3 GENERAL

3.1 INTRODUCTION

3.1.1 Scope

1 This section details the requirements for air conditioning, refrigeration and ventilation systems. It shall apply to all mechanical and electrical systems and equipment.

2 All regulations and requirements shall comply with the latest compulsory regulations or requirements issued by Qatar General Electricity & Water Corporation (KAHRAMAA).

3 If the technology or material or specification are not mentioned in this section, modifications are permitted and shall be subjected to approval as mentioned in the introduction of QCS (00-02)

4 The purpose of QCS is to provide as a general technical guide for acceptable construction work practices in the State of Qatar, considering this; any addition for technology, material, specification, standard that are not mentioned in this section or their modification, shall be subject to approval as stated in the introduction of QCS (00-02)

5 For voltages and frequencies, regulations and requirements of Kahramaa and relevant authorities should be taken into account.

6 Related Sections are as follows:

Section 1	General
Section 5	Concrete
Section 10	Instrumentation, Control and Automation
Section 16	Structural Metal Work
Section 17	Metal Work
Section 21	Electrical Installations

3.1.2 References

1 The following standards are referred to in this Part:

ASHRAE.....Standard 52.1 - 1992 Gravimetonic and Dust spot Procedures for testing air cleaning devices

ASHRAE..... 90.1 – 2013 for Design of Energy Saving

ASHRAE.....189.1 - 2014 for Design of High Performance Green Building

BS 1710.....Identification of building services pipework

BS 1724.....Bronze welding by gas

BS 2600.....Radiographic examination of fusion welded butt joints in steel

BS 2640.....Class II oxy–acetylene welding of carbon steel pipework for carrying fluids

BS 2910.....Radiographic examination of fusion welded circumferential butt joints in steel pipes

BS 2971.....Class II arc welding of carbon steel pipework for carrying fluids

BS 4515.....Process of welding steel pipelines on land and off-shore

3.1.3 Standard of Work

1 The Contractor shall install equipment, air conditioning ducts, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Engineer. Air conditioning ducts and pipes shall be installed parallel and perpendicular to the building planes. All piping and ductwork shall be concealed in chases, behind furring, or above ceiling, except in unfinished areas. All exposed systems shall be installed neatly and be grouped to present a neat appearance.

2 All gauges, thermometers, etc., shall be installed in such a way as to facilitate easy observance.

3 All equipment and apparatus, which requires maintenance, adjustment or eventual replacement, shall be installed making due allowance for access.

4 Control sensors shall be installed to guarantee proper sensing. Elements shall be shielded from direct radiation and shall avoid being placed behind obstructions.

5 All panels and boards, etc., shall be installed to remit easy operation.

6 The Contractor shall include in the work all the requirements of the manufacturer's as shown on their drawings.

7 The Contractor shall replace all work not performed to the satisfaction of the Engineer without extra cost and to the standard required by the Engineer. This applies to any item that is found to be defective in service during the maintenance period, or extended maintenance period as appropriate.

8 Where height dimensions are given, the installation shall be reasonably expected to be within 13 mm of actual position.

9 Items displaying a horizontal dimension or edge must be plumbed with a level and must be to the Engineer's satisfaction. Any apparent discrepancy between "level" electrical and mechanical items and adjacent items MUST be reported immediately to the Engineer.

10 All work shall be co-ordinated with other works so as not to obstruct equipment and apparatus which requires maintenance, adjustment or eventual replacement.

11 Manufacturers and subcontractors shall operate an ISO 9000 approved quality system or equivalent in house system. If requested, details of the quality system shall be submitted to the engineer.

12 Equipment shall conform to the requirements of the Project Documentation and reference standards.

13 All equipment furnished shall be new, and where feasible shall be a standard product of an experienced or approved manufacturer, and assembled from standard components readily available.

3.1.4 Data to be Supplied with Tender

1 Initial technical submissions are to accompany the bid including full technical details of every item of equipment proposed for the Project, with the appropriate figures and details highlighted in marker pen or similar in standard manufacturer's catalogues.

2 After final checking of sizing after award of contract, re-submission shall be made with any changes specifically noted.

3 Technical submissions shall be submitted for all equipment as specified in the Project Documentation.

4 In the even that the Engineer requires further information on any of the proposed items the Contractor shall arrange visits to similar units that he has installed. In an event, all equipment proposed for the Project shall be currently installed and working satisfactorily locally. The Contractor must be able to provide references of at least three satisfied Owners and Engineer with equipment of the particular size and model proposed.

3.1.5 Practical Completion Certificate

1 A Practical Completion Certificate for works included in this Section shall only be issued when the Engineer is satisfied that all the requirements of this Section have been met.

3.1.6 Air Conditioning Subcontractor

1 The air conditioning services subcontractor shall be responsible for co-ordination with other trades and services and shall provide all materials, labour and supervision, equipment, tools, appliances, services, etc. for the supply and installation of the following items or work:

(a) air conditioning and ventilation plant and equipment.

(b) insulated ductwork complete with air terminals, dampers, supports, etc.

(c) chilled water pipework complete with valves, fittings supports, etc.

(d) controls and control panels

(e) motor control centres and starter panels complete with cabling from the panels to the respective equipment. Power supply up to the panel shall be the responsibility of the electrical subcontractor

(f) insulated drain piping from each air handling unit fan coil unit to the nearest drain point. The drainage subcontractor shall be responsible for provision of a floor drain in each mechanical room location to be co-ordinated with air handling units (AHU).

2 The contractor shall also include all overheads at office and site, labour, sundries, plant, appliances and consumable both for the Works and for testing and commissioning, and during the maintenance period.

