SPECIFICATIONS WORKS

The Completion of Construction and Finishes Works
Training and Conference Center
Mhammra- Akkar-
North Lebanon

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SECTION 01100

PART 1 GENERAL

1.1 INTRODUCTION

A. The requirements of this Section do not supersede any provision of the Special Conditions of Contract and of the General Conditions of Contract.

1.2 SECTION INCLUDES

A. Contract description.

B. Contractor's use of site.

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1.3 CONTRACT DESCRIPTION

A. Scope:

1. This Project covers the completion of construction and finishes of **"a Training and Conference Center at the 3rd level of the Municipality Building at Mhammra Akkar"**, as per the Drawings, Bill of Quantities, and as detailed in the Contract Documents (Special Conditions of Contract, General Conditions of Contract, etc.) and as instructed by the Purchaser and Supervisor.
2. The Contract comprises execution, completion of the works and remedying any defects therein including the provision of all labor, materials, constructional plant, temporary works and everything whether of a temporary or permanent nature required for the execution and completion of the works.
3. The organization of the Specifications into Divisions, Sections and paragraphs and the arrangement of Drawings shall not necessarily control the Contractor in dividing the Work among sub-contractors or in establishing the extent of Work needed to be performed by any trade for the successful completion of the project.
4. The Contractor shall examine any section of the specifications in conjunction with the other sections as well as the Documents and Drawings which affect the Work of that section.

B. Description of the Project:

1. The Project scope of work comprises the completion of construction and finishes of **"a Training and Conference Center at the 3rd level of the Municipality Building at Mhammra Akkar"** with related civil, architectural and finishes works, and electromechanical works including commissioning and warranty.

C.Performance and Standards:

1. The performance required of materials and products and the standards to be complied with are specified in relevant sections of the Specifications.

D. Cross References:

1. The specifications are prepared based on the Constriction Specifications Institute (CSI) master format.
2. The specifications section numbers and titles are used in the Bill of Quantities as cross-references to help define the part or parts of the Specification which apply to particular kinds or parts of the Work. If the references are to specific clauses or kinds or types of work within a section of the Specifications, they shall be taken as applying to the section as a whole, with all related sections and other relevant information. The Specifications as a whole shall be taken as applying to the Work as a whole. The Supervisor shall have a discretionary interpretive role in case of contradiction or ambiguity.

1.4 CONTRACTOR'S USE OF SITE

A. All construction operations and site establishment facilities shall be confined to within the site boundaries unless otherwise agreed with the Supervisor.

B. The Contractor shall be responsible for safeguarding all existing structures and neighboring occupancies, facilities, utilities and properties.

C. The Contractor shall be responsible for arranging its own working space, storage of materials, setting of all temporary accommodations, utilities, services, facilities, etc.

D. The Contractor shall keep all driveways and entrances serving the site clear and available to Purchaser, Purchaser's employees, third parties, and emergency vehicles at all times. The Contractor shall not use these areas for parking or storage of materials.

E. The Contractor shall Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

F. The Contractor shall not unreasonably crowd the site with materials or equipment. The Contractor shall confine stockpiling of materials and storage sheds to the areas approved by the Supervisor. If additional storage is necessary, the same shall be arranged at the Contractor's own responsibility and cost.

1.5 COORDINATION

A. The Contractor shall be responsible for all the scope of work described and shall coordinate the installations of equipment (outside the scope of this contract) by third parties. To this effect, the Contractor shall provide all necessary installation support required by those third parties if and when required.

B. The Contractor shall ensure that all the works are carried out in proper sequence having regard to the progress of the works, and that all necessary provisions are made for locating, routing, supporting and fixing the engineering services, providing the necessary holes, chases and access for them, and in all respects fully integrating them with the works.

1.6 WORK SEQUENCE

A. Execute Works in approved stages and phases.

B. Coordinate construction schedule and operations with Supervisor.

1.7 PURCHASER OCCUPANCY

A. The Purchaser or its designated Beneficiary will occupy the site and premises at the date indicated in the Contract.

B. The Contractor shall cooperate with Purchaser to minimize conflict, and to facilitate Purchaser's operations.

C. The Contractor shall schedule the Work with the Supervisor to accommodate Purchaser or Beneficiary occupancy.

1.8 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon ":" or semi-colon ";" is used within sentences or phrases.

B. Related Sections: All "Division 1" specifications sections are general requirement sections and are applicable to all other specifications sections with no need to mention them in the “Related Sections” of each specifications section. In general, “Related Sections” are only the “Technical Related Sections”.

C. The terms “Purchaser”, “Client”, “Contracting Authority”, “Employer” or “Procurer” may be used interchangeably and they shall refer to UNDP.

D. Reference to “Supervisor” shall mean the UNDP appointed representative either as a consultant or UNDP staff.

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 INTRODUCTION

A. The requirements of this Section do not supersede any provision of the Special Conditions of Contract and of the General Conditions of Contract. In case of any discrepancy, the order of precedence is as follows: SCC, GCC and these Specifications.

1.2 SECTION INCLUDES

A. Coordination and project conditions.

B. Field engineering.

C. Regulatory Requirements.

D. Management and Administration Procedures.

1.3 COORDINATION AND PROJECT CONDITIONS

A. The Contractor shall coordinate scheduling, submittals and Work of various sections to ensure efficient and orderly sequence of execution of interdependent construction elements/trades. The Contractor shall accommodate for the installation of equipment and items by third parties. Such equipment includes but is not limited to the ones shown in the Drawings.

B. The Contractor shall verify utility requirements and characteristics of operating equipment are compatible with project utilities. The Contractor shall coordinate work of various sections related to the installing, connecting to, and placing in service, of third party equipment.

C. The Contractor shall coordinate space requirements, supports and execution of all works along with mechanical works and electrical installations. The Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

D. The Contractor shall complete and clean-up the Work of separate sections in preparation for Substantial Completion.

1.4 REGULATORY REQUIREMENTS

A. Scope:

1. This Specification calls attention to the regulations to be observed by the Contractor and the Standards and Codes of Practice.

