PHILIPPINE GENERAL HOSPITAL
VARIOUS PROJECTS – P06

Taft Avenue, Ermita, Manila, Philippines

TECHNICAL SPECIFICATION FOR PLUMBING SYSTEMS

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PART 1 - INSTRUCTION TO BIDDERS

1.1 The Stipulated Bid Sum shall be for base Specification equipment only. Where a choice of base bid equipment is given, indicate selection included in Stipulated Bid Sum by submitting this Section. Failure to complete and submit this section will indicate that the GENERAL CONTRACTOR has agreed to provide the base bid equipment specified in each specification section, listed in each equipment schedule, and/or shown on the Drawings.

1.2 Express alternative prices as an addition to or deduction from the Stipulated Bid Sum.

1.3 The EMPLOYER reserves the right to accept or reject any alternative price offered.

1.4 The Stipulated Bid Sum will be adjusted by the addition or deduction of alternative prices accepted by EMPLOYER to form the Contract Price.

1.5 The EMPLOYER may select the GENERAL CONTRACTOR on the basis of the adjusted bid price.

1.6 Where modifications to the work of Other Trades are required as a result or part of the alternative offered, include the cost of said modifications in the alternative price offered.

1.7 Submit the following list of base bid and alternative suppliers in accordance with Bid requirements.

Spec. Reference Section	Equipment	Base Bid Manufacturer or Supplier	Alternative Mfg. or Supplier Name	Deduct From Base Bid Price
15055	Conductors and Cables	American Wire Columbia Phelps Dodge Philflex		
	Non-Metallic Conduit and Tubing	Atlanta Emerald Moldex Neltex	Crown	
	Metallic Conduit and Tubing	Allied Matsushita/Panasonic Smart Tube		
15061	Hangers	Grinnell Hilti Myatt Unistrut	Caddy-Erico Hokki	
15111	General Duty Valves (Gate, Ball, Globe, Check, Y-Strainers	Crane Honeywell (Bronze Only) Kitz (Japan) Nibco OCV Tozen (Japan) Victaulic	Gala Weilong	

Spec. Reference Section	Equipment	Base Bid Manufacturer or Supplier	Alternative Mfg. or Supplier Name	Deduct From Base Bid Price
15140	HDPE Pipes and Fittings	Geberit George Fisher REHAU Valsir	Atlanta Weixing	
15140	Water Meters	Arad Badger Crane Precision	Ace Asahi B Meter	
15140	Stainless Steel	Eldridge Sanyo Seiki		
15150 & 15160	Bell & Spigot Pipes	AB&I Charlotte	ASA Lino	
15150 & 15160	Hubless Cast Iron Pipes	Tyler Charlotte P-A Mousson	Lino Tiger Top One	
15150	Polyvinyl Chloride Pipes & Fittings	Crown Pipes Emerald Neltex	Imperial Moldex	
15150	Ductile Iron Pipes	Goodyear Nippon Zenith	Conglin	
15155 15140	Polypropelene Pipes & Fittings	Alfaidro Bugatti George Fischer Plastherm	Honeywell Pilsatherm Thermovar	
15155	Drainage Products	Jaman-Eurobrass J.R Smith Wade Zurn	JPI Metma	
15155	Grease Interceptor	AGI Edelstahl J.R. Smith Kessel Lowe Eng'ng. Zurn		
15480	Fire Cladding/Fire Stopping Materials	3M Metacaulk Promat Rectorseal Spec Seal Tremco		
15430	Electric Water Heaters	Ao-Smith Ecotherm Rheem Jett Amore Aqua Power		

END OF SECTION

SECTION 15010
GENERAL PROVISIONS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. These Specifications are an integral part of the Contract Documents. Tendering, Contract Requirements and General Requirements apply to all Division 15 Specification Sections.

B. Work in the Specifications is divided into descriptive Sections which are not intended to delegate functions or work to any specific Subcontractor or identify absolute contractual limits between Sub-contractor, nor between the Contractor and his Subcontractor. The requirements of any one Section apply to all other Sections, for example: the motor service factor requirement. Refer to other Divisions and Sections to ensure a completed operational product and fully coordinated standard of work.

C. The direction to 'provide' equipment, materials, products, labour and services shall be interpreted to 'supply, install and test' the Division 15 work indicated on the Drawings and specified in the Specifications.

D. Provide and include in the Contract Price Division 15 work including mechanical components and normal system accessories not shown on the Drawings or stipulated in the Specifications, and required to ensure completed operational systems and a fully coordinated standard of Work acceptable to the Consultant and all authorities having jurisdiction.

E. The work essentially shall include, but shall not be limited to the following items:

1. Submission of technical material/specifications and samples of all supply items for approval by the Consultant(s).

2. Submission of shop drawings of all items for fabrication for approval by the Consultant(s) prior to fabrication.

3. Application and securing of required permits and licenses including facilitating inspection by governing agencies and payment of all fees levied therewith.

4. Supply, installation and testing of the following:

   a. Cold water supply system complete in all respects including submittals, shop drawings, piping, water meters, valves, back-flow preventer, bib, insulation, all accessories required for complete and operational of the system.

   b. Hot water supply system including installation of pipes, fitting valves and hot water heater for complete and operational of the system.

   c. Soil waste and vent system complete in all respect including connection to existing sewer, submittals, shop drawings, pipes, fittings, valves, cleanout, drains, etc. Complete and operational.

   d. Storm drainage system complete in all respect including connection to existing storm drainage, submittals, shop drawings, pipes, fittings, valves, cleanout, drains, etc. Complete and operational.

5. Provision for interfacing with others.
6. Fire stopping of all vertical and/or horizontal pipe penetration to fire rated

areas.

7. Miscellaneous Works:

   a. Hacking of non-structural wall and partitions to provide opening for pipes and sealing of opening around sleeves and pipes including provision of escutcheon plates.

   b. Grouting of opening in walls after such pipes are in place and sealing of all such openings if not used.

   c. Flushing of newly installed plumbing system.

   d. Restoration/repair of existing structures damaged during installation.

   e. Miscellaneous items and other provisions required to maintain cleanliness level of adjacent areas during the entire duration of construction.

   f. Full instruction after completing the job to the Maintenance Personnel regarding operation and maintenance operation of the entire installation. Provide complete printed/type instruction booklets (hardbound) covering maintenance operation and adjustment of each piece of equipment and list of each spare parts.

8. Testing and commissioning.

9. Submission of five (05) sets of operations and maintenance manuals and as-built plans.

10. Training of Owner's plant operators on the system's maintenance and operation.

11. Coordination with other trades for special requirements for this package. (i.e. concrete pads, block-outs, relays, etc.)

12. Provision of guarantee as specified in the Specifications.

1.2 QUALITY ASSURANCE

A. Comply with the current applicable codes, ordinances, and regulations of the authority or authorities having jurisdiction, the rules, regulations and requirements of the utility companies serving the project and the Owner's insurance underwriter.

B. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, the more stringent apply.

C. Should any change in drawings or specifications be required to comply with the governing regulations, notify the Project Manager prior to submitting bid.

D. All equipment and installations shall meet or exceed minimum requirements of the Standards and Codes listed under item 1.3.

E. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced, full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

1.3 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1.	PS	Philippines Standard
2.	PEC	Philippine Electrical Code (Part 1:1992, Part 2:1988)
3.	ANSI	American National Standards Institute
4.	ASTM	American Society for Testing and Materials
5.	ETL	Electrical Testing Laboratories
6.	IEC	International Electro-technical Committee
7.	IEEE	Institute of Electrical and Electronic Engineers
8.	IES	Illuminating Engineering Society
9.	NEC	National Electrical Code
10.	NEMA	National Electrical Manufacturer's Association
11.	NFPA	National Fire Protection Association
12.	UL	Underwriters Laboratory
13.	AMCA	Air Moving & Conditioning Association
14.	ADC	Air Diffusion Council
15.	ARI	Air Conditioning & Refrigeration Institute
16.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
17.	ASME	American Society of Mechanical Engineers
18.	AWWA	American Water Works Association
19.	PSME	Philippine Society of Mechanical Engineering Code
20.	NPCP	National Plumbing Code of the Philippines
21.	NBCP	National Building Code of the Philippines
22.	FCP	Fire Code of the Philippines
23.	IPC	International Plumbing Code
24.	IMC	International Mechanical Code
25.	FM	Factory Mutual
26.	NBS	National Bureau of Standards
27.	ASPE	American Society of Plumbing Engineers (Handbook)

B. Definitions

1. Where it is stated in these specifications to submit to Engineer for review, refer to Architectural General and Special Conditions for proper procedures.

2. FURNISH means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application.

3. INSTALL means to join, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.

4. PROVIDE means to FURNISH, INSTALL and TEST.

5. AS DIRECTED means as directed by the Project Manager, or his representative.

6. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, furniture wiring management or installed within hung ceilings.

7. SUBMIT means submit to Project Manager for review.

8. "Architect", "Project Manager/Engineer", "Consultant", "Employer's Representative", "Owner", the Party or Parties responsible for interpreting, accepting and otherwise ruling on the performance under "this Contract".

9. "Contractor", the party responsible of the installation.

1.4 REFERENCE STANDARDS

A. Provide new materials and equipment of proven design and quality. Provide current models of equipment with published ratings certified by recognized local and international testing and standards agencies.

B. Workmanship and installation methods shall conform to the best modern practice. Employ skilled tradesmen to perform work under the direct supervision of fully qualified personnel.

C. Install equipment in strict accordance with manufacturers written recommendations.

D. Meet ASTM, ANSI, AWWA and other industry standards in the selection and provision of equipment, materials, pipe and system components.

E. Meet ASTM, ANSI, AWWA Standards for the supply and installation of all equipment.

F. Meet the additional selection, sizing and performance criteria specified in this Specification.

1.5 REGULATORY REQUIREMENTS

A. Meet the requirements and recommendations of local Municipal Ordinances.

1.6 COORDINATION

A. Coordinate and schedule Division 15 work with all other work in the same area or with work which is dependent upon Division 15 work so as to facilitate mutual progress.

B. Identify and resolve interference problems prior to prefabrication and installation of equipment. Submit interference drawings for review upon Consultant Request.

C. Examine the site and all Contract Documents prior to bid submission. No allowance will be made for any difficulties encountered due to any features of the building, methods of construction, site or surrounding public and private property which existed up to the bid close.