3 The air conditioning subcontractor shall be approved so as to meet all QGEWC regulations.

3.1.7 Design Data

1 Design parameters. Design, in general, shall be based on ASHRAE recommendation in addition to the following particular requirements:

2 Design Conditions

(a) external (Summer) : 46 ^{o}C Dry Bulb, 30 ^{o}C Wet Bulb

(b) Internal : 23 $\pm$ 1 ^{o}C Dry Bulb, 50 $\pm$ 5 % RH

3 Fresh air supply. One air change - minimum quantity as indicated on drawings.

4 Noise levels

In general, the following noise ratings shall not be exceeded for central A/C plants:

	DbA	NCLevel
General Office	40-45	35-40
Private Office	35	30
Meeting Rooms	35	30
Corridor	45	40
Library	35	30
Cafeteria	50	45
Auditorium	35	30
Mosque	35-40	30-35
Class Room	40	35
Manned Control rooms	40-45	35-40

5 Solar load. Solar loads shall be based on maximum instantaneous values in appropriate direction for consideration of the worst exposure calculations. They shall also be based on the worst cumulative block load when checked on any hourly basis from 10 AM to 6 PM over the period May to October, coincident with the maximum outside ambient as listed above. Values as listed in ASHRAE or CARRIER SYSTEM MANUAL for 20 º north will be acceptable.

6 Air Filtration

Based on ASHRAE 52.1 - 1992
Primary filters (flat panel) : 95 % Gravimetric
Secondary filters (bag) : 60 % Opacimetric

7 Chilled water to cooling coils

Chilled water inlet temperature : 7 ºC
Chilled water outlet temperature : 12 ºC
Maximum velocity of water through pipework : 2.43 m/s
Pipes to be sized for full flow rate of all cooling coils Maximum coil face velocity : 2.5 m/s

8 Air Distribution

Duct Velocity, supply : 5 m/s
Duct Velocity, return : 4 m/s
Duct Velocity, Kitchen exhaust : 10 m/s
Higher velocities are permissible in the ducts located in the shafts

9 Fire Philosophy. Smoke detectors shall be positioned in return air ductwork of Air Handling Units (AHU). A fire condition sensed by the smoke detectors shall shut off the relevant AHU through the fire annunciation panel. Smoke detectors installed within rooms shall be interlocked with the fan coil unit serving the respective room such that the fan coil unit will be shut off in a fire situation through the fire annunciation panel. Fire dampers shall be positioned in all ductwork crossing firewalls. Fire dampers shall be included in return and extract ductwork at each fire zone crossing. They shall be triggered from a fusible link connection sited in the damper.

Note: The above data that is mentioned in items 7 & 8 could vary subject to project specification.

3.1.8 Rating for Continuous Service and Local Ambient Condition

1 The design of the Plant shall be in accordance with the latest good engineering practice. All parts shall be of ample strength to withstand without failure or injury the maximum mechanical and electrical stresses to which they may be subjected in the course of operation of the plant.

2 The Works shall be designed to facilitate inspection, cleaning, and ease of maintenance and operation in which continuity of service and reliability is the primary consideration. The design shall incorporate every reasonable precaution and provision for the safety of all concerned in the operation and maintenance of the plant.

3 All plant and equipment shall be suitable for operation under the prevailing ambient conditions at site and all special requirements for thermal insulation, finish, painting and lubrication etc. shall be incorporated.

4 Except where otherwise stated, all equipment shall be constructed and sealed as to prevent damage by the ingress of wind blown sand and other matter. All equipment shall be suitable for operation over the ambient temperature range 0 °C to 55 °C.

5 Except where otherwise stated in the Project Documentation, the declared ratings for all equipment shall be for continuous operation in final service position for the following environmental criteria.

(a) maximum daily average ambient temperature of 50 °C

(b) relative humidity of 80 %

(c) altitude 20 m above sea level.

These criteria shall be achieved independently of any forced means of mechanical ventilation or air conditioning plant.

3.1.9 Quality of Materials and Equipment

1 All materials used on the Project shall be brand new and of high quality. Obtain approval of all manufacturers from the Engineer and Owner.

2 New is defined as newly manufactured, state of the art, tested and proven item of equipment. Items that have been held in stock for any extended period of time by either the manufacturer or the supplier will be rejected.

3.1.10 Cleaning

1 Each day as the work proceeds, and on completion, the Contractor shall clean up and remove from the premises all rubbish, surplus material, equipment, machinery, tools, scaffolds, and other items used in the performance of the work. The Contractor shall clean out dirt and debris and leave the buildings broom clean with no stains and in a condition acceptable to the Engineer.

2 Where electrical items form part of the visible finish in the rooms, the Contractor shall protect them from over-painting, etc. and shall give all items a final cleaning before handing over.

3.1.11 Accessibility

1 Each item of equipment shall be located so as to be accessible for maintenance or repair without removing adjacent structures, equipment, piping, ducts, or other ducts, or other materials. For large air handling units the Contractor shall ensure that these can be assembled on site from components taken into the area.

2 Clean outs shall be located to permit rodding of all drain lines. These shall be located wherever possible external to occupied areas, and to minimise spillage problems during rodding.

3.1.12 Cutting and Patching

1 The Contractor shall Inform all other Divisions in time concerning required openings. Obtain the approval of the Engineer before doing any cutting.

2 In existing work and in work already finished as part of this contract, all cutting and patching will be carried out at the expense of this Contractor. Where finishing work is involved, this will only be reinstated by the Contractor responsible for the original work. The Contractor shall obtain the approval of the Engineer before doing any cutting. Supporting members of any floor, wall or the building structure shall only be cut and in such a manner as approved by the Engineer. All reinstatement work must be done to the same standard as the original work.