B. Regulations:

1. The Contractor shall carry out the Works in full observance of the municipal and governmental authorities' requirements and regulations. Special attention shall be also given to:

a. All Lebanese legal regulations regarding construction, workmanship, material, general requirements, site administration, safety, health and environmental regulations.
b. Municipal regulations and planning requirements.

C. Standards:

1. Notwithstanding the Specifications of certain Standards and Codes of Practice, all Materials, Products and Workmanship shall comply with the requirements of the latest edition of all relevant Standards, Standard Codes of Practice and all current amendments thereto.
2. Compliance shall be understood to mean that the standard attained shall not be less than that specified in the Standard or Code of Practice but may well be higher. In particular, where a higher standard is called for in the Specification, that higher standard shall take precedence over the relevant Standard and Code of Practice, even if these are referred to in the text of the Specification. The more stringent requirements shall always govern.
3. In the case of materials and products which have been produced or manufactured in accordance with a published Standard or Code, that fact shall be brought to the attention of the Supervisor together with full particulars of the standard in question; it is up to the Supervisor to accept the material or product if he is satisfied with the provisions of the standard or code.

1.6 MANAGEMENT AND ADMINISTRATION PROCEDURES

A. Superintendence:

1. The Contractor shall assume full responsibility for implementation, coordination, superintendence and administration of the Work including all sub-contracts.
2. The Contractor shall arrange and monitor a program with each subcontractor, supplier and authority and obtain and supply information as necessary for coordination of the Work.

B. Sub-Contractor's Site Meeting:

1. The Contractor shall hold meetings with appropriate sub-contractors and suppliers shortly before main site meetings to facilitate accurate reporting of progress.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 INTRODUCTION

A. The requirements of this Section do not supersede any provision of the Special Conditions of Contract and of the General Conditions of Contract. In case of any discrepancy, the order of precedence is as follows: SCC, GCC and these Specifications.

1.2 SECTION INCLUDES

A. Scope.

B. Definitions.

C. Submittal Procedures.

D. Supervisor’s Representative Review of Submittals.

1.3 SCOPE

A. This section generally specifies procedures regarding submittals. Nevertheless, additional procedures and requirements for submittals are specified in individual sections of the specifications.

B. Submittals shall include but not limited to the following:

1. Submittal schedule.
2. Coordination and sequencing.
3. Site layout organization chart.
4. Submittal preparation and procedure.
5. Product data.
6. Construction time schedule.
7. Design by Contractor and Design data.
8. Shop drawings and CAD produced drawings.
9. Samples.
10. Certificates.
11. Test and inspection reports.
12. Manufacturer's instructions and manuals.
13. Manufacturer's field reports.
14. Miscellaneous submittals.
15. Progress reports and Photographs.
16. Correspondence.

C. The requirements of this section do not supersede or take precedence over any provision of the Contract. Should any discrepancy become apparent between these requirements and the Contract, the requirements of the Contract shall prevail.

1.4 DEFINITIONS

A. The work related to submittals of this section, in addition to the definitions of the Contract, are further categorized for convenience as follows:

1. Product data shall include manufacturer's latest standard printed literature such as manufacturer's installation instructions, catalog cuts, color charts, roughing diagrams, wiring diagrams, and performance curves on materials, equipment and systems for this project. Product data shall include references to applicable specification section and item number. Product data shall be in addition to the required shop drawing submittals.
2. Any design required by the Contractor, where called for in the Contract Documents, shall include calculations, and working and shop drawings (CAD).
3. Construction time schedule shall be in the form of a Gantt chart incorporating activities for all work to be performed by the Contractor, its Sub-Contractors and suppliers to be employed in or about the Site, prepared in accordance with the principles of Critical Path Method Programming.
4. Shop drawings shall include specially prepared technical data with diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, plans, sections, details and measurements in standard printed form (A4 size or A0 size for drawings). Shop drawings shall be in addition to the required product data and shall indicate applicable specification section and item numbers.
5. Samples shall include physical examples of materials, in complete units and as smaller portions of units, for visual inspection. Samples shall indicate applicable section and item numbers within that section.
6. Certificates shall include statements of suitability, certifying reports from governing agencies, industry standards and testing agencies and applicable certificates specified in each section of the specification.
7. Test and inspection reports shall include reports specified to be required in each section of the specifications.
8. Schedules shall include schedule of required submittals organized by related specification section number and sequence of submission, schedule of sequence of work and time schedule, schedule of sequence of application of specific units of work and schedule of materials, equipment and systems as listed in applicable sections of the specifications.

9. Miscellaneous submittals shall include submittals related directly to the work (non-administrative) including maintenance agreements, physical work records, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the work and not processed as shop drawings, product data, samples or certificates.

1.5 SUBMITTAL PROCEDURES

A. General:

1. Transmit each submittal with the required form.
2. Sequentially number transmittal forms.
3. Mark revised submittals with original number and sequential alphabetic suffix.
4. Identify Project, Contractor, Sub-Contractor and Supplier and relevant drawing and detail number, and specification section number, appropriate to submittal.
5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information are in accordance with requirements of the Work and Contract Documents.
6. Schedule submittals to expedite Project, and deliver to Supervisor at business address instructed. Coordinate submission of related items.
7. Identify variations from Contract Documents and product limitations which may be detrimental to successful performance of the completed Work.
8. Allow space on submittals for Contractor and Supervisor review stamps.
9. When revised for resubmission, identify changes made to previous submission.
10. Distribute copies of reviewed submittals as appropriate.
11. Instruct parties to promptly report inability to comply with requirements.
12. Submittals not requested will not be recognized or processed.

B. Submittal Schedule:

1. All submittals and correspondence shall be submitted to the Supervisor.
2. Any design required by the Contractor, where called for, shall be submitted to the Supervisor for approval.
3. All shop drawings, material and samples submittal schedules shall be submitted to the Supervisor for approval. In addition, the Contractor shall submit Material delivery schedule for Supervisor’s approval. The Contractor shall adhere to the approved schedules.
4. Schedule submissions to ensure that the Supervisor is given a reasonable time to review each submission within the scheduled period of time.