1.7 CHANGES TO CONTRACT WORK

A. Do not proceed with any changes to the Work without written authority from the Owner.

B. Follow procedures outlined in Tendering and Contract Requirements for administration and execution of Contract revisions.

C. Quotations for changes to Division 15 work shall be based on:

1. Methods either approved or directed by the Consultant.

1.8 PRE-PURCHASED EQUIPMENT (NOT APPLICABLE)

A. Where equipment has been pre-purchased by the Owner for installation by Division 15, assume complete responsibility for acceptance, delivery schedule, off-loading, storage, rigging, installation, protection, start-up and warranty of this equipment, all as if the equipment were provided by Division 15.

B. The responsibilities of the equipment supplier are delineated in the pre-purchase documents which are available for Contractor review during the bid period.

C. The following equipment has been pre-tendered in order to ensure equipment delivery in time to meet the building construction schedule.

D. Include in Contract Price, the cost of the following pre-purchased equipment.

E. The Owner shall bear the equipment and FOB job site shipping costs directly.

F. Request from the Owner, full details of the equipment and the manufacturer's Shop Drawings. Include related information in the Operating and Maintenance Manual.

G. Assume extensions of warranties to meet specified times.

1.9 DEFECTS LIABILITY PERIOD

A. The Defects Liability Period for the purposes of this Sub-Contract shall be a period of twelve months from the 'Date of Practical Completion', providing that during such period the Sub-Contractor shall have remedied and made good all faults or defects as described below, to the Employer's Representative satisfaction.

B. During the Defects Liability Period, the Sub-Contractor shall at his own cost remedy and make good with all possible speed any faults or defects in the Plant or Works due, in the opinion of the Employer's Representative, to faulty materials, workmanship or design and, shall indemnify the Employer and/or the Main Building Contractor against any damage or injury to the Building contents and/or occupants arising as a result of such faults or defects.

C. If the Sub-Contractor fails to remedy such faults or defects within a reasonable time the Employer may proceed to do so at the risk and expense of the Sub-Contractor and without prejudice to such other rights as the Employer may have under the Sub-Contract.

D. Other requirements shall be as described in the relevant section of the Specification.

1.10 INSTRUCTIONS TO BIDDERS

A. Submit Supplementary Sanitary Bid Form. Failure to comply with the stated requirements of the Bid Form may nullify the bid.

B. The Bidder is invited to submit additional alternative prices not specifically requested with the Bid.

C. Alternative prices may be used to establish the lowest Contract Price.

D. The lowest or any Bid will not necessarily be accepted.

1.11 SEPARATE PRICES

A. Submit separate prices on the Bid Form and express as a credit or an extra to the Stipulated Bid Sum.

B. Calculation of the Contract Price will include separate prices consistent with their acceptance or rejection by the Owner.

1.12 ALTERNATIVE MANUFACTURER AND SUPPLIERS

A. Equipment and materials are specifically described for the purpose of indicating standards of quality and workmanship. Base Bid on the items specified and shown on Drawings.

B. Alternatives for equipment or materials considered equal in quality and performance may be submitted with the Bid Form. Supply with each alternative, following bid submission, upon request by Consultant, the following information:

1. Details of manufacture

2. Dimensions including required clearance

3. Performance data

4. The cost saving for piping and electrical changes imposed by the alternative

5. The effect upon and cost to other trades

C. Where alternatives are accepted, there will be no further cost allowances for subsequent changes in Division 15 work or other Contracts to make the alternative complete and equal to the specified equipment and materials.

D. If alternative equipment, differing from that which is shown on Drawings is accepted, prepare when requested, equipment layouts at no extra cost. Show clearly in plan, elevations and sections, all equipment details including dimensional changes. Show location changes to pipes and wiring and the effect of these changes on the building. Drawings shall be 1:50 scale.

E. The right is reserved to accept or reject any alternative.

1.14 SAMPLES

A. Within one month following the award of the Sub-Contract, the Sub-Contractor shall submit for review one set of labeled samples as follows:

1. Cast iron pipes and fittings
2. PVC pipes and fittings
3. Valves, strainers vents and drains
4. Pipes supports
5. Galvanized steel pipes and fittings
6. Floor drain gratings
7. Cables and wiring
8. Cable supports
9. Vibration isolators

B. The Employers Representative reserves the right to require samples which show the fabrication techniques and workmanship of component parts, and the design of accessories and other auxiliary items, before any installation work process.

C. The Sub-Contractor shall submit to the Employer's Representative for endorsement, manufacturer's specification and installation instructions for trade products.

1.15 EQUIPMENT SELECTION

A. All equipment supplied shall be in accordance with this Specification and the relevant drawings and to the approval of the Employer's Representative.

B. The capacities of all plant and equipment described in the Sub-Contract are minimum capacities and the Sub-Contractor shall check them with the Employers Representative, taking into account any variations which may be made to the systems during the progress of the Sub-Contract Works.

C. The Sub-Contractor shall be required to demonstrate at site that the duties required of the equipment are obtainable.

D. Physical sizes of all plant and equipment are to be suitable for the space allocated for the accommodation of such plant and equipment, taking into account the requirement of access for maintenance purposes.

E. In selecting makes and types of equipment, the Sub-Contractor shall ascertain that facilities for proper maintenance, repair and replacement are provided.

F. Where the Sub-Contractor proposes to use an item of equipment other than that specified or detailed in the drawing, which requires any redesign of the system, drawings showing the layout of the equipment and such redesign as required therefore shall be prepared by the Sub-Contractor at his own expenses. Where such approved deviation necessitates a different quantity and arrangement of materials and equipment's from that originally specified or indicated in the drawings, the Sub-Contractor shall furnish and install any such additional materials and equipment's required by the system at no additional cost.

G. Equipment catalogue and manufacturer's specifications must be submitted for examination and details shall be submitted for the approval of the Employer's Representative before any equipment is to be ordered.

   This shall include all information necessary for the Employer's Representative to ascertain the equipment comply with this Specification and drawings. Data and sales catalogue of a general nature will not be accepted.

H. Before ordering equipment, the Sub-Contractor shall provide the Employers Representative with full details of the weights and characteristics of the equipment for purposes of determining floor loading, power consumption etc.

1.16 PACKING, STORAGE AND PROTECTION

A. All materials, equipment, components and accessories shall be delivered to the Site in a new condition, properly packed and protected against damage or contamination or distortion, breakage or structural weakening due to handling, adverse weather or other circumstances and, as far as practicable, they shall be kept in the packing cases or under approved protective coverings until required for use.

B. Any items suffering from damage during manufacture, or in transit, or on site whilst in storage or during erection shall be rejected and replaced without extra cost to either the Employer or the Main Contractor unless either of them, or their respective representatives, cause such damages.

C. In the case of such materials, equipment, components and accessories which originate overseas:

   1. The said items shall be adequately and securely packed for safe transportation with due regard to the climatic conditions encountered in transit and on arrival.

2. British Standard 1133 and supplements, or other comparable and acceptable code, shall be used as a guide for the standard of packing and package required. All bright polished or plated parts shall be treated with suitable corrosion preventative.

3. At the time of shipping, each consignment shall be documented with packing lists and bills of lading which shall contain full statements of the packages consigned with particulars of the dimensions, weights, contents, shipping marks and approximate value of each package shall be provided in duplicate to the Main Contractor.

D. Where it is stipulated in the Specification or elsewhere in the Sub-Contract that packages, pallets, casks or other packaging or handling materials are returnable, then the Sub-Contractor shall forthwith upon receiving written notice to that effect from the Main Contractor, remove the same from the site as any other place where the materials, equipment, components and accessories have been unpacked.

E. Neither the Employer nor the Main Contractor shall be liable for loss or damage to or return of any packages, pallets, casks or other packaging or handling materials where the Sub-Contractor fails to collect as notified by the Main Contractor.

F. After delivery to site and prior to installation the Sub-Contractor shall ensure that all materials and equipment are properly stored on site to avoid mechanical damage and the adverse effects of heat, humidity etc. The Sub-Contractor shall provide proper shelving and racking to support and protect the equipment and materials. All electrical equipment shall be stored covered in its original packaging or by plastic sheeting.

G. The Sub-Contractor shall apply an approved protective crating or fix some other protective material to the materials, equipment, components and accessories so as to protect them after installation. In the event that the Sub-Contractor fails to do, the Sub-Contractor shall repair to the satisfaction of the Employers Representative or supply free of all charge any replacement required to substitute for any part of the materials, equipment, components and accessories which may have been damaged in whole or in part as a result of such failure as directed by the Employers Representative and shall without prejudice to such other liabilities under this Sub-Contract, pay for all expenses and outgoing of the Employer or the Main Contractor incurred in respect of the removal and disposal of the damaged parts and the installation of the substitute parts.

H. The Sub-Contractor shall be responsible for the off-loading and handling of cables on site and shall ensure that cables are new and delivered to site on new drums and properly protected against mechanical damage and loss with manufacturer's seals still intact. Partly used drums of cables which have already been used elsewhere shall not be acceptable unless special approval is given by the Employers Representative in writing.

I. The Sub-Contractor shall be responsible for unpacking and removal from site all temporary protective covers prior to the handover of the Installation to the Employer.

J. The Sub-Contractor shall accept at job site the sanitary fittings from the Sanitary Fitting Supplier and store on Site. The sanitary fittings shall be well protected by the Sanitary Sub-Contractor from damage of any kind. After installation, each fixture shall be well protected from damage and spoilage by effects of weather and subsequent construction and the finishing activities of other trades.

K. All fixtures or fittings damaged due to improper installation, storage or handling will be rejected by the Employers Representative and shall be replaced with new, undamaged items as specified. Any costs shall be borne by the Sub-Contractor.

1.17 DRAWINGS AND APPROVAL

A. Interpretation of Drawings

1. The Specification and any drawings or other documents attached thereto and issued by the Employers Representative shall be deemed to include, whether or not specifically mentioned or shown, any materials, accessories or work as may be necessary for the satisfactory completion of the Works. The Sub-Contractor shall make due allowance in his Tender for such materials or work.

2. Where a discrepancy exists between the drawings and Specification, or where the interpretation of either is in doubt, the Sub-Contractor shall obtain written clarification on such matters before submitting his Tender. Any such clarification from the Employer's Representative to the Sub-Contractor or vice versa dated prior to the submission of the Tender, shall form part of the Sub-Contract Documents. If no clarification is requested and obtained by the Sub-Contractor the Employer's Representative reserves the right to select either option irrespective of the allowances the Sub-Contractor has made in his tender.

