

## **TECHNICAL SPECIFICATIONS**

### **PART 2 MECHANICAL ENGINEERING SERVICES**

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**CHAPTER ONE**  
**GENERAL TECHNICAL REQUIREMENTS**

## **1.0 GENERAL TECHNICAL REQUIREMENTS**

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## **CHAPTER ONE**

### **GENERAL TECHNICAL REQUIREMENTS**

#### **1. SCOPE, REGULATIONS AND STANDARDS**

##### **Specification Scope**

This Specification covers the supply, installation and testing of all necessary equipment required for the complete Mechanical and Ventilation Services as described in the attached Contract Documents and incorporates standard descriptions for equipment and the installation to be provided under this Contract. The clauses shall be read in conjunction with the accompanying General Conditions of Contract, Scope of Works document, Schedules and Drawings.

The words 'as indicated', 'where indicated', 'unless otherwise indicated', refer to requirements identified elsewhere in the documents issued in connection with the Contract, e.g. on a drawing, in the specification or in a schedule.

The extent of the work shall comprise the system engineering, the whole labour and materials required to form a complete installation, together with such tests, adjustments and commissioning as prescribed in subsequent clauses and otherwise as may be required in order to provide an effective working installation to the satisfaction of the Engineer.

The words 'complete installation' in the foregoing clause shall mean not only the major items of plant and equipment covered by this Specification, but all the incidental sundry components that are required for the complete execution of the works; also for the proper operation of the installation, together with associated labour charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the Contract.

The Contractor shall comply with the latest applicable Standards of the followings:

- 1) ASME , American Society of Mechanical Engineers.
- 2) ASHRAE, American Society of Heating , Refrigerating and Air Conditioning Engineers, Inc.
- 3) ANSI, American National Standards Institute.
- 4) CIBSE, Chartered Institute Of Building Services Engineers.
- 5) ASTM, American Society of Testing Materials.
- 6) AMCA, Air Moving and Conditioning Association.
- 7) NEMA, National Electrical Manufacturers Association.
- 8) NFPA, National Fire Protection Association.
- 9) BS, British Standards
- 10) ASPE, American Society of Plumbing Engineers.
- 11) DIN Deutsches Institut Für Normung
- 12) FM, Factory Mutual.
- 13) IBR, Institute of Boiler and Radiator Manufacturers
- 14) ISO, International Standardization Organization.

##### **Compliance with Regulations**

The work shall comply with all relevant stringent statutory instruments and regulations, applicable to local codes and regulations, at the date of construction and in particular with the following:-

The requirements of the Local Authority Planning Department, District Surveyor or equivalent.

The requirements of the Local Fire Officer.

The Local Water Authority Regulations.

All installations and materials used for the works shall be carried out and provided in full compliance with the appropriate Specifications or Codes of Practice issued by the above mentioned institutions.

Alternatively the installations and materials may be carried out and provided to other equivalent internationally recognized standards provided the standards are acceptable to the Engineer and the relevant local Authorities.

## **2. INSTALLATION GENERAL**

### **General**

The Contractor shall allow in his Tender for all labor, materials, tools, plant and equipment required to supply, deliver and erect all equipment, pipework, fittings, etc., described in this Specification and indicated on the drawings to form a complete working facility including tests and commissioning. This shall mean not only the main items of plant and equipment but also all incidental sundry components with their labor charges necessary for the complete execution of the works.

The Contractor shall ensure that his work is installed in the correct sequence.

The Contractor shall be responsible for ensuring that all sections of the work and all materials are compatible with one another. The Contractor shall check and ensure that all of the equipment and works offered by him will fit into the space provided in the building(s) including the limited entry through doorways and into ducts.

### **Operating Conditions**

All equipment will be required to operate successfully in the climatic conditions prevailing in the locality. Equipment, even if normally operating in air conditioned spaces, may be required to operate at times when the air conditioning system is not being used. Under such conditions all equipment must operate satisfactorily and still have a working life comparable with that expected from top quality equipment operating in more temperate conditions.

### **Workmanship and Materials**

Materials and workmanship generally shall be of the highest standard and the Specification shall be closely adhered to. Materials shall be brand new bearing stamped ratings as required.

Where materials or equipment are not described in detail they shall be of the best quality available and shall comply with the appropriate Standards. The Contractor shall, if required, submit drawings or samples of such materials or equipment to the Engineer for his approval before use on the Contract works.

### **Samples of Workmanship**

The Contractor shall provide the following samples of workmanship for the approval of the Engineer:-

#### Samples of pipework.

The samples shall be submitted to the Engineer as soon as possible after the order for the work has been placed so that the subsequent delivery of the associated equipment will not be delayed. No orders shall be placed until the Engineer has approved the samples.

All samples shall be correctly labelled and forwarded to the Engineer's office or to the site as directed by the Engineer. At least 14 days shall be allowed for approval of samples by the Engineer.

Unless otherwise stated, approved samples shall be retained on site by the Engineer, who will reject all such materials, which do not correspond with the approved samples. Rejected materials shall be removed from the site immediately.

Where the Engineer carries out an inspection of materials before they leave the manufacturer's premises prior to being delivered to the site, the Engineer shall be at liberty to reject any such materials after delivery should he consider them to be in any way unsatisfactory notwithstanding the preliminary inspection and tests at the manufacturer's premises.

The Contract shall include for the cost of remedial work or tests and inspections necessary due to unsatisfactory material and/or equipment.

### **3. NOISE AND VIBRATION CONTROL**

#### **Anti-Vibration Mountings**

All equipment containing moving parts generating noise and vibration shall be mounted upon specially designed vibration isolators. All service connections to such equipment shall include customised flexible connectors and shall be installed in such a way as to prevent transmission of noise and vibration to the structure, other areas of the building or to other items of equipment.

Where required, mountings shall be provided with a positioning or restraining device, which will prevent the equipment position changing if its load changes, for example, during draining down of the equipment, or other maintenance.

Mounting selection should allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under operating conditions.

### **4. INSPECTION, TESTING AND COMMISSIONING**

#### **General**

All the works provided as part of this contract shall be inspected, tested, regulated and commissioned in accordance with all relevant Standards, Specifications and Codes of Practice and the details given in the specification and/or as indicated on the drawings, to the entire satisfaction of the Engineer.

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 may require to inspect or test any equipment during manufacture at the manufacturers works. All necessary arrangements shall be made as part of this contract.

All tests shall be arranged in co-operation with the Engineer and the Engineer and other interested parties shall be given seven (7) days notice in writing of the time, location and nature of the test to be performed. No test shall be considered valid unless the Engineer is present.

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

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

Where failure during a test, inspection or commissioning process results in damage to the building fabric and/or any services or requires subsequent builders work in connection to be carried out, then the remedial work shall be carried out at no cost to the contract.

Where valve and flange boxes and access covers and de-mountable ceilings need to be removed and replaced during the commissioning of the works, these shall be removed, protected from damage and replaced in good order by the Contractor.

The Contractor shall arrange a progressive regulation testing and balancing programme to achieve the Date of Completion of the Contract Works.



During the Commissioning Period the Contractor will hold commissioning meetings, which will be attended by the Engineer. The Senior representative of the Contractor's site and Management staff shall attend the meetings which will be held at fortnightly intervals.

The meetings may continue after issue of the 'Taking Over Certificate' for as long as necessary to deal properly with any outstanding works and defects in the Contract Works.

All representatives present during inspection, testing and commissioning shall be fully conversant with the system concerned and the method of system and instrument operation. Manufacturers or specialist contractors representatives shall attend where specifically indicated elsewhere in the Specification 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 Specification.

All necessary precautions shall be taken to safeguard against frost damage during inspection, testing or commissioning. Any damage so caused shall be made good at no cost to the contract.

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

All performance tests shall be carried out initially prior to the Engineer being requested to witness the tests and thereby avoid unnecessary re-tests being required.

#### **Provision of Test Points:**

The Bills of Quantities do not separately enumerate test point in pipework and ductwork installations. These are deemed to be included in the pipework or ductwork installation. The Contractor shall allow sufficient points for the correct and complete regulation, testing, and commissioning of the installations. All test points shall be indicated on the Working and Record Drawings.

All test points shall be provided which are necessary to carry out the specified tests and commissioning requirements including facilities for temperature, pressure, pressure drop, volume flow, and other relevant conditions to be measured. Such points shall be fitted with removable plugs, flanges or other approved devices appropriate to the service concerned. Permanent test or reading points shall be provided only where specified elsewhere.

#### **Provision of Regulating Valves and Dampers:**

Balancing valves and dampers shall be included on every main, branch and sub circuit to facilitate system commissioning. All such devices shall be identified on the Working drawings and submitted for approval.

#### **Testing of Soil, Waste, Vent and Rainwater Pipework**

All works which are to be concealed shall be tested before being finally enclosed, a final test shall be made upon completion for soundness and performance strictly in accordance with the British Standard 5572 for Sanitary Pipework, or equivalent and shall be to the entire satisfaction of the Engineer.

#### **Cleaning and Flushing Out of System**

Prior to setting systems to work all systems shall be thoroughly cleaned and pipework systems shall be flushed out.

Water installations shall be flushed out using cold water at maximum mains pressure.

Steam and gas installations shall be thoroughly scavenged with steam or compressed air.

During the cleaning process the flow shall be interrupted occasionally to dislodge debris.

Tanks and vessels shall be similarly cleaned.

Water services for domestic use shall then be chemically cleaned by Chlorine treatment as described elsewhere, tested and set to work to comply fully with the UK Department of Health Code of Practice on the Control of Legionellae, and any other recognized recommendations to prevent the development of legionellae bacteria.

All cleaning and flushing out operations shall be conducted in the presence of the Engineer.

Following the cleaning and flushing out operations a signed certificate shall be provided confirming that the systems have been adequately and satisfactorily flushed through and cleaned. This certificate shall be countersigned by the Engineer and forwarded to the Engineer. No commissioning whatsoever shall take place until the Contractor has received written acknowledgement of receipt of this certificate from the Engineer.

## **Commissioning of Services**

All systems shall be filled with the working fluid, vented as necessary, and brought to operating conditions and the flows then regulated to the design values.

The balancing and testing of systems to verify performance of the engineering systems shall be carried out by a team of experienced specialist Balancing and Testing Engineers who shall be responsible to the Contractor for the complete balancing and testing of all systems and the production of a complete log of all tests including any comments they may wish to make for improving the performance of the installations.

Following regulation and balancing procedures all plant systems shall be put into operation and examined to ensure that the installations are operating correctly.

## **5. HANDOVER PROCEDURES AND DOCUMENTATION**

### **Operation and Maintenance Instruction Manuals**

Three copies of a manual, (or series of manuals if required by the extent of the installations) shall be provided 1 month prior to the anticipated completion date of the contract and shall contain complete operational and maintenance instructions for the various installations.

The purpose of the manuals is to:-

- (a) Familiarise maintenance staff with the overall philosophy of the project.
- (b) Describe the Mechanical and Public Health Services systems and their inter-relation with other systems.
- (c) Act as central point of reference and as such, to contain specific references to Record Drawings and Vendors/ Manufacturers literature to enable the reader to easily locate further information.
- (d) Give all the specific information and instructions including safety information, to enable an operator, of technician level, to manually start and run each system at Local Control Station and from any Central Monitoring Control Station included in the Contract. This shall also include procedures for start-up of systems after an emergency shutdown.
- (e) To give details of action to be taken by operators in event of fire, plant malfunction or alarm condition occurring.

- (f) Provide information and warnings necessary to ensure the health and safety of the general public together with operating and maintenance staff.

The manual(s) shall be agreed in draft form with the Engineer and shall be primarily sub-divided into (a) instructions relevant to items of plant or equipment and (b) instructions relevant to complete systems.

The plant and equipment section shall contain the manufacturers printed maintenance and operator's instructions relevant only to the particular item of equipment concerned. General catalogues will not be acceptable.

The section dealing with complete systems shall be sub-divided 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 illustration and line diagrams in schematic form showing the location and function of control valves, items of equipment and which spaces or areas are served by these items. The colour coding and identification systems employed shall be explained, and a full lubrication schedule for all lubricated items of plant and equipment shall be included.

Operation and Maintenance charts shall be included for each plantroom area and shall provide essential information and reference data for daily running checks together with weekly, monthly and annual maintenance procedures.

Where more than one system can be shown on a single chart without loss of clarity this will be acceptable. Complex systems must be shown on individual charts.

A special section shall be included in the manual for dealing with fault finding routines and emergency procedures in case of plant or system malfunction.

All equipment shall be scheduled in the document including a complete valve schedule with all items identified in accordance with the plant reference provided on the item of plant or equipment and the as-installed drawings.

A complete itemized list of essential and secondary spares together with the manufacturers ordering reference numbers shall be provided. A list of plant manufacturers names, addresses and telephone numbers shall also be included.

The Operation and Maintenance manual(s) shall include copies of all manufacturers works test certificates for plant items such as heat generating plant, heat exchangers, calorifiers, refrigeration machines, tanks, vessels, motors, fans, pumps, controls, electrical and other like equipment. In the case of fans and pumps copies of the manufacturers characteristic curves for the actual unit fitted shall be supplied.

### **Labels and Identification**

All valves controlling mains and sub-circuits shall be provided with a treffolyte label not less than 75mm x 50mm x 1.6mm thick with a reference number clearly engraved and coloured red. Labels shall be securely fixed to the valve body, handle or spindle in a position where they can be easily read.

The numbers on the valve labels shall refer to those on the "as installed" drawings and valve charts.

All items of plant, motor starters and isolators shall be labelled with their corresponding plant reference engraved on a treffolyte label securely fixed to the item in a prominent position. The plant reference shall correspond to that indicated on the "as installed" drawings and plant schedules in the operation and maintenance manuals.

In addition items of plant such as fans, pumps, calorifiers, etc. shall bear a metal label fixed by the manufacturer giving the makers name, date of manufacture and manufacturer's serial number, test and working pressures, duty, kW, phasing, hertz, speeds, BS number, etc. as appropriate to the item of plant such that its origins and details may be easily traced at a later date.

### **Schedule of Outstanding Items and Defects**

Until the installation is finally taken over as complete, the Contractor shall be responsible for any necessary protection of the installation and electrical safety requirements.

On the completion of the Contract an inspection of the installation will be made by the Engineer. During the inspection a schedule of outstanding items or defects will be provided by the Engineer.

All items included in this Schedule shall be attended to within fourteen days of the date of the inspection.

### **Certificate of Practical Completion**

When the Contractor has demonstrated to the Engineer and to the Engineer's complete satisfaction that the works are operating as intended within the design limits and tolerances of the manufactured items, then the Engineer will issue a Certificate of Practical Completion subject to the clearance of any outstanding items or defects within 14 days of the date of the Certificate and the responsibility for the operation of the plant will pass from the Contractor to the Employer or as otherwise agreed with the Engineer.

This Certificate will not be authorised until all items in this clause have been cleared to the Engineer's satisfaction.

### **Responsibility During Period of Maintenance**

The Contractor shall include for making checks of the Thermal Environment in the building when occupied and in use by the Client and for making normal adjustments to the commissioning and testing settings to tune the installations to the actual building usage.

The Contractor shall include for making checks of the water flow capacities on domestic water services in buildings when occupied and used by the Client and for making normal adjustments to the commissioning settings to tune the installation to the actual building usage.

### **Testing of Plant Capacity and Efficiency**

A heating test shall be carried out under maximum load and design conditions to check the actual plant capacity as supplied and installed. Where possible, thermal efficiency checks shall be made. These tests shall be carried out during the year following practical completion.

### **Adjustments During Course of Period of Maintenance**

The Contractor shall include for making a further visit to the site before the end of the Period of Maintenance to check over and, if necessary, re-adjust the system.

### **Certificate of Making Good Defects**

The Contractor shall carry out a thorough detailed examination of the installations between the eleventh and twelfth month of the defects liability period and shall put right any outstanding works or defects that might have occurred under the Defects Liability Period in the Conditions of Contract.

On completion of such works, and agreement that the requirements of the Conditions of Contract and Specification have been met, the Engineer will recommend to the Architect that a Certificate of Making Good Defects can be issued.

## **6. RE-MODELLING**

Contractor, at Contractor's expense, will be responsible for any items not included in bid, but are shown on plans or specified in the General Specifications or required by local codes and ordinances.

In order to do so the contractor shall inspect all the existing mechanical prior to pricing. All work to conform to all applicable codes. Contractor shall provide all necessary Mechanical works, maintenance, cleaning, relocation or removing, testing & commissioning for the existing Mechanical system to ensure properly working system. Work performed under this section shall result in complete and updated plumbing systems. All material, labor, equipment, and other items to complete the plumbing system as outlined in Bid Document shall be furnished.

All plumbing work, whether existing and to be kept, or new installation performed under this contract SHALL BE INSPECTED, tested, and approved by the Consultant.

Cutting, patching, and cleaning shall be done as necessary by the contractor performing the work; however, special permission shall be obtained from the Consultant before cutting structural members of finished construction.

The plumbing contractor shall clean away all debris caused by his work at the close of each work day, and upon completion of the job.

A salvaged plumbing fixture and upon approval by the Engineer, shall be handed to the Owner representative.

Upon removal of old fixtures, contractor shall inspect all cleats, supports, and floor joists to assure a solid and secure installation. If unforeseen repair or replacement is needed, contractor shall notify the Engineer.

The contractor shall further determine if a change in the location of any plumbing fixture and/or pipes is necessary for proper functional replacement of the unit, and to meet codes.

### **Repair All Existing Supply lines.**

Furnish and install all labor and materials necessary to repair all existing supply lines in and under structure. All work to conform to local plumbing code. Examine all supply lines in and under structure for proper operation. Replace all galvanized.