3.1.13 Inserts, Sleeves, Escutcheons and Curbs.

1 The Contractor shall use only factory made, threaded or toggle type inserts as required for supports and anchors, properly sized for the load to be carried. The inserts shall be place only in portions of the main structure and not in any finishing material.

2 The Contractor shall use factory made expansion shields where inserts cannot be placed, but only where approved by the Engineer and for light weights.

3 The Contractor shall not use powder activated tools except with the written permission of the Engineer.

4 The Contractor shall supply and locate all inserts, holes anchor bolts, and sleeves in good time when walls, floors, and roof are erected.

5 The Contractor shall ensure that insulation is unbroken where pipe or duct is insulated. Size sleeves shall be sized to provide adequate clearance all around.

6 The following materials shall be used for pipe sleeves:

(a) through all interior walls above grade, standard weight galvanized steel pipes, machine cut, flush with finished structure. The Contractor shall check the room finishes schedules.

(b) through all exterior walls above grade, standard weight galvanized steel pipes machine cut, flush with finished structure inside and to suit flashing on outside

(c) through al exterior walls below grade and all other waterproof wall use extra heavy weight cast iron sleeves, machine cut. Refer to Section 14, Roofing, for further details.

(d) through all waterproof floors, janitor's closets, mechanical rooms kitchens, roofs, use extra heavy weight cast iron sleeves, machine cut. As an alternative, copper DWV sleeves up to and including 150 mm sleeve size and rolled 10 kg/m^2 copper sleeves for larger than 150 mm may be used. The sleeves shall be extended 100 mm above finished floor level upwards and cut flush with underside of floor. The Contractor shall make particular reference to flashing details through waterproof floors

(e) approved type plastic sleeves may be used as an alternative for standard weight galvanized sleeves in interior areas if approved in writing by the Engineer

(f) the Contractor shall provide 100 mm high, 100 mm wide watertight concrete curbs with 20 mm chamfered edges around all pipes passing though waterproof floors except where furred in. Concrete works shall be done in accordance with Section 5, Concrete.

7 The Contractor shall pack all sleeves between the insulated pipe and the sleeve or where uninsulated between the pipe and the sleeve with polyurethane insulation. Seal the annular space as follows:

(a) for all horizontal sleeves in exposed areas, the Contractor shall use a seal equal or better fire rated than the wall to be sealed

(b) for horizontal concealed sleeves through fire walls and through walls separating areas of different air pressure, use a permanently resilient silicone based sealing compound.

(c) for all vertical sleeves through roofs, janitor's closets, equipment rooms, use permanently resilient silicone based sealing compound, non-inflammable and waterproof.

8 The Contractor shall ensure that the seal is compatible with the floor and ceiling finishes. The room finishing schedules shall be checked for further details and clarified if necessary with the Engineer.

9 The following sleeving shall be used for ducts: The minimum thickness of duct material passing through a sleeve shall be 1.3 mm. For rectangular duct openings through walls and floors a removable hardwood box-out shall be provided of the required size, soft wood or plywood will not be acceptable. Through fire walls, build fire dampers into wall, or make detailed fixing in accordance with Engineer's instruction. Through floors where ducts are not furred in or enclosed in a duct shaft, provide 100 mm high and 100 mm wide watertight concrete curbs, with 25 mm chamfered edges all around. Extend sleeves where used flush to top of curb. Concrete works shall be done in accordance with Section 5, Concrete. Through floors where duct is enclosed in a duct shaft or furred in, provide the watertight curbs at the extreme top and bottom only. Cover exposed floor and wall pipe sleeves in finished areas with satin finish chrome or nickel plated solid brass or with satin finished stainless steel escutcheons with non-ferrous set screws. Split cast plates of the screw locking type may not be used. Do not use stamped steel friction type split plates. Through roofs, provide curbs and sleeves as shown on drawings and to suit flashing requirements.

10 After ducts are installed, the openings shall be packed and sealed as follows:-

(a) fibreglass insulation for packing except through curbed concrete floors where a fibre proof packing must be used

(b) fibre proof packing shall be sealed in openings through floors with permanently resilient silicone base non inflammable waterproof compound; duct supports shall be pressed firmly down into caulking before bolting it down to curb

(c) through all vertical walls, seal the fibreglass packing using permanently resilient silicone based sealant.

11 Duct sleeves and box-outs shall be braced to retain their position and shape during the pouring of concrete and other work.

12 Bracing for each duct at ever passage through structure shall be provided to prevent sagging.

13 Exposed duct sleeves and openings shall be covered in exposed areas. 100 mm long galvanized steel escutcheons shall be used in the form of a duct collar. Over curbs, the collar shall be extended 30 mm down the side of the curb, similar to counter flashing. The collar shall be fixed in place with Cadmium plated screws.

3.1.14 Access Panels and Doors

1 The Contractor shall install all concealed mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels or doors. Install systems and components to result in a minimum number of access panels. Indicate access panels on as-built drawings.

2 The Contractor shall prepare drawings showing the location and type of all access doors in co-ordination with other trades before proceeding with installation and hand these to the Engineer to obtain approval. On smaller Projects, the Contractor shall indicate on the ceiling plans access required at the discretion of the engineer.

3 All access doors shall be sized to provide adequate access commensurate with the type of structure and architectural finish. Should it be necessary for persons to enter, a minimum opening of 600 x 450 mm shall be provided.