B. Tender Drawings

1. Tender Drawings are generally diagrammatic and indicative of work to be installed. Run and arrangement of piping and the positioning of apparatus shall be approximately as indicated.

2. The Tender Drawings are primarily intended to enable the Tender to prepare his estimate and submit Tender. Where runs of piping, cables, conduits, etc. are shown to small scale these do not necessarily indicate exact positions, and all offsets fittings and accessories that may be required are not necessarily shown. The Tender Drawings are based on agreement with the Employer taking into account co-ordination with other services and no alteration in principle will be allowed without approval.

3. If directed by the Employer's Representative, the Sub-Contractor shall, without extra charge, make reasonable modifications in the layout as needed to execute properly the work and prevent conflicts with the works of other trades.

4. After the award of the Sub-Contract, the Employer's Representative will, without charge, furnish two copies of the drawings and Specifications and will within a reasonable time also furnish such further drawings as are reasonably necessary to enable all the Employers Representative's Instructions to be carried out. The Employer's Representative will also provide all details which in the opinion of the Employer's Representative are necessary for the execution of any part of the work.

5. Additional copies of the drawings and the Specification can be provided to the Sub-Contractor upon written request to the Employer's Representative, but the Employer's Representative will charge for such additional copies at current commercial rates.

C. Sub-Contractors Drawings

1. The Sub-Contractor shall prepare, or be responsible for obtaining, the following drawings:

    a. Installation Drawings.

b. Manufacturer's Shop Drawings.
c. Builders Work Drawings.
d. Progress Drawings
e. Record Drawings and Charts.

2. The symbol notation on all drawings shall be the same as the Tender Drawings. New symbols, not previously used on the Tender Drawings shall be agreed with the Employer's Representative. All drawings shall have a stenciled title block and stenciled notes.

3. The Sub-Contractor shall be responsible for verifying the accuracy of all dimensions abstracted from Tender Drawings and used in the preparation of his drawings.

D. Installation Drawings

1. The Sub-Contractor shall, before the relevant work proceeds, prepare and submit for approval by the Employer's Representative, all Installation Drawings showing details of his proposals for the execution of the Sub-Contract Works. The Installation Drawings shall be based on the Tender Drawings, and shall take into account any modifications, either to the building or to the installation which may have taken place, and incorporate details of the actual items of plant and equipment to be installed.

2. They shall be in such detail and with all necessary dimensions as to enable the Sub-Contract Works to be installed, and shall indicate all piping and fittings necessary for installation, and also particular installation methods to be applied in certain instances.

3. The Sub-Contractor shall similarly prepare all necessary Schedules of equipment, and necessary schematic diagrams, including internal diagrams for items of electrical equipment and diagrams showing the inter-connections between different items.

4. The Sub-Contractor's Installation Drawings shall be prepared to a scale of 1:100 for all services in the building and 1:50 or 1:20 for all plant rooms and similar spaces, unless otherwise approved by the Employer's Representative.

5. The Sub-Contractor shall produce and submit for approval drawings detailing and dimensioning the following:

a. Site distribution, piping routes.
b. General layout drawings of all plant and equipment included in the Contract.
c. Schematic distribution for main and sub-main distribution.
d. Waste soil, vent and rain water piping layouts and details.
e. Potable water piping layouts and details.

E. Manufacturer's Shop Drawings

1. The Sub-Contractor shall submit for review shop drawings of any item of plant or equipment produced by a manufacturer or equipment supplier indicating principle dimensions, fixings, connections and all other relevant details. These shall include drawings of all control, and instrumentation panels, pumps and other equipment as requested by the Employer's Representative.

2. The Sub-Contractor shall provide engineering drawings showing the construction, external and internal layout of panels and wiring diagrams

comprising internal wiring, schematics of interlocking and external wiring diagrams, for the complete system in the panels. The drawings shall also show all electrical, pipework and capillary connections from the panels to external equipment.

F. Sub-Contractor's Approval of Manufacturer's Shop Drawings

1. All drawings, schedules or other information provided by Manufacturers, Nominated Suppliers, Nominated Sub- Contractors or Specialist Contractors shall be approved by the Sub-Contractor and such approval shall ensure that all requirements of the Sub-Contract documentation have been incorporated.

2. When this procedure has been completed, the Sub-Contractor shall forward paper prints of the approved drawings or copies of the approved schedules or their information to the Employer's Representative in a similar manner to that described for the Installation drawings.

3. No order to a Manufacturer, Nominated Supplier, Nominated Contractor or Specialist Contractor, to commence manufacture/installation shall be given until written approval has been given by the Employer's Representative.

4. Any costs arising from failure to meet the above conditions shall be borne by the Sub-Contractor at no cost to the Sub-Contract.

G. Builders Work Information & Drawings

1. The Sub-Contractor shall provide fully detailed Builders Work drawings to show requirements for architectural or structural provisions necessary to facilitate the execution of the Sub-Contract Works, and allow their integration into the project. These drawings shall show dead and live loads of all plant, and fully dimensioned details of all plant bases, wall chases, and penetrations.

2. This information shall be prepared in sufficient time for incorporation in the Main Building Contractors programme.

3. In cases where preliminary builders' work and structural information has already been given by the Employer's Representative, such information shall be confirmed by the Sub-Contractor (including confirmation of weights of items of equipment, sizes of access ways, etc.) and incorporated on his drawings.

4. The Sub-Contractor shall provide templates for, and supervise all builders' work required, including drilling and plugging of walls, floors and ceilings for securing of brackets, and other builders work as is considered normal to the trade.

5. The details required by the Main Building Contractor are to be provided as directed, which may require advance information to be provided by the Sub-Contractor before the Works defined in this Specification are to commence. The Sub-Contractor shall be responsible for checking any details that may have been given before commencement of the Works to ascertain that the said advance details are correct.
6. The Sub-Contractor shall be liable for all costs associated with the late submission or omission of builders work information.

H. Progress Drawings

1. The Sub-Contractor shall arrange for a full set of white prints of Installation Drawings to be kept on the Site showing the progress of all work in

connection with the Sub-Contract. Such prints shall be kept up-to-date before each site progress meeting, and all conduit cable, pipe and trunking runs, positions of equipment and apparatus shall be recorded on the drawings as they are installed.

2. The Progress Drawings shall be available for inspection at any time by the Employer's Representative and Main Building Contractor.

3. The Sub-Contractor shall include for his representative to keep a diary recording the progress of the works and details of all instructions received. The diary shall be at the disposal of the Employer's Representative as and when required.

I. Record Drawings and Charts

1. The Sub-Contractor shall issue draft copies of Record Drawings, showing the whole of the services as installed, to the Employers Representative one month prior to the start of commissioning.

2. Within one month of the Practical Completion of the installations, the Sub-Contractor shall provide to the satisfaction of the Employer's Representative one durable plastic negative and one copy diskette (Autocad) and four complete final sets of white prints showing the whole of the services installed. Prior to this formal issue, the Sub-Contractor shall submit two copies of his proposed finalized Record Drawings to the Employer's Representative for approval.

3. Two sets of drawings for symbols shall be submitted, one of the same size as the tender drawings, the other set shall be of A4 size suitable for eventual inclusion in the Operation and Maintenance Manual.

4. The complete symbol notation used for all Record Drawings shall be computer generated.

5. The preparation of the Record Drawings shall proceed during the installation of the Works as each section is completed. The Employer's Representative shall be allowed to inspect the drawings on request during their preparation.

6. In addition to the foregoing Record Drawings, the following charts and drawings shall be laminated in plastic and hung in the plant rooms and switchgear rooms:

   a. Plant room key Drawings: showing all plant item numbers, locations and duties.
   b. Control Schematics
   c. Electrical system schematic diagrams

J. Submission of Drawings and Equipment for Review

1. Information for review must be submitted in accordance with the agreed programme of work and in packages relating to complete buildings or previously agreed parts of the building.

   The packages must include:

   a. Installation drawings.
   b. Builders work drawings.
   c. Associated Manufacturer's shop drawings.
   d. Technical information of proposed equipment and materials.

e. Any other relevant information required by the Employer's Representative.

Each submission must be accompanied by a letter which:

a. Identifies the contents of the submission in detail.
b. Refer to previous submissions of the information and any relevant correspondence.
c. Refers to the purpose of the submission and any other requirements of the Sub-Contractor.

K. Employer's Representative's Approval

1. The Sub-Contractor shall obtain the Employer's Representatives review of his information before it is used for ordering, fabrication or installation. The form of review will be an examination of the drawings and/or samples by the Employer's Representative to ensure that the design criteria and engineering principles described in the Tender documents have been correctly interpreted and applied by the Sub-Contractor.

2. The review will not entail any checking of working dimensions on the drawings.

3. The Sub-Contractor must carry out his own checking procedure before submitting information for review this checking must cover not only his own work, but that of Manufacturers and Specialists for whom he is responsible.

4. The review of information by the Employer's Representative will in no way relieve the Sub-Contractor of his responsibility for error in his work or of his other contractual responsibilities and obligations.

5. The Sub-Contractor shall allow a period of 2 weeks in his programme for the Employers Representative to review and return the Sub-Contractor submission with comment. The Sub-Contractor shall also indicate in his programme time allowed for resubmission of drawings not allowed to be used for installation by the Employer's Representative.

L. Review Procedure for Sub-Contractor Submission

1. Five (5) copies of all information and drawings shall be submitted to the Employer's Representative. One copy will be retained by the Employer's Representative and the other copy will be returned to the Sub-Contractor.

The information will be returned and marked either:

Stamp	Interpretation
Approved/Unaltered	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents.
Approved with corrections /comments as noted prior to general issue	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents and the Engineer's notation are complied with.
For Re-submission	The submittal does not comply with the Contract Documents; do not proceed with fabrication, manufacture, or construction. The work and shop drawings are not permitted at the job site. Re-submit appropriate shop drawings.

2. Modifications and variations found to be necessary after the initial review has been given must be re-submitted for further approval in the above manner.

3. Revision marks must be included on all revised drawings, and the revisions must be fully and clearly described.

4. Six copies of all reviewed drawings and noted as “Approved/Unaltered” shall be submitted to the Employers Representative for general distribution to the Main Building Contractor and other interested parties.