### **Repair All Existing Drain lines.**

Furnish and install all labor and materials necessary to restore all drain lines in and under structure to good condition (no leaks and fast positive drainage and venting) in accordance with the Code. Care to be taken to not damage any plumbing fixture or other pipes.

### **Reseat Toilet**

Remove toilet and old seating gasket. Clean area and reseat toilet with new wax seal. Make all connections and leave free of any leaks. Installation shall meet all local plumbing codes. If Contractor shall uncover a lead flange once toilet is removed, the Contractor shall notify the Engineer for a decision on whether the flange should be replaced.

### **Toilet**

Replace existing toilet with new first quality vitreous china toilet. Installation shall be complete with new toilet seat and all required plumbing connections. Plumbing equipment and materials and workmanship shall comply with local codes and as per the other sections of this Specification. Color and style of fixture to be selected as per the specification.

### **Replace Flush Mechanism**

Remove deteriorated flushing unit and install a suitable adaptable unit. All new seals to be installed with new unit. After replacement, unit shall function properly with moderate pressure and completely shut-off when optimum water level is reached.

### **Repair Faucet**

Repair existing defective faucet(s) as set forth in Bid Document. Restore to a watertight condition in accordance with code. Any replacement handles or equipment shall conform to original style as closely as possible. Contractor shall take all necessary precautions to prevent tool scarring or damage to fixture or other accessories. Work shall include replacement of all worn internal components. Final result shall be a faucet that operates easily with no leaks or drips.

### **Drains, Wastes, Vents, Traps**

Furnish and install all required drains, wastes, vents, and traps. Installation shall meet all local plumbing codes. Stack shall extend through roof and be made waterproof. Repair all scarring. When a new plumbing fixture is installed, or an existing fixture is relocated, all work shall conform to local plumbing code. Snake drain lines - where called for in the work write-up a professional contractor shall be used to snake the entire sewer system including all clean outs, roof vents and yard line to the street.

### **Kitchen Sink**

Furnish and install double well, stainless steel sink with sound dampening. Replace all waste to the wall including baskets strainers. Work shall include removal and reinstallation of all items not replaced in the Bid Document.



### **Vanity/Lavatory/Faucet Top**

Remove existing vanity and lavatory. Repair/replace wall surface as needed. Size shall be as specified. Include new supply and waste lines to wall. Unit shall be complete with vented drains, proper traps, cutoffs and washer less faucets.

### **Replace Existing Drain**

Furnish and install all labor and materials to replace existing drain. If existing drain is not vented, provisions shall be made to vent the replacement drain. Size and slope shall conform to the current plumbing code.

### **Replace Existing Supply Lines**

Furnish and install all labor and materials necessary to replace supply lines as indicated in the Bid Document. Piping with all necessary fittings, hangers, supports, and all accessories needed to run piping in a workmanlike manner in conformance with the plumbing code.

### **Sump Pump**

Furnish and install all labor and materials necessary to install sump pump as specified in Bid Document. Pit shall be located at lowest corner of basement. Materials included are sump pump pit, rigid outflow pipe, and electric hook-up. Drainage from sump pump shall not be connected to the sanitary sewer. All work shall conform to local codes in particular if the repair of the existing pumps is required.

### **Floor Drain Cover**

Furnish and install new floor drain cover on existing drain. Cover should fit snugly.

### **Demolition**

Where required, demolition shall be performed without damage to adjacent existing work. All existing fixtures, equipment and piping which have been removed or disconnected by the contractor shall become the property of this contractor and shall be removed from the site at his expense. All remaining lines that are not to be reused shall be deactivated and properly capped and plugged in basement or crawl space areas.

When concrete is removed in a basement floor for access to underground pipes, concrete shall be replaced.

**CHAPTER TWO**  
**BELOW GROUND DRAINAGE**

**2.0 BELOW GROUND DRAINAGE**

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## **CHAPTER TWO** **BELOW GROUND DRAINAGE**

### **1. GENERAL PREAMBLE**

#### **Description of Works**

The belowground drainage shall comprise a separate system of drainage as described herein.

Where drainage is located beneath the building ground floor slab the pipe work shall be suspended from the underside of the concrete slab, where located externally pipe work shall be below ground installed in trenches as described.

#### **Scope of Work**

The Contractor shall carry out all works described in these documents strictly in accordance with this Specification, relevant Standards and Codes of Practice and the requirements of the Local Authority.

Connect the foul drainage installation to the Local Authority Foul Sewer, at a point external to the site, as indicated on the site layout plan.

Connect the surface water drainage installation to discharge into the drainage system, if it exists, at a point external to the site, as indicated on the site layout plan.

Co-ordinate the works with the Local Authority in accordance with the building programme and ensure the least inconvenience to the site or surrounding areas.

Strictly adhere to the materials described within this Specification.

Do not commence the drainage works until all materials are delivered to site.

#### **Drainage Termination (Internal)**

The underground drainage installation shall in general terminate at Lowest Floor Slab Level.

Where drainage pipe work is indicated as passing through a structural retaining wall connecting to a suspended pipe work installation include the suspended pipe work to form part of the drainage works and terminate at the Floor Slab level immediately above the point of entry through the retaining wall.

#### **Drainage Termination (External)**

The drainage installation shall terminate at and include the connections to the Local Authority Sewer.

#### **Drainage By-Laws and Regulations**

The Contractor shall state which standards are to be used and submit a copy of the relevant International Standards to the Architect/ Engineer or his appointed representative at the commencement of the contract.

### **Notification for Inspection**

Give a minimum of 24 hours' written notice to the Architect/Engineer or his appointed representative for the purpose of inspection and measurement whenever sections of:-

- a) Setting out is completed;
- b) Excavations are completed;
- c) Concrete and/or granular beds are laid;
- d) Drainage installed ready for testing;
- e) Compaction/Backfill is to be carried out;
- f) Sewer connections are complete;
- g) Final testing/commissioning;
- h) Simultaneous discharge test.

No further work shall be carried out until each stage of the work has been inspected approved and signed off.

### **Existing Drain/Sewers/Manholes**

Check invert levels of all existing drains, sewers, or manholes before laying new drains, notify the Architect/Engineer or his appointed representative if the declared invert levels are found to be inaccurate.

Where it is necessary to cut into any live drain within the boundary of the site carry out the works causing the minimum disruption to the existing drainage system while the connection is being made.

Check existing drains crossing the area of the site operations, ensure they do not serve other buildings outside the site boundary and either remove and plug off at manholes, or divert clear of the works as directed by the Architect/Engineer or his appointed representative.

Check all drains to be abandoned and record the locations on drawings before filling is carried out. The Contractor shall indemnify the Employer against all risks connected with any existing pipe mains, drains, sewers and the safety thereof and for all damage caused to them through, or in consequence of, site operations during the construction of the works.

### **Local Water Authority Sewers**

Obtain written consent from the Local Authority before cutting into any Public Sewer.

Confirm to the Local Authority the requirements for the sewer connections, giving size, line, level, and location and establish a programme for the work to be carried out, make necessary arrangements for traffic diversions, road closure order, and any other requirements to comply with the programme.

### **Drainage, Water, Electric, Telephone Supply Authorities**

Give information regarding the line and level of these services and co-operate with the Local Authority, Water, Electricity and Telecommunications Authorities, or any other authorized firms to enable them to provide and lay mains, cables, sewer connections etc., along routes on or adjacent to the site without any undue delays or interruption.

No claim will be allowed for any delay or interference which may be occasioned by this work.

Ensure the various authorities or companies lay their mains in the given positions and/or make provision to enable them to do so at a later date without disturbing the structure of carriageways and/or paved areas, supply drawings showing the runs and positions of such mains to be included as part of the contract.

Ensure supply authorities, companies and/or their agents properly consolidate and reinstate all trenches and other excavations opened by them to ensure the safety of the persons passing adjacent to or within the area of site operations.

### **On-Site Drainage, Sewers /Water Mains, Electric/Telephone Cables etc.**

Take all precautions to avoid damage to water, drains, sewers, culverts, telegraph, telephone or electric cables, ducts or other apparatus that may be met in the course of excavation, together with any walls, buildings or other properties adjacent to the area of operations. Maintain and protect during the progress of the works.

When any water mains, drains, cables etc., are encountered, inform the Architect/Engineer or his appointed representative and obtain information as to the necessary supports or protective measures which may be necessary in accordance with the requirements of the respective Authority or Company, including approval to any permanent works that may have to be put in hand for the purpose of support, protection or deviation.

The cost of providing temporary supports, protection of pipes, drain cables, etc., shall be included and measured as part of the Contract.

If the Architect/Engineer or his appointed representative on inspection of any existing pipes, drains, cables etc., considers that they are in a condition requiring repair, renewal, deviation or other work to maintain their efficiency, and such work not being considered due to any damage caused by site operations, he shall request remedial works be carried out to make good any such damage.

### **Invert Levels**

Invert levels are generally given at all main points of intersection and changes of direction determine all intermediate levels as required by calculating the gradients between given invert levels.

### **Setting Out**

Where the drainage works are to connect directly to a soil, waste or rainwater system the Contractor shall be responsible for:-

- (a) Checking all dimensions with his Plumbing Sub-contractor to ensure that all connections relate accurately to his "Sanitary Pipe work Installation Drawings";
- (b) Ensuring all dimensions relate correctly to the site setting out and building dimensions shown on the latest Architect/Structural Engineers drawings; and
- (c) Relating to the specified sanitary fittings dimensions shown on the Architects Sanitary Fitting Schedule.

Report any uncertainty as to the accuracy of the dimensions or tolerances before the works are carried out, check the drawings and all associated details in sufficient time to enable any adjustments to be made and necessary instructions to be issued. Unless sufficient time is given no claim for delay will be considered.

## **2. MATERIALS**

### **General**

Provide all pipe work, fittings and materials to the entire satisfaction of the Architect/Engineer or his appointed representative in accordance with British Standard Specification or equivalent International Standard.

### **Standards**

EN1401 UPVC Pipes & Fittings for below ground gravity drainage & sewerage.

OR APPROVED EQUAL to European norm i.e. Din, NF, American Standards ...Etc.

All materials or article required to comply with a shall incorporate the stamp of the registered certification "kite mark" of the Standard Institution, or alternatively, copies of test certificates shall be furnished by the suppliers or manufacturer indicating compliance with the relevant Standard.

### **Manhole/Inspection Covers and Frames**

Covers and frames shall be either solid or recessed top as described and conform to the following requirements:-

Grade B - Medium Ductile Iron covers and frames shall withstand a test load of 250kN used in areas subject to a wheel load of up to 5.00 tones with non-rocking covers and/or machined faces.

### **Pre-Cast Concrete Manholes**

Shall conform to BS.5911, or equivalent be "Kite Marked" and consist of concrete aggregate chamber rings incorporating "Ogee" joints. Manholes exceeding 1.800m. in depth shall have either a reinforced concrete reducing slab, or a straight back taper with pre-cast concrete shaft rings.

The rings shall have rebate joint for watertight construction.

Provide a pre-cast reinforced concrete cover slab with clear opening to suit the specified manhole cover.

The opening in the concrete cover slab shall be set over galvanized step irons cast into the concrete manhole rings by the manufacturer.

The chamber rings shall be set on an "in situ" concrete base slab incorporating the main drainage channel, and branch drain connections.

### **Submersible Sewage Pumps**

Supply and install submersible sewage pumps where shown on the drawings and of indicated capacities and heads.

The pump and motor housing form a compact integral unit and shall be of the completely submersible



type. The motor shall be cooled by the fluid in the sump.

The pump/motor housing shall be complete with:

- ☐ Lifting Yoke
- ☐ Electrical terminal board, and submersible electric flexible cable between pump motor and control unit.
- ☐ Ball bearings good for three years continuous operation
- ☐ Stainless steel shaft with precision ground finish.
- ☐ Stator, cast iron stator housing and class F stator insulation.
- ☐ Rotor.
- ☐ Statically and dynamically balanced non-clog impeller with a minimum passage cross-section of 2 1/2" (65mm).
- ☐ Cast iron pump.
- ☐ Base and Stainer.
- ☐ Tungsten carbide shaft seals to withstand heavily contaminated liquid.
- ☐ Gate valve and check valve at pump discharge.

The wet well housing the pump/motor assembly shall be complete with the following accessories:

- ☐ Grouting-in cast iron frame with cast iron cover plate and upper guide rail bracket.
- ☐ Cable holder to collect power cables and permit adjustment of height of level regulators.
- ☐ Discharge connection with lower guide rail bracket.
- ☐ Automatic control unit with level regulator to start and stop the pumps automatically. The contronit shall also alternate the operaof the pumpsto equalize their operating time. In case of failure of one pump; the control unit shall initiate an alarm and automatically start the other pump.

A high level floats, when reached shall automatically initiate an alarm.

The level regulators (float switches) shall be of polypropylene housing with eccentrically positioned lead weight, mercury switch and 13 meters waterproof cable.

The control unit shall be complete with circuit breakers, starters and indicating lights.

### **3. WORKMANSHIP**

#### **Setting Out**

Before laying new drains check existing datum reference points, invert levels, and positions of existing drains, sewers, inspection chambers and manholes with the levels indicated on the Contract Drawings, and relate to building foundations, piles or other features to which the works are related.

The checking of any setting-out, line or level by the Architect/ Engineering of his appointed representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.

#### **Connections to Sewers**

Make arrangements to connect new drains to existing sewers to the satisfaction of the Local Authority.

#### **Excavation**

Carry out all excavation work arranging to visit site and to judge the extent of works, and site/ground conditions, check information on site reports, trial pits, borehole reports and establish ground conditions and strata.

Main excavation of drain trenches on any section of the works shall not be commenced until a full supply of pipes, fittings and materials is available for completing that section.

Clear the working area of all vegetation, rubbish, debris, contaminated earth, concrete, tarmacadam etc., and include for excavation in whatever type of soil is encountered.

Where top soil is to be replaced over backfilled trenches allow for removal and place clear of the main excavated material. Replace in a single layer at completion of the backfill operation and leave proud to allow for settlement.

Carry out in open cut all excavations to the lines and levels having a minimum size to permit accurate setting out, and installation of the works, including trench sheeting, efficient refilling of voids with approved material, all placed and compacted in accordance with this specification.

### **Formation of Excavations**

Excavate immediately before laying bedding or pipe work.

Remove mud, rock projections, boulders and hard spot. Replace where necessary with approved filling material well consolidated, local soft spots to be stabilized by tamping in bedding material.

Excavations taken out to a greater depth than necessary shall be filled to the required levels with concrete or granular bedding material as directed by the Architect/Engineer or his appointed representative. The cost of additional fill material shall be deemed to be included in the rates of excavation.

The bottoms of all excavations, trenches and headings shall be inspected and approved by the Architect/Engineer or his appointed representative before any concrete or granular bedding is deposited or pipes laid.

Where a true trench formation is required and this cannot be achieved by excavation, a true trench formation shall be achieved using filled bagging or alternatively filled concrete blocks to give a trench profile as described in the Excavation clauses of this specification.

### **Transport of Spoil**

Vehicles and containers used to transport excavated materials from site shall be constructed and loaded to avoid spillage, level all loads before commencement of journey.

Any spillage that occurs outside the boundary of the site shall be cleaned away at the end of each working day.

### **Laying Drainage Pipe work - General**

All pipe materials including concrete, granular material for bedding and surround to be in accordance with the Materials Specification of this document. All pipes, fittings and associated materials to be installed strictly in accordance with the manufacturer's recommendations and technical installation manuals.

Check all pipes and fittings, and test for soundness. Do not use damaged pipe work or fittings in the work.

Cut all pipes square and clean, using approved pipe cutting apparatus or chain cutters.

## **Road Gully Construction**

Construct 150mm thick concrete base and set gully pot truly level, making allowance for finished levels, thickness of grating and frame, and two courses of engineering brick.

## **Manholes/Inspection Chambers General**

Construct all main drainage lines, channels, step irons, benching and branch connections in the specified pipe work and materials with all branch connections discharging in the direction of flow.

Set the concrete cover slab to suit the completion of the surround levels, adjust as necessary, and make allowance for the thickness of the cover and frame and the required courses of engineering bricks for level adjustment.

The depth of the main open channel shall not be less than half the diameter of the main drain line unless otherwise indicated on the Contract Drawings, use vitrified clay channels on pipes up to and including 300mm diameter and joint in sand/cement mortar 1:2.

Where level invert channels and branch connections are required use level invert branch vitrified clay channels or form in situ granolithic concrete 1:1 trowelled to formation and smooth finish.

On branch channel bends up to an included 150mm diameter install three quarter section curved bends in the direction of flow set to discharge over the main channel invert joint in sand/cement mortar 1:2 and form benching.

On branch channel bends over 150mm diameter form in situ concrete as part of the benching and finish in 25mm thickness granolithic concrete 1:1 trowelled smooth and curved in the direction of flow.

When installing the main drainage line the channels or chambers within the manholes/inspection chambers must be installed at the same time to give continuity of line and to ensure the correct setting of branch connections.

Build galvanized step iron into manhole/inspection chamber walls as work proceeds at 300mm horizontal and 300mm vertical centres directly above the benching as shown on the Contract Drawings, carried up to and within 225mm of the cover and channel benching.

Fix covers and frames in position, bed all frames in sand/cement mortar 1:3 maintaining cover level with surrounding areas, providing an angled fillet to hold frame square to the brick base where covers are located in temporary positions held secure with angled filled and rest to suit final finishes.