5. Certify that each submittal has been checked and approved by Subcontractors, installers, manufacturers and suppliers. Note any deviations from drawings or specifications. Without such an explicit note, no approval on any submittal shall be deemed a variation or a waiver of the Contractor's responsibility to fully comply with the Contract Documents.
6. No submissions shall be processed without signed & approved certification of Contractor. This certification shall be stated on each submission as follows: ***Material submitted for approval has been checked for conformance with drawings and specifications for this project. Any deviation from drawings and specifications has been explicitly and clearly marked on the material or detailed in the transmittal letter.***

C. Coordination and Sequencing:

1. Coordinate preparation and processing of submittals with the Construction Program and progress so that the work will not be delayed.
2. Coordinate and sequence submittals for work and work interfaced with other work so that the processing of submittals will not be delayed by the lack of required coordination between submittals.
3. The obligation to coordinate the work indicated on any submittal material with other trades and with field conditions is the responsibility of the Contractor. No claim will be allowed for work that may have to be moved or replaced based on a claim that the work was placed in accordance with dimensions indicated on an approved submittal.
4. No claim for an extension of time will be granted because of Contractor's failure to coordinate submissions.

D. Site Layout Organization Chart:

1. Submit to the Supervisor's approval, a site layout organization plan,
2. Submittal Preparation and Procedure:

1. Contractor shall submit any design required by the Contractor where called for, shop drawings, material and other samples accompanied by "Design, Shop Drawings, Materials and other Samples Transmittal" forms.
2. The format of transmittal forms shall be to the approval of the Supervisor.

E. Product Data:

1. Within 7 days after the Contract Commencement Date, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product called for under "Submittals" in each individual specification section.

2. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
3. Submit product data in triplicate for review. Indicate the actual materials being submitted for review when literature contains selections.

F. Construction time schedule:

1. Program Submittal Procedures and Requirements:
   a. The Contractor shall submit his initial Construction Program for approval, in three copies and one soft copy, within 2 weeks of the Contract Commencement Date. Such initial Construction Program shall include a scheduling software Gantt chart highlighting the critical path and proving completion within contractual deadlines.
   b. After approval of the Contractor's initial Construction Program, revisions and updates must be submitted on a monthly basis.
   c. Revisions and monthly updates to the Construction Program shall be submitted within five (5) working days of the data date for inputting revised/updated information. The data date for the first monthly update shall be one month after approval by the Supervisor of the Contractor's initial Construction Program, and successive data dates shall be at monthly intervals. The said data date should coincide with the date of the site progress meeting at which time the records of progress are verified.
   d. Each program submitted shall be signed by all principal Subcontractors before being submitted to the Supervisor thereby confirming that they have reviewed the said program. If any Subcontractor has reservations regarding his ability to comply with the program requirements to which he has appended his signature, the Contractor shall instruct the Sub-Contractor to list such reservations in writing and a copy thereof shall be submitted to the Supervisor with the program submittal for his information. Neither reservation by any Sub-Contractor, nor the fact of informing the Supervisor in respect thereof, shall relieve the Contractor of his responsibilities under the Contract in the time prescribed therein.
   e. Submit a bi-weekly report detailing the preparation, submittal and approval status of shop drawings, materials and equipment, samples, and the status of materials and equipment procurement, order placed, delivery periods and site delivery dates.

2. Programming Costs:

   a. All costs in establishing, maintaining, revising and updating the construction program shall be borne by the Contractor.

Design by Contractor and Design Data:

1. Any design required by the Contractor, where called for, with all necessary calculations, working and shop drawings, shall be submitted to the Supervisor within 7 days after the Contract Commencement Date.
2. The design by Contractor, together with all necessary calculations, working drawings and shop drawings shall be prepared by the Contractor and by his principal Sub-Contractors for structural, architectural and electro-mechanical works, proper liaison and coordination between trades shall be attended to and ensured. Contractor shall also allow the Supervisor's access for review and approval during the preparation process.
3. The design by Contractor shall be prepared after site dimensions have been taken. Shop drawings shall be prepared on Cad and printed on reproducible transparencies; they shall use metric units of measurement.
4. The Supervisor's review and approval of any design required by the Contractor is for general conformance with the design concept and specifications and shall not relieve the Contractor from responsibility for errors or omissions in respect of the requirements of any standards and codes.
5. The Contractor shall make any corrections or amendments required by the Supervisor including calculations, working drawings and shop drawings, and shall resubmit until approved. All such corrections or amendments shall be clearly indicated on the resubmitted design with all necessary calculations, working drawings and shop drawings, by the use of revision numbers in circles or triangles, or other method approved by the Supervisor.
6. No acceptance or approval by the Supervisor of any design by the Contractor submission made by the Contractor, nor any notes, comments, stipulations, requests for clarifications, etc., made by the Supervisor upon such submissions during his review and approval thereof, shall constitute an authorization to any variation in the Contract price or scope or to any extra time for completion of the works.

1. Shop Drawings, CAD Drawings and Samples: The Contractor shall prepare, review, coordinate and submit to the Supervisor for approval such shop drawings and samples as are required by the Contract Documents or as may be required by the Supervisor during the course of the works.
2. At the time of making his submission, the Contractor shall inform the Supervisor in writing of any deviation between shop drawings/samples being submitted and the requirements stipulated or reasonably implied by the Contract Documents.
3. By submitting shop drawings and samples, the Contractor represents that he has determined and verified all dimensions, relation to existing work, coordination with work and equipment to be installed later, coordination with information in previously submitted shop drawings and has verified their compliance with all the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor. The Contractor shall be responsible for the correct locations of his work, irrespective of approval by the Supervisor, and shall pay all costs and expenses incurred by others due to improper location of his work.
4. Sub-Contractors shall submit their shop drawings and samples through the Contractor who shall review and coordinate with his own and other Subcontractor's drawings and/or samples before submitting to the Supervisor. The Contractor shall be responsible in all respects for his Sub-Contractor's shop drawings and samples as if they were his own.
5. Neither the fabrication of prefabricated items, nor the ordering of any work, materials or equipment, nor the execution of any work on site, shall commence until shop drawings and samples, relevant to the said items, work, etc., and required by the specifications, have been submitted and approved in writing by the Supervisor.
6. Shop drawings shall be prepared by the Contractor and by his principal Subcontractors for structural, architectural and electro-mechanical works. Proper liaison and coordination between trades shall be attended to and ensured. Contractor shall also allow for the Supervisor's access for review and approval during the preparation process.
7. Shop drawings shall describe accurately the method of fabrication, installation, applied finishes, types and sizes of all members and fixings, and shall, where applicable, indicate methods of marking components for site erection. Shop drawings shall be to scales approved by the Supervisor.
8. The Contractor shall verify all dimensions and field conditions and shall check and coordinate the shop drawings and samples required in connection with a particular trade or section of the works with the requirements of other trades or section related there