4 Proper fire rating of access doors shall be ensured in fire separations.

5 Lay-in type ceiling tiles, if properly marked may serve as access panels.

6 The Contractor shall provide panels in glazed tile walls of 2.6 mm thick 304 alloy stainless steel, with no. 4 finish, with the recessed frame secured with stainless steel, countersunk, flush-headed screws.

7 Panels in plaster surfaces shall be provided with dish shaped door and welded metal lath, ready to take plaster. A plastic grommet shall be provided for door key access.

8 Details of other types of access doors shall be submitted to the Engineer for approval.

3.1.15 Flashing

1 The Contractor shall provide flashing to all mechanical and electrical parts passing through or built into a roof, outside wall, or waterproof floor.

2 49 kg/m^2 sheet lead flashing shall be provided for cast iron sleeves passing through roof. Factory manufactured flange plates shall be provided to flash PVC-U pipes passing through roofs.

3 7 kg/m^2 copper flashing shall be provided for copper sleeves passing through roof where copper sleeves are used for copper pipework

4 All flashing shall suit the roof angle and shall extend a minimum of 400 mm on all sides. The Contractor shall build the flashing into the roofing system to render a completely watertight connection.

5 Counter flashing shall be provided on all stacks, ducts, and pipes passing through roofs to fit over the flashing or curb.

6 Pipes through waterproof floors shall be flashed as per approved details.

7 Provide pipes and sleeves passing through outside walls with lead or copper flashings and as directed by the Engineer. All visual aspects of such sleeves to be approved by the Engineer. All sleeves shall be installed according to the relevant standard and shall be suitable for local ambient conditions.

8 The Contractor shall pay special attention to the waterproof conditions of basements and walls and floors that may exist. The Contractor shall ensure co-ordination at all times with the waterproofing trade to prevent damage to any water proofing seal. The Contractor shall provide piping sleeves passing through waterproof walls which shall be sealed to the satisfaction of the Engineer.

3.1.16 General Welding Requirements

1 All welding shall be generally in accordance with BS 4515. This will be modified where appropriate for other materials and may be relaxed or varied by order of the Engineer, provided that the Contractor has made a comprehensive request for an alternate.

2 Tack welds shall be performed by fully qualified welders and all tack welds shall be of a length equal to twice the pipe thickness and shall fully penetrate the pipe walls.

3 Where welding is carried out in the proximity of inflammable materials special precautions shall be taken to prevent risk of fire or other damage to the building fabric.

4 Where oxyacetylene cutting equipment or any welding plant is being used by an operative for any of part of the Works, then fire extinguishers shall be supplied and carried as part of the equipment. The operators of cutting and welding equipment shall be trained in the use of the fire extinguishers which they carry and all extinguishers shall be fully charged and ready for use. In all cases, extinguishers shall be positioned immediately adjacent to the position where cutting and welding is being carried out and shall be readily accessible for use in the event of an emergency.

5 All accommodation, benches, tools, welding plant, acetylene, oxygen or electricity, filler rods and electrodes, which are necessary for installations where welding is required, shall be provided as part of this Contract.

6 All welded pipe assemblies shall be constructed so that individual welded joints do not affect each other. The distance between the centres of adjacent welds shall be not less than twice the bore diameter of the pipe.

7 No welded joints shall be left partially completed. Any joints tacked in position must be promptly finished within the working day. The Engineer will reject all work not done in accordance with this instruction.

8 Where work is rejected, pipes must be machine cut at least 150 mm either side of rejected welds and proper weld preparation must be used on the shortened sector. Where shorter fill-in sections are required because of such rejection and re-working, then new full sized lengths must be supplied by the Contractor.

9 Where pipes with longitudinal seams are specified, pipes seams shall be arranged such that adjacent seams are opposed 45 º from each side of top dead centre and branches shall be made only with weldable fittings.

10 All filler metals that are coated shall be protected from excessive moisture changes. Filler materials or fluxes that show any sign of deterioration shall not be used. If instructed by the Engineer, samples of filler rods to be used shall be submitted for approval before any work is done on site. These may be submitted, at the Contractor's cost, to an independent testing laboratory for verification.

3.1.17 Testing for Welder Qualification

1 The purpose of the welder's qualification tests is to determine the ability of the welders to make sound and acceptable welds. Before any site welding on the contract is allowed, each proposed welder shall carry out the tests required in the presence of the Engineer.

2 A responsible person shall keep any weld test specimens that have been suitably marked and approved on site, so that they can be produced at any time, at the request of the Engineer.

3 All accommodation, benches, tools, welding plant, acetylene, oxygen, electricity, test pieces, filler rods, electrodes, facilities for cutting and grinding, polishing, bending and examining, which are necessary for welders qualification tests shall be provided by the Contractor. In the absence of any items for inspecting the welds, the Engineer may submit the finished samples to an independent laboratory for testing at the Contractor's expense.

4 Under no circumstances shall a welder be employed on the Works, either on or off the site, for welding operations other than those for which that welder is qualified.

5 Copies and records of all test reports shall be promptly given to and kept by the Engineer.

6 For tests for Qualification on Steel Pipes, each test shall be carried out in accordance with the test procedures laid down in BS 2640 and BS 2971. The test position shall be similar to the working conditions expected to be encountered and test pieces shall not be rotated to suit any individual welding procedures. Each test sample shall be subjected to the following examinations and test.

(a) Pipes up to 100 mm diameter shall undergo visual examination and normal tongue bend test and X-ray test

(b) Pipes over 100 mm diameter shall undergo visual examination and 2 normal tongue bend tests and two reverse bend tests and X-ray tests.