Keep all covers in their respective frames at all times to prevent rocking and deformation of frame. Set light duty frames with covers in position to prevent distortion of the frame.

Fill recessed pattern covers with suitable material to match surrounding areas, the infill material to be well consolidated and tampered, all finished truly level with smooth trowelled finish to paved areas, smooth recessed for filed finish, and tampered finish to rough textured surface.

## **Pre-Cast Concrete Manhole Construction**

Refer to "Manholes/Inspection Chambers General" for description of all associated works.

Construct the pre-cast concrete rings on an "in situ" reinforced concrete base slab to the thickness and profile shown on the Contract Drawings.

Place the rings in position on the base slab set over the main drainage pipeline, channels, branch connections, etc., all set truly level and vertical.

Construct the "in situ" concrete base up to a level of 150mm above the crown of the main drainage line to the profile shown on the Contract Drawings, and form a level base to receive the manhole rings.

Set pre-cast concrete manhole rings on a sand/cement mortar bed 1:2 on the concrete base all set level and firm for placing additional rings.

Ensure all joints are liberally provided with sand/cement mortar 1:2 before lowering sections into position, and neatly strike off joints on the inside of the chamber, filling any voids as work proceeds. Make good any lifting holes.

Make all watertight construction joints in accordance with manufacturer's recommendations and technical installation manuals. Neatly strike off joints on the inside of the chamber, filling any voids as work proceeds, and make good any lifting holes.

When placing pre-cast concrete manhole rings ensure the step irons are aligned vertically and at 300mm horizontal pitch, set over the benching, and in line with any access shafts, pre-cast concrete cover slabs and manhole cover.

Where pre-cast concrete manhole rings are to be supplied without step irons, build in a galvanized mild steel access ladder in the location indicated on the Contract Drawings, complete with all bolt fixings.

When all pre-cast concrete manhole rings, access shafts, cover slabs etc. have been set in position, using sectional fiber glass manhole shuttering, completely surround the manhole rings in 150mm in situ concrete well compacted.

Set pre-cast concrete cover slab in position with the opening in line with the step irons laid on a sand/cement mortar 1:2 bed, all set truly level, filling any voids in the bedding and flush point on the inside of the manhole wall as work proceeds.

Allow concrete work to set hard before back-filling the voids between the concrete surround and side of the excavation.

### **Concrete Block Manhole Construction**

Refer to Manholes/Inspection Chamber General for description of all associated works.

Construct manholes in concrete blocks on an in situ reinforced concrete base with blocks set in bond with no straight joints using sand/cement mortar 1:3, building in galvanized step irons as work proceeds.

Fill hollow blocks with concrete and compact well before construction.

Completely fill all beds and vertical joints with mortar, and cut and flush point as work proceeds.

## **Backfilling General**

Backfilling to trenches shall not be carried out until all interim tests have been successfully concluded.

Backfill adjacent to foundation in accordance with the details shown on the Contract Drawings.

Do not fill void between side of excavation and pre-cast concrete manhole walls until seven days after concrete has been poured and set hard.

Where excavated material is unsuitable for backfilling, suitable material shall be imported to comply with the requirements of this specification and the Engineer's requirements.

## **4. TESTING**

### **Testing & Inspection**

Test all drainage works to obtain the approval of the Local Authority, Architect/Engineer or his appointed representative and generally the following requirements.

Give a minimum of 24 hours' notice to the Architect/Engineer or his appointed representative when interim and final tests are to be carried out to give him/her the opportunity to observe tests.

Keep a record of all tests duly signed, and hand a copy to the Architect/Engineer or his appointed representative for retention.

Any works having previously passed any tests will not relieve the Contractor of his obligations when any further defects are shown during final tests, or appear during the maintenance period. Any defects shall be located and rectified, and the system retested in accordance with this section of the specification and as directed by the Architect/Engineer or his appointed representative.

Ensure all sections of the drainage system are completely clear of obstructions, builder's debris, silt, etc. before interim and final tests are carried out on each section of the installation, all drains to be cored through using apparatus to suit the diameter of the pipe.

Provide all facilities, equipment, clean water, appliances and materials for interim and final testing, and arrange to place in position any branch connections, tubes and plugs when and where required. Seal off and remove all equipment during and after tests.

### **Testing Underground Manholes/Chambers**

Test all chambers for water tightness. Keeping external faces clear of backfill for inspection until approved, temporary seal all pipe connections within the chamber and fill with water up to 1.500m above the crown of the pipe allowing time for absorption. Allow adding water before starting the test, and maintain water level for 30 minutes without adding further water. Any manhole/chamber failing the test shall be re-constructed until a satisfactory test result can be achieved.

### **Record Drawings**

The Contractor shall keep a record of any changes to pipe work location or adjustments to levels during the course of the contract and prepare upon completion Record Drawings/Schedules equal to the Contract Drawings.

The Contractor shall keep a record of any changes to pipe work location or adjustments to levels during the course of the contract, and upon completion hand to the Architect/Engineer to enable him to prepare record drawings.

## **Handover**

Thoroughly clean and flush out the entire drainage installation and clean out silt and debris from drainage gullies etc. before handover.

Give a minimum of 24 hours' notice when tests are to be carried out and provide sufficient personnel to carry out the flushing operation of the various appliances.

Hand to the Architect/Engineer or his appointed representative, copies of the "As Fitted" drainage record drawings.

**CHAPTER THREE**

**SANITARY, WASTE & RAINWATER**  
**PIPEWORK INSTALLATION**



**3.0 SANITARY, WASTE AND RAINWATER**  
**PIPEWORK INSTALLATION**

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1. General Preamble
2. Materials
3. Pipe work Materials
4. Pipe work Installation
5. Waste Installation
6. Approved Manufacturers

## **1. GENERAL PREAMBLE**

### **Scope of Work**

Soil, Waste, Vent and Rainwater Installations.

Waste Installations.

All Overflows Pipes.

### **Sanitary Fittings**

Shall include the following:-

Order, take delivery, store, and protect during the course of the contract all sanitary ware including fixtures and fittings all in accordance with the sanitary fitting specification and standard.

Allow for fixing and protecting all sanitary ware, fixtures and fittings as indicated, all strictly in accordance with the manufacturers' recommendations.

All pipework and fittings used in the hot and cold water service installations shall be as specified herein.

Allow for all overflows and warning pipes where indicated on the drawings using pipework and fittings specified herein.

## **2. MATERIALS**

### **General**

All pipework, fixtures and fittings shall comply strictly in accordance with the relevant International Standard Specification.

## **Standards**

Where a British Standard and/or Code of Practice is quoted in this Specification, refer to the latest published standard and any subsequent amendments.

British Standard Institution documents referred to in this Specification are:-

BS.4514 Unplasticized PVC soil and ventilating pipe, fittings and accessories or approved equal EN.

BS.5254 Polypropylene waste pipes and fittings (external diameter 34.6 mm, 41.0 mm and 54.1 mm) or approved equal EN.

BS.5255 Plastics waste pipe and fittings or approved equal EN.

BS.3943 Plastics waste traps or approved equal EN.

BS.2494 Materials for elastomeric joint rings for pipework and pipelines or approved equal EN.

British Standard Code of Practice referred to in this Specification are:-

BS.CP.5572 Sanitary Pipework or approved equal EN.

BS.6367 Drainage of Roofs and Paved Areas or approved equal EN.

## **Building Standards and Regulations**

All pipework and fittings shall be installed strictly in accordance with Local Authority Regulations or equivalent.

## **Termination**

The installation shall be deemed to terminate at the buried drain connections.

### 3. PIPEWORK MATERIALS

#### Main Soil Waste and Rain Water

Pipe Size	Material
110mm, 160mm 200mm 300mm	- UPVC (EN – 1401)

Main Soil, Waste Rain Water and Vent Pipework shall be deemed to include horizontal pipework underground drainage.

#### Branch Soil, Waste and Vent Pipes

Pipe Size	Material
- 50mm	- UPVC (DIN. 19531)
- 82mm 110mm 160mm 200mm	- UPVC(BS.4514)+(EN.1329)

Branch Soil, Waste and Vent Pipework shall be deemed to include for all vertical and/or horizontal pipework between the connection to drain or main soil, waste and vent stack, and the terminal connections to the Sanitary appliance or fitting.

All soil and waste pipe work discharging from sump pits shall be cast iron.

#### Rainwater Pipes

Material	Pipe Size
UPVC (BS.4514) + (EN.1329)	φ 80 - φ 110 - φ 200

#### General Requirement

There shall be no deviation from the details indicated on the drawings, any alterations to the design intent without prior approval shall be restored to the original design at no extra cost to the contract unless it is proven that the original design cannot be accommodated.

The entire installation shall be carried out to the satisfaction of the Architect/Engineer or his appointed representative.

## **4. PIPEWORK INSTALLATION**

### **General**

All pipework shall be installed truly vertical or if horizontal to the gradient dictated by the design.  
All bends and offsets shall be kept to the minimum number and if required be of a wide sweep pattern.

All pipework shall be cut clean and square with the axis of the pipe with all sharp edges and/or burrs removed before installation.

Should any blockage occur within the system caused by general negligence or abuse pipework shall be removed and the system thoroughly cleaned out at no extra cost to the contract.

### **Pipework Fixtures and Fittings**

All pipework fixtures and fittings shall be installed using the correct fixtures and fixing procedures including support brackets to suit the specified materials, and hold pipework secure.

All bracket and support fixings shall be in accordance with the details shown on the coded detail drawings.

### **UPVC Pipework and Fittings**

Shall comply to British Standard 4514 bear the British Standard Kite Mark, or equivalent and shall be installed strictly in accordance with manufacturers recommendations.

All pipework shall be supplied in plain ended lengths.

The pipe and fittings shall be to colour grey, British Standard 5252 with the exception of water closet connections which shall be coloured white where exposed to view.

Method of jointing shall be a combination of solvent welding using the manufacturer's approved solvent cement, with seal ring fittings used where necessary to accommodate thermal movement. The sockets of standard fittings shall be converted to incorporate a rubber seal ring where required.

### **UPVC Pipework Installation**

All pipework shall be installed to accommodate thermal movement, flexible joints shall be incorporated at all fixed points and changes of direction with a secure fixing bracket located in the retention groove moulded on the socket of the fitting.

Waste boss connections when fitted to the pipes shall consist of two parts with inner and outer flanges, solvent welded as a complete unit with inbuilt gradients of 1 1/4o. Where it is not possible to gain access to the bore of the soil pipe self-locking bosses with integral clamping devices shall be used providing the mating surfaces are suitable for and used with solvent weld cement.

Access shall be provided to gain entry into all pipework either by means of an integrally moulded door in an access fitting with external fitted rubber seal and secured with two galvanised bolts and nuts, or alternatively a two piece clamp type door fitted into the pipe run.

Where WC connections are to be fixed in a range a single manifold branch shall be used comprising a single branch with a standard WC connector welded together, up to six WCs may be connected on either side of the soil stack using the available left or right hand fittings as required. The correct angle and type of fitting to suit the application shall be as described in the manufacturers Product Handbook.

The system shall be installed strictly in accordance with the Product Handbook complying with the recommendations of BS.4940.

### **UPVC Pipe Supports**

UPVC pipe supports shall be made of mild steel with galvanised or PVC protective coating, supplied to suit the specified pipework and fittings and have a two position fixing suitable for either acting as a pipe support allowing thermal movement, or alternatively as a clamp fit on a fitting creating a fixed point. For optimum fit on pipe supports UPVC spacing pieces shall be used.

Maximum intervals between pipe supports shall be:-

Pipe Size	38 mm	42 mm	50 mm	75 mm	100mm
Horizontal	0.5 m	0.5 m	0.6 m	0.9 m	0.9m
Vertical	1.2 m	1.2 m	1.2 m	1.8 m	1.8m

Pipework shall be fixed truly vertical with all horizontal runs laid to gradients in accordance with British Standard 5572 and in any event not less than 18mm/m unless otherwise instructed.

The pipework shall be fixed to the fabric of the building in accordance with BS CP 5572.

## **5. WASTE INSTALLATION**

### **Access Fittings**

All fittings shall give full width access into the bore of the pipe and located as indicated on the drawings.

### **Access Location (General)**

Access points shall be provided to give full access to all sections of installation at the locations indicated on the drawings, to enable section testing and efficient maintenance operations to be carried out and to enable every section of Soil, Waste or Rainwater Pipework to be rodded, tested, inspected and to enable the easy removable of objects or debris from the system.

### **Roof Vent Fittings**

All vent pipes passing through the roof shall be fitted with a connector suitable for a weatherproof seal and to ensure a completely watertight arrangement.

The pipe shall terminate 450mm above finished roof level with a section of spigot end and vent cage, complete with a weathering shroud to enclose the waterproof finish.

### **WC's Connectors**

Pipework connections to WC's shall be flexible self-sealing connectors incorporating multiple plastic and rubber seal gaskets. The connector shall incorporate outward facing rubber seals and plastic fins for insertion into the pipe, and an internal rubber seal with plastic shroud for connection to the WC pan.

The Connectors shall suit the specified pipe materials.

### **Storage of Pipework and Fixtures and Fittings**

All pipework fixtures and fittings including jointing materials shall be stored within a clean dry storage area protected from extreme temperatures and where applicable in accordance with manufacturers recommendations.

### **UPVC**

All pipework fittings, gaskets, and solvents shall be stored to avoid direct exposure to sunlight, and extreme temperature conditions.

Pipework shall be stored on level ground free from stones or sharp objects either on timber bearers 75mm wide and not greater than 1 metre centres and stacked neatly not more than 1 metre high, or alternatively stored in loose racks with side support not greater than 1.5 metres apart.

All fittings, gaskets and solvents shall be stored within a well ventilated cool compartment, and retain in plastic bags and storage containers until ready for installation.

### **Pipe Sleeves**

Where pipes pass through walls, or floors tubular pipe sleeves of non-combustible material shall be provided of sufficient size to permit the free passage of the pipe through the sleeve to ensure the pipe neither touches the sleeve nor the building structure.

All pipe sleeves shall be set in the walls, or floors before plastering or screeding is completed. All sleeves shall be suitable for the pipe on which they are to be fitted and shall extend the full thickness of the division through which the pipe is to pass, after installation the gap between pipe and sleeve shall be "fire stopped" with suitable non-combustible caulking compound.

Where UPVC pipework passes through walls or floors a fire sleeve shall be provided tested in accordance with BS.476 comprising of a metal clad flanged sleeve with fire resistant filler rings in accordance with the detailed drawings.

### **Rainwater Roof Outlets (Roof Drain)**

All rainwater outlets shall be cleaned to the satisfaction of the Engineer / Architect suitable for the specified pipe material.

### **Floor Gullies (Floor Drain)**

Floor gullies and channel gratings shall be supplied and installed as required within public bathrooms and toilet areas and playgrounds. Where these are of a quality finish they shall be suitably protected until completion of the contract.

Where traps are suspended they shall have weight support lugs cast on with suitable bracket fixing back to the structure.

FCO :	Floor clean out – 20 cm x 20 cm Chrome Plated, Ø 1100mm Bottom outlet
FD-01 :	Floor drain – 20 cm x 20 cm Chrome Plated, Ø 80mm Bottom outlet
FD-02 :	Floor drain – 20 cm x 20 cm Chrome Plated, Ø 80mm Side outlet
CHD-01 :	Channel floor cover – 750 cm x 250 cm Stainless steel medium duty grating cover, Bottom outlet
CHD-02 :	Channel floor drain – 750 cm x 250 cm Nickel bronze medium duty grating cover, Bottom outlet (for excavation of channels, refer to Chapter 2, Below Ground Drainage).

### **Waste Connections to Mechanical Services Plant**

Waste and/or overflow connections from, pump glands, etc, shall discharge into a tundish and connect to drain via a trap connection or alternatively discharge over a trapped floor gully, but on no account connect to a soil pipe.

### **Overflows/Warning Pipes and Sanitary Fittings**

All overflows and/or warning pipes shall be installed strictly in accordance with the Water Authority Bylaws/Regulations including any subsequent amendments, and the detailed drawings. Depending on the location, the overflows and/or warning pipes shall discharge in the following locations and as indicated on the drawings.

- a) External to the building
- b) Over a Sanitary Fitting
- c) Over the floor

### **Testing, Flushing Out and Cleaning of Soil, Waste, Vent and Rainwater Pipes**

All pipework to be concealed shall be tested before being enclosed, a final test shall be made upon completion for soundness and performance strictly in accordance with the British Standard 5572, and include a simultaneous discharge test.

At completion of the installation all plugs shall be removed and the entire system flushed and rodded through.



## **6. APPROVED MANUFACTURERS**

### **UPVC**

- a. Redi
- b. Nicoll

or approved equal.

### **FB & JB**

- a. Zurn
- b. Wade
- c. Josam

or approved equal.

**CHAPTER FOUR**  
**PIPED SYSTEMS (LIQUIDS)**

## **4.0 PIPED SYSTEMS (LIQUIDS)**

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7. Water storage tanks (P.E.&.S.S.)

## **1. GENERAL**

This section of the Specification shall apply to the following pipework installations:-

Domestic Hot and Cold Water (including distilled and cold and hot soft water)

And as a supplement to the following sections:-

Soil, Waste and Rainwater

### **Demarcations**

The Domestic Hot and Cold-water service installation shall include final connections between isolation stop-cocks or valves serving sanitary appliances or equipment and the appliances/equipment being served.

## **2. PIPEWORK INSTALLATION (GENERAL)**

### **Mild Steel**

All tubes shall be of uniform thickness within the manufacturing tolerances as stated in the appropriate British Standard and shall have a concentric bore throughout.