M. Co-ordination

1. The Installation Drawings shall illustrate that the Sub-Contractor design has been co-ordinated and integrated with that of other Sub-Contractors, the structure, and building elements, before work commences. In addition to the Works for which he is responsible, the drawings must show the structure, adjacent building elements and the zone required by other Sub-Contractor to install, operate and maintain their equipment.

2. If the Sub-Contractor deviates from the design intent of the Tender drawings, he shall ensure that this deviation either does not involve a change in any of the other Sub-Contractor installations or that any change necessary in the other Sub-Contractor installations does not incur an additional cost to their Sub-Contract.

3. The Sub-Contractor shall be fully liable for any cost incurred through his lack of co-ordination.

1.18 OPERATING AND MAINTENANCE MANUALS

A. Before the handover of the installation, the Sub-Contractor shall prepare complete Operation and Maintenance Manuals which are to be printed in English for all the installations. When these manuals have been agreed in details, the Sub-Contractor shall submit to the Employers Representative three copies thereof suitable bound. The Operating and Maintenance Manuals must be handed over before the Date of Completion.

B. Operating and Maintenance Manuals should comprise the following:

1. A hard cover giving:
the name of the development
the title of the document
the name and address of the installation contractor

2. Inside page giving similar information to the cover but including contact telephone numbers for normal and emergency use.

3. Contents page.

4. Description of the installation.

5. Scheduled details of all equipment and plant.

6. Operating instructions including details of any automatic control system.

7. Maintenance and fault finding instructions including composite schedule of routine maintenance.

8. Test reports and commissioning records.

9. Recommended spare parts and lubricants.

10. List of equipment and plant with manufacturer's name and address and local agent, if applicable.

11. Manufacturer's literature suitably indexed to include shop drawings, wiring diagrams, performance curves, etc.

12. List of as-installed drawings.

13. A complete valve schedule.

C. The manual should be produced on A4 size paper, all sections should be suitably separated and readily identifiable or pages should be numbered consecutively and page numbers included in the contents page.

D. The Sub-Contractor shall provide a copy diskette of the complete text of the operation and maintenance manuals.

1.19 PROPOSED SEPARATION OF WORK BETWEEN THE TRADES

A. The specifications describe in detail the proposed work included for each trade when the main Contractor divides the work among their Sub-Contractors. The following summary is an outline of the work to be "Provided", "Furnished" or "Installed" by each of the trades included in the contract, i.e., Plumbing & Sprinkler, (Div. 15) HVAC, [Building Management System] (Div. 15), Electrical (Div. 16) and other Divisions 1-14.

B. In the absence of more detailed information, consider the list as specific instructions to include such work in the named contract.

C. Abbreviations are as follows:

1. "OD" - Other Division of the Contract (not Electrical or Mechanical)

2. "Plb" - Plumbing – Division 15

3. "Spr" - Sprinkler – Division 15

4. "Mech" - Mechanical – Division 15

5. "Elec" - Electrical – Division 16

6. "F" - Furnished

7. "I" - Installed

8. "P" - Provided (Furnished and Installed)

ITEM	OD	Plb.	Spr.	Mech.	Elec.	Remarks
Motors for Mechl., Plumbing, Fire Protection Equip't	_	P	P	P	_	
Feeder Cables from Electrical Panels to Motor Controls	_	_	_	_	P	Cables to be terminated in the Motor Controls by each trade.
Motors for Mechl., Plumbing, Fire Protection Equip't	_	P	P	P	_	Specification and drawings delineate detailed exceptions.
Wiring for Mechl., Plumbing, Fire Protection Equip't Motors including the feeder cables from motor controller	_	P	P	P	_	
Wiring for Mech'l Equipment Motor Controls and Alarms	_	P	P	P	_	Specifications and drawings delineate in detail the work to be performed by each trade.
Temporary Light and Power	_	_	_	_	_	As per Contract Documents.
Temporary Water	_	_	_	_	_	As per Contract Documents.
Toilets	_	_	_	_	_	As per Contract Documents.
Temporary Fire Protection	_	_	_	_	_	As per Contract Documents.
Hoisting	P	P	P	P	P	
Rigging	P	P	P	P	P	
Bracing of Building for Safe Rigging	P	_	_	_	_	

ITEM	OD	Plb	Spr.	Mech.	Elec.	Remarks
Cutting, Chasing & Patching	P	_	_	_	_	Cost where due to late installation or improper coordination of work is the responsibility of the delinquent trade.
Framed Slots and Openings in Walls, Decks and Slabs	P	_	_	_	_	Includes drilling of holes when required. Cost where due to late installation or improper coordination of work is the responsibility of the delinquent trade.
Sleeves	P	_	_	_	_	
Waterproof Sealing of Sleeves through Waterproof						
Slabs, Decks and Walls	_	P	P	P	P	
Fireproof Sealing of Excess Openings in Slabs, Decks and Fire Rated Walls	_	P	P	P	P	
Excavation and Backfill Inside Buildings	_	P	P	P	P	
Excavation and Backfill Outside Buildings	P	_	_	_	_	Coordination with the trades. Cost where due to late installation or improper coordination of work is the responsibility of the delinquent trade.
Keep Site and Excavation Free From Surface Water During Construction	P	_	_	_	_	

ITEM	OD	Plb	Spr.	Mech.	Elec.	Remarks
Fastenings	_	P	P	P	P	
Supports	P	P	P	P	P	
Concrete Encasement of Conduits	_	_	_	_	P	
Below Grade						
Drainage Inside Building	_	P	_	_	_	
Base Flashing of Electric Conduits Through Roof (Pitch Pockets)	P	_	_	_	_	Cap flashing by Trade.
Electrical Handholes, and Covers	_	_	_	_	P	
Finish Painting (does not include I.D. marks or color coding specified and provided by each trade)	P	P	P	P	P	
Finished Walls and Ceiling Access Doors, Panels and Supporting Frames	P	_	_	_	_	Supplying list of location of all items requiring access doors included in the Division requiring same.
Plaster Rings and Frames	I	_	_	_	F	Plaster rings and frame furnished in electric only for lighting fittings which are so equipped.

ITEM	OD	Plb	Spr.	Mech.	Elec.	Remarks
Rubbish Removal	P	P	P	P	P	Where one trade furnishes and another installs, the installing trade removes the shipping and packing materials which accumulate.
Special Tools for Equipment Maintenance	F	F	F	F	F	
Electric Power Consuming Items and Controls for Other than Mechanical Equipment, e.g. Motorized Doors	P	_	_	_	_	
Concrete Foundations, Pads, Pits, Curbs, and Bases Inside Buildings	P	_	_	_	_	Furnishing exact dimensions of anchors, vibration mounts and templates included in each trade providing the associated equipment.
Concrete Foundations Pads and Bases Outside Buildings	P	_	_	_	_	Furnishing exact dimensions of anchors, vibration mounts and templates included in each trade providing the associated equipment.
Masonry Pits	P	_	_	_	_	Furnishings of covers and associated frames included in each trade.
Sump Pits	P	_	_	_	_	Furnishing of covers and associated frames included in each trade.
Concrete Lined Trenches inside Building Foundations	P	_	_	_	_	

ITEMS	OD	Plb	Spr	Mech.	Elec.	Remarks
Prime Coat Painting	_	P	P	P	P	
Fiel Touch-up Painting of Damaged Shop Coats	_	P	P	P	P	
Rustproofing Field Cut and Assembled Iron Supporting Frames and Racks	_	P	P	P	P	
Grating and Exterior Wall Louvers	P	_	_	_	_	
Duct Connections to Louvers	_	_	_	P	_	
Equipment Delivered and Set in Place	P	_	_	_	_	Except Mechanical and Electrical Equipment by Divisions 15, & 16.
Vinyl Tape or Painted Color- Coding, Banding Arrows and Similar Identification for Mechanical and Electrical Work	P	P	P	P	P	
Underfloor and Header Duct	_	_	_	_	P	Responsibility for coordination is included in this Section.
Lighting Fixtures	_	_	_	_	P	See Drawings.
Elevators, Escalators and Dumbwaiters	P	_	_	_	_	Power connections to disconnect switch included in Electrical Section.

ITEM	OD	Plb	Spr.	Mech.	Elec.	Remarks
Catwalks and Ladders to Electrical Equipment	P	_	_	_	_	
Food Service Equipment	P	_	_	_	_	Line connections included in each trade.
Services to Food Service Equipment	_	P	P	P	P	
Laundry Equipment	P	_	_	_	_	Line connections Included in each trade.
Services to Laundry Equipment	_	P	P	P	P	
Roughing to Equipment Furnished by Others	_	P	P	P	P	

D. Each Division is required to supply all necessary supervision and coordination information to any other Division supplying work to accommodate that Division.

E. For items which are to be installed but not furnished as part of this Division, the electrical work includes:

1. Coordination of their delivery.

2. Unloading from delivery trucks driven into any point on the property line at grade level.

3. Safe handling and field storage up to the time of permanent placement in the project.

4. Correction of any damage, defacement or corrosion to which they may have been subjected.

5. Field make-up and internal wiring as indicated for their proper operation.

6. Mounting in place.

7. Connection to building wiring, including the purchase and installation of all termination junction boxes necessary to adapt and connect them to this wiring.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide products and materials that are new, clean, free of defects, and free of

damage and corrosion.

B. Products and materials shall not contain asbestos, PCB, CFCs, Halons, or any other material which is installed considered hazardous by the authority having jurisdiction.

C. Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Engineer or its authorized representative.

D. Provide name/data plates on major components of equipment with manufacturer's name. Model number, capacity data and electrical characteristics attached in a conspicuous place.

E. Install materials and equipment with qualified trades people.

F. Maintain uniformity of manufacturer for equipment used in similar application and sizes.

G. Fully lubricate equipment where required.

H. Follow manufacturer's instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.

I. Where factory testing of equipment is required to ascertain performance, and attendance by the Owner's representative is required to witness such tests, associated travel costs and subsistence shall be paid for by the Contractor.

J. Equipment capacities, ratings, etc., are scheduled or specified for job site opening conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on the submittals.

K. Enclosures for electrical equipment installed in mechanical equipment rooms shall be NEMA type 1 gasketed. Enclosures for electrical equipment installed outdoors shall be NEMA type 3R.

L. Energy consuming equipment shall meet local energy ordinances.

PART 3 – EXECUTION

3.1 PROGRAMME

A. Within 2 weeks of the letter of intent or award, the Sub-Contractor shall submit a programme showing the details of delivery and required installation period for each system.