7 The Engineer may at his discretion require macro-etch examination in the event of any doubt. For a successful test, the weld shall conform in all respect to the requirements of the relevant British Standard. Each welder who qualifies shall be issued with a metal punch with an identifying number and shall stamp adjacent to each weld. If any test sample does not reach the required standard, two further welds shall be made and tested as detailed. Both of the re-tests shall be successful for the welder to qualify for the work.

8 For testing for Qualification on Copper Pipes, each test shall be carried out in accordance with the test procedures laid down in BS 1724. The test position shall be similar to the working conditions expected to be encountered and test pieces shall not be rotated to suit any individual welding procedure. Each test sample shall be subjected to the following tests and examinations.

(a) visual

(b) flattening test

(c) micro examination

For a successful test, the weld shall conform in all respects to the requirements laid down in BS 4515. Other conditions are similar to the above for steel pipes.

3.1.18 Testing of Welded Pipework Installation

1 Testing of welded pipework installations shall be by either destructive or non destructive test methods as detailed in the following schedules.

2 All services 75 mm and below shall have two joints per floor for destructive testing. All services above 75 mm shall have two joints per floors for non-destructive testing. If a weld fails the testing requirements, then two additional welds made by the same operative shall be tested, at no additional cost. If both additional welds are successful, then in the case of destructive testing, the cost of making good shall be at no additional cost. If either of the two additional welds fail the test requirements, then further tests on other or all of the welds made by that operative shall be carried out, at the Engineer's discretion. All costs resulting from either of the two additional welds failing the test requirements shall be at no cost to the Contract. If either of the two additional welds fail, then the operative concerned shall not make any further welds on any service unless approved by the Engineer.

3 The detailed requirements concerning testing shall be as follows:

(a) destructive testing. Destructive testing and examination shall be exactly as detailed under Tests for Welder Qualification

(b) non-destructive testing shall consist of radiographic inspection to comply with BS 2600 and BS 2910. Non-destructive testing shall be carried out by a specialist company approved by the Engineer

(c) the specialist company shall provide a report on the radiographic tests which have been made, including an interpretative results section. The report and films shall be handed to the Engineer

(d) the material of the image quality indicator shall be radiographically similar to that of the filler metal under examination

(e) the use of x-ray and gamma radiation sources shall be in strict accordance with the requirements of the Ionising Radiation (Sealed Sources) Regulations.

(f) the required radiographic sensitivity shall not be more than two, and the required image details shall be readily seen on each radiograph

(g) radiographs which do not comply with this requirement, whatever the cause, shall be unacceptable and the weld in question shall be re-examined at no cost to the Contract. All interested parties shall be advised well in advance where and when radiographic tests are to be conducted, in order that appropriate precautions may be taken

(h) macro-examinations. When the Engineer requires macro examinations, these shall be carried out by a specialist company who shall present etched section photographs and a report on the tests to the Engineer. All costs for these tests are to be borne by the Contractor.

3.1.19 Painting, Tags, Name Plate Identification and Colour Coding

1 All painting of plant, equipment, storage vessels, and the like, and all surfaces to be painted in the areas where such items are installed, including generator areas, condenser areas, etc. shall be carried out by an approved specialist painting contractor.

2 Painting shall be applied to all pipework and associated pipework components, valves, fittings, etc. equipment, supports of any kind, insulation, plain mild steel, copper, or cast iron surfaces. Where movement is required between adjacent surfaces, the Contractor shall request clarification from the Engineer.

3 The following items do not require site painting:

(a) Insulation having any of the following finishes:
  (i) aluminium foil
  (ii) metalwork
  (iii) polyisobutylene sheeting/bitumen coating
  (iv) vinyl-glass/resin-aluminium foil laminate

(b) equipment or plant or supports or frames delivered to site with any of the following finishes:
  (i) painted finish, other than printed only, provided that the finish is not damaged in any way
  (ii) stainless steel or plastic coated steel
  (iii) stoved enamel.

4 All surfaces to be painted shall be prepared by thoroughly cleaning and removing all rust, grease, oil, dirt and surface corrosion, using wire brush, emery paper and/or degreasing medium as required. The paint shall be applied in accordance with the manufacturer's instructions and the type of paint to be used shall be in accordance with the following:-

(a) ferrous surface, one coat of zinc chromate primer plus wash primer as necessary, followed by 2 undercoats, and one finishing coat.

(b) (non-ferrous surface, one coat of zinc chromate primer plus wash primers as necessary, followed by 2 undercoats, and one finishing coat.

Approved manufacturers shall supply all paint.

5 For factory applied finishes, repainting or refinishing of any surfaces damaged during shipping, erection or construction shall be done using only factory supplied materials.

6 After finished painting is completed, each piped and ducted service shall be identified, and identification and flow arrows located.

(a) behind each access door

(b) at each change of direction on all joining pipes and ducts

(c) at not more than 10 m in straight runs of exposed pipes and ducts, but on both sides of sleeves

(d) at not more than 10 m apart in straight runs of pipes and ducts behind removal enclosures such as lay-in ceiling but on both sides of sleeves

(e) above each floor or platform for vertical exposed pipes, preferably 1.5 m above floor or platform level.

7 PVC tape identifying bands will not be accepted.

8 Stencils and stencil paint shall be used on all piping and ductwork. letters a minimum of 30 mm high shall be Used. After completion of the Works, the Contractor shall provide to the Engineer usable stencils for each service.