All pipework shall be free from rust and without any signs of scaling, pitting or weathering to the satisfaction of the Engineer.

All pipework shall be supplied with varnished finish and each length must have at least one coloured identification band when delivered.

When screwed pipes are required they shall be supplied with at least one socket for each length fitted and threads not fitted with sockets shall be fitted with protectors during transit.

All branches off mains shall be of the easy sweep type, where the size of the branch off the main is outside the range of branch bends available; the branch shall be formed from piping carefully formed to an easy sweep.

## Gradients and Erection of Pipework

Pipework shall be graded to ensure adequate draining and venting and wherever possible be self-venting. Draining and venting facilities as detailed in this Specification shall be fitted at all low and high points respectively and wherever else necessary to ensure that all sections and subsidiary sections can be drained and no air locks can form.

The gradients shall be in the direction of flow and shall be appropriate to the service as follows unless otherwise stated on the drawings:-

Service	Gradient
All services	1 in 250

Pipework shall generally be set around all pipes and columns and shall follow the contours of the building whether so indicated or not.

Bare piping shall be erected so that there is 75 mm clear below it to the finished floor level and at least 25 mm to the finished wall face.

Insulated piping shall have sufficient clearance for the proper application of the insulating material. The finished surface of any covering shall be at least 25 mm from walls etc. Clearance between adjacent insulated pipes shall be at least 25 mm.

All pipework valves, fittings and equipment forming the piping installation shall be erected so that it can be dismantled and is accessible for repair and replacement.

## Pipe and Services Supports

All pipework shall be supported by means of clips, hangers etc., or in the manner and positions indicated at intervals not exceeding the following:-

Nominal Bore	Steel Interval (Metre)	
	Vert.	Horiz.
15mm	2.4	1.8
20mm	3.0	2.4
25mm	3.0	2.4
32mm	3.0	2.4
40mm	3.7	2.4
50mm	3.7	2.4
65mm	4.6	3.0
80mm	4.6	3.0
100mm	4.6	3.0
125mm	5.5	3.7
150mm	5.5	4.5
and over	6.0	6.0

Care should be taken with the design and installation of supports for A.B.S., pipework, which shall be designed in accordance with the manufacturer's recommendations but shall not be greater spacings than the following table:-

Pipework O/D	UPVC Maximum Horizontal Support Distance m
15	1.0
20	1.0
25	1.0
32	1.1
40	1.1
50	1.2
63	1.4
75	1.6
110	1.9
125	1.9
160	2.1
200	2.5

In the event of two or more pipes being carried by a single support the spacing shall be for the short intervals. No more than two pipes may be supported from a single drop rod support. Double hanging of pipes with unequal expansion movement due to different service temperatures shall not be permitted.

All supports for mild steel pipes and fittings shall be ferrous as indicated and/or specified herein.

Metal pipe clips on plastic pipework shall be free of sharp edges likely to damage the pipe.

Valve supports shall be provided for all large diameter valves in plastic pipework to ensure that distortion of the pipework does not occur.

It shall be the responsibility of the Contractor to ensure that all supports are adequate, firmly and truly fixed, and that they do not transmit vibration.

The Contractor shall provide and install all fixings to the structure or cast in support channels where appropriate to carry the brackets, clips, hangers, etc., for the various services.

The Contractor shall provide all necessary steelwork for the support of the Services in vertical risers at the required intervals, which shall be detailed on drawings and submitted for approval. The drawing shall show full details of all steelwork sizes and fixings and shall show the imposed load from each service.

All pipework shall be supported by substantial brackets, hangers, or clips to the approval of the Engineer. The layout of piping shall take into account expansion and contraction, particularly at ends of runs where changes of direction occur. Main walls or partition walls etc., where pipes pass through sleeves shall not be considered as pipe supports.

Supports for insulated pipes on cold-water service shall be arranged so that there is no penetration by metal of the pipe insulation. In addition precautions must be taken to preserve an unfractured vapour-proof skin at these joints. Two half sections of high density phenolic foam (120 kg/m<sup>3</sup>) to fit the pipes and of correct thickness to suit the insulation shall be used at all support positions. The joints between the high-density phenolic foam and the insulation shall be chamfered and trowelled in with a mastic compound.

In exposed areas and where metalclad pipework insulation finish is provided the vapour barrier shall be over the band clip to ensure a concealed and straight line finish appearance.

When rested upon fixed supports, freedom of longitudinal movement must be provided.

### **Pipe Sleeves and Puddle Sleeves**

Where pipes pass through walls, floors, footings and waterproof membranes, the Contractor shall include in his price pipe sleeves.

The inside diameter of sleeves shall not be less than 15 mm larger than the outside diameter of the pipe except where pipes pass through bearing walls or footings where sleeves shall be sized to allow for structural movement and 15 mm clearance from the outside diameter of the pipe.

The diameter of the sleeves for cold-water pipework shall be such that adequate clearance between the pipe and the sleeve will enable the insulation to be carried through the sleeve.

Sleeves shall protrude not less than 2 mm and not more than 4 mm proud of the finished surface.

### **Flushing of Pipework Systems**

Prior to the chemical cleaning or treatment of any pipework system the entire system, sectionally or as whole, shall be subjected to a full bore rapid flush to ensure the complete removal of any loose foreign material. This shall also apply to pipework systems where chemical cleaning is not called for.

The Contractor shall also be responsible for providing temporary fill and drain points on each system and for making whatever temporary arrangements that may be necessary to have adequate raw water available at the fill points and for the removal of flushing water from the drain points.

### **Approved Manufacturers**

Galvanized Steel Supports for Pipes

- a. Flamco
- b. Walraven
- c. Mupro
- d. Erico

or approved equal.

## **3. PIPEWORK SERVICE MATERIALS**

### **Polypropylene (PPR) Pipes and Fittings**

A. Polypropylene pipe shall conform to the following requirements:

- Polypropylene pipes shall be made of polypropylene, a copolymer RANDOM, Beta PPR with enhanced crystalline structure, Class-2 (S-3.2; SDR-7.4) for embedded domestic cold and hot water pipes applications. Beta PPR with Aluminum layer for exposed and embedded heating pipes, and for exposed cold and hot water pipes application conforming to EN ISO 15874 or approved equal International Standards (DIN, ASTM, ....) for polypropylene pipes.
- Polypropylene pipe: ASTM F 2389, pipe pressure rating shall comply with temperature and pressure ratings per the plumbing code requirement for the applicable service (water distribution, water service).
- Fittings shall have same material and quality as pipes and according to EN ISO 15874.
- Polypropylene Fittings: ASTM F 2389, socket fusion, butt fusion, electrofusion, or fusion outlet fittings shall be used for fusion weld joints between pipe and fittings.
- Mechanical Fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances.
- Polypropylene pipe shall not be threaded. Threaded transition fittings per ASTM F 2389 shall be used where a threaded connection is required.

B. Polypropylene – Random Copolymer



- Polypropylene – Random Copolymer (PP-R) used for the manufacture of pipes shall confirm to the requirements of IS 10951 and IS 10910.
- The specified base density shall be between 900 Kg/m<sup>3</sup> and 910 Kg/m<sup>3</sup> (both inclusive) when determined at 27°C according to procedure prescribed in IS 13360 (Part 3/Sec 1).
- The MFR of the material shall be ≤0.5 g/10min when tested at 230°C with nominal load of 2.16 Kg as determined by method prescribed in IS 13360 (Part 4/Sec1). The MFR of the material shall also be within ± 20percent of the value declared by the manufacturer.
- The resin shall be mixed with sufficient quantity of colour master batches. The colour master batch description shall be uniform throughout the pipe surface.
- Outer Layer (Optional)

The base resin used for outer layer compounds shall be a base resin certified by the supplier to be compatible to the PPR resin/master batch that is used to produce the pipes.

Coloured outer layer compound shall be UV stabilized with minimum of 0.2 percent of a hindered amine light stabilizer (HALS).

- Anti-oxidant

The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS 10909.

## **4. VALVES AND COCKS**

### **General**

All valves and cocks shall be generally as described and of first class quality.

All castings shall be clean close-grained metal free from rough projections. Unless otherwise specified valves of 50 mm nominal bore and under shall have female ends screwed to BS 21 and valves 65 mm nominal bore and over shall have flanged ends.

Screwed valves shall have heavy hexagon reinforcements at openings, threads of ample length and heavy shoulders to prevent over entry to pipes. Flanged valves shall have the flanges flat faced on valves 50 mm and below and raised face on valves 65 mm and above and of thickness conforming to the appropriate Specifications and drilled.

All valves must have the maker's name or trade mark cast or heavily stamped or rolled on. Valves not bearing these distinguishing marks will be rejected.

Each valve must be made easy to operate before being installed.

Regulating and isolating valves shall be fitted to permit proper isolation and regulation of plant and primary and secondary mains.

All mains shall be provided with isolation valves at the point of entry or exit.

All valves shall be suitable for the fluid carried and the temperatures, test and working pressures of the system in which they are installed.

Where flanged ends are specified, the flanges shall be of the type and nominal pressure rating as specified in the 'Flanged Pipework Jointing' clause in this Section of the Specification.

### **Isolating Valves to Hot and Cold Water Services**

#### **(i) General**

Isolating valves shall be installed in the locations shown on the drawings and on connections to single groups of wash-hand basins or wc's, on the draw-off connections to individual sinks and on connections to equipment.

#### **(ii) Mains Water Services**

Isolating valves on pipework size 54 mm and below shall be stopcocks of the screw down pattern gunmetal construction in accordance with BS 1010 with pinned jumper and gunmetal or brass spindle with crutch head and union connection.

Alternatively isolating valves where used internally shall be full way lever operated quarter turn spherical ball valves manufactured from dezincification resistant bronze, polished balls and PTFE seats. Ends shall be compression to BS864 Part 2 and the valve shall be suitable for working pressure up to 16 bar.

Servicing valves up to and including 22mm to be the spherical plug type manufactured to BS6675 with compression ends to BS864 and shall be chromium plated.

Valves above 54 mm shall be cast iron, with inside screw, wedge gate valves manufactured in accordance with BS 5163 Class 2, having flanged ends and provided with wheel head assembly unless otherwise noted on the drawings.

Alternatively valves above 54mm shall be butterfly valves to BS5155, lever operation, suitable for pressures up to 16 bar. Valves shall be approved for use on potable water services.

### **(iii) Cold Water Services**

Full way gate pattern valves 54 mm diameter and below shall be bronze or gunmetal construction in accordance with BS 5154 solid wedge disc, non-rising stem, and having either integral solder ring capillary ring union ends, or compression ring joints in accordance with BS 864 Part 2.

Alternatively isolating valves where used internally shall be full way lever operated quarter turn spherical ball valves manufactured from dezincification resistant bronze, polished balls and PTFE seats. Ends shall be compression to BS864 Part 2 and the valve shall be suitable for working pressure up to 16 bar.

### **(iv) Hot Water Services**

Full way gate pattern valves 54 mm diameter and below shall be bronze or gunmetal construction in accordance with BS 5154 solid wedge disc, non-rising stem, and having either integral solder ring capillary ring union ends, or compression ring joints in accordance with BS 864 Part 2.

Alternatively isolating valves where used internally shall be full way lever operated quarter turn spherical ball valves manufactured from dezincification resistant bronze, polished balls and PTFE seats. Ends shall be compression to BS864 Part 2 and the valve shall be suitable for working pressure up to 16 bar.

### **(v) Fitting Isolation Valves**

Isolation valves to individual fittings shall be full port in-line spherical plug ball type of bronze or nickel construction, to BS 6675 with operating lever and compression ring joints in accordance with BS864 Part 2.

### **Ball Float Valves**

Unless otherwise specified ball valves shall be of bronze or gunmetal construction manufactured in accordance with BS 1212, Part 1 and having a bronze or gunmetal seat, lever and plastic float conforming to BS 2456.

Where required ball valves of the delayed action type shall be provided generally as above and complete with hydraulic delay subsidiary tank and bottom float. Galvanised mild steel supports shall be provided to the valve manufacturers recommendations.

The ball valves shall be suitable for the particular pressure requirements at the point of discharge.

### **Hose Union Bib Taps**

Hose Union Bib Taps shall be of the screw down pattern, gunmetal construction manufactured in accordance with BS 1010 and be complete with a bib hose union connection.

The bib taps shall have a polished finish and be complete with a polished brass dust bonnet.

### **Drain Cocks and Drain Valves**

Drain cocks shall be fitted on all low points and on the 'dead' side of all isolating valves and cocks.

Other than on HTHW drain cocks where in exposed positions in rooms shall be of the bronze draining tap type to BS 2879 Type A with screwed end and lockshield dustcap. Elsewhere they shall be of the bronze gland cock type with hose union.

Drain cocks where used on hot, cold and mains water services shall be of the pattern that can be readily rewashered and that are suitable for 1.5 times the system working pressure.

### **Safety Valves**

Safety valves shall be of the enclosed spring loaded type complying with BS 6759 and of size not less than that required for the equipment specified. The safety valve shall be arranged vertically and attached directly to the equipment shell.

The safety valves shall have a padlock and key. Unless otherwise specified safety valve set pressure shall be:-

1.1 x working pressure

The setting shall not exceed the design pressure of the equipment.

Safety valves up to 50 mm n.b. shall have screwed connections, bronze body, cadmium plated steel spring with high tensile brass adjusting screw and locknut suitable for a maximum working pressure of 24 bar.

### **Approved Manufacturers**

- a. Crane
- b. Nibco
- c. Hattarsley
- d. Serseg

or approved equal.

## 5. PIPEWORK ANCILLARIES

### Flow Commissioning Sets

Flow Commissioning Sets shall be provided on all main, branch and sub-circuits throughout the heating and chilled water pipework installations to enable satisfactory commissioning of hydraulic circuits. The sets shall comprise a measuring orifice ring with pressure tappings, fitted complete with valve. This valve shall be a double regulating valve in accordance with the appropriate Service Specification, located in the return pipe.

Orifice ring fittings 50 mm and below shall have gunmetal body castings with screwed ends to BS 21 and comply with BS 1400. Orifice ring fittings 65 mm and above shall have cast iron flangeless bodies with notches for pipe alignment fitted with stainless steel orifice plates and gunmetal retaining bushes.

Pressure tappings shall be the brass body mechanical self-sealing type with screwed blanking caps.

For flow rates below 0.04 litres/s low flow or ultra low flow sets shall be provided, appropriate to the low flow rate condition.

### Water Strainers

Strainers shall be located at inlets to control valve arrangements and pump sets and generally as detailed on the drawings.

The strainer shall be simplex or duplex as indicated on the drawings.

Each strainer shall be provided complete with a stainless steel strainer screen as follows:-

Application	Perforation Size mm
In pipework 15mm to 50mm nominal bore and on inlets to all control valves.	0.8
In pipework 65mm to 100mm nominal bore.	1.2
In pipework 125mm nominal bore and above.	1.6

### Cold Water Applications, HWS and LTHW:

Strainers up to 50 mm shall be "Y" type of bronze or gunmetal construction in accordance with BS 5154 screwed ends to BS 21.

### Pressure Gauges

Pressure gauges shall be 100 mm and 150 mm diameter as specified, aluminium alloy cased with chromium bezel Bourdon Type BS 1780, Part 2 and shall be with plain glass front, concentric pointer

and red line at the working pressure scaled in bars.

The range, unless otherwise stated shall be a maximum of one and a half times the working pressure. The tubes shall be of brass construction and removable, and the outlet screwed BSPT.

### **Temperature Gauges and Wells**

Dial type temperature gauges with aluminium alloy cases black painted with chromium bezel shall be fitted in the positions as indicated. Each dial type gauge shall be of mercury in steel type having a nominal dial size of 150 mm.

All gauges shall have a white dial with black numbering and shall be calibrated to cover the operating temperature range plus 30°C on DHWS and cold water.

## **Water Meters**

Water meters shall be provided on the incoming water main and shall be located within an accessible position so as to facilitate easy reading and maintenance.

Meters for use on pipework over 40 mm diameter shall be of the in-line Helical Vane type with graphite iron body to BS 2789 1973 420/12, polypropylene rotor, stainless steel bearings, and shall be provided with flanged connections to BS 4504.

Each meter shall be provided with a suitable pulsed output suitable for connection to a central control and monitoring system.

All counters shall read in cubic meters.

All meters in exposed positions shall be suitable for the prevailing temperature conditions without loss of performance or accuracy.

## **Air Release LTHW, HWS, Oil**

Air vents shall be fitted at all high points. Pipework which requires venting shall be fitted with 6 mm air cocks on air bottles. Air bottles shall be formed from 150 mm length of tube of equal bore to the pipe which is being vented, with 6 mm pipe welded into the top and taken to a low level accessible position unless otherwise specified and fitted with 6 mm lockshield needle valve. The discharge from the needle valve shall be piped to a convenient position for discharge into a container.

In addition, vent points on oil lines shall be provided with a mild steel receptacle hooked onto the piping and arranged to collect oil drips.

## **Automatic Air Vents**

Automatic air vents shall be installed in accessible positions and shall be of aluminium bronze construction with brass spindle nickel alloy valve and seat, brass float and integral lockshield isolating valve. In all cases the air vent shall be preceded by a lockshield pattern stop valve and the discharge from the air vent shall be 10 mm copper pipe. Automatic air vents shall be provided on each service, with the exception of HTHW and MTHW, at the highest point of the service within each plant area and on each vertical distribution riser.

Discharge pipes shall be collected over a covered tundish and the outlet piped to the nearest drain gully. Discharge pipes shall be labelled according to the service.

## **6. ELECTRICAL WATER HEATER**

Supply and install electric water heaters whenever shown on the drawings of capacities as indicated on the drawings.