These details shall also be forwarded to the Main Contractor, and the Sub-Contractor shall work with the Main Contractor to produce an overall coordinated programme for the works.

B. The Sub-Contractor shall make such labor available at all stages of the works to permit the programme to be achieved and to carry out his work in accordance with the requirements of the Main Contractor and Main Construction programme.

C. The Sub-Contractor shall include all key dates into his programmes including the dates required of all Utility submissions and also the dates that permanent power, permanent water etc. will be made available for the project.

D. The Sub-Contractor shall be responsible for informing the Main Contractor of his detailed requirements in respect of fuel, water, drainage and electrical supplies, for the testing and commissioning of the plant and equipment.

The Sub-Contractor shall immediately inform the Employer's Representative of any delays caused by labor shortages, later delivery of materials and equipment, or the failure to meet programme by any other contractor on site, which may affect his own programme.

E. The programme shall be updated monthly.

3.2 PROGRESS REPORT

A. The Sub-Contractor shall submit two copies of the monthly report to the Employer's Representative containing:

1. Percentage of work completed including a BOQ comparison between and actual and contracted work.
2. Description of executed work.
3. Problems or delay (if any) and how to solve these.
4. Special occurrences, accidents, etc.
5. List of drawings, also indicating revisions.
6. List of memos and instructions ordered by the consultant.
7. List of equipment and workers at the site.
8. Color photographs of the site showing necessary views of the work at not less than 10 locations.

3.3 INSPECTION, TESTING AND CERTIFICATES

A. Periodic inspections of the work in progress will be made to check general conformity of the work to the Contract Documents. Observed deficiencies will be reported. Correct deficiencies immediately.

B. Meet the requirements of all laws, bylaws, codes, regulations and authorities having jurisdiction.

C. Where the Contract Documents, instructions or the governing authorities require Division 15 (Mechanical General Provisions) work to be tested, inspected or approved, give sufficient notice of its readiness for inspection and schedule the date and time for such inspection.

D. Uncover Division 15 (Mechanical General Provisions) work that is covered up without consent, upon Consultant request, for examination and restore at no extra cost to the Owner.

E. Furnish certificates and evidence that Division 15 work meets the requirements of authorities having jurisdiction.

F. Correct deficiencies immediately upon notification.

G. Cleaning and Flushing

1. The Sub-Contractor shall clean the entire installation including all sanitary fittings and pipework, etc. after installation and keep them in a new condition.

2. All pipes, etc. shall be flushed through with water, rodded when necessary to ensure clearance of debris.

3. Cleaning and flushing shall be carried out in sections as the installation becomes completed.

H. Hydraulic Testing of Pipework

1. The Sub-Contractor shall carry out hydraulic test on the complete plumbing systems and the drainage system to show that it is functioning satisfactorily within the requirements of this Specification and local regulations.

2. The Sub-Contractor shall provide suitable test pumps and arrange for a supply of water required in connection with testing of pipework. The test pump shall be fitted with pressure gauges which shall be of suitable range for the pressure being applied.

3. Hydraulic tests shall be carried out as the pipework is installed and shall be completed before chases in walls and ducts are closed. Also test shall be carried out prior to false ceilings and other finishes are installed.

4. All cold water and fire fighting pipework shall be hydraulically tested for a period of not less than 6 hours to a pressure of not less than one and half times the working pressure, but in any case the testing pressure shall not be less than 150 PSI for cold water and 250 PSI for fire fighting. The Sub-Contractor must record all test figures together with schedules of pipe lengths and should note that testing shall be witnessed by the Employers Representative. No pressure drop shall be allowed during the tests.

5. Testing apparatus shall be provided by the Sub-Contractor. Where any section of pipework or equipment is unable to withstand the maximum pipework test pressure, it shall be isolated during the pipework test then that

section of pipework or equipment shall be re-tested at the appropriate test pressure.

6. The Sanitary Sub-Contractor must carry out any additional tests required by the local authorities.

7. Drainage pipe shall be test by filling the water higher than testing point 3 m. waiting 15 min, then checking leakage at every joint.

8. Testing of drainage systems shall be carried out in sections by dividing the system horizontally. Each section shall comprise pipework and fitting for three floors/storeys required for testing.

9. Drainage pressure pipe shall be hydraulic test at minimum pressure 50 PSI.

10. On completion of the section of drainage pipework to be tested blank off all open ends of pipes and ensure that all access covers are securely tightened so that they are airtight.

    a. At the base of each stack, a drain bag or drain plug is inserted and a small quantity of water allowed to settle above it so as to form a seal that can easily be inspected if it leaks.

    b. A drain plug should be inserted at the top of the stack and in the case of rainwater pipes at every intermittent outlet with a small quantity of water above it.

    c. Remove the blank cap from one of the drain plugs (at the top of the stack if possible) and connect the tube from a manometer gauge to it or by passing the tube through one of the trap seals.

    d. Blow air through the tube and reconnect at the manometer gauge to obtain a reading of 38mm w.g. the level should remain for a period of not less than five minutes without falling and without further air being added.

I. Operation Tests

1. The Sub-Contractor shall ensure to the approval of the Employers Representative that the installation or portion thereof has been set to work and complies with all requirements including the following:

    a. That the plant and apparatus is of robust construction and of capacity for the duty specified.

    b. That all valves, switches, controls, etc. are properly regulated and capable of proper operation and in the case of valves that are capable of tight shut-off.

    c. That all apparatus is silent.

    d. That all instruments are correctly calibrated and read accurately.

    e. That all services are tested in accordance with the details of the relevant clauses of this Specification.

    f. That the alignments for all pumps are proper.

2. Should the results of these tests show that the pumps, etc. or any other items of equipment fail to perform to the efficiencies or other performance figures

as given in this Specification, and as accepted in the Sub-Contractor tender, then the Sub-Contractor shall adjust, modify and if necessary replace the equipment without additional cost to the Sub-Contract in order that the required performance is obtained. Should it be necessary for the Sub-Contractor to attend to items of plant as described he will be responsible for cost for any damage or deterioration to the building or any other services consequent on such attendance.

3. The Sub-Contractor shall perform all tests and demonstrations as called for by the local authorities.

4. Testing procedures shall be submitted two months after the approval of major equipment to the Employers Representative for approval.

J. Supply of Testing Equipment

1. The Sub-Contractor shall provide all tools, pressure pumps, instruments and recorders required to carry out the tests given in this Section.

2. All water and electricity required for testing purposes will be supplied by the Main Contractor.

K. Pretreatment

1. Prior to start-up and after satisfactory hydraulic testing, all piping systems shall be flushed and drained at least once through to rid off contaminating materials.

2. All strainers shall be inspected and cleaned out or replaced.

L. Disinfection

1. For Pipe Installation

a. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.

b. The system or part thereof shall be filled with a water/chlorine solution containing or least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valve off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours.

c. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.

d. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

3.4 RESULTS OF TESTS

A. If the test results show that the plant and equipment is not functioning in a satisfactory manner nor providing the requirements of this Specification, the Employer's Representative shall decide whether this is due to incorrectness of faulty work by the Sub-Contractor and if this be the case, the Sub-Contractor shall, when called upon, carry out at his own expense such alterations, replacements and adjustments as may be required to the Employer's Representative's complete satisfaction. The Employer's Representative decision as to what constitutes a satisfactory test shall be final.

3.5 TEMPORARY SERVICES

A. Provide temporary mechanical services in accordance with the requirements of Section 01500.

B. Make connections to temporary power source provided and provide extensions for use by Division 15.

C. Install and maintain temporary fire protection services as required by the authorities having jurisdiction.

D. When the permanent water service is installed, it shall be used to supply water for the use of Other Contractors.

E. Perform operations necessary for checking, testing and balancing after written approval is given to start up systems. Ensure that care is taken to protect equipment from damage and to prevent distribution of dust through duct systems.

F. Do not use permanent plumbing, heating or air conditioning systems for temporary services during construction, except with written permission from Consultant.

3.6 CUTTING AND PATCHING

A. Give notification in time to Other Contractors of openings required for Division 15 Work. Supply accurate details of location and size. When this requirement is not met, bear the cost of cutting and patching.

B. In existing work, cutting, patching and restoration of finished work to original condition will be carried out by Other Contractors at the expense of Division 15.

C. Obtain written Consultant approval before cutting openings through structure.

D. Where new work connects with existing and where existing work is altered, cut, patch and restore to match existing work.

3.7 PROTECTION

A. Protect all Division 15 work from damage. Keep all equipment dry and clean at all times.

B. Cover openings in equipment, pipes with caps or heavy gauge plastic sheeting until final connections are made.

C. Repair any damage caused by improper storage, handling or installation of equipment and materials.

D. Protect equipment, pipes and temporary services installed by Division 15 from weather damage.

3.8 PAINTING, LABELLING AND FINISHING

A. Materials

1. All parts of the work installed under this Specification shall be painted with approved high quality enamel paints, except those items specified as being painted by others or otherwise exempted from painting in this section of the Specification.

2. Paint shall be selected to withstand the temperature on the surface which it is applied, and shall be suitable in all respects for the environmental conditions in which it shall be located.

3. All paint used shall be of one approved manufacture, and finishes shall be full gloss unless otherwise specified.

4. Before ordering any primer, undercoat and finishing paint, the Sub-Contractor shall submit the color scheme to the Employers Representative for approval.

5. Before ordering any painting materials, the Sub-Contractor shall submit the type and manufacturer of all materials for approval.

6. The Sub-Contractor shall select all finishing and painting materials from types suitable for the surfaces to which they are applied and for the environmental conditions in each area.

7. The fire services equipment shall be painted in red color with two coatings of red lead primer.

B. Plant, Machinery & Equipment

1. All items of plant, machinery and equipment supplied painted ex-factory shall be given one finishing coat of full gloss enamel, except where the manufacturer's standard finish is approved.

C. Exposed Metalwork

1. All exposed metalwork shall be wire-brushed and cleaned from rust, scale, dirt and grease, and shall then be given one priming coat, one undercoat and one approved color finishing coat of full gloss enamel.

2. The priming coat for exposed galvanized iron shall be an approved galvanized iron primer.

3. The priming coat for exposed non-ferrous metalwork shall be approved as suitable for the metal to which it will be applied.