9. In order to ensure proper coordination, shop drawings and samples for each system or element of work shall be submitted in a single package. The Supervisor may require that all relevant parts of a system or element be submitted before any component item is approved.
10. Except for finish, pattern, color and other matters in respect of which the Supervisor's decision is required in accordance with the Contract Documents, the Supervisor's review and approval of shop drawings and samples submitted by the Contractor is for general conformance with the design concept and specifications and shall not relieve the Contractor from responsibility for any deviation from, or errors or omissions in respect of the requirements of the Contract Documents, unless the Contractor has informed the Supervisor in writing of specific deviations and the Supervisor has given written approval thereto.
11. The Supervisor may at any time call upon the Contractor to submit samples of any material used or to be used in the work, including those specified in the Contract by "Brand Name", for comparison with the specification and/or approved sample. Should any such sample fail to meet the requirements of the specification and/or standard of the accepted sample, then all materials from which the sample has been taken shall be removed from the site immediately and all work executed incorporating such material shall be removed and made good to the satisfaction of the Supervisor all at the expense of the Contractor.
12. No acceptance or approval by the Supervisor of any shop drawing or sample submission made by the Contractor, nor any notes, comments, stipulations, requests for clarifications, etc., made by the Supervisor upon such submissions during his review and approval thereof, shall constitute an authorization to any variation in the Contract price or to any extra time for completion of the works.

G. Certificates:

1. When specified in any specification section under "Submittals", submit certification by manufacturer, installation or application sub-contractor, or Contractor to Supervisor, in quantities specified for Product Data.
2. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
3. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Supervisor.
4. Submit certificates in triplicate for review.

H. Test and Inspection Reports:

1. Submit test and inspection reports called for in each specification section.
2. Submit test reports for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

Manufacturer's Instructions:

1. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Supervisor for delivery to Purchaser in quantities specified for Product Data.
2. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

I. Manufacturer's Field Reports:

1. Submit reports for Supervisor in duplicate.
2. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

Progress Reports and Photographs:

1. The Contractor shall submit to the Supervisor each month a progress report showing actual progress by identifying activities and Works commenced and those completed during the previous week, estimated time required to complete all activities under way in relation to the program of Works, a detailed program for activities to be carried out during the following week and progress photographs. Such reports shall be to Supervisor’s satisfaction.
2. During the progress of the work, submit in triplicate, colored photographs taken by an approved professional photographer consisting of minimum ten (10) views, all taken where directed by the Supervisor. The prints shall be 130 x 180mm matt finish, unless otherwise stated in the Conditions of Contract. Photographs shall be taken before and after every activity.
3. At the completion of all work final photographs shall be taken as directed by the Supervisor.
4. Identify each print on back. Identify Name of Project, Contract Number, orientation of view, date and time of view, name and address of photographer.
5. All soft copies (digital camera) shall be delivered to the Supervisor in their proper order and shall become the property of the Purchaser. Include typed table of contents of all photographs in chronological sequence.
6. The Contractor shall submit photographs for all works to be covered before covering such works to the approval of the Supervisor.

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 INTRODUCTION

A. The requirements of this Section do not supersede any provision of the Special Conditions of Contract and of the General Conditions of Contract.

1.2 SECTION INCLUDES

A. Quality control and control of installation.

B. Tolerances.

C. References.

D. Testing and inspection services.

E. Manufacturers' field services.

F. Examination.

G. Preparation.

1.3 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. The Contractor shall submit a Quality Assurance Program to the Supervisor’s approval.

B. The Contractor shall monitor quality control over sub-contractors, suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

C. The Contractor shall comply with manufacturers' instructions. When manufacturers' instructions conflict with Contract Documents, request clarification from Supervisor before proceeding.

D. The Contractor shall comply with specified standards as minimum quality requirements for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. The Contractor shall perform Work using persons qualified to produce required and specified quality.

F. The Contractor shall verify the field measurements as indicated on shop drawings or as instructed by manufacturer.

G. The Contractor shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.4 TOLERANCES

A. The Contractor shall monitor fabrication and installation tolerance control of products to produce acceptable Work. Tolerances should not accumulate.

B. The Contractor shall comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Supervisor before proceeding.

C. The Contractor shall adjust products to appropriate dimensions at full responsibility. Products shall be positioned in place prior to fixing.

D. The works are to be set out and constructed in accordance with the tolerances given in BS 5606:1990 or equivalent.

1.5 REFERENCES

A. Whenever specific standards, brands, trades, etc. are mentioned, equivalent equal are acceptable without having to state "or equivalent" each time.

B. For products or workmanship specified by association, trades, or other consensus standards, the Contractor shall comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

C. The Contractor shall conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.

D. The Contractor shall obtain copies of standards where required by product specification sections.

E. When specified reference standards conflict with Contract Documents, the Contractor shall request clarification from the Supervisor before proceeding.

F. Neither the contractual relationships, duties, responsibilities of the parties to the Contract, nor those of the Supervisor shall be altered from the Contract Documents by mention or inference otherwise in any reference documents.

1.6 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, the Contractor shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment/products, test and adjust and balance of equipment/products as applicable, and to initiate instructions when necessary.

B. The Contractor shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. The Contractor shall verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning any new Work, means acceptance of existing conditions at the sole responsibility of the Contractor having acquainted itself with all site and substrate conditions before submitting its bid.

B. The Contractor shall verify that existing substrate is capable of structural support or attachment of new Work being applied or attached at the sole responsibility of the Contractor having acquainted itself with all site and substrate conditions before submitting its bid.

C. The Contractor shall examine and verify specific conditions described in individual specification sections.

D. The Contractor shall verify that utility services are available, of correct characteristics and in the correct locations.