Each electric water heater shall be of the cylindrical storage type constructed of heavy gauge steel with white enamel finish and glass lining from inside.

Heater shall have polyurethane foam insulation wall between the outer casing and the glass lining all around top and bottom of cylinder. Heater shall be suitable for a working pressure of 100 psi (690 Kpa).

Each electric water heater shall be complete with the following:

- Fast acting surface mounted thermostat for automatic temperature control.
- Factory installed sensitive high limit energy cut-off (for safety to prevent overheating) present at 210 °F (99 °C).
- Electric element of 1500 watt capacity and smaller as indicated on the drawings. Element shall be constructed of highest quality resistant wire sheathed in mineral filling and the whole encased in a copper tube and subjected to a high voltage test.

The water Supply System shall consist of piping, valves, automatic controls, tanks, electric water heaters, and all equipment as hereinafter specified and shown on the Drawings.

### **Approved Manufacturers**

- a. Rheem
- b. Buderus
- c. Ariston

or approved equal.



## **7. WATER STORAGE TANKS**

### **Polyethylene Water Tank (s)**

Polyethylene water tank(s) shall be of the size and shapes as indicated on the drawings. All elements of the tank(s) and their appurtenances shall be designed to withstand all conditions of the intended service without undue stress or deflection. The design shall take into account the stressed caused by the contents of the tank. The minimum allowable thickness of any portion of the tank(s) and their appurtenances shall be 7 mm, which shall be increased as necessary to provide adequate strength and shall be fully insulated to minimize heat gain.

The tank(s) shall be provided with reinforced threaded openings for all pipe connections and float switches indicated on the Drawings.

The top of tank(s) shall be equipped with a removable cover. The cover shall have a whole cur for the fill.

Interior and exterior surfaces shall have a relatively smooth texture.

### **Stainless Steel Water Tank (s)**

Stainless steel tank shall be made of stainless steel sheet and as per the described size. It shall be construction free from any wrap or deform under direct sunlight. No temperature rise shall be incurred of stored water by sunlight due to mirror finish material. It shall be tested for leaks and shall be protected against insects from entering & contaminating the water. The material of construction is the most preferred material for use of potable water.

It shall have no rust, solvents or painting requirements and shall remain ductile at all temperature ranges with its properties been not impacted by exposure to UV light.

Inlet and outlet pipes shall be connected firmly with gate, float valves and small vent pipe with screen and elbow shall be provided on the upper level.

A drain pipe shall be provided with valve to allow hygiene flushing.

## TESTING AND DISINFECTION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Work Specified
  - 1. Testing and disinfection of all pressure piping for leakage as specified.
    - a. The CONTRACTOR shall furnish all labor, equipment, test connections, vents, water and materials necessary for carrying out the pressure and leakage tests as specified and required.
    - b. The work specified shall include all labor, material, equipment, services and incidentals necessary to fill, clean, chlorinate, flush, and test all pipelines which will carry or hold potable water.
- B. Related Work Specified Elsewhere
  - 1. Section 02080 - Fire Hydrants
  - 2. Section 15051 - Buried Piping Installation
  - 3. Section 15106 - Ductile Iron Pipe and Fittings
  - 4. Section 15108 - Thermoplastic Pipe
  - 5. Section 15109 - Prestressed Concrete Cylinder Pipe
  - 6. Section 15110 - Valves and Appurtenances
  - 7. Section 15120 - Piping Specialties and Accessories
- C. Description
  - 1. Permission shall be obtained from the OWNER of the water system before the use of water from any existing system. The CONTRACTOR shall:
    - a. Conform to the requirements of the OWNER.
    - b. Pay all costs connected with the taking or use of water for any retesting.
    - c. The CONTRACTOR shall provide written notice to the Authority and ENGINEER at least three working days in advance of testing and disinfection.
  - 2. All work under this section shall be performed in the presence of the ENGINEER. A representative of the public health authority having jurisdiction must also be present, as required.
  - 3. Chlorination shall be scheduled such that sampling and flushing will be performed during normal business hours.

## 1.2 QUALITY ASSURANCE

### A. Reference Standards

1. AWWA B300, Standard for Hypochlorite
2. AWWA B301, Standard for Liquid Chlorine
3. AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
4. AWWA C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type for Water and Other Liquids
5. AWWA C502, Standard for Dry-Barrel Fire Hydrants
6. AWWA C504, Standard for Rubber Seated Butterfly Valves
7. AWWA C600, Standard for Installation of Ductile Iron Watermains and Their Construction
8. AWWA C651-14, Standard for Disinfecting Water Mains
9. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch Through 12-inch for Water Distribution
10. NSF/ANSI Standard 60 and 61 (as applicable)
11. Standard Methods for the Examination of Water and Wastewater, latest edition
12. 1996 Safe Drinking Water Act

## 1.3 SUBMITTALS

- A. The CONTRACTOR shall submit proposed materials, methods, and operations regarding testing and disinfection to the ENGINEER for review prior to the start of testing.
- B. CONTRACTOR must provide a sketch to the ENGINEER of the sampling locations identifying at minimum the following:
1. Street names,
  2. North arrow,
  3. Sampling locations,
  4. House numbers of nearest buildings to sampling locations.
  5. Other distinguishable landmarks,
  6. Any other information as requested by ENGINEER, OWNER, AUTHORITY, or County Health Department.
- C. The CONTRACTOR shall submit certification that all backflow preventers (Reduced Pressure Zone attachments) and pressure gauges have been tested and certified within the last year.
- D. Qualifications of laboratory analyzing biological samples shall be New York State ELAP certified.
- E. Chain-of-Custody forms are to be furnished for all biological samples taken.

- F. For flushing operations, ENGINEER shall supply calculations identifying that a minimum 3.0 ft/sec scour velocity has been achieved in the new waterline and that three pipe volumes have passed through it.
- G. ENGINEER shall provide pressure testing and leakage test results.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. All products must be suitable for use in a potable water system and NSF-60 certified. All piping, valves, etc. shall be NSF-61 certified.
- B. Chlorination shall be by the use of a solution of sodium hypochlorite contained in the pipe or structure as specified. The use of calcium hypochlorite in powdered, granular, or tablet form, shall not be allowed.
- C. If the chlorination procedure was found to be harmful to the network, other chemicals, such as bromine or any other equivalent chemical, can be used

## PART 3 - EXECUTION

### 3.1 TESTS ON PRESSURE PIPING FOR POTABLE WATER

- A. General
  - 1. Flush, test and disinfect prior to connection to existing water mains as specified below, except as otherwise authorized by the ENGINEER.
  - 2. The length of piping and sections included in the tests shall meet the approval of the ENGINEER; however, the length shall not exceed 2,000 feet in any case. Pressure test of pipe section shall be from valve to valve regardless of water main size.
  - 3. Notify the ENGINEER 72 hours in advance of testing.
  - 4. Equipment in or attached to the pipes being tested shall be protected. Any damage to such equipment during the test shall be repaired by the CONTRACTOR at his expense.
  - 5. Conduct all tests per AWWA C-600 and C-651, latest editions in the presence of the ENGINEER. Repeat tests in the presence of local authorities having jurisdiction if required by them.
  - 6. CONTRACTOR shall have sufficient personnel at the site for the entire duration of all tests.
  - 7. When piping is to be insulated or concealed in a structure, tests shall be made before the pipe is covered.
  - 8. Provide outlets to flush line, expel air and perform specified tests.
  - 9. Where connections to existing lines are called for only one such connection will be allowed.
  - 10. All fittings, hydrants and appurtenances must be properly braced and harnessed before the pressure is applied. Thrust restraining devices which will become a part of the system must also be tested at the test pressure.

11. When testing absorbent pipe materials such as cement or concrete, the pipeline shall be filled with water at least 24 hours before the test is made.
12. The CONTRACTOR must supply all materials and manpower to perform the tests as specified herein.
13. Testing and disinfection shall be acceptable and approved by the agency of jurisdiction before another connection is made.

B. Initial Flushing

1. CONTRACTOR shall fill and flush new main to remove dirt and miscellaneous debris from the inside of the watermain.
2. CONTRACTOR is responsible for removing all entrapped air during flushing.
3. Flushing must have sufficient flowrate to achieve a fluid velocity of 3.0 feet per second inside the waterline.
4. A minimum 2" tap is required for proper flushing of all watermains having a diameter of 8 inches or less, however, multiple taps or larger taps may be required. ENGINEER shall be responsible for determining necessary connections and providing calculations verifying flushing conditions are met.
5. Refer to AWWA C651, for number of taps required to obtain the minimum 3.0 feet per second flow velocity in all pipes.
6. CONTRACTOR is responsible for providing a water source for flushing. With the permission of the OWNER, an existing watermain may be used as a water source, however, the following restrictions apply:
  - a. The CONTRACTOR is not allowed to operate any valves or hydrants or operate any components which belong to the OWNER.
  - b. If water is drawn from the existing system, an appropriate backwater preventer such as a Reduced-Pressure Zone (RPZ) device must be used. The RPZ must be tested within one (1) year and approved prior to usage.
  - c. Water from flushing procedures must be disposed of properly. Water may be piped or gravity-fed to an existing storm sewer with the ENGINEER'S and the OWNER'S permission if proper erosion control methods to minimize sediment build-up are used. Discharge of water into a roadway or into a parking lot area is strictly prohibited. Water discharging operations shall not cause damage to any public or private property.
7. CONTRACTOR shall partially open and close valves and hydrants several times under expected line pressure to flush foreign material out of the valves and hydrants.
8. Flushing shall continue until three pipe volumes have passed through the new waterline and the water appears sediment-free.

C. Pressure Test

1. Pressure test apparatus must be installed as shown on the Drawings
2. Test pressure shall be as specified in Section 15051, Buried Piping Installation, at the lowest point in the line.
3. Test pressure shall be held on the piping for a period of at least 2 hours, unless a longer period is requested by the ENGINEER, OWNER, or AUTHORITY. Pressure should not fluctuate by more than 5 psi during testing.
4. Pressure gauge must be in good working condition and must be demonstrated to be accurate to the ENGINEER prior to any testing.
5. Gauge must have proper labeling to allow ENGINEER to accurately distinguish the maximum allowable 5 psi change in pressure. Gauge must have markings at no greater than 2 psi increments to allow accurate readings.
6. ENGINEER is responsible for reading the gauge and recording the test results he/she witnesses. Results obtained by the ENGINEER are considered final, and not subject to discussion by the CONTRACTOR.
7. ENGINEER may tap pressure gauge at each reading to ensure needle is measuring pressure accurately.
8. The AUTHORITY reserves the right to read the pressure gauge and record the test results for those lines considered suspect or for potentially inaccurate result recording.
9. ENGINEER shall record pressure at 15 or 30 minute intervals to help determine if the pressure loss is stabilizing.
10. The CONTRACTOR will inform the ENGINEER when to begin the test.
11. If the pressure drop is greater than 5 psi in 2 hours, or if the ENGINEER believes the line is suspect, the CONTRACTOR shall explore for the cause of the excessive leakage and after repairs have been made, the line shall be retested. This procedure shall be repeated until the pressure loss is less than the maximum allowable and the ENGINEER is satisfied.
12. If the pressure drop is 3 psi or greater but less than 5 psi in 2 hours, the CONTRACTOR shall continue the test for another 2 hours. If the pressure drop over the 4 hour period is 5 psi or greater, the test failed and must be repeated after the cause of the leakage is explored and the necessary repairs have been made
13. The ENGINEER shall make a preliminary determination if the test passes or fails based on the pressure and volume losses recorded during testing.
14. After each test, the CONTRACTOR must demonstrate that the test apparatus, including the pressure gauge, is fully functional and accurate. Inaccurate gauges or non-satisfactory equipment will be grounds for test failure, regardless of test results. CONTRACTOR will resupply proper equipment and retest, at his expense.
15. The pressure loss recorded over the 2 or 4-hour test must be acceptable to the County Health Department and AUTHORITY for final hydrostatic testing approval to be given.
16. At the end of the test, the pressure shall be increased to the starting pressure, so that the leakage test data is acquired. See Section D Leakage Test below, for additional information.

17.

D. Leakage Test

1. The leakage test shall be conducted concurrently with the pressure test.
2. The rate of leakage shall be determined at 15-minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure. The test shall proceed until the rate of leakage has stabilized or is decreasing below an allowable value, for three consecutive 15-minute intervals. After this, the test pressure shall be maintained for at least another 15 minutes.
  - a. At the completion of the test the pressure shall be released at the furthestmost point from the point of application.
3. All exposed piping shall be examined during the test and all leaks, defective material or joints shall be repaired or replaced before repeating the tests.
4. The leakage for pressure pipelines shall not exceed the following allowable rates in gallons per hour per 1000 feet of pipe at the test pressure specified in Section 15051, Buried Piping Installation:

<u>Pipe Diameter</u>	<u>Pipe Material</u>	<u>ECWA Allowable Leakage*</u>
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4"	PVC, DIP	0.26
6"	PVC, DIP	0.40
8"	PVC, DIP	0.53
10"	PVC, DIP	0.66
12"	PVC, DIP	0.79
16"	DIP, PCCP	1.06
20"	DIP, PCCP	1.32
24"	DIP, PCCP	1.59
30"	DIP, PCCP	1.98
36"	DIP, PCCP	2.38
42"	DIP, PCCP	2.78
48"	DIP, PCCP	3.17

\* 75% of allowable leakage per AWWA C600-17.

5. Regardless of the above allowables, any visible leaks shall be permanently stopped.
6. The CONTRACTOR shall provide a meter certified within the last year or a source-water tank/barrel of small enough cross section so that measurable changes in water depth can be accurately recorded. A two hour test is permitted for circular tanks/barrels of 15 inches in diameter or less. A four hour test is required for circular tanks/barrels greater than 15 inches in diameter. If a tank of non-circular cross section or irregular shape is used, and the change in water depth cannot be properly measured, the ENGINEER or AUTHORITY may require the test to be run more than 2 hours until an accurate depth change can be recorded and the ENGINEER is satisfied with the results.
7. The leakage volume recorded over the 2 or 4-hour test must be acceptable to the County Health Department and AUTHORITY for final waterline approval to be given.

### 3.2 BUTTERFLY VALVE TESTING

- A. Each butterfly valve shall have a field leakage test performed with the pressure differential as identified in Section 15051, Buried Piping Installation, applied in both directions. This requirement does not waive the requirements stipulated in AWWA C504.
- B. The duration of each field test in each direction shall be a minimum of two (2) hours.
  1. The CONTRACTOR shall demonstrate to the ENGINEER'S satisfaction that all system components operate correctly, both individually and as a system. All testing equipment and materials required to perform all tests shall be provided by the CONTRACTOR and demonstrated as functional and accurate to the ENGINEER. Non-functional or inaccurate equipment, regardless of test results, will be grounds for test failure. CONTRACTOR shall resupply proper equipment and retest.

### 3.3 RESILIENT SEAT GATE VALVE TESTING

- A. Each gate valve shall have a field leakage test performed with the pressure differential as identified in Section 15051, Buried Piping Installation, applied in both directions. This requirement does not waive the requirements stipulated in AWWA C509.
- B. The duration of each field test in each direction shall be a minimum of two (2) hours unless specifically defined by the ENGINEER.
- C. The CONTRACTOR shall demonstrate to the ENGINEER'S satisfaction that all system components operate correctly, both individually and as a system. All testing equipment and materials required to perform all tests shall be provided by the CONTRACTOR and demonstrated as functional and accurate to the ENGINEER. Non-functional or inaccurate equipment, regardless of test results, will be grounds for test failure. CONTRACTOR will resupply proper equipment and retest.



### 3.4 TAPPING SLEEVE AND VALVE TESTING

- A. Prior to making the tap, gate valves shall have a field leakage test performed with a hydrostatic pressure as identified in Section 15051, Buried Piping Installation, on the open end.
- B. Once the system is complete, the valves shall be tested in accordance with the Butterfly and Resilient Seat Gate Valve Testing criteria stated above.
- C. The duration of each field test shall be a minimum of two (2) hours unless specifically defined by the ENGINEER.
- D. After installation of the tapping sleeve or saddle and prior to tapping the main, the sleeve or saddle shall be air tested in accordance with manufacturers' recommendations. If the results of the air test do not meet manufacturers' specifications, the sleeve or saddle will be replaced and retested until the results are satisfactory.
- E. The CONTRACTOR shall demonstrate to the ENGINEER'S satisfaction that all system components operate correctly, both individually and as a system. All testing equipment and materials required to perform all tests shall be provided by the CONTRACTOR and demonstrated as functional and accurate to the ENGINEER. Non-functional or inaccurate equipment, regardless of test results, will be grounds for test failure. CONTRACTOR will resupply proper equipment and retest.

### 3.5 DISINFECTION

- A. Before disinfection, the line shall be cleaned and flushed with clean water as defined in the Initial Flushing section. CONTRACTOR shall provide outlets as required.
- B. The chlorine solution shall be admitted to pipelines through corporation stops placed in the horizontal axis of the pipe, to structures by means of tubing extending directly into the structure or other approved methods.
- C. CONTRACTOR shall install 2-inch saddles on existing and proposed mains and run 2-inch Type K copper tubing with backflow prevention device to allow for addition of chlorinated water. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe or structure that the resulting free chlorine residual shall be between 50 and 100 milligrams per liter (mg/l). Concentrations over 100 mg/l shall not be allowed to enter the piping system.
- D. The placement of chlorine powder or tablets inside the pipe during installation as a means of disinfection will not be allowed.
- E. The proposed piping shall be tested in all respects, prior to connecting the second end of the pipe to the existing system and prior to installing the annular fill at casing pipes.
- F. All valves to existing mains must be closed during the chlorination process. CONTRACTOR must flush the proposed main through a backflow preventer such as a Reduced Pressure Zone (RPZ) and 2-inch copper until chlorine residual at the opposite end reaches 50 mg/l. All valves to the existing water network are to remain closed until this level is reached. While the chlorinated water is being added, all appurtenances on the main shall be operated so as to completely disinfect the new work. The operation shall be repeated as necessary to provide complete disinfection.