D. Concealed Metalwork

1. All galvanized iron surface concealed in roof spaces, false ceilings, building ducts etc. shall not be painted. All black iron and steel surfaces shall be wire bushed and given one coat of zinc chromate or red lead.

E. Pipework & Metal Sheathing

1. Pipework and metal sheathing shall be painted as for exposed or concealed metalwork as applicable.

2. Turned parts of valves, controls etc., shall be cleaned and polished to approval.

F. Pipework Identification

1. All pipes etc. shall be identified in accordance with British Standards 1710:1984 or other comparable and acceptable code.

2. Circumferential bands of standard colors shall be not less than 100mm wide on pipes up to 50mm nominal diameter, and not less than 150mm wide on pipes greater than 50mm nominal diameter.

3. Supplementary colors shall be displayed as bands not less than 25mm wide in the center of the ground color bands.

4. Where lettering is required it shall be painted in contrasting colors in accordance with the standard, in block letters not less than 15mm high for pipes up to 50mm nominal diameter, and in block letter not less than 40mm high for larger pipes.

5. Identification bands shall be located where they are clearly visible in each room or compartment through which the pipe runs, and shall be placed at centers not exceeding 6m.

6. Direction of flow shall be indicated by an arrow painted on the pipe adjacent to each color band. Arrows shall be 75mm long on pipes up to 50mm nominal diameter, and 150mm long on larger pipes.

G. Colour Schemes

1. The whole of the piping installation shall be painted in accordance with the existing piping colors schemes wherever applicable and color coded as follows:

Cold water pipe	-	Green
Soft water pipe	-	Blue
Waste pipe	-	Brown
Soil pipe	-	Black
Vent pipe	-	Gray
Fire pipe	-	Red
Compressed air pipe	-	White
Vacuum pipe	-	Orange

Equipment shall be paint and color coded to BS 381C:1980 or the PSME Code as follows:

Equipment	Color	No.
Switchboard and Control Panel	Electric Orange-White Interior	
Electric Motors	Primrose	310
Electric Conduits	Light Orange	557
Pumps and tanks	As for respective piping service	-
All other equipment	As directed	-

H. Labelling

1. All plant and equipment provided under this Specification is to be labeled in English as to duty or services, all such Labelling to correspond to schedules, diagrams, etc. to be provided as part of the Record Drawings. Labels are of white Traffolyte with black engraved lettering not less than 20mm high or as otherwise required and approved.

2. Manufacturers' nameplate shall generally be provided for all plant and equipment and shall show serial and model numbers and date of manufacture.

3. All valves, motor starters, fans, distribution boards, gauges, contactors, cable terminals in switchboards, circuit breakers shall have labels.

4. Labels should be attached to valves (or pipe adjacent thereto) with a light gauge metal band or alternatively to be screwed to the insulated valve box where provided. These labels shall state the valve number.

5. Distribution boards, starters etc. shall be labeled to indicate the circuit number, phase and item controlled.

6. Labels shall be screwed or riveted to sheet metal. Adhesive fixing is not acceptable.

7. Details of exact lettering shall be agreed with the Employers Representative prior to manufacture.

8. A complete valve schedule shall be incorporated in the as-built drawings and this schedule shall clearly indicate the valve numbers, duty, function, size, flow rate and any other relevant information necessary to allow the Employer's plant operators to safely operate each valve and to subsequently maintain or replace the valve as required.

9. The valve schedule shall clearly relate to the various system schematics to enable the entire operating sequence and circuitry to be followed.

I. Application of Painting

1. All paints shall be prepared and applied in accordance with the manufacturer's recommendations.

2. All galvanized metal surfaces shall be properly etch-primed to ensure correct adhesion of the paint to the surface. Materials for etch-priming shall be as recommended by the paint manufacturers. Subsequent painting of galvanized surfaces shall comply with this Specification.

3. Prior to painting, all metallic surfaces except galvanized surfaces shall be thoroughly scraped and wire brushed as necessary to remove scale, rust and swarf. Surfaces shall then be solvent cleaned to remove all oil, grease and dirt.

4. When the surfaces to be painted are clean and dry, one coat of an approved primer shall be evenly applied over the entire area. After surfaces have been primed, the Sanitary Sub-Contractor shall notify the engineers so that an inspection of the primed surfaces can be made prior to the application of the undercoat and the finishing coats.

5. When the priming coat has been approved, one coat of an approved paint flat undercoat shall be applied. Before applying the finishing coats, the Sub-Contractor shall ensure that the undercoated surface is rubbed flat and smooth. Finally, two coats of an approved high gloss finishing paint shall be applied when all dust has been removed.

6. Each successive coating shall be completely dry prior to the application of the next coat. The minimum thickness of each layer to be 50u.

3.9 TEMPORARY AND TRIAL USE

A. Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance acceptance by Consultant.

B. Consultant may use equipment and systems for test purposes prior to acceptance. Provide labour, fuel, material and instruments required for testing. Rectify incomplete work immediately to the satisfaction of Consultant.

C. Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage.

D. Clean and renew equipment and systems used prior to acceptance.

E. Warranty, including duration and commencement date, shall not to be affected by start-up date of equipment.

3.10 COMPLETION

A. Remove all debris from inside Division 15 systems and equipment.

B. Rectify deficiencies and complete work before submitting request for Substantial Performance inspection.

C. Follow manufacturer's written instructions regarding bearing lubrication. Remove grease from pillowblock type bearings and install new grease before equipment is put into operation.

D. Check and align all drives to manufacturer's acceptable tolerances.

E. Check and align all pumps to manufacturer's acceptable tolerances.

F. Remove all temporary protection and covers.

G. Remove oil and grease from equipment and bases.

H. Clean all fixtures and equipment. Polish all plated surfaces.

I. Change air and water filters.

J. Remove, clean and reinstall pipeline strainer screens.

K. Leave Division 15 work in as new working order.

3.11 INSTRUCTIONS TO OWNER

A. Submit to Owner, check lists for each system or piece of equipment, indicating that all components have been checked and are complete prior to instruction period.

B. Thoroughly instruct the Owner in the safe and efficient operation of the systems and equipment.

C. Arrange and pay for the services of qualified manufacturer's representatives to instruct Owner on specialized portions of the installation, such as refrigeration machines, boilers, automatic and water treatment.

D. Submit a complete record of instructions given to the Owner. For each instruction period, supply the following data:

1. Date
2. Duration
3. System or equipment involved
4. Names of persons giving instructions

5. Names of persons being instructed
6. Other persons present

E. Submit receipted verification of completed training to Consultant prior to final release of retentions.

F. Carry out instructional period during a period of 5 days scheduled at Owner's convenience.

G. Video tape all instructional sessions and turn over copy of tape to Owner upon completion of training period.

3.12 PROTECTION OF OWNER'S PREMISES

A. Adhere strictly to the Owner's requirements.

B. Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.

C. Execute work with least possible interference or disturbance to occupants, public and normal use of premises.

D. Provide temporary means to maintain security when security has been reduced by Division 15.

E. Only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use may be used for moving men and material within building. Protect walls of passenger elevators, to approval of Owner prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.

F. Provide temporary dust screens, barriers, warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.

G. Drawings indicate approximate locations of known existing underground and above ground facilities. Avoid damage to existing services. Bear cost of repairs and replacements.

H. Immediately advise Consultant when unknown services are encountered and await instructions.

I. Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

END OF SECTION

SECTION 15040
COMMISSIONING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Comply with the Agreement between the Construction Manager and Trade Contractor and all other documents referred to therein.

B. Provide all services, materials and labour required to fully commission the plumbing systems in accordance with this Section of the Specification.

1.2 COORDINATION

A. Meet the requirements of the General Instructions.

B. Coordinate the work of this Section with all other Divisions to ensure complete and operational plumbing systems at completion of this work.

C. Appoint a single person as Commissioning Coordinator who shall be responsible for progressing the commissioning activities of each Division 15 trade. The Commissioning Coordinator shall report to the Commissioning Manager.

D. Review the design intent of the project and the intended operation of systems with the Consultant before proceeding with commissioning.

1.3 QUALITY ASSURANCE

A. Division may elect to source start-up and handover by a specialist commissioning company. Supply to the Commissioning Manager, the following details regarding the proposed firm:

1. Principal Representative and qualifications

2. Proposed personnel and relevant project experience

3. Previous similar assignments and references

4. Scope of work to be undertaken

5. Company resources and equipment

B. Use of a commissioning specialist shall not relieve Division 15 of the obligation to name one of his own employees as the person responsible for progressing commissioning, i.e. the Commissioning Coordinator.

C. Supply the name, qualifications and experience of the proposed Commissioning Coordinator upon Construction Manager Request. Selection shall be subject to review and the approval of the Consultant. Supply alternative person(s) when requested by Consultant.

D. The Consultant may, at his discretion, attend and advise in the commissioning process. Meet Consultant requirements.

E. Hold and attend regular meetings during the commissioning process. Prepare detailed progress reports to coincide with regular commissioning meetings. Coordinate with the Commissioning Manager, the preparation and issue of minutes for each meeting to be circulated to each involved trade, the Consultant and the Construction Manager

representative/s. Minutes shall highlight action items.

PART 2 - PRODUCTS

2.1 SCHEDULES AND COMPLETION OF INSTALLATION OF SYSTEMS

A. Submit to the Consultant, 60 days prior to the scheduled Substantial Performance, a detailed and comprehensive installation completion/start-up/testing schedule, identifying all trades and suppliers to be involved. Update the schedule and resubmit for review, on a biweekly basis, during the course of commissioning. If found to be unacceptable, revised the schedule and the construction forces to suit the reviewed schedule. This schedule shall include, but is not limited to the following items:

1. Installation and testing of pipe systems
2. Chemical clean out and treatment of pipe systems, including disinfection of domestic water piping
3. Control system wiring (by Control Contractor)
4. Electrical service connections (by Electrical Contractor)
5. Operational testing of system components
6. Performance testing of equipment and systems
7. Troubleshooting
8. Submittal of completed equipment and system checkout sheets
9. Demonstration of systems and equipment
10. Maintenance manual preparation and submittal
11. Record documentation submittal

2.2 RECORD DOCUMENTATION

A. Prepare record documentation for each equipment installation covering:

1. Equipment identification and supplier;
2. Shop Drawing submittal, review, production release, and delivery dates;
3. Dates for completion of all work required to prepare for equipment installation;
4. Dates for equipment installation, supplier pre-start checkout and system availability for start-up;
5. Dates for equipment start-up, performance testing, and proposal for temporary use, acceptance testing, demonstration, turnover and warranty start/finish.