3.2 PREPARATION

A. The Contractor shall prepare and clean substrate surfaces prior to applying next material or substance.

B. The Contractor shall seal cracks or openings of substrate prior to applying next material or substance.

C. The Contractor shall apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION

SECTION 04810

MASONRY

PART 1- GENERAL

1.01 DESCRIPTION:

This section covers concrete unit Masonry where indicated on the drawings and specified herein.

The Contractor shall provide labor, materials, equipment and services, and perform operations required for installation of masonry walls, mortar and related work as indicated on the drawings and specified herein.

1.02 APPLICABLE CODES AND STANDARDS:

The standards and codes applicable to only a portion of the work specified in this section are referenced in the relevant parts or clauses. Standards and codes which are generally applicable to the work of this section are listed hereinafter:

A. ASTM - American Society for Testing and Materials:

B. UL - Underwriters' Laboratories, Ins

Standard 618 Concrete Masonry Units - Fire Resistance Index

1.03 SUBMITTALS

The following submittals are required:

A. Detail Drawings and/or Shop Drawings
B. Quality Assurances
C. Samples
D. Certificates of Compliance with these specifications for approval. Obtain approval prior to shipment of materials.
E. Test Reports
F. Product Data: Submit copies of manufacturer's latest published literature for materials specified herein for approval, and obtain approval before materials are delivered to the site.

1.04 TRANSPORTATION HANDLING, STORAGE AND PROTECTION

A. Delivery: Delivery masonry materials, other than bulk materials to project site in manufacturers unopened containers, bundles, pallets or other standard packaging devices; fully identified with name, type, grade, color and size.

Deliver mortar materials specified herein in manufacturer's unopened containers, with manufacturer's name and point of origin on each container.

Deliver mortar materials and handle as to prevent the inclusion of foreign materials and the damage of materials by water.

B. Storage: Store on platforms and protect from weather, soiling and damage.

1.05 QUALITY CONTROL

A. Samples and Testing: Samples from stock on the site shall be taken by the Contractor in the presence of the Government Representative.

1. Cement: Sampled cement shall be tested by the testing laboratory at no additional cost to the Government. Certified copies of laboratory test reports shall be furnished for each lot of cement and shall include all test data, results and certification that the sampling and testing procedures are in conformance with Contract Documents. No cement shall be used until test results are satisfactory. Cement found unsatisfactory under test shall be immediately removed from the construction site.

2. Aggregates: Aggregate sampling shall conform to ASTM D75.

3. Water: Water analysis shall be performed in accordance with ASTM D596.

4. Admixtures: Sampling and testing of all admixtures used in mortar and grout shall be in accordance with the standard procedure recommended by the testing laboratory and at no additional cost to the Government.

5. Unit Masonry: Sampling and testing shall be in accordance with ASTM C426. Test to determine the linear drying-shrinkage of units shall be performed note more than 3 months and not less than 2 weeks before delivery of units to the construction site. Sample units shall prove under test to be free from cracks or other structural defects. Air-dry condition test of masonry units shall be performed when so requested by the Government Representative, at no additional cost to the Government.

6. Mortar and Grout: At start of masonry work, at least one sample of mortar and of grout shall be taken on three successive working days and continuously stored in moist air until tested.

Materials shall conform to the latest edition of reference specifications specified herein and to applicable codes and requirements of local authorities handing jurisdiction.

- British Standards (BS).

- American Society for Testing Materials (ASTM).

Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

Mortar and grout shall have the following minimum compressive strengths in Megapascals.

	Size	Strength After 7 days	Strength After 28 days
Mortar Cylinders	50 mm x 100 mm (2 in. x 4 in.)	8.6 MPa (1,250 psi)	17.2 MPa (2,500 psi)
Grout Specimens	76 mm x 76 mm x 152 mm (3 in. x 3 in. x 6 in.)	6.9 MPa (1,000 psi)	13.8 MPa (2,000 psi)

.PART 2-PRODUCTS

2.01 MATERIALS

A. Concrete Masonry Units: Hollow units shall conform to ASTM C90 or solid units, where required, shall conform to ASTM C145. All units shall be Type I, Grade N-1, normal weight, sizes as shown and vertical cells so as to provide specified clear spaces for grouting. Provide half units, bond beam units, open end units, corners, lintel, jamb, sash, header, and other shapes necessary to properly complete the work. Provide square edge blocks unless otherwise shown.

1. Fire Rated Units: Provide units for fire-rated masonry construction complying with UL 618, or units which have been tested in accordance with ASTM E119 and are listed in the UL "Fire Resistance Tndox" .

B. Anchors and Ties: Hot-dip galvanized steel complying with ASTM A153, or Eraydo Zinc alloy of acceptable design, complying with the following requirements:

1. Dovetail Slots: 0.76 mm (22 gages), felt or fiber filled.

2. Anchors for Dovetail Slots: 1.58 mm (16 gage), corrugated, of length required.

3. Wire Ties: 3.42 mm (10 gage), looped at both ends.

4. Wire Mesh Ties: 1.58 mm (16 gage), 12.5 mm (1/2 in.} mesh, 75 mm (3 in.) wide.

5. Anchor Straps 32 mm (1-1/4 in.) x 3 mm (1/8 in.) by length required, with ends turned up 50 mm (2 in.).

C. Horizontal Wire Joint Reinforcing ICBO approved truss type units prefabricated of cold-drawn wire, ASTM A82, in - straight lengths not less than 3 m (10 ft.) long, with matching corner and intersection units, continuous deformed longitudinal side rods, 3.8 mm (9 gage) or larger plain cross rods electrically

buttwelded to side rods, unit widths 38 to 50 mm (1-1/2 to 2 in.) less than wall thickness, rod sizes as shown, units hot-dip galvanized after fabrication in accordance with ASTM A153, Class B2.

D. Reinforcing Bars: ASTM A615, Grade 60 except where otherwise shown.

E. Control Joint Filler: Extruded rubber, ASTM D2000, Type R. Shore A, Durometer 80 when tested in accordance with ASTM D2240, size and shape as shown.