- G. Chlorinated water from hydrants and taps must be properly collected and disposed of by the CONTRACTOR. Discharge of chlorinated water into the existing storm sewer or a natural water body shall not be allowed.
- H. The chlorine treated water shall be retained in the pipe or structure at least 24 hours, unless otherwise directed. During the retention period all valves and hydrants within the treated sections shall be operated.
- I. The chlorine residual shall be not less than 25 mg/l at any point in the pipe or structure at the end of the retention period. CONTRACTOR shall immediately perform final flushing to reduce the retention time high levels of chlorinated water.
- J. When making repairs to or when specified, structures and portions of pipelines shall be chlorinated by a concentrated chlorine solution containing between 200 mg/l and 300 mg/l of free chlorine. The solution shall be applied with a brush or sprayed on the entire inner surface of the empty pipes or structures. The surfaces disinfected shall remain in contact with the strong chlorine solution for at least 30 minutes.
- K. The CONTRACTOR must use an approved test method, as defined in AWWA C651 and *Standard Methods for the Examination of Water and Wastewater*, to determine chlorine levels. Test strips and test kits will be allowed for testing chlorine levels if the kit is less than six months old, in the original bottle, is not past the expiration date, and has a color coded scale on the side with legible concentrations defined. ENGINEER and AUTHORITY reserve the right to reject test results if the test strip or kit is suspect. Sending samples to an approved laboratory is also acceptable.

### 3.6 FINAL FLUSHING

- A. Upon completion of each disinfecting operation, the CONTRACTOR will be required to empty the contents of the pipe into a tank truck. Dumping into a sewer will only be allowed with approval from the local governing body. In no instance will chlorinated testing or flushing water be emptied onto the roadways, in ditches, culverts, streams, wetlands, or any other natural water body.
- B. Final flushing will continue until such time as the chlorine residual is between 0.5 and 1.2 mg/l.
- C. Prior to discharging into storm or sanitary sewer systems, and with the written approval of the municipality, the CONTRACTOR shall use a reducing agent (such as sodium thiosulfate) to neutralize any chlorine residual. CONTRACTOR shall prove to the ENGINEER, AUTHORITY and municipality that the water has been properly neutralized prior to discharge using an appropriate testing method.

### 3.7 BACTERIOLOGICAL TESTING

- A. After disinfection and final flushing, a representative of the laboratory hired by the CONTRACTOR shall, in the presence of the ENGINEER, take two bacteriological samples from sampling points at maximum 1,000-foot intervals along the waterline, at every branch off the main line, and at each end of the test section (one immediately after final flushing and a second one after 24 hours) for testing by an ELAP certified laboratory in accordance with the latest Health Department requirements.
- B. Should acceptable results not occur after these two consecutive tests, the CONTRACTOR shall, at his expense, repeat the disinfection procedure until safe results are obtained.
- C. All precautions shall be taken to maintain dry and sanitary conditions and to prevent contamination of any piping, at the CONTRACTOR'S expense.
- D. If, in the opinion of the ENGINEER or AUTHORITY, contamination has occurred, the CONTRACTOR shall repeat the disinfection and bacteriological testing at his cost and expense.
- E. Test results from the laboratory shall be sent directly to the ENGINEER. Test results sent through the CONTRACTOR shall not be considered.
- F. Bacteriological test results shall expire 30 calendar days after the samples are taken. After 30 calendar days, the CONTRACTOR shall be required to repeat the process, taking two sets of samples and submitting results for review.
- G. As per AWWA C651-14 standards, the limit for pipe installed without bacteriological samples being taken is 20 linear feet.

### 3.8 APPROVAL

- A. The ENGINEER shall submit the Waterline Installation Complete Works Approval Report(s) to the Erie County Water Authority for review and processing.
- B. Once approval is given, after reconnecting the proposed piping to the existing piping, the CONTRACTOR shall slowly refill the water main with water and allow it to pressurize so that the ENGINEER may inspect the connections and/or other piping.
- C. The CONTRACTOR shall, at his expense, correct any observed defects to the satisfaction of the ENGINEER and OWNER.

END OF SECTION

**CHAPTER SIX**  
**GENERAL BOILER PLANT**

## **5.0 GENERAL BOILER PLANT**

### **TABLE OF CONTENTS**

1. General
2. Products
3. Execution
4. Fuel Oil System

## **1. GENERAL**

### **Related Work**

- Pipe and pipe fittings.
- Valves.
- Pumps.
- Control & Instrumentation.
- Testing and Commissioning.

### **System Description**

#### **A. General**

1. Provide and install where indicated on the drawings sealed expansion unit for each separate heating system.
2. This section of the Specification covers the supply, installation, testing and commissioning of boiler plant and all associated ancillaries necessary to generate the required heat at a central source for onward distribution to terminal equipment.

### **References**

Refer to individual materials for specified standards.

### **Submittals**

#### **A. Product Data**

Descriptive literature for each of the actual proposed equipment to be used including:

- a. Capacity
- b. Operating Pressure Ranges
- c. Pressure Losses

- d. Fluid Flows
- e. Test Reports
- f. Certificates of Approval
- g. Operation and Maintenance Data
- h. Any other Technical Data

## **B. Shop Drawings**

Shop Drawings for each of the actual proposed equipment shall include the following:

- a. Working or Manufacturing Drawings.
- b. Calculations.
- c. Installation Details.
- d. Connections by other services.
- e. Wiring and Control Diagrams.
- f. Accessories Available indicating those included.
- g. System Diagrams.

## **2. PRODUCTS**

### **Materials**

The pipe work shall be as specified in Chapter 4. Seamless black steel, schedule 40, ASTM A53 Grade B.

Valves shall be as specified in Chapter 4.

Insulation shall be as specified in Chapter 11.

### **Heating Pumps**

Supply and install whenever shown on the drawings hot water circulators of the centrifugal in line type directly coupled to an electric motor suitable for handling hot water at 200° F (93° C).

Circulators shall be horizontal or vertical all bronze with stainless steel and watertight mechanical seals. Motor shall be sleeve type bearing drip proof with built in automatic over load protection.

Circulators shall be complete with switch pilot light and electric wiring adjustable immersion type thermostat shall be furnished and installed for each pump to start and stop the pump motor and maintain its thermostat setting.



### **Aluminum Radiator**

- The contractor shall supply and install aluminum radiators of capacity as indicated on the drawings.
- Each radiator shall be of sectional type
- Each radiator shall be complete with the following:
  - Supply valve
  - Manual air vent
  - Manual flow adjusting bronze elbow
  - Wall brackets
- Each radiator shall have two coats of finishing paint over the base paint.

### **Boilers**

#### **A. Cast Iron Hot Water Heating Boiler**

Type : cast iron, sectional type, design for firing by forced draught burner, with pressurized combustion chamber. It is to be factory assembled, sealed and hydrostatically tested to 10 bars for a operating pressure of 6 bars at 100° C.

Combustion Chamber : to be water cooled by being completely surrounded with water. It is not to require firebrick or refractory except at limited locations such as on rear wall and at bottom if front of burner to evaporate oil drippings from burner nozzle.

Boiler Section : high grade cast iron ribbed to provide continuous path for combustion gases for best efficiency of heat transfer. Boiler to have integrally cast supporting legs to permit it to rest directly on concrete support with uniform distribution of load throughout length. Boiler to be assembled with steel tie rods and nuts and externally sealed with special high temperature mastic for complete gas tightness.

Access doors : cast iron cleanout doors to be provide on front section to permit easy access to internal combustion gas passages hinged cast iron burner mounting door to be provided for full access to combustion chamber. Doors to be sealed gas-tight with asbestos rope gaskets, stud bolts and brass nuts.

Burner Mounting door to be fitted with thick; steel front plate for securing burner, supplied undrilled and provided with internal frame to support factory supplied refractory. Hole for burner nozzle to be formed in refractory. Door to have pyrex observation port with cover for inspecting flame condition.

Boiler shall be supplied with motorized air damper installed on boiler chimney and interlocked with the boiler.

Accessories : boiler to have cast iron real smoke hood with horizontal smoke outlet fitted to boiler with asbestos rope gasket to ensure permanent gas-tight seal. Necessary threaded connections to be integrally cast with boiler sections for boiler fill, boiler drain, altitude gauge, thermometer and two thermostats. Connections to be plugged at factory.

Accessories : the following are to be packed separately for field installation : all-around fiber glass insulated heavy gauge sheet steel jacket, sectionalized for fitting to boiler without removal of door fittings or pipe connections, cast iron flanged outlet and return headers with steel counter flanges, gaskets, bolts and nuts, brass separable socket wells for insertion of thermometer and thermostat bulbs into boilers and decorative control panel designed for fitting on boiler.

Maintenance equipment : boiler to be provided complete with set of cleaning brushes with handle, special tools required for maintenance and installation, gun for application of sealing mastic and recommended quantity of sealing mastic in sealed containers required for field sealing of joints.

## **B. Oil Fired Boiler (Cast Iron)**

### **Boiler Construction**

Boiler shall be of the steel type rated for 88.5 psi (610 kpa). each boiler shall be complete with the following :

- Automatic, high pressure, gun-type burner suitable for light oil No. 2 atomization.
- Fuel oil solenoid valve.
- Burner Plate.
- Insulated and enameled steel jacket and fire bricks.
- 4mm. thick steel breaching with 2" (50mm) insulation, connecting the boiler with the chimney.
- Draft control damper.
- Thermometer.
- Pressure gauge.
- Aquastat.
- Pyrostat or photocell.
- Safety relief valve.
- Electric control panel complete with switches and pilot lights and all electrical wiring.

The Aquastat shall control burner operation to maintain water leaving the boiler at 180°F (82 °C) and the Pyrostat or the photocell shall monitor burner operation and stop it in the event of flame failure or if combustion does not take place.

### **Burner**

Burner shall be of the fully automatic mechanical pressure atomizing type; factory assembled and fire tested.

Burner shall be suitable for burning diesel fuel No. 2. It shall be complete with the following components

and accessories.

- Oil burning nozzles.
- Ignition transformer and ignition electrodes.
- Fuel oil pump of the rotary type, directly connected to the blower motor.
- Blower.
- Blower and oil pump motor auto-starter.

### **Controls**

Burner shall be automatically controlled by an aquastat actuated by the outgoing boiler water temperature.

In addition to the aquastat, the burner shall be controlled by the following safety devices.

High limit thermostat, for protection against high water temperature.

Pyrostat to provide for a shutdown of the burner in the event that combustion does not take place.

Audible alarm shall be provided in case of malfunctioning of the boiler.

### **Boiler Stacks and Insulation**

Boiler stacks must be carefully sized for the total simultaneous capacity of the plant and other fuel fired devices in order to maintain reasonable flue gas velocities for the fuel being burned, the firing equipment and the available draft.

Field fabricated stacks are to be of 2.5 mm. (No. 12 U.S. gauge) black iron welded construction, insulated with 50 mm. (2 in.) of hydrous calcium silicate (asbestos free), all joints cemented. Exposed sections are to be covered with an aluminum jacket. The stack must be self-supporting, with an air space between it and the enclosing shaft wall.

Insulation shall be of Rockwool ( 120kg/m<sup>3</sup>) 100 mm thick with aluminum sheet metal jacket 0.8 mm thick as described for heating water pipes in Mechanical Rooms

### **C. Boiler Control Panel & Electricals**

A fully factory prewired, tested and mounted boiler electrical panel shall be installed at the front end or side of boiler.

The control panel shall be fully enclosed, hinged, dust-proof. The control panel shall be of the PLC type fully programmable. The cascade operation of the two boilers shall be fully automatic, with the first boiler with the main controller being the master and the second boiler being the slave with a PCB. The connection between the two boilers shall be using a bus cable.

All sensors shall be connected to the main control panel. The system shall include the following sensors:

- ☐ Outside temperature sensor.
- ☐ Indoor temperature sensor with automatic mode, night mode or off mode.
- ☐ Aquastat sensors.
- ☐ Supply water temperature sensor.

The control panel shall include:

- ☐ A step-down control transformer.
- ☐ Control and power fuses.
- ☐ All relays and transformers.
- ☐ A blower motor starter with overloads and auxiliary contracts.
- ☐ A oil pump motor starter with overloads and auxiliary contracts.
- ☐ The flame safeguard and programming relay complete: Base.
- ☐ Chassis and modules as outlined elsewhere.
- ☐ Terminal strips, numbered for easy tracing of wiring, complete with all hardware.

All wires running out of the panel shall be installed within metallic conduits and terminated at the punched holes to the panel sides, with the required hardware as per IEC code.

Refer to division 16, section for wiring recommendations shall stay on until the failure condition has been corrected.

The control panel shall be able to be programmed for a full week. It shall take also night or day mode in addition to weekend mode.

The reading of the outside temperature sensor shall regulate the supply water temperature to meet the required load and comfort.

#### **D. Boiler & Burner Manufacturers:**

Obtain unit from one of the following:

De Dietrich (France)

Buderus (Germany)

#### **Chemical Feeder Pot**

The unit shall be of a quality construction with dished ends for safe operation at pressure and shall be supplied complete with all valves and funnels all factory assembled. The feeder unit shall be supplied with a stand and shall be pressure tested with a certificate from the factory.

Chemical feeder pot shall be similar to Houseman dosage pots or approved equal.

#### **Expansion Tank**

Provide compression tank (expansion tank) as shown on the drawings, constructed for 930 Kpa working pressure, stamped with "U" symbol and supplied with National Board from U-1 denoting compliance with ASME boiler and pressure vessel code or any equivalent European standards. Provide fittings and connections to related equipment in accordance with tanks manufacturer's recommendations. Tank shall be insulated externally. Insulation shall be same type used for exposed ductwork, specified hereinbefore. Tank diaphragm shall withstand 10 deg. C up to 120° suitable for heating water systems.

Refer to drawings for tank support.

#### **Heating Water Treatment**

Contractor shall assign a chemical specialist to execute all chemical treatment works subject to the approval of the Engineer.

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The scope of work for the chemical treatment specialist is as follows :

1. Chemical Supply
2. Supervision of treatment program applied
3. Water analysis and recommendations.

The mechanical contractor shall make sure that the following are completed and handed over to the engineer prior to commencement of water treatment works:

1. System is electromechanical operating.
2. System is tested and pressurized for leaks.
3. System to be cleaned should be final and any new loops to be connected should be separately.
4. Drain points should be provided and sufficient for quick system draining.
5. Make-up water supply should match with system volume.

### **3. EXECUTION**

#### **General Installation**

##### **A. Piping**

The piping shall be installed generally as described and as shown on the drawings for heating water.

Install thermometers in piping system adjacent to the heat exchanger inlet and outlet secondary connections.

Install strainers in water piping a head of all pumps, automatic modulating valves, and heating coils.

Provide balancing valves and pressure gage cocks in all returns from three way valve bypass loops to balance the system.

Balancing valves shall be required on the return of each branch main to balance the system.

Provide flexible connections at the inlet and outlet to all major equipment which require vibration isolation.

B. General : Except as otherwise indicated, install heating plant work, including components and controls required for boiler operation, in accordance with boiler manufacturer's instructions, and. with recognized industry practices, to ensure that boiler equipment complies With requirements and serves intended purposes.

C. Locate boilers in general position indicated in relation to other work. Position boilers with sufficient clearance for normal service and maintenance, including clearance for cleaning and replacement of tubes and clearance for component replacement.

D. Paint damaged and abraded factory finish with touch-up paint matching factory finish.

### **Examination of Related Work**

Observe installation of other work (related and connected to boiler work) and after completion check for inadequacies and protect operation and performance of boiler work to suit boiler manufacturer's requirements and to the Royal Commission's satisfaction and approval, do not start boiler work until inadequacies have been corrected in a manner acceptable to the Engineer.

### **Field Quality Control**

Manufacturer's Supervision: Boiler manufacturer shall supervise field assembly (if any) and installation of boiler work, with a factory-trained technical service representative, for a minimum of 2 working days, plus one additional day for each boiler unit in excess of one. Prepare manufacturer's written report of installation.

### **Boiler Start-Up**

General: Except as otherwise indicated, start-up boiler in accordance with boiler manufacturer's instructions.

Sustained Operation: Do not place boiler in sustained operation prior to initial balancing of mechanical systems affected by boiler operation. Refer to requirements of Division 15 sections for testing, adjusting, and balancing.

Cooperate with other trades of other work during the testing, adjusting, balancing and start-up of mechanical systems

### **Testing**

General: Except as otherwise indicated, test boiler as directed by the Engineer.

## 4. FUEL OIL SYSTEM

### GENERAL

#### System Description

A. This Section covers:

1. The daily services tanks constructed of steel
2. Underground main fuel tanks.
3. The oil feed pumps and piping circuits.

#### Quality Assurance

A. Manufacturers Qualifications

1. The manufacturer must be experienced in the manufacture of the type and size of tank using the materials specified and shall be approved.

#### References

A. Refer to individual materials for specified standards.

B. American Petroleum Institute ( API )

1. API - 650 Fabrication of Oil Tanks.

#### Submittals

A. Product Data

1. Descriptive literature for each of the actual proposed equipment to be used including :
  - a. Capacity.
  - b. Test Reports.
  - c. Certificates of Approval .
  - d. Operating and Maintenance Data .
  - e. Any other Technical Data.