B. Submit proposed record sheets and procedures to Consultant for review, when requested by the Owner.

C. List all specialist personnel and equipment required for the test and ensures that these are available by the test date.

D. Provide documentation of the commissioning process for inclusion into the maintenance manuals. These are to include checkout sheets, equipment data sheets,

start-up certificates from suppliers involved in start-up, documentation concerning demonstration to the Owner. Include all record and result sheets form commissioning tests.

E. Maintain a log of key operating parameters, problems encountered, solutions employed and verification of effectiveness of solutions. Include log in maintenance manuals.

F. Refer to example documentation available from Construction manager's representative. Meet or exceed this level of reporting.

2.3 START-UP

A. Coordinate and supervise the start-up of the various pieces of equipment and systems. Utilize the start-up services of the manufacturer's representative. Ensure that the equipment is operating in a satisfactory manner. Check the following items:

1. Direction of flow.

2. Noise, if deemed to be a problem

3. Piping connections and safeties

4. Electrical amp draw, starting inrush current and trip/heater settings

B. TEMPORARY AND TRIAL USE

1. Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance acceptance by Consultant.

2. Consultant may use equipment and systems for test purposes prior to acceptance. Provide labour, fuel, material and instruments required for testing. Rectify incomplete work immediately to the satisfaction of Consultant.

3. Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage.

4. Clean and renew equipment and systems used prior to acceptance.

5. Warranty, including duration and commencement date, shall not to be affected by start-up date of equipment.

2.4 TROUBLESHOOTING

A. Resolve inters Division coordination problems.

B. Where problems become apparent during the commissioning process, identify and resolve these problems. The basic functions in troubleshooting are:

1. What - identification and definition of the problem

2. Why - determination and evaluation of the causes

3. When - determine the time available to resolve the problem

4. Involve the designing authority in the review of the problem and proposed resolution

5. Coordinate remedial action with the appropriate parties

6. Evaluate the effectiveness of the remedial action

7. Record the problem, cause, remedial action and result

2.5 OPERATION AND TESTING

A. Inspection, Testing and Certificates

1. Periodic inspections of the work in progress will be made to check general conformity of the work to the Contract Documents. Observed deficiencies will be reported. Correct deficiencies immediately.

2. Meet the requirements of all laws, bylaws, codes, regulations and authorities having jurisdiction.

3. Where the Contract Documents, instructions or the governing authorities require Division 15 work to be tested inspected or approved, give sufficient notice of its readiness for inspection and schedule the date and time for such inspection.

4. Uncover Division 15 works that is covered up without consent, upon Consultant request, for examination and restore at no extra cost to the Owner.

5. Furnish certificates and evidence that Division 15 work meets the requirements of authorities having jurisdiction.

6. Correct deficiencies immediately upon notification.

7. Cleaning and Flushing

   a. The Sub-Contractor shall clean the entire installation including all sanitary fittings and pipework, etc., after installation and keep them in a new condition.
   b. All pipes, etc., shall be flushed through with water, rodded when necessary to ensure clearance of debris.
   c. Cleaning and flushing shall be carried out in sections as the installation becomes completed.

8. Hydraulic Testing of Pipework

   a. The Sub-Contractor shall carry out hydraulic test on the complete plumbing systems and the drainage system to show that it is functioning satisfactorily within the requirements of this Specification and local regulations.
   b. The Sub-Contractor shall provide suitable test pumps and arrange for a supply of water required in connection with testing of pipework. The test pump shall be fitted with pressure gauges which shall be of suitable range for the pressure being applied.
   c. Hydraulic tests shall be carried out as the pipework is installed and shall be completed before chases in walls and ducts are closed. Also test shall be carried out prior to false ceilings and other finishes are installed.
   d. All cold water and fire fighting pipework shall be hydraulically tested for a period of not less than 6 hours to a pressure of not less than one and half times the working pressure, but in any case the testing pressure shall not be less than 150 PSI for cold water and 250 PSI for fire fighting. The Sub-Contractor must record all test figures together with schedules of pipe lengths and should note that testing shall be

witnessed by the Employers Representative. No pressure drop shall be allowed during the tests.

e. Testing apparatus shall be provided by the Sub-Contractor. Where any section of pipework or equipment is unable to withstand the maximum pipework test pressure, it shall be isolated during the pipework test then that section of pipework or equipment shall be re-tested at the appropriate test pressure.

f. The Sanitary Sub-Contractor must carry out any additional tests required by the local authorities.

g. Drainage pipe shall be test by filling the water higher than testing point 3 m. waiting 15 min, then checking leakage at every joints.

h. Testing of drainage systems shall be carried out in sections by dividing the system horizontally. Each section shall comprise pipework and fitting for three floors/storeys required for testing.

i. Drainage pressure pipe shall be hydraulic test at minimum pressure 50 PSI.

j. On completion of the section of drainage pipework to be tested blank off all open ends of pipes and ensure that all access covers are securely tightened so that they are airtight.

1. At the base of each stack, a drain bag or drain plug is inserted and a small quantity of water allowed to settle above it so as to form a seal that can easily be inspected if it leaks.
2. A drain plug should be inserted at the top of the stack and in the case of rainwater pipes at every intermittent outlet with a small quantity of water above it.
3. Remove the blank cap from one of the drain plugs (at the top of the stack if possible) and connect the tube from a manometer gauge to it or by passing the tube through one of the trap seals.
4. Blow air through the tube and reconnect at the manometer gauge to obtain a reading of 38mm w.g. the level should remain for a period of not less than five minutes without falling and without further air being added.

9. Operation Tests

A. The Sub-Contractor shall ensure to the approval of the Employers Representative that the installation or portion thereof has been set to work and complies with all requirements including the following:

a. That the plant and apparatus is of robust construction and of capacity for the duty specified.

b. That all valves, switches, controls, etc., are properly regulated and capable of proper operation and in the case of valves that are capable of tight shut-off.

c. That all apparatus is silent.

d. That all instruments are correctly calibrated and read accurately.

e. That all services are tested in accordance with the details of the relevant clauses of this Specification.

f. That the alignments for all pumps are proper.

B. Should the results of these tests show that the pumps, etc. or any other items of equipment fail to perform to the efficiencies or other performance figures as given in this Specification, and as accepted in the Sub-Contractor tender, then the Sub-Contractor shall adjust, modify and if necessary replace the equipment without additional cost to the Sub-Contract in order that the required performance is obtained. Should it be necessary for the Sub-Contractor to attend to items of plant as described he will be responsible for cost for any

damage or deterioration to the building or any other services consequent on such attendance.

C. The Sub-Contractor shall perform all tests and demonstrations as called for by the local authorities.

D. Testing procedures shall be submitted two months after the approval of major equipment to the Employers Representative for approval.

10. Supply of Testing Equipment

1. The Sub-Contractor shall provide all tools, pressure pumps, instruments and recorders required to carry out the tests given in this Section.
2. All water and electricity required for testing purposes will be supplied by the Main Contractor.

11. Pretreatment

1. Prior to start-up and after satisfactory hydraulic testing, all piping systems shall be flushed and drained at least once through to rid of contaminating materials.
2. All strainers shall be inspected and cleaned out or replaced.

12. Disinfection

1. For Pipe Installation

a. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
b. The system or part thereof shall be filled with a water/chlorine solution containing or least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valve off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours.
c. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
d. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

13. Test the operation of the individual components and systems. Go through each step of the sequence of operation and verify that each component operates correctly. Direct and ensure that all trades involved make the required changes and adjustments to effect the proper operation of all components and systems. Meet commissioning test requirements.

14. Document operation and testing.

15. Carry out operational tests for the current season and simulate operation during peak hour.

2.6 DEMONSTRATION

A. Demonstrate to the Owner the proper operation of all equipment and systems supplied under this Division. Demonstrations shall occur only after the operation and testing has been successfully completed. Ensure that Trade Contractor and equipment suppliers participate in the demonstration as required.

B. Instructions to Owner

1. Submit to Owner, check lists for each system or piece of equipment, indicating

that all components have been checked and are complete prior to instruction period.

2. Thoroughly instruct the Owner in the safe and efficient operation of the systems and equipment.
3. Arrange and pay for the services of qualified manufacturer's representatives to instruct Owner on specialized portions of the installation, such as refrigeration machines, boilers, automatic and water treatment.
4. Submit a complete record of instructions given to the Owner. For each instruction period, supply the following data:
    1. Date
    2. Duration
    3. System or equipment involved
    4. Names of persons giving instructions
    5. Names of persons being instructed
    6. Other persons present
5. Submit receipted verification of completed training to Consultant prior to final release of retentions.
6. Carry out instructional period during a period of 5 days scheduled at Owner's convenience.
7. Video tape all instructional sessions and turn over copy of tape to Owner upon completion of training period.

2.7 OPERATING AND MAINTENANCE MANUALS

A. Coordinate the manual provision with Consultant prepared Operation and Maintenance Manual, if available.

2.8 SPARE PARTS

A. Provide a list of spare parts, special tools, etc. for each item of equipment which has been purchased as part of the Contract.

B. Provide a listing of recommended spare parts for all equipment installed under Division 15, to cover a period from Substantial Completion to Warranty end.

C. Provide at minimum, the following information for recommended spare parts:

1. Manufacturer's name, address, phone and fax numbers

2. Manufacturer's part name, part number, unit price, lead time, shelf life

3. Quantity recommended for 1 year

4. Alternative suppliers of compatible parts, including local supplier name, address, phone and fax numbers

D. Submit preliminary list of spare parts and tools to Owner at least 30 days prior to intended system handover to Owner. The Owner reserves the right to add to, reduce or omit entirely, the recommendations contained on these lists.

END OF SECTION

SECTION 15410
PLUMBING AND DRAINAGE PIPING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labour, materials, products, equipment and services to supply and install the plumbing and drainage inside the building to point of connection outside the exterior building wall as indicated on the Drawings and specified in this Section of the Specifications.

B. The work essentially shall include, but shall not necessarily be limited, to the following items:

1. Installation and connection of proposed sanitary drainage and vent system to existing building sanitary drainage and vent system.
2. Installation and connection of proposed cold water supply system to existing building cold water supply system.
3. Coordination with other trades
4. Provision of shop drawings suitable for submission to the local authority, as built drawings.
5. Testing and Commissioning.
6. Liaison with local authority to obtain all necessary certificates and approvals including the completion of all forms and payment of any fees and charges. All costs for all the tests required by local authority shall be included.
7. All other works and systems as specified in the contract document and or shown on the drawings.