9 Wherever insulation is to be painted, the paint used shall comply with all the fire resistance requirements for insulation finish, and shall be carried out by the insulation subcontractor. In all cases, the actual grade of paint to be used shall be suitable for the operating surface temperature and shall be approved by the maker for the application concerned. In certain cases, the grade of finishing coat may not require the application of undercoats in which case these may be omitted, provided that the Engineer's approval in writing is obtained beforehand. All insulated or un-insulated pipework in concealed positions shall be identified by means of 75 mm wide identification bands, painted neatly on and at right angles to the pipe axis at intervals not greater than 3 m. In addition to the name of the service and pipe diameter shall be stencilled on in a visible position with an arrow indicating the direction of flow. Flow and returns shall have the letter "F" or "R" added to the identifying name. The identifying band colours and the finishing colour of the services to be painted shall be in accordance with the colours and procedures given in BS 1710. Ductwork shall be identified in accordance with the procedures laid down in HVAC Code of Practice No. DW 144.

10 All equipment located in concealed positions shall have a nameplates secured to the item giving the following information.

Equipment reference number (as indicated on the record drawings).
System
Room/Area served
Duty/output information

11 The name plate shall be 100 x 100 mm approximately, of white plastic 3 mm thick with the above information engraved in black lettering and the plate shall be secured by screws, bolts, clips, etc. as appropriate to the item concerned. This plate is in addition to any name plate supplied by the manufacturer of the item giving detailed specification information for the equipment.

3.1.20 Contract Drawings

1 The drawings included in the Project Documentation are diagrammatic, and intended to convey the scope of work and indicate general arrangement and approximate locations of apparatus, fixtures, pipe and duct runs, etc. The drawings are not intended to indicate Architectural or Structural details, nor do they show any fabrication or installation details.

2 Do not scale drawings. Obtain accurate dimensions to structure and architectural items from drawings of those trades. Confirm by site measurement. The Contractor shall verify the location and elevation of all services (water, electrical, telephone, sanitary, storm drainage, gas, etc.) before proceeding with the work.

3 The Contractor shall install all ceiling mounted components (diffusers, grilles, detectors, light fixtures, emergency lights, fire detectors, loudspeakers, camera points, etc.) in accordance with the reflected ceiling drawings which are to be prepared by the Contractor and co-ordinated with all trades. These must be submitted for approval and be approved before any work commences on site.

4 Sufficient space shall be left clear to install all work to accommodate future materials and/or equipment as indicated and/or supplied by another trade. All pipe runs, conduit runs, cable trays etc. shall be installed to maintain maximum headroom and clearances, and to conserve space in shafts and ceiling spaces and under floors, and to provide adequate space for service and maintenance.

5 The exact location of outlets and fixtures shall be confirmed on the site, also the locations of outlets and fixtures provided by any other trade shall be confirmed.

3.1.21 Construction Drawings

1 The Contractor shall prepare drawings in conjunction with all trades concerned in the Works, showing sleeves and openings for all passages through the structure and all insert sizes and locations.

2 Composite construction drawings shall be prepared of piping and equipment in tunnels, shafts, mechanical equipment rooms and areas, and all other critical locations to avoid a conflict of trades that are fully dimensioned. The equipment drawings shall be based upon shop drawings and include but not necessarily limited to, all details pertaining to access, clean outs, tappings, sleeves, electrical connections, drains, location and elevation of pipes, ducts, conduits, etc. obtained from consultation with, and agreement of, all trades involved.

3 The Contractor shall prepare drawings of equipment bases, pump pits, anchors, inertia slabs, floor and roof curbs, wall openings, trenches, pertaining to mechanical work.

4 All drawings shall be prepared to scale and dimension. These shall be forwarded, after approval by the trades concerned to the Engineer for his records. Transparencies and printed copies shall be provide in the number specified in the Project Documentation, but in any case not less than four sets.

5 The Contractor shall bind one complete set of construction drawings showing “as built” conditions in each operating and maintenance instruction manual. The extent of these drawings will be indicated to the Contractor in advance by the Engineer.

3.1.22 Shop Drawings

1 The Contractor shall submit shop drawings and samples for materials and equipment as listed in this and in each subsequent section. Transparencies shall be provided wherever possible as well as printed copies in the number specified in the Project Documentation. The Engineer may retain the sample of each item at his discretion until the completion of the Works.

2 The Contractor shall submit to the Engineer a schedule of shop drawings after award of the Contract, in accordance with programme detailed in the Project Documentation. The schedule shall indicate the anticipated date when the drawings will be submitted for review. The Contractor shall be fully responsible for the timely submission of all drawings. An allowance of three weeks shall be made for the Engineer’s review period. At time of submission, the Contractor shall indicate any other constraints and associated cost implications resulting from the programme, etc. otherwise the Engineer will advise the Owner that cost and completion date will be unaffected.

3 The Engineer will only consider shop drawing bearing the stamp of the Contractor and all Subcontractors involved. The Contractor shall check the drawings for all pertinent information such as physical dimensions, make, performance, electrical characteristics, and shall use reference symbols or enumeration to correspond to the design drawings.

4 The Contractor shall assume responsibility for the accuracy of equipment dimensions related to space available, accessibility for maintenance and service and compliance with inspection authority codes. Shop Drawings shall indicate the shipping and working weights of all equipment.

5 The submission of samples will be subject to the same procedure as those of shop drawings. The materials for which samples are to be submitted shall include, but may not be limited to conduits and accessories, wiring accessories, distribution boards, cables and wires, fire alarm accessories, speakers, light fittings, sanitary fixtures and fittings, valves, Instruments, thermostats, Insulation and grilles and diffusers. One set of such samples shall be required to be brought to site and kept there after approval until substantial completion.