F. Concrete Inserts: Ferrule loop insert, 19 mm (3/4 in.) diameter, ASTM A501, capable of supporting working loads of 4.88 kN m (3600 lb.ft.) tension and 7.72 kN m (5700 lb. ft.) shear as specified.

G. Mortar Materials

Portland cement shall be complying with the following:

ASTM C150, Type I or B.S. 12. Provide natural color, non-staining, without air-entertainment.

Nonstaining Cement: Not more than .03 percent soluble alkali - Fed. Spec. SS-C-181e.

Mortar plasticizer.

Aggregates: Natural, clean, washed, hard sand particles of mineral origin conforming to the following:

Aggregates for Mortar: ASTM C 144 or B.S. 1200.
Aggregates for Grout: ASTM C104.
Use white sand (natural or ground white stone) when non-staining is used and required.

Water: Potable and free of salts and deleterious substances.

Masonry Cements: The use of masonry cements is prohibited.

PART 3- EXECUTION

3.01 INSTALLATION

A. Layout: Layout walls in advance for accurate spacing of exposed bond patterns with uniform joint widths, and to properly locate openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half size units at corners, jambs, and wherever possible, at other locations. Coordinate with and cooperate with installation of reinforcing, dowels, anchors, and other work built into concrete for proper location of such work into masonry.

B. Alignment and Tolerances: Lay up walls plumb and true with courses level, accurately spaced and coordinated with other work. Comply with following tolerances:

1. Variation from Plumb: For lines and surfaces of columns, walls and arises do not exceed 6 mm in 3 m (1/4 in. in 10 ft.), or 10 mm (3/8m in.) in a story height or 6 m (20 ft.) maximum, nor 13 mm in 12 m (1/2 in. in 40 ft.) or more. Except for external corners, expansion joints and other conspicuous lines do not exceed 6 mm (1/4 in.) in any story or 6 m (20 ft.) maximum, nor 13 mm in 12 m (1/2 in. in 40 ft.) or more.

2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 6 mm (1/4 in.) in any bay or 6 m (20 ft.) maximum, nor 19 mm in 12 m (3/4 in. in 40 ft.) or more.

3. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 13 mm (1/2 in.) in any bay or 6 m (20 ft.) maximum, nor 19 mm in 12 m (3/4 in. in 40 ft.) or more.

4. Variation in cross-sectional Dimensions: For thickness of walls, from dimensions shown, do not exceed minus 6 mm (1/4 in.) nor plus 13 mm (1/2 in.)

C. Joints: Tool exposed joints slightly concave, unless otherwise shown. Cut joints flush for masonry which will be Concealed or covered by other materials, except paint and similar coatings. Rake out mortar wherever joints are to receive walking or sealants.

D. Adjustment: Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove masonry units, clean off mortar, and reset in fresh mortar.

3.02 **LAYING, REINFORCING AND GROUTING**

A. Laying: Lay units with full head and bed mortar joints. Walls and crosswebs of cells shall be full-bedded in mortar. Maintain head and bed joint widths shown, or if not shown, provide 10 mm (3/8 in.) joints. Bond each course at corners and intersections and bond into or anchor to adjacent construction with metal anchors spaced not over 800 mm (32 in.) o.c. in both directions. Do not wet concrete masonry before lying. Lay wall units in 1/2 running bond with vertical joints in each course centered on units in courses above and below, unless otherwise shown. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

1. Vertical Continuity: Maintain vertical continuity of core or cell cavities, which are to be grouted to provide minimum clear dimensions shown

and to provide minimum clearance and grout coverage for vertical reinforcing bars. In any case, maintain a clear, unobstructed continuous vertical cell measuring not less than 50 mm by 75 mm (2 in. x 3 in.).

2. Cutting Masonry Units: Use motor driven Carborundum saw designed to cut masonry units with clean sharp corners. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible. Avoid the use of less than half-size units at corners, jambs and at other locations.

3. Metal Frames: Set units tightly against metal frames and fill voids completely with grout. Build frames anchors into joints. Cut units accurately to fit around pipes, ducts, and openings; and fill voids full with grout. Fill jambs and head of hollow metal frames solid with mortar.

4. Partitions: Built partitions of thickness shown. Give sufficient opportunity to the various trades to install built-in-work before proceeding with the partitions, leaving openings where required for testing; such openings to be closed up later. Construct masonry partitions full height and terminate against underside of structure above unless otherwise shown.

5. Joint Reinforcement: Place joint reinforcement in horizontal mortar joints on 400 mm (16 in.) centers unless otherwise shown. Make reinforcement continuous except at control joints and expansion joints. Lap reinforcement 150 mm (6 in.) at ends and use prefabricated "T" and "L" sections at corners and intersections to provide continuity. Provide reinforcement in first and second bed joints above lintels and below sills extending 600 mm (2 ft.) beyond jamb openings.

3.03 BUILT-IN-WORK

A. General: Build in frames, struts, hangers, miscellaneous metal, and other items of work furnished under other sections. Prepare for, build in, and protect flashings, regrets, anchors, and other similar items occurring in connection with work of this section.

B. Access Doors Frames and Panels: Install access doors, frames and access panels occurring in masonry construction where shown and required for access to mechanical and electrical installations and equipment.

3.04 CURING:

Maintain masonry continuously in a damp condition during installation and until at least 48 hours after pointing

END OF SECTION

SECTION 07140 FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

a. Section includes fluid applied rubberized asphalt and/or elastomeric membrane waterproofing; and surface dusting and/or protective covering Where, and to the extent indicated, install membrane waterproofing under ceramic tilework at toilet floor areas, well dressed and turned against upstands and around penetrations and well-sealed.