## B. Shop Drawings

1. Shop drawings for each of the actual proposed equipment shall include the following :
  - a. Working or Manufacturing Drawings.
  - b. Calculations.
  - c. Installation Details.
  - d. Connections by Other Services.
  - e. Wiring Diagrams.
  - f. Accessories Available Indicating Those Included.
  - g. System Diagrams.

## PRODUCTS

### Pipes And Tubes

A. Refer to Part 3 Article “ Piping Applications” for identification of system where pipe and tube materials specified below are used.

B. Steel pipe : ASTM A53, Schedule 40, Seamless type, Grade B, black, with beveled ends.

### Pipes And Tubes Fittings

A. Refer to Part 3 Article “ Piping Applications” for identification of system where pipe and tube fitting materials specified below are used.

B. Malleable-iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads according to ASME B1.20.1.

C. Steel Fittings: ASTM A 234/A 234M, welded, for welded joints.

### Oil Safety Valves :

UL-listed for flammable or volatile liquids, 1725 kPa maximum working pressure, 288 deg C maximum operation temperature. Include ASTM B 61 bronze body, bronze bases and discs, and field adjustable cadmium- plated carbon steel springs, factory set at 20 percent above operating pressure. End connections have inside threads according to ASME B1.20.1.

## **Oil Tanks**

### **A. General**

1. Fuel oil storage tanks shall be provided where located on the drawings with capacities as scheduled.

### **B. Storage Tank (Horizontal Mounting)**

- Tank shall be constructed of 4 mm. thick welded black steel sheet metal to the capacities indicated on the Drawings.
- Tank shall be tested for leaks before installation and shall be painted with two coats of red lead oxide or approved equal, and two coats black bituminous paint.
- Tank shall be mounted on a concrete pad and shall be equipped with the following:
  - \* Manhole and manhole cover, air tight.
  - \* Protected oil level indicator fixed to the tank.
  - \* Fill and vent pipes.
  - \* Gate valves as shown on drawings.
  - \* Overflow, drain and supply lines.

### **C. Fuel Oil Strainers**

Y-pattern, full size of connecting piping. Include Type 304 stainless steel screens with 1.2 mm perforations.

1. Pressure Rating: 860 kPa (125 psig) minimum steam working pressure.
2. Size 65 mm and Smaller: Bronze body, with female threaded ends.
3. Sizes 80 mm and Larger: Cast-iron body, with flanged ends.
4. Screwed screen retainer with centered blow-down and pipe plug.

#### D. Level Switches in Fuel Tank

Level switches installed in daily fuel oil tank all on one stem to operate solenoid valve shall be of the type suitable for fuel oil with four level switches as indicated on drawings. Mounting and stem material shall be of brass, float shall be of polysulfone or polypropylene. Switches shall give signal for:

- Low level alarm
- Low level open valve.
- High level close valve.
- High level alarm.

Grip rings shall be of copper and collar of brass Stem size shall be 5/16 inches diameters of the adjustable type with length suitable for day tank height.

Level switch shall be UL listed, Thomas products LTD level and flow switches mode 4000 or approved equal.

Low level switch and high level switch in underground fuel tank shall be as described above but shall give low level signal BMS and high level signal to give alarm that tank is over filled with fuel oil by tanker and a signal to BMS.

#### Flame Arrestor

Flame arrestor shall be installed at end of fuel oil vent pipes and shall consist of a series of sturdy round discs mounted on a durable collar casing.

Flame arrestor shall be constructed of light weight cast aluminum collar, weather hood and flame arrestor plates. Flame arrestors shall be UL listed with quality assurance from factory before shipment.

Flame arrestor shall be Protectoseal Model No 6670 or approved equal.

#### Pressurization and Expansion Units

##### HWS Expansion Vessels

Expansion vessels shall be constructed of mild steel generally in accordance with BS 4814 and BS 5169 and as per ASME section VII Div. 1.

Each vessel shall be provided with a removable, heavy duty Butyl rubber bladder, removes easily for inspection and maintenance.

Each vessel shall be suitable for the working pressure of the system and shall be provided with a charging valve connections and feed connection to the system.  
The vessels shall be suitable for the total water content of the various systems.

**EXECUTION**

**Piping Applications**

A. Aboveground Piping, Sizes 50 mm and smaller : Steel pipe, malleable-iron fittings, and threaded joints.

**Pipe Installations**

A. Install strainers on the supply side of each control valve, pressure regulating valve, oil burner connection, and elsewhere as indicated. Install 20 mm pipe nipple and ball valve in blow-down connection of strainers 50 mm and larger. Use same size nipple and valve as blow-off connection of strainer.

**Hanger And Support Installation**

- A. Refer to Division 15 Section “ Hangers & Supports “ for hanger and support devices.
- B. Install hangers for horizontal piping with following maximum spacing and minimum rod sizes :

Nominal Pipe Size ( Millimeters)	Span (Meters)	Steel Pipe Max. Diameter (Millimeters)	Min. Rod Diameter (Millimeters)
15 & smaller	2.1	2.1	
20	2.1	2.1	
25	2.1	2.1	

- Support vertical steel pipe at each floor and at spacing not greater than 4.6m.

**Valve Installations**

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install gate valves at each branch connection to supply mains and elsewhere as indicated.

C. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

### **Terminal Equipment Connections**

A. Sediment raps : Install a “T” fitting with the bottom outlet plugged or capped as close to the inlet of the oil burning appliance as practical. Drip leg shall be a minimum of 3 pipe diameter in length.

### **Field Quality Control**

A. Test fuel oil piping according to NFPA 31 . Remark leaking joints and connections using new materials.

B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

### **Demonstration**

A. Train Owner’s maintenance personal on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in Operating and Maintenance Manuals. Refer to Division 1 Section “ Project Closeout”.

C. Schedule training with Owner with at least 7 days advance notice

### **Commissioning**

A. Before activating system perform these steps:

- 1- Open valves to full open position and close bypass valves.
- 2- Remove and clean strainer screens.
- 3- Check pump for proper direction of rotation.
- 4- Fill oil storage tank with proper fuel type.
- 5- Check operating controls of fuel burner units.
- 6- Check operation at automatic bypass valves.
- 7- Check and set operating temperature controls on oil heaters.

**CHAPTER SEVEN**  
**VENTILATION**

7.0 VENTILATION

TABLE OF CONTENTS

- 1. Ductwork
- 2. Ductwork ancillaries
- 3. Dampers and terminal units
- 4. Inlet and outlet terminals
- 5. Fans

## **1. DUCTWORK**

### **1.1 General**

All site measurements for manufacture and installation co-ordination of ductwork shall be taken by the Contractor.

Ducts shall be anchored securely to the structure in an approved manner and shall be installed so as to be completely free from vibration under all conditions of operation.

### **1.2 Construction of Sheet Metal Ductwork**

Supply and install all ductwork as shown on the drawings and specified therein.

Ducts shall be constructed of galvanized steel sheets conforming to ASTM A 526-71, galvanized by the hot-dip process coating designation G90 or approved equivalent standard. Minimum weight of zinc coating (total on both sides) 275 g/m<sup>2</sup>.

Ductwork shall be installed in accordance with ASHRAE or SMACNA requirements for low pressure ducts.

Ductwork galvanized after manufacture shall be of adequate thickness to avoid undue distortion during the galvanizing process. All ductwork shall be to the approval of the Engineer.

The ductwork shall be manufactured without longitudinal joints at the bottom and suitable gaskets shall be provided at flanges to prevent leakage of condensation. The ductwork shall be installed with a fall back to the dishwasher or grease filters as applicable. Access doors shall be provided for inspection and cleaning at 3 meters intervals and at each change in direction. Where restricted space dictates that these access panels must be mounted on the bottom face of the duct an internal lip shall be incorporated to minimize the risk of spillage. The access panels shall be provided with suitable gaskets.

Sheet metal ducts shall be properly braced and reinforced with steel angles or other structural members approved by the Engineer all in accordance with ASHRAE & SMACNA requirements. Unless otherwise required, the internal ends of all slip joints shall be installed in the direction of flow.



## **2. DUCTWORK ANCILLARIES**

### **2.1 Flexible Connectors**

#### **2.1.1 General**

Flexible connectors shall be included in the price on ductwork crossing building movement joints on all fan and air handling plant ducting connections including fan coil units and grille/diffuser plenum boxes to provide isolation. Metal ducts shall be arranged so that there is a clear gap of not less than 100 mm or greater than 200mm where necessary between the ends of the ducts and the fan spigots, and the ducts shall be supported either side of the connector to ensure the alignment of the duct and/or fan spigots.

Flexible connectors shall be hemmed and seamed as appropriate and formed to a section to suit the dimensions of the duct or fan connection.

The flexible connections shall be made from non-inflammable and rot resistant approved material with a surface spread of flame of Class '0' as defined in BS 476 Part 7 in ceiling voids and Class '1' to BS 476 Part 7 in plantrooms. The material shall be of adequate thickness to give a minimum of noise reduction of 12 dB at 125 Hz.

#### **2.1.2 Sheet Metal Ducting**

Angle iron welded flange frames shall be secured to the ends of the flexibles by riveting through the inside flange of the angle iron and using a flat mild steel backing strap on the outside of the flexible. Mating flanges shall be provided unless otherwise specified on the adjacent ductwork or fan connection.

In rectangular ductwork other than fan connections with the longest side less than 450 mm the flexible may be riveted direct to the ductwork using a flat mild steel backing strap or when approved a four piece bolted band clip provided that angle iron stiffeners are fitted to the ductwork.

In circular ductwork other than on fan connections and ductwork over 900 mm diameter mating flanges may be omitted and flexibles secured with a worm driven draw up band clip provided that angle iron stiffening rings are fitted to the ductwork.

### 3. DAMPERS AND TERMINAL UNITS

#### 3.1 Fire Dampers

##### Sheet Metal Ductwork

Fire dampers and duct access panels shall be provided wherever ductwork penetrates a fire barrier.

Fire dampers shall be stainless steel curtain dampers comprising a continuous series of folded interlocked blades contained within, and arranged to close the opening of a surrounding frame.

The damper blades when set shall fold up out of the airstream.

The damper blades shall be of not less than 0.7 mm stainless steel strip type 430 to BS 1449. All blades shall be shaped on both edges to form a continuous interlocking hinge extending the full length of the blade to ensure correctness of action, each blade incorporating two Vee formed ribs along each blade length for maximum strength.

The blade assembly shall be fixed to the damper framework by the first blade being secured flat to the inside face of one side of the outer frame.

The damper casing shall be of rolled section so shaped as to provide two 25.4 mm internal flanges spaced at not more than 78 mm apart. This frame shall be airtight and of not less than 1.59 mm strip mill cold reduced sheet continuously hot dipped galvanized to BS 2989, Group 2, Class B.

All welded edges and joints shall be protected with zinc chromate primer or zinc rich paint.

Spring tempered 0.25 mm stainless steel type 301S21 to BS 1449 side gasketing shall be inserted between the blade end and damper casing to provide an increased blade edge seal to reduce the passage of smoke and combustible gases.

The blades shall be held open by a purpose made straight bar type fusible link, locking into two stainless steel cam latch assemblies or similar.

This link assembly, combined with a ramp blade release toggle fitted to the leading blade of each fire damper assembly, shall allow the fire damper to be tested and reset from either side of the damper when installed. The fusible link shall be rated 72°C unless otherwise specified.

The unit shall include indication that the damper is closed.

The dampers shall be clearly marked "bottom of unit" to assist correct installation.

All dampers shall be closed by two constant tension coil band springs exerting a pull of not less than 35N, and shall be capable of completely closing against the normal in duct air flow total pressure. These springs shall be stainless steel 17/7PH or type 304S31 to BS 1449 and not less than 19 mm wide by 0.3 mm thick.

The coiled end of the spring shall be retained around a stainless steel pivot fixed to a catch plate in such a way that it will not become dislodged from the pivot by side movement.

### **3.2 Constant Volume Dampers**

The Contractor shall supply and install as indicated in the Scope of Works constant volume controllers designed to maintain a constant downstream duct pressure regardless of fluctuating upstream pressures.

The controller shall be system operated with mechanical constant volume action factory preset to the required air volume.

The volume tolerance shall be + 5% with a pressure variation of 700 Pa.

The constant volume control damper shall be manufactured from galvanized steel in circular construction with damping by air bellows and a stainless steel control spring. The blade spindle shall be mounted in ball bearings. The control damper shall be suitable for connection to circular ductwork. It shall be possible to site adjust the volume setting.

Each supply unit shall be provided complete with a downstream LTHW reheater battery and with outlet attenuation to achieve the relevant required room noise level, all as a composite proprietary constant volume terminal unit.

### **3.3 Hand Operated Volume Control Dampers**

#### **3.3.1 Sheet Metal Ductwork**

Galvanized steel aerofoil opposed blade control dampers shall be installed on systems without constant volume dampers to ensure the ventilation systems can be properly balanced. The use of opposed blade dampers behind diffusers to balance ductwork branches will not be permitted. A separate branch ductwork damper shall be provided and the diffuser damper used only for fine-tuning of the flow to the room. Blades shall be of a low profile and aspect ratio for lowest possible turbulences, air resistance and noise. The blade size shall be such as will permit site withdrawal of the complete damper regardless of damper blade position.

Volume control dampers shall be provided on every main duct, branch duct and sub-branch in accordance with the C.I.B.S.E. COMMISSIONING CODE.

Damper control shall be via finely toothed precision moulded nylon gears and bearings, which shall be completely out of the air stream. The gearing shall have a 4:1 ratio to give minimum torque during operation.

All moving parts shall be enclosed in a galvanized sheet steel dustproof control box and be complete with visual blade position indicator, operating and locking assembly.

The damper casing shall be of slimline airtight dustproof double skin construction of high rigidity and maximum strength. The outer frame shall be manufactured from roll formed 1.6 mm galvanized steel and the inner frame from 1.0 mm. The outer frame shall have continuously welded corners and integral peripheral flanges pre-punched with elongated holes for ease of duct attachment and height adjustment. The external damper casing surface area shall have only one penetration of drive shaft to simplify insulation where required.

In large ducts where a multiple assembly is required the dampers shall be arranged so that control shall be from one central control.

In circular low velocity (not exceeding 7.5 m/s) ductwork dampers shall be as specified above and fitted with rectangular to circular masking plates. The air leakage past the damper shall not exceed 5% when in the fully closed position at a static pressure equal to the maximum static pressure in the system.

All volume control dampers shall be supplied with duct access panels as specified.

### **3.4 Back Pressure Dampers**

Backpressure dampers shall be of the automatic self-operating type and constructed in a galvanized mild steel frame with flanged connections drilled for installation in the ductwork system. The blades shall be coupled together and shall be constructed from aluminium on stainless steel shafts with bronze bearings and neoprene seals.

## **4. INLET AND OUTLET TERMINALS**

### **4.1 Grilles**

The Contractor shall select and locate the grilles and diffusers and coordinate them into the architectural reflected ceiling plans where applicable.

During construction the Contractor shall co-ordinate the location and fixing of the grilles and diffusers with the ceiling installations. The Contractor shall site measure and agree with the Engineer the final dimensions of all grilles and diffusers before manufacture.

## **4.2 Louvers**

Intake and discharge louvers in the face of the building will be provided as part of the Mechanical Contract and are therefore included in the Scope of the Mechanical Services. All louvers shall be of aluminum construction, weather proof and complete with bird screens.

Acoustic louvers, silencers etc. shall be installed as indicated on the drawings. All louvers will be painted to match the buildings facia.

### **Approved Manufacturers**

- a. KBE
- b. Trox
- c. Titus

or approved equal.

## **5. FANS**

### **5.1 General**

The Contractor shall supply and install in accordance with this Specification, fan and motor assemblies as detailed in the Schedules of Equipment and as indicated on the drawings.

Fan unit performance curves derived in accordance with BS 848 shall be supplied showing volume, static pressure, maximum absorbed kW and static efficiency with the unit operating condition clearly marked. These details shall be issued to the Engineer for approval prior to the fans being installed.

A sound spectrum for each fan and motor assembly derived in accordance with BS 848 shall be supplied to the Engineer before manufacture, but under no circumstances shall the sound power level exceed that given in the Schedule of Equipment.

Additional attenuation is specified in the Schedules to meet specific noise criteria for fan systems. Where fans are supplied having different sound spectrum or ductwork is modified, the attenuator insertion losses shall be adjusted to ensure design noise criteria are maintained.

The fan motors shall comply with the relevant clauses on Electric Motors set down elsewhere in this Specification.

Unless otherwise specified or detailed each fan assembly shall be installed on a 150 mm concrete base and shall be isolated from the structure by anti-vibration mountings in accordance with the relevant clauses of this Specification.

The complete fan assembly shall be primed and painted in a colour to be agreed with the Engineer and in accordance with the relevant section of this Specification relating to painting.

Each fan shall be isolated from the ductwork installation by flexible connections complying with the relevant clauses set down elsewhere in this Specification.

## **5.2 Axial Flow Fans**

Axial flow fan impellers shall be of the multi-blade type dynamically balanced with blades of 'aerofoil section' constructed from aluminum alloy.

The casings shall be of the long type of heavy gauge mild steel having flanges at both ends and hot dipped galvanized to BS 729 after manufacture.

The casings shall be provided with bolted inspection doors and an external weatherproof terminal box.