6 The Engineer shall mark the drawings “re-submit specified item”, “rejected”, “no exception taken”, or “make correction noted”. In the last case, all revisions will be clearly marked on the returned print and corrected prints may be issued for manufacture and construction. The Contractor shall make the revisions shown on the “make corrections as noted” prints onto the drawings as soon as practicable and forward copies to the Engineer for his records. This must be done within one month. Failure to re-submit in this time will cause the drawings to be treated as “revise and re-submit” and the contractor will be responsible for any delays so caused.

7 The Engineer is not responsible for any delays caused by the inadequacy of the Contractor’s drawings or his failure to obtain initial or subsequent approval. Any time taken by the Contractor to obtain approval after the originally scheduled date will be considered as a delay to the contract caused by the Contractor.

8 When drawings are marked “re-submit specified item”, the Contractor is to re-submit the item as originally specified or as may be determined to be equivalent by the Engineer. The Engineer is the sole arbiter of whether any item is satisfactory or equivalent.

9 When drawings are marked “rejected” a complete re-submission of the particular drawing is necessary, subject to the same conditions as outlined above.

10 The Engineer’s review shall not relieve the Contractor from responsibility for deviations from the Project Documentation, unless he has, in writing, called the Engineer’s attention to such deviations at the time of submission of drawings. The Engineer’s review shall be construed to apply to, and only to, general arrangements and shall not relieve the Contractor from the entire responsibility. Any approval by the Engineer shall be on the understanding that any item submitted shall be ordered with options and modifications to fully meet the requirements of the Project Documentation. Any fabrication, erection, setting out or other work done in advance of receipt of stamped drawings shall be done entirely at the Contractor’s risk and cost.

11 The Contractor shall furnish prints of the reviewed details to all other parties who may require them for proper co-ordination of their work, and furnish all information necessary for the work as a whole.

12 The Contractor shall obtain manufacturer’s installation directions to aid in the proper execution of the work. Two copies of such directions shall be submitted to the Engineer prior to installation, for use in inspecting the work.

13 One complete set of checked shop drawings shall be bound into each operating and maintenance manual.

3.1.23 Record Drawings

1 As the job progresses, the Contractor shall mark on one set of prints to accurately indicate the status of installed work. The white prints shall be available for inspection at the site at all times, and be presented for scrutiny at all progress meetings. All information shall be transferred onto the set of transparencies. One set of transparencies and five sets of white prints shall be submitted to the Engineer for onward transmission to the Owner.

2 The record drawings shall show the installed inverts of all services entering and leaving the building and the property. Underground services shall be dimensioned at key points of every run in relation to the structure and building. Record all elevations for underground services shall be recorded in relation to floor level of the building and give reference datums to Municipality benchmarks.

3 The exact locations of all services left for future work shall be indicated. All embedded work shall be shown and dimensioned in the structure.

3.1.24 Storage of Materials and Equipment

1 The Contractor shall protect all mechanical and electrical works from damage and shall keep all equipment dry and clean at all times.

2 All openings in equipment and materials shall be covered. all temporary openings in ducts and pipes with polyethylene sheets or caps shall be covered until the final connection is made. The quality of such cover must be determined with due regard to how long it may be until final connection.

3 The Contractor shall be responsible for and make good any damages caused directly or indirectly to any walls, floors, ceilings, woodwork, brickwork, finishes, services, roads, gardens etc.

3.1.25 Inspection of Material Prior to Installation

1 The following shall be inspected prior to Installation:

(a) pumps and fans shall be inspected to ensure there is no damage to the casings impellers or drives

(b) pipework and ductwork shall be checked for any obstructions or dirt

(c) valves dampers set shall be checked for damage and proper operation

(d) all material shall be inspected to ensure that it is an approved item.

3.1.26 Inspection, Testing and Adjusting

1 All the works provided as part of this Contract shall be inspected and commissioned in accordance with all relevant British Standards and to the entire satisfaction of the Engineer.

2 The electrical/mechanical subcontractor shall employ the services of a specialist testing and commissioning company approved by the Engineer. The specialist company should be regularly engaged in providing a testing and commissioning service and have been in continuous business for not less than seven (7) years. The company shall employ fully trained staff having not less than three (3) years dedicated experience. A senior experienced commissioning engineer with minimum dedicated experience of seven (7) years shall be responsible for supervising and directing the activities for the testing and commissioning team.

3 The Contractor shall carry out all tests specified any other tests required by the Engineer. Equipment shall be tested to the requirements of, and where necessary, in the presence of the manufacturer and the Engineer.

4 The Contractor shall provide all equipment, labour, instruments, loading devices, incidentals, and pay for all fuel, power and sundries required to carry out the tests.

5 All installations shall be inspected and tested in sections as the work proceeds and on completion as composite systems and it shall be noted that the Engineer or any of the other relevant Authorities may require to inspect or test any equipment during manufacture at the manufacturer's works. All necessary arrangements shall be made as part of this Contract. This will generally not apply to specified items unless specifically noted in the Project Documentation, but may be necessary for alternate equipment, should this be considered at all.

6 All tests shall be arranged in co-operation with the Engineer and all other concerned parties and shall be subject to at least five (5) days notice in writing of the time, location and nature of the test to be performed. Not test shall be considered valid unless the Engineer is present.

7 All necessary skilled and unskilled labour shall be provided for attendance during the tests (including pre-and post-test activities) and the test media shall be provided and subsequently disposed of except where specifically stated otherwise.

8 The testing and adjusting is the contractual responsibility of the Contractor but actual performance of the tests is expected to the sole responsibility of an approved subcontractor.