1.2 REFERENCES

A. ASTM International:

1. ASTM C836 - Standard Specification for High Solids Content, Cold Liquid- Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
2. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
3. ASTM D429 - Standard Test Method for Rubber Property - Adhesion to Rigid Substrates.
4. ASTM D471 - Standard Test Method for Rubber Property - Effect of Liquids.
5. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
6. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
7. ASTM D822 - Standard Practice for Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus.
8. ASTM D1004 - Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
9. ASTM D2240 - Standard Test Method for Rubber Property- Durometer Hardness. 10. ASTM D3468 - Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing.
11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Roofing Contractors Association:

1. NRCA - The NRCA Waterproofing and Damp Proofing Manual.

1.3 SYSTEM DESCRIPTION

A. Waterproofing System: Fluid applied material to prevent moisture migration to interior.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

C. Product Data: Submit data for surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.

D. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Waterproofing Manual.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Waterproofing Material Manufacturer: Company specializing in waterproofing membrane with minimum fifteen years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum ten years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct Mockup, 10 s q m of horizontal and vertical waterproofed panel; to represent finished work including internal and external corners,

jointing, attachment method, flashings, drainage panel, base flashings, control and expansion joints, and protective cover.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

1.8 PRE-INSTALLATION MEETINGS

A. General Requirements: Administrative requirements for pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Maintain ambient temperatures above 5 ºC for 24 hours before and during application and until liquid or mastic accessories have cured.

1.10 WARRANTY

A. General Requirements: Execution requirements for product warranties and bonds.

B. Furnish ten-year manufacturer warranty for waterproofing failing to resist penetration of water.

C. For warranty repair work, remove and replace materials concealing waterproofing.

PART 2 PRODUCTS

2.1 FLUID APPLIED WATERPROOFING

A. Manufacturer: Any internationally recognized manufacturer having an official technical agreement to conformity with standards for the product.

2.2 COMPONENTS

A. Waterproofing Membrane: Fluid; cold applied; quick setting.

B. Cured Membrane Characteristics:

1. Properties	Test
a. Tensile Strength	ASTM D412

b.	Elongation	ASTM D412
c.	Hardness - Shore A	ASTM D2240
d.	Tear Strength	ASTM D624 and/or D1004
e.	Water Absorption	ASTM D471
f.	Moisture Vapor (perms)	ASTM E96
g.	Exposure at Low Temperature	ASTM D822
h.	Brittleness	ASTM D746
i.	Adhesion	ASTM D429

2.3 ACCESSORIES

A. Surface Conditioner and/or Primer: type compatible with membrane compound; as recommended by membrane manufacturer.

B. Elastic Flashings: 1.2 mm thick, as recommended by membrane manufacturer.

C. Joint Cover Sheet: Elastic sheet material designated for and compatible with membrane. Thickness as recommended by membrane manufacturer.

D. Cant Strips: Remolded composition material, as recommended by membrane manufacturer.

E. Drainage Panel: As recommended by membrane manufacturer.

F. Joint and Crack Sealant: As recommended by membrane manufacturer.

G. Back-up Material: As recommended by membrane manufacturer.

H. Reglet Strip Devices: As recommended by membrane manufacturer.

I. Counter flashings: As recommended by membrane manufacturer.

J. Tack-free Surfacing: Type 1 Portland cement and/or Stone dust.

K. Separation Sheet: As recommended by membrane manufacturer.

L. Protection Board: Rigid insulation specified in Section 07212.

PART 3 EXECUTION

3.1 EXAMINATION

A. General Requirements: Administrative requirements for coordination and project conditions.

B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.

C. Verify substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

D. Verify items penetrating surfaces to receive waterproofing are securely installed.

E. Verify substrate surface slopes to drain for horizontal waterproofing applications.

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing.

C. Do not apply waterproofing to surfaces unacceptable to manufacturer.

D. Seal cracks and joints with sealant materials using depth to width ratio as recommended by sealant manufacturer and/or in accordance with Section 07900.

3.3 INSTALLATION

A. Apply surface conditioner at rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

B. Apply 300 mm wide strip of joint cover sheet over cracks, non-working joints, and expansion joints over 1.6 mm but not exceeding 13 mm in width.

C. At expansion joints from 13 to 25 mm in width, loop cover sheet down into joint between 31 and 44 mm. Extend sheet 150 mm on both sides of expansion joint.

D. Center cover sheet over crack or joints. Roll sheet into 3.2 mm coating of waterproofing material. Apply second coat over sheet extending minimum of 150 mm beyond sheet edges. Apply this procedure especially to expansion joints between horizontal and vertical surfaces.

E. Apply waterproofing material.

F. Apply and spread waterproofing material to a minimum cured thickness and averaging thickness as recommended by the manufacturer.

G. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 150 mm above horizontal surface.

H. Install cant strips at inside corners.

I. Apply extra thickness of waterproofing material at corners, intersections, angles, and over joints.

J. Seal items protruding to or penetrating through membrane and install counter-flashing membrane material.

K. Extend waterproofing material and flexible flashing into drain clamp flange and apply adequate coating of liquid membrane to assure clamp ring seal. Coordinate with drain installation specified in Division 15 - Mechanical.

L. Install membrane flashings and seal into waterproofing material.

M. Conform to NRCA - Waterproofing Manual drawing details as noted:

N. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward.

O. Place protection board and/or panel directly against drainage panel and/or membrane; butt joints.

P. Adhere protection board and/or drainage panel to substrate with mastic. Scribe and cut boards around projections, penetrations, and interruptions.

Q. Install Work in accordance with the drawings, to the manufacturer’s instructions and to the approval of the Engineer.

3.4 FIELD QUALITY CONTROL

A. General Requirements: Quality requirements for testing and inspection services, and execution requirements for testing, adjusting and balancing.

B. On completion of membrane installation, dam installation area as directed by the Engineer, in preparation for flood testing.

C. Flood to minimum depth of 25 mm with clean water. After 48 hours, verify no leaks with the Engineer.

D. When leaking is found, remove water, patch leaking areas with new waterproofing materials as directed by the Engineer; repeat flood test. Repair damage to building.

E. When area is proven watertight, drain water and remove dam.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. General Requirements: Execution requirements for protecting installed construction.

B. Do not permit traffic over unprotected or uncovered membrane.

C. After membrane has cooled and/or cured, but before it becomes dusty, apply separation sheet. Lap joints to ensure complete coverage.

3.6 SCHEDULES

A. As indicated on drawings and where directed by the Engineer.

END OF SECTION

SECTION 07900

JOINT SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Work: The extent of joint sealant work includes furnishing and installing sealants and related materials as called for and indicated on drawings and where required to obtain a weather tight construction.

1.02 QUALITY ASSURANCE

A. Manufacturer: Firms with not less than 5 years of successful experience in the production of types of sealants specified.