The impellers shall be direct driven by motors of totally enclosed continuously rated 3-phase type with ball bearings and extended grease point. The impellers shall be capable of giving fan total efficiency of not less than 75%.

Purpose made feet shall be provided on the fan casing for supporting the fans.

The fan speed shall not exceed 24 rps (1440 rpm).

Each axial flow fan shall be supported by means of a strong rolled steel angle or channel frame from the steelwork, wall or floors as necessary.

## **5.3 Approved Manufacturers**

- a. Penn
- b. Woods
- c. Ventaxia
- d. Kanaflakt
- e. Greenheck
- f. Acme

or approved equal.

**CHAPTER EIGHT**  
**FIRE PROTECTION**

8.0 FIRE PROTECTION

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- 1. General
- 2. Products



## **PART 1.0 – GENERAL**

### **1.1 DESCRIPTION**

This section of the specifications includes the furnishing and installation of fire extinguisher.

## **PART 2.0 - PRODUCTS**

### **2.1 PORTABLE FIRE EXTINGUISHERS**

Portable fire extinguishers shall be provided to the types specified, and at locations as shown on the drawings. Standard portable fire extinguishers are 10 pound (4.54 kilogram) ABC dry chemical units with a UL rating of 4A-60BC. A 20 pound (9.07 kilogram) BC dry chemical unit shall be located adjacent to each cooking line. Carbon dioxide extinguishers shall be provided for all electrical equipment areas.

Portable extinguishers shall be located within combined hose rack cabinets where shown, or attached to walls with purpose made brackets. Extinguishers with a gross weight of forty (40) pounds (18.14 kilograms) or less, may be installed in a position where the top of the extinguisher is no more than 5 feet (1.53 metres) above the floor. Extinguishers with a gross weight in excess of forty (40) pounds (18.14 kilograms) shall be installed such that the top of the extinguisher is no more than 42" (1070mm) above the floor.

### **2.3 APPROVED MANUFACTURERS**

- a. Kiddi
- b. ABC
- c. Fridhom

or approved equal.

**CHAPTER NINE**  
**WATER TREATMENT**

## **8.0 WATER TREATMENT**

### **PRODUCT: COMMERCIAL REVERSE OSMOSIS SYSTEM**

#### **1.0 GENERAL**

Furnish a commercial reverse osmosis system (RO) as specified here in this section and as called for in the equipment schedule for the reduction of total dissolved solids. The RO shall be supplied complete, and assembled entirely by one manufacturer. System to include all components required for proper operation of the system. These components include system control package, flow meters, high pressure pump, membranes, pre-filter, adjustment valves, pressure gauges, automatic inlet valve, and frame. RO shall be from a known manufacturer with a proven record.

#### **3.0 COMPONENTS**

##### **3.1 System Support Frame**

All components of the reverse osmosis (RO) system will be mounted on a single support frame. The support frame shall be constructed of a one piece broke 304 stainless steel panel measuring .10" in thickness. The support frame shall be suitable for wall mounting.

##### **3.2 Pre Filter**

The pre-filter housing shall be a single element type constructed of FDA grade reinforced polypropylene and certified to NSF/ANSI standard 42. The housing will have a 100 PSI maximum working pressure and a maximum temperature rating of 100 deg. F (37 deg. C). The housing will have 1" NPT inlet and outlet and accept a 4 ½" X 10" single replaceable filter cartridge element... The housing will be sized to flow 15 GPM at a pressure drop of 3 PSI using a five micron pleated cartridge. The replaceable filter element shall be a pleated type five micron nominally rated cartridge with plastisol end caps. The pleated filter fabric shall be composed of 100% polyester to resist the growth of microbiologic films.

##### **3.3 High Pressure Pump**

A high pressure pump will be provided, mounted on the RO frame, to boost the membrane feed water pressure to a maximum of 250 psi. The pump shall be a multi-stage type with 304 stainless steel pump housing, motor adaptor base, pump shaft, and discharge. Impellers shall be constructed of acetal. All motors must be 230 volt 1 phase with ODP motor housings. 1.25 and 2.5 gpm production systems will use a 1 horsepower motor and 3.75 gpm production systems will use a 1.5 horsepower motor to ensure adequate membrane feed water volume and pressure.

##### **3.4 Membrane and Membrane Housings**

The membrane housings shall be constructed of fiberglass reinforced plastic for superior corrosion resistance, with glass reinforced polypropylene end caps. The maximum operating pressure of the housings shall be 300 psi. The housing's maximum operating temperature will be 100 deg. F (37 deg. C). Membranes shall be of a known brand. Membranes must have a minimum average salt rejection of 95% under the standard test conditions of 225 psi feed pressure, and 77 deg. F (25 deg. C), with a 2000 ppm NaCl feed solution at a pH of 7.0.

##### **3.5 System Controls**

The system will include electronic and hydraulic controls for automatic operation and manual adjustment. The electronic controller shall be a micro processor based controller with inputs and outputs for automation of the RO components. Input signals shall be: low feed water pressure, tank level full, and pretreatment interlock. Output signals shall be: open/close automatic inlet valve and start/stop high-pressure pump. The controller shall have an adjustable 10 minute through 80 minute delayed automatic restart after a low feed water pressure shut down to prevent on off cycling of the system during a low feed water pressure condition. The controller will have a rocker switch for manual on off control of the system and indicator lights for tank full/ pretreatment interlock, low pressure shut down, and supply power. The electronic controls will be housed in an ABS electrical enclosure with a NEMA 3 rated gasket sealed access door. The automatic inlet valve will be a normally closed nylon globe valve rated for 150 PSI maximum working pressure, 176 deg. F (80 deg. C) maximum temperature, with a 24V coil. Manual hydraulic control valves will be provided on the RO system to

regulate reject recycle and reject water volume. The reject water and recycle water adjustment valves shall be globe valves, constructed of 316 stainless steel, and rated for 300 psi maximum working pressure.

### **3.6 Flow indicators and Gauges**

The RO system will be supplied with pressure gauges to indicate the pressure of the pre-filter inlet, pre-filter outlet, and pump discharge water. All pressure gauges shall have an acrylic window. The pump discharge pressure gauge will be glycerine filled. Flow meters will be provided to give an indication of product and reject water flow rates. Flow meter flow rate scales are to be calibrated to gallons per minute and liters per minute within 3 percent accuracy. Flow meters shall be variable area inline type with disconnects at each end to ease internal cleaning of the meter body. Meter bodies are to be constructed of polysulfone or acrylic, with 316 stainless steel float and float rod, and viton orings. Prefilter inlet/outlet and pump discharge pressure gauges and all flow meters are to be mounted next to the electronic controller so that all are in plain view of the operator while the system is running.

### **3.7 System Piping**

Pump suction, pump discharge, reject and reject recycle piping will be high pressure UPVC pipes. Membrane interconnecting piping will be UPVC pressure pipes.

### **3.8 Test Kit**

Provide a Myron L model 6 P hand held water quality meter along with pH 4 and pH 10 calibration solutions and conductivity KCl- 7000 (7 mS), 442-3000 TDS calibration solutions. Each calibration solution shall be provided in a one quart quantity. Also provide a silt density index test kit, Watts model number T3031, for testing RO feed water SDI.

## **4.0 SERVICES**

### **4.1 Warranty**

Provide a 1 year parts and labor warranty for the system to protect against manufacturers defects. System shall not be subjected to water temperatures above 100 deg. F (37 deg. C), below 35 deg. F (2 deg. C), iron, hardness, or chlorine.

### **4.2 Start Up**

The Contractor providing the equipment shall provide startup of the RO system, a complete set of operating, maintenance, and installation instructions, one complete set of spare pre-filter cartridges for the pre-filter housing, and operator training.

## **Approved Manufacturers**

- a. Culligan
- b. Metito
- c. Emco
- d. Alama

or approved equal.

**CHAPTER TEN**  
**SANITARY FIXTURES**

## **9.0 SANITARY, FIXTURES**

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- 7b. Lavatory Fittings
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8. Sinks - Type KS
9. Bathrooms Accessories
10. Execution

## **1. GENERAL**

The Sanitary Fixtures Work shall consist of installing, testing and putting in operation all Sanitary Fixtures, accessoires, pipe fittings and equipment as here inafter specified and as show on the drawings.

## **2. GENERAL REQUIREMENTS**

- All fixtures and trimmings, in sofar as practicable, shall be of one manufacture.
- Ample application of petroleum jelly shall be made to all surfaces of exposed chrome plated piping, valves and fittings immediately after installation
- All fixtures shall be set straight and true.
- Concealed brackets, hangers and plates shall have a shop coat of paint.
- All exposed piping and trim shall be chrome plated and fully protected during installation.
- Strap or padded wrenches shall be used on chrome plated pipefittings and valves.

## **3. SANITARY FIXTURES**

- Sanitary fixtures shall be complete with all required trimming, including mixers, waste plugs or flow waste, traps, supplies, stop valves, escutcheons, casings and all necessary hangers, plates, brackets, anchors and supports.
- Vitreous china fixtures shall be of first quality with smooth glazed surfaces, free from warp, cracks, checks, discolorations or other imperfections.
- Enamelled cast iron fixtures shall be of acid - resisting type.
- The selection & approval of sanitary fixtures and their accessories & manufacturers is decided by the Client and or/his Representative

## **4. EXPOSED PIPING AND TRIM IN TOILET AREAS**

All piping, valves and fittings exposed to view shall be screwed, polished, chrome plated brass. Plating shall be accomplished after threading.

## 5. FIXTURE SETTING

Fixtures shall be set in a neat, finished and uniform manner making the connections to all fixtures at right angles to the wall, unless otherwise directed by the Engineer. Roughing for this work must be accurately laid out so as to conform to finished wall material. Fixtures are not to be set until so directed by the Engineer.

The location and disposition of all items shall be as indicated on the relevant drawings.

All fixtures and fittings shall be as detailed in the schedule of fixtures, indicated on the drawings.

## 6. WATER CLOSET - Type EWC

White vitreous china, dual flush, water closet with wall outlet, syphonic action. EWC shall be complete with the following fittings:

WC pan with side outlet, cistern of 6 litres capacity for bottom supply and overflow with plastics syphon fitting, flush valve and mechanism, HP/LP bottom supply ballvalve with refill unit,  $\frac{3}{4}$  in bottom overflow, servicing valve and close coupling fitment (cistern fittings are not reversible), and chrome plated side lever, seat and cover, screws (pair), Plastic outlet connector for connection to 102 bore soil pipe. System shall be completed with flushing hose.

EWC-1 Kids WC

EWC-2 Teacher / Student WC

EWC-3 Ditto as ECW-2 but for handicapped

EWC-4 Floor mounted – Kids

EWC-5 Floor mounted – Teacher / Student

## 7a. LAVATORY - Type LAV

White vitreous china lavatory shall be mounted basin into granite or marble vanity top and complete with the following fittings: 1 taphole ,mixer, 1  $\frac{1}{4}$  in bead waste, 1  $\frac{1}{4}$  in chrome bottle trap with 75mm seal concealed bracket with fixing clamps in aluminium alloy & servicing valve.

LAV-1 Kids LAV. (without mixers: Mixers specification, refer to Item 7b).

LAV-2 Teacher / Student LAV.

LAV-3 Ditto as LAV-2 but for handicapped

## 7b. LAVATORY FITTINGS

1 tap self close mixer, 1in bead waste, 1in chrome bottle trap fitted on LAV-1 & LAV-4 (Resin LAV-4: Refer to Architectural BOQ & Specifications)



### **7c. TAPS FOR BASINS**

Faucet shall be self-closing wall-mounted, push button and adjustable fitted on the pan as provided by others.

It shall include an integrated aerator, chrome finish complete with flow regulator, vandal proof and wall plate.

1¼" drain shall be provided with chrome plated trap and connected to the drain UPVC pipe.

The number of faucets shall be as shown on the drawings.

### **8. SINKS - Type KS**

Sinks shall be made of satin finish 18/10 non-ferrous stainless steel, lay on with back slash. Sinks shall be provided with the following: Mounting flange, Combination sink tap centre-set with swing spout & Stainless steel waste with over flow tube.

Kitchen sinks shall be provided with drain boards. Underside of compartment must contain sound absorbing asphaltic plate.

The mixer shall be provided with a gooseneck swing spout and aerator mounted on common deck base with loop for chain. Sinks shall be provided with vitreous china semi recessed soap and sponge holder.

KS-01 (60 – 120 cm width)

KS-02 (140 cm width)

### **9. BATHROOMS ACCESSORIES**

Refer to Architecture BOQ and Specifications.

### **10. EXECUTION**

#### **Fixture Joints**

Joints shall be standard fittings furnished with the fixtures. Where space conditions will not permit standard fittings, special short-radius fittings shall be provided.

The fixture joints on soil pipes shall be made absolutely gastight and watertight.

### **Strainers and Fixture Outlets**

Lavatory basins shall have waste outlets not less 30mm in diameter. Wastes may have open strainers or may be provided with stoppers.

Shower-receptaclewaste outlets shall be not less than 50mm in diameter and have removable strainers.

Sinks shall be provided with waste outlets not less than 40mm in diameter. Waste outlets shall have open strainers or shall be provided with stoppers.

### **Fixture Supports**

Wall hung plumbing fixtures not supported on chair carries shall be supported on wall hangers on screw bolts furnished with the fixtures.

Where appearance of the bolts is not objectionable, the fixture shall be fastened to the wall by through-joint bolts. Bolt heads or nuts shall be hexagonal and painted or chromium-plated, and washers shall be painted or chromium-plated to match bolt heads or nuts.

Where appearance of bolt heads or nuts is objectionable, fixture shall be fastened to walls by machine-bolt expansion shields or stud-type expansion bolts.

### **Fixture Traps**

Sanitary fixtures, excepting those having integral traps, shall be separately trapped by a water-seal trap, placed as close to the fixture outlet as possible.

The trap shall be of the same diameter as the fixture drain to which it is connected.

The fixture trap shall have a uniform interior and smooth waterway.

Each fixture trap shall have a water seal of not less than 60mm.

Fixture trap, except those integral or in combination with fixtures in which the trap seal is readily accessible or except when a portion of the trap is readily removable for cleaning purposes, shall have accessible brass trap-screw of ample size.

Cleanouts on the seal of a trap shall be made tight with threaded element plug and approved washer.

No fixture shall be double trapped.

**CHAPTER ELEVEN**  
**THERMAL INSULATION**

10.0 THERMAL INSULATION

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Products

1. PIPEWORK THERMAL INSULATION ( Type A)

A. Material

1. Thermal insulating material shall be made from long, fine fiber glass, Rockwool, free from short or coarse fibers, bonded with a temperature resistant binder and formed into a cylindrical or semi-cylindrical rigid pipe sections with aluminum foil facing as described in duct insulation of thickness as specified below with a thermal conductivity of not greater than 0.05W/m•C. Insulation exposed on roof tank and in Mechanical Rooms shall have a density of 96kg/m3. Insulation in false ceiling voids and shafts shall have a density of 64 kg/m3.

2. Thickness of Insulation

DOMESTIC HOT WATER SUPPLY AND HEATING WATER PIPES

NOM-BORE MM	THICKNESS MM
15-32	25
40-100	30
125	40
150 & above	50

3. The insulation shall have an alkalinity of between PH6.0 and PH10.0. Then insulation shall not include substances which will promote corrosive attack on the services with which it is to be in contact. The insulation shall also be free from objectionable odour at the temperature at which it is to be used, unable to encourage pests or support the growth of fungi, or suffer deterioration under the specific conditions of use or as

a result of contact with moisture due to thickness, uniformity of thickness and internal diameter from manufacturer's standards dimension are as follows:

Thickness : + 3 mm

Uniformity of thickness The local thickness at any point shall not differ from the average thickness by more than 3 mm.

Internal Diameter : -0+1.5 or 1% , whichever is the greater

### **Pipe Fittings Insulation**

- Where hangers are installed on the pipe covered with insulation, the entire hanger up to the rod shall be insulated.
- Where insulated piping is subject to movement and supported on rollers and chairs, or sliding plate brackets, steel protection saddles shall be provided.
- All insulated pipework not supported as described in Section 15060 but subject to movement, shall be provided with protection shields at all hanger locations. Shields shall be No. 10 gauge galvanized iron extending on each side of the hanger for a distance equal to the diameter of the insulation and shall be provided with cork pad support.
- Insulate valves, strainers, fittings and flanges with identical material, density, thickness and finish as the pipe insulation. Use premoulded material where available, otherwise use shaped block segments wired on with all edges filled with insulating cement or filler.
- Insulate strainers to permit removal of the basket without disturbing the insulation of the strainer body.

### **2. PIPEWORK THERMAL INSULATION ( TYPE B)**

This type of insulation shall apply to domestic hot water system under tiles or in walls.

Pipes shall be insulated with rubber type insulation Armaflex 19 mm thick. Insulation shall be closed cell tubing with finished skin, chemical and oil resistant with minimum water absorption. Insulation shall stand extremes temperatures ranging from 40°C to 120°C. Inner tubing insulation diameter shall be equal to outer utility pipe diameter. Rubber insulation shall be wrapped with 2 layers of PVC tape.

Insulation density shall be 0.111 Gms/m<sup>3</sup> with thermal conductivity K value at 40°C mean temperature 0.041 W/M-K insulation shall be self extinguishing.

Insulation shall be ASTM approved similar to Gulf – O – Flex or approved equal.

**3. APPROVED MANUFACTURERS**

Johns – Manville	( USA )
Armstrong	( France )
Fiberglass Limited	( UK )
Isotoprack	( Turkey )
ST. Goban	( France )
Al Fujairah Rockwool Factory	( U.A.E. )
Knauf Insulation	( USA )