9 The Contractor shall have all testing and balancing performed only by persons who are thoroughly versed in this type of testing and balancing and with proven ability. Names, complete with experience records, and references shall be submitted for the approval of the Engineer.

10 Any defects occurring at any time during the test duration shall be made good and a complete re-test shall be carried out, at no additional cost to the Contract.

11 Where failure occurs during a test, inspection or commissioning procedure which results in damage to the building fabric and/or any services not provides as part of this Contract, or requires subsequent builder's work to be carried out, this work shall be performed to the entire satisfaction of the Engineer at no additional cost to the Contract.

12 All the test points shall be provided which are necessary to carry out the specified tests and commissioning procedures including facilities for measuring or monitoring temperature, pressure, pressure drop, volume flow, in-duct sound power or sound pressure, humidity, or other relevant conditions in both air side and water side systems. Such points shall be fitted with removable plugs, flanges, or other appropriate and approved devices.

13 Prepare test report forms for each test to be performed and submit these to the Engineer at least two weeks prior to the commencement of any tests.

14 Only after the system installation has been completed and the system has been put into continuous operation shall testing be carried out. The testing, adjusting, and balancing shall be performed when outside conditions are commensurate with the design conditions for the given system. Dummy loads shall be added to the system if outside conditions are less severe than the specified points.

15 The Contractor shall prepare a complete list of instruments for each test containing for each instrument.

(a) name of instrument manufacturer
(b) scale and full scale accuracy
(c) date of last calibration test
(d) name of last calibrating company.

16 All instruments and consumable, such as recording paper, necessary for conducing the tests shall be provided, including but not limited to the following:-

(a) electronic anemometer
(b) inclined tube manometer or micromanometer
(c) pitot tubes of various lengths
(d) digital thermometers
(e) weekly recording thermometers
(f) weekly recording relative humidity meter
(g) anemometer for diffusers, with collector
(h) ammeter, voltmeter, wattmeter
(i) power factor meter

(j) insulation tester

(k) earth loop impedance tester

(l) tachometer

17 Duplicate signed test certificates shall be provided after each test which will be countersigned by the attending Engineer. The test certificate shall give the following particulars:

(a) apparatus or section under test

(b) maker's number (if any)

(c) nature, duration and conditions of test

(d) result of test

No test shall be valid until the test certificate is provided.

18 Duplicate copies of test certificates carried out at manufacturer's works shall be forwarded to the Engineer for approval prior to despatch of the article to site.

19 No section of the Works shall be insulated or in any other way concealed prior to testing and inspection and subsequent concealment where applicable shall only take place following written authority from the Engineer.

3.1.27 Testing

1 All necessary facilities, measuring and recording instruments including test pumps and gauges for inspection, testing and commissioning requirements shall be provided and shall be checked or calibrated as necessary before use.

2 The Engineer reserves the right to call for a demonstration of the accuracy of any instruments provided.

3 All representatives present during inspection, testing and commissioning shall be fully conversant with the system concerned and the method of system and instrument operation.

4 Manufacturer's of specialist subcontractors' representatives shall attend where specifically indicated elsewhere in the Project Documentation or where necessary to ensure full service and co-operation is available to the Engineer to enable the Works to be tested and commissioned in accordance with the requirements of the Project Documentation.

5 All necessary precautions shall be taken to safeguard structures and existing equipment against damage during inspection, testing or commissioning. Any damage so caused shall be made good at no cost to the Contract.

6 All tests shall last for the minimum time period stated or longer if necessary to ensure all sections have been fully examined as required by the test.

3.1.28 Instructions for Operation and Routine Maintenance

1 The Contractor shall provide instruction to the Owner's staff on how to make minor adjustments, carry out necessary maintenance and how to operate each system.

2 For new equipment, the Contractor shall provide the Engineer with three copies of complete operating and maintenance instruction for equipment at the time of delivery of the equipment.

3 Equipment shall be rejected unless accompanies by instructions. Such documents must be received al least one month prior to the completion date of the relative section of the Works.

4 Instructions shall be bound in a suitable loose leaf booklet or binder, and shall include prints of the following drawings:

(a) list of all equipment installed

(b) general layout

(c) wiring diagram of control panels

(d) non-dimensional layout, showing location of all electrical devices

1 The contractor is to operate a draft for discussion with the Engineer prior to finalising the documents.

5 Portable tools and spare parts shall be correctly labelled and handed over to the Engineer.

6 The section dealing with complete systems shall be subdivided into each service with a ready means of reference and detailed index. The function and manner of operation of each system shall be clearly described together with illustrations and line diagrams in schematic form showing the location and function of control valves, items of equipment and spaces or areas which are service by these items. The colour coding and identification systems employed shall be explained.

3.1.29 Maintenance

1 Maintenance is defined as the Contractual Liability to maintain the equipment in working condition, plus the regular checks and servicing of equipment during the maintenance period to keep the equipment in best working order.

2 Regular maintenance shall be as necessary, but in any event not less frequently than monthly.

3 In the even that the Owner has his own staff, the Contractor is still to check monthly and advise on any problems and is still to assume responsibility. The Owner is to ensure that his staff do nothing to adversely affect the Contractual maintenance.

3.1.30 Warranty

1 All Warrantees for equipment suppliers will be vested in the Owner regardless of whether the Contractor who supplied the equipment is still associated with the Project or not.

2 Warranty will be full warranty and will include all overhead, profit, incidental charges and sundries.

3 Where damage is caused to any other item by any failure of the item warranted then the warranty shall also include the costs incurred in rectifying the damage.

END OF PART