for operation with the steam supply specified for the application.

All coils and fittings shall be pressure tested to twice the maximum working pressure plus 350kPa.

4.20.2 The casings shall be attractively finished and of heavy gauge sheet steel construction. The casings shall be stove enamelled to a high gloss finish.

Louvred openings shall be stamped from heavy gauge sheet steel. The grilles shall be neatly and firmly mounted so as to prevent unsightly seams or openings and eliminate any vibration or noise.

4.20.3 The depth of the cabinets shall not exceed 350mm.

4.20.4 The type required will be either

a) wall mounted;
b) ceiling mounted; or
c) recessed type

as specified in the Supplementary Specification.

4.20.5 The air inlet and discharge shall be as indicated on the main drawings.

4.20.6 Mounting against concrete ceilings or brick or plastered walls shall be by means of suitable raw bolts or other approved method.

Mounting beneath a suspended ceiling shall be by means of hanger bolting to tie beams or to additional angle iron supports in the roof space above ceiling level and between the tie-beams.

Provision shall be made in the cabinet structure for piping and electrical conduit connections. The positions of these points are to be determined according to site conditions.

4.20.7 The fans shall be of the centrifugal type and driven by totally enclosed motors. The fan and motor bearings shall be lubricated and sealed for life. Fans and motors shall be mounted on anti-vibration

pads.

The fans and motors shall be easily accessible and be of the replaceable assembly type.

4.20.8 The noise rating of the whole unit may not exceed 50dbA and unit shall be suitably sound insulated.

4.20.9 Motors shall be suitably protected against thermal overloading and shall be suitable for working conditions of high temperature.

4.20.10 Automatic control gear such as thermostatic on-off control and speed control shall be provided as specified in the Supplementary Specification.

It shall be possible to operate the fan without heating at either low, normal or high speed according to option.

4.20.11 A washable, rigid, removable filter shall be provided.

4.20.12 The convectors shall have single row finned coils. The coil tubes shall be made of solid drawn copper and the design shall be such that there is free and unrestricted expansion of each tube. The fins shall be of non-ferrous metal (Copper or aluminium), and shall be mechanically attached to the tubes to give maximum heat conduction.

4.20.13 Basic fan and coil capacities shall be rated with an entering air temperature of 15ºC, a steam pressure of 350kPa gauge and the fan set at normal speed.

Relevant capacities are shown on the main drawings.

4.21.0 STEAM HEATED HOT WATER URNS

4.21.1 The urn shall consist of a single drum construction of stainless steel of not less than 0,9mm with a polished exterior.

4.21.2 The steam coil/coils shall be of seamless copper tubing, tin plated and it is required to operate on 350kPa gauge steam pressure with a hydraulic test pressure of 700kPa. The steam coil/coils shall be easily removable.

4.21.3 The urn shall be supplied complete with gauge glass (water level indicator), cold water feed valve, water draw-off valve, right angled steam supply valve, thermostatic steam trap and strainer and all necessary piping so that the urn can be readily be connected to the steam, condensate and water supplies.

4.21.4 Visible piping to the urn shall be seamless copper tubing, chrome plated and unlagged.

4.21.5 All steam fittings shall be made of copper or bronze and have chrome plated finishes. All valves shall have insulated handles labelled “steam”, “water”, etc.

4.21.6 The lids of the urns shall be of the same materials as the drum and shall be tight fitting with insulated handles.

4.21.7 Suitable wall mountings shall be supplied with the urns. These mountings may be of stainless steel or chrome-plated steel. The brackets shall support the urns approximately 50mm away from the wall over the sink. The brackets shall be supplied complete with all necessary accessories for fittings and installation and shall include stainless steel or chrome plated bolts complete with chrome-plated nuts.

4.21.8 Capacities of the urns required will be given on the main drawings.

4.22.0 FUEL OIL BURNERS

4.22.1 Boilers shall only be fitted with fuel oil burners where specified in the Supplementary Specification.

4.22.2 Burners shall be capable of burning all currently available fuel oils, from heavy fuel oil to light fuel oil such as diesoline, needing only minor adjustments to match the specific fuel requirement specified in the Supplementary Specification.

Burners of the rotary cup type are preferred.

4.22.3 Fully automatic modulating control over a wide range of turndown on all possible fuels shall be provided.

4.22.4 Combustion air shall be provided by centrifugal fan with integral damper control and proper air distribution throughout the burner operating range.

4.22.5 Heavy fuel oils needing assisted ignition shall be provided with either a LP gas or diesoline ignitor with integral ignition flame monitor.

The ignitor fuel shall be as specified in the Supplementary Specification.

4.22.6 Fuel oil flow shall be automatically controlled with metered modulating control in response to the boiler load demand.

4.22.7 All burners shall be equipped with an automatic ignition and main flame (as applicable) proving system.

4.22.8 Automatic sequencing, supervisory and modulating controls shall be housed in a robust steel cabinet and shall incorporate all necessary safety circuits, relay logic and programmable logic control based controls with electrical/ electronic modulating control.

4.22.9 Combustion emissions shall comply with Atmospheric Pollution Prevention Act with the fuel specified for the particular application.

4.22.10 Automatic controls shall incorporate safe light-up and shutdown sequence control with pre-purge, pre-ignition and lockout safety timed intervals.

Controls shall be configured fail-safe.

4.22.11 Fuel oil storage and piping shall be provided as set out in the Supplementary Specification.