1.2 REFERENCE STANDARDS

A. Refer to the General Provisions.

1.3 CERTIFICATION AND APPROVALS

A. The Contractor shall be responsible for all technical submissions, applications and liaison with the government departments and supply authorities, whether they are new submissions or following up of previous submissions already made. The Contractor shall be responsible for obtaining all the necessary approvals and certificates for his installations and payments for his applications.

1.4 WORKMANSHIP

A. Shall be first class and in accordance with the best practices of the trade.

1.5 MATERIALS AND DEVICES

A. Only new materials and devices shall be installed on the job.

1.6 GENERAL CONTRACTOR'S RESPONSIBILITY

A. Coordination of all sub-contractors is the responsibility of the General Contractor; work to follow plans and specifications which are complementary to each other.

1.7 CONFLICT BETWEEN PLANS AND SPECIFICATIONS

A. Specification shall govern.

1.8 AS-BUILT PLANS

A. As construction progresses, the contractor shall indicate on the field copy of the

contract plans any and all deviations from originally drawn thereon. Upon completion of the contract, these field corrections shall be incorporated on reproducible drawing sheets of the system. The reproducible drawing sheets, including two (2) white print copies, shall be submitted to the Owner(s) at no cost to the Owner(s).

1.9 ACCEPTANCE OF THE WORK

A. Shall be conditioned on a successful test of the entire system.

1.10 INSPECTION AND TESTING

A. The Owner representative reserves the right to inspect and witness at manufacturer's works test on any items of equipment or piping whichever the Owner representative may select. The Contractor shall allow all testing facilities for this purpose.

B. The Contractor shall carry out all tests specified in this specification and all tests required by Authorities having jurisdiction over the works. All tests shall be carried out in the presence of the Owner representative or M&E Consultant.

C. All apparatus, instruments, equipment, materials and labour required for conducting these tests and demonstration shall be provided at the cost of the Contractor. The Contractor shall carry out pressure for hydraulic test on the complete Plumbing System to show that it is functioning and satisfactorily within the requirements of this specification. Copies of all test certificates shall be endorsed by the Client's site staff and forwarded to the Owner representative for his review.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Provide chrome plating on all exposed piping within washrooms.

B. Drainage and Vent Piping:

1. Polyvinyl Chloride (PVC) series 1000 and fittings "for the vent lines conforming to ASTM D 2665 or as per base build material.

2. Hubless cast iron pipe and fittings for soil and waste pipe conforming ASTM A888/ISO 6594 or as per base build requirement.

C. Domestic Water:

1. Domestic Water pipes and fittings - all sizes:

   a. Copper pipe, type "L" hard-drawn or as per base build requirement.

2. Potable Water Piping

   a. Polypropylene Random Pipes (PPR), pipes & fittings ISO 10931-1BCF (Bead and Crevice Fee) fusion joints or as per existing material.

3. Drinking Fountains with built-in R.O System will be provided with Potable water supply.

2.2 VALVES

A. Provide Crane or Kitz domestic gate valves (50 mm and smaller) - soldered 1400kPa.

2.3 FLOOR DRAINS

A. Provide floor drains manufactured by Zurn or approved equal series 100 floor drains with cast iron body, and 100 mm dia. strainer.

2.4 GREASE INTERCEPTOR

A. Provide Grease interceptor, resistant coated interior and exterior fabricated steel, rated at 15gpm, with internal air relief by-pass, bronze cleanout plug and visible double wall trap seal with removable combination pressure equalizing/flow diffusing baffle and sediment tray.

2.5 PIPE HANGERS

A. Provide pipe hangers and supports for all piping. Provide hangers in accordance with the following requirements. Provide steel supports in accordance with the subsequent article in this specification section. Provide galvanized steel hangers and supports with galvanized fittings and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

B. Provide manufactured hangers, accessories and supports in accordance with ANSI B31.1 and MSS SP58, SP69, SP89 and SP90.

C. Select products to ensure adequate safety factors under anticipated loads.

D. Provide upper attachments as follows:

1. Standard beam clamp for normal service
2. Standard side beam clamp for normal service
3. Top beam clamp.
4. C clamp.
5. Angle clip for light duty side mounting.

E. Provide pipe attachments as follows:

1. Clevis hanger for copper piping up to and including 100mm diameter.
2. Swivel ring hanger for copper tubing up to and including 25mm diameter - epoxy coated.
3. Standard duty clevis hanger for steel piping.
4. Standard duty long clevis hanger for steel piping.

F. Provide supports for other piping types such as plastic, mechanically fused or packed joint pipe according to the pipe manufacturers published recommendations. Support piping continuously where required to prevent sagging. Provide sway brazing to meet local seismic requirements.

G. Provide protection saddles where insulated piping is supported from below.

2.6 BIDET

A. Provide Bidet at Women's toilet.

2.7 ELECTRIC WATER HEATER

A. Provide Multi Point Instantaneous water heater at Showers and sink.

B. Provide the following accessories:
   1. built-in magnetic contactor including 220V transformer, control circuit switch, fuses, pilot light and externally mounted toggle switch.
   2. cold water diffuser.
   3. thermostats.
   4. magnesium anodes.
   5. high limit control with manual reset.
   6. drain valve.

PART 3 – EXECUTION

3.1 VERIFICATIONS OF INVERTS

A. Verify all field service conditions immediately after award of Contract to ensure that drainage runs can meet the inverts of the site services.

B. Give notification immediately of any apparent difficulties or discrepancies.

C. No extra will be paid at a later date for rerouting of drains because site inverts cannot be met.

3.2 TESTING

A. Carry out not less than the following tests:

   1. Perform water tests on all soil, waste, vent and rainwater systems when rough-in of the system, or section thereof including fittings, branches, clean-outs and traps except fixture traps. When the system or section is filled, shut off the water, and allow to stands for one hour. There shall be no loss by leakage during this time.

   2. Pressure test domestic cold water, domestic hot water, and re-circulation lines with water at 150% of maximum operating pressure, for 6 hours without loss of pressure.

B. Conduct additional tests required by the authorities having jurisdiction.

C. If tests are required by an authority having jurisdiction, perform tests in the presence of each governing authority's authorized inspector, and obtain certification.

D. Certify tests not required by the authorities having jurisdiction.

E. Perform tests before piping, drains or vents are covered or concealed.

F. Remove all components which will not withstand test pressure, and replace after tests.

G. Eliminate leaks, or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.

H. Repeat tests as often as necessary to obtain certification.

I. Set all fixtures and fill all traps with water after tests have been completed.

3.3 CLEANING AND FLUSHING SEWERS

A. On completion of construction of drains, flush all drains until the deposits of earth and other foreign material have been removed.

3.4 CLEANING, FLUSHING, AND DISINFECTING WATER PIPING

A. Be responsible for care and cleaning of the piping system during and after construction. Plug all open ends during construction to prevent the entrance of foreign materials.

B. Flush all systems with clean, potable water to remove scale and sediment immediately upon filling.

C. Sterilize all potable water lines to meet local municipal requirements.

D. After completing satisfactory hydrostatic tests of the complete system, and flushing mains as outlined above, disinfect the mains in accordance with AWWA Standard C651-86. Repeat the flushing and disinfecting operation until the test results are satisfactory.

E. Ensure by operation of isolating valves or the installation of check valves that the disinfecting solution does not flow back into other sections of piping in use.

F. Arrange and pay for water quality tests to be performed by a recognized independent testing laboratory. Obtain certificates confirming safety of potable water supply.

3.5 CONNECTIONS TO OWNER'S EQUIPMENT

A. Rough in and connect to Owner's equipment. Do not rough in prior to receipt of final approved layout of Owner's equipment.

END OF SECTION

SECTION 15480
FIRESTOPPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work of this Section shall conform to the requirements of the Contract Documents.

B. Firestop Compounds.

C. Damming Material.

1.2 SUBMITTALS

A. Submit shop drawings, product data, and manufacturer's installation instructions for all materials and prefabricated devices, providing descriptions sufficient for identification at the job site.

B. Submit shop drawings showing proposed material, reinforcement, anchorage, fastenings, and method of installation. Construction details shall accurately reflect actual job conditions.

C. Submit Material Safety Data Sheets with product delivered to job site.

D. Submit complete details of each type of penetration to be used indicating the proper U.L. approved firestop system.

1.3 QUALITY ASSURANCE

A. Firestop system installation shall conform to requirements of qualified designs or manufacturer approved modifications, as supported by engineering reports.

B. Install firestop materials and systems as required by these Contract Documents.

C. Submit manufacturer's product data, letter of certification, or certified laboratory test report that the material or combination of materials (firestop system) meets the requirements specified in accordance with the applicable referenced standards.

D. The firestop compound shall not contain any solvents or inorganic fibers. The penetrations seal material must be unaffected by moisture and must maintain the integrity of the floor or wall assembly for its rated time period when tested in accordance with ASTM E8 14 (UL1479). The system shall be Classified for up to and including 3 hours.

1.4 FIRESTOPPING

A. Provide firestop compounds for caulk, pour, trowel or pump application. Material must be capable of sealing openings around single or multiple pipes against fire, smoke and toxic gases, and maintaining rating with a thickness no greater than the structure.

B. Provide a damming material, where required, per manufacturer's recommendations.

C. Provide a firestop system consisting of a material, or combination of materials, to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke or gases through penetrations in fire-rated barriers. It shall be used in specific locations as follows:

1. Penetrations for the passage of utility services through fire-rated vertical

barriers (walls and partitions), horizontal barriers (floor slabs and floor/ceiling assemblies), and vertical service shafts.

2. Locations shown specifically on the drawings or where specified in other sections of these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Firestopping materials/systems shall be flexible to allow for normal movement of building structure and penetrating item(s) without affecting the adhesion or integrity of the system. Necessary perforations for the inlet and outlet pipes shall be provided. Each storage tank shall be equipped with overflow, scour pipes, and vent pipes.

B. Firestopping materials shall not require hazardous waste disposal of used containers/ packages.

C. Provide firestopping materials free of solvents which will not experience shrinkage while curing.

PART 3 – EXECUTION (NOT APPLICABLE)

Not Used. (As per Manufacturers recommendation)

END OF SECTION