B. Installer Qualifications: Engage an experienced installer who has completed joint sealant applications similar in material, design and extent to that indicated for project.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.03 CODES AND STANDARDS

Comply with the applicable requirements of the following codes and standards:

ASTM	American Society for Testing and Materials (ASTM).
C792	Test Method for Effects of Heat Aging on Weight Loss, Cracking and Chalking of Elastomeric Sealants.
C834	Specification for Latex Sealing Compounds.
C919	Practice for Use of Sealants in Acoustical Applications.
C920	Specification for Elastomeric Joint Sealants.
C1193	Guide for Use of Joint Sealants.
D217	Test Method for Cone Penetration of Lubricating Grease.
D1056	Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
D1752-67	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications and other data for each type of joint sealant proposed for use, including certification that the proposed product are recommended and compatible with each other and substrates for the intended applications. Include instructions for handling, storage, installation, protection and maintenance of material.

B. Sealant Schedule: List type, grade, class. Use classification and joint sealant backing for each proposed sealant system in project.

C. Samples: Submit samples of each type of expansion joint filler, bond breaker, sealant and gasket. Install sample between two strips of material, similar to or representative of typical surfaces where sealant or compound will be used, held apart to represent typical joint widths.

The Engineer will review samples for fabrication, colour, texture and compliance with all other requirements and give approval accordingly.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials in original, sealed containers, clearly labelled with manufacturer's name, product identification and lot numbers. Protect the materials from damage during loading, shipment, delivery and storage.

B. Storage: Store materials off the ground in covered storage sheds and in strict accordance with the manufacturer's instructions. Promptly remove from site any materials which show evidence of damage and immediately make all replacement necessary.

1.06 JOB CONDITIONS

A. Environmental Conditions: Do not proceed with the installation of sealants under the following conditions:

- Adverse weather conditions and when the air temperature is below 4 degrees C or above 32 degrees C without the written concurrence of the sealant manufacturer.
- When joint substrates are met due to rain, frost, condensation or other causes.
- When cementitious substrates are not thoroughly cured and dry.
- When joint substrates contain contaminants or other material which may interfere with adhesion.
- When joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

B. Exterior Sealant: No exterior sealant work shall be carried out during conditions of blowing sand.

C. Ventilation: Provide adequate ventilation during the installation of indoor sealants which contain toxic ingredients.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. General: Provide all sealant materials from the same manufacturer to ensure chemical compatibility and colour match.

B. Colour: For exposed materials, provide colour as required to match adjacent construction and as reviewed by the Engineer. For concealed materials, provide natural colour which has best overall performance characteristics.

C. Hardness: As recommended by manufacturer for application shown, unless otherwise indicated.

D. Modulus of Elasticity: Provide the lowest available modulus of elasticity, which is consistent with exposure to weathering, indentation, vandalism, abrasion, support of loading and other requirements.

E. Compatibility: Before purchase of each required material confirms its compatibility with each other material it will be exposed to in the joint system.

F. Size and Shape: As shown or, if not shown, as recommended by manufacturer for type and condition of joint and for indicated joint performance or movement.

G. Grade of Sealant: For each application, provide grade of sealant as recommended by manufacturer for particular condition of installation (location, joint shape, ambient temperature, exposure to chemical attack and sunlight and similar conditions), to achieve best possible overall performance.

H. Products furnished in pre-packaged cartridge or other forms in which no job-site mixing.

2.02 EXTERIOR SEALANTS FOR GENERAL APPLICATION

A. Elastomeric joint sealers shall be used at all non-protected exterior applications. Provide manufacturer's standard chemically curing, elastomeric silicone sealant, which complies with ASTM C920 requirements, including those for type, grade, class and uses and as recommended by the manufacturer for the intended use.

B. Products furnished shall be in pre-packaged cartridges or other forms in which no job-site mixing is required.

C. Products shall permits application in joints on vertical surfaces without sagging or slumping when applied at temperatures between 40 degrees C and 50 degrees C.

D. Products furnished shall remain adhered, within given parameters, to various standard specimens.

2.03 INTERIOR SEALANTS FOR GENERAL APPLICATION

A. Acrylic-emulsion sealant shall be used in fixed or on-moving joints, including but not limited to, such joints as drywall trim and masonry or concrete, hollow metal frames and adjacent material, wood cabinets and wall materials. Product to comply with ASTM C834 requirements.

B. Silicone emulsion sealant shall be used where dynamic joint movement will occur complying with ASTM C792 and ASTM C920.

C. Silicone rubber sealant shall be used to seal around tubs, shower-tub enclosures, sinks, urinals and for sealing fixtures in bath/washroom facilities. Product to comply with ASTM D1056.

2.04 SEALANTS FOR SPECIAL APPLICATION

A. Carry out application of sealants appropriate for the intended use in accordance with approved manufacturer's written directions.

B. Sealants for Sanitary Sewerage System: Provide sealants that are formulated from non-biodegradable, chemically resistant elastomeric polymers and which perform satisfactorily and permanently under extreme conditions of exposure to sanitary sewerage and other wastewater, to repeated wetting and drying and to prolonged sunlight, as applicable.

2.05 JOINT FILLERS AND GASKETS

A. General:

1. Provide joint filler of the sizes and shapes as indicated on drawings and as required.
2. Materials impregnated with oil, bitumen or similar materials will not be acceptable.

B. Materials: Provide the following joint fillers as applicable:

1. Unless otherwise shown on drawings joint fillers will be resin bonded cork to ASTM D1752-67 with the following minimum characteristics:

Density:	200 kg/m³
Maximum load to compress to 50% of original thickness:	0.55 N/mm²

Recovery after compression: 95%

2. Neoprene Gasket Seals: Proprietary neoprene compressible tubular gasket for use as material seal to pre-cast cladding panels.

2.06 MISCELLANEOUS MATERIALS

A. Joint Cleaner: Provide the type of joint cleaning compound, oil free and recommended by the sealant or caulking compound manufacturer, for the joint surfaces to be cleaned.

B. Joint Primer/Sealer: Provide the type of joint primer/sealer recommended by the sealant manufacturer, for the joint surfaces to be primed or sealed and shall be non-staining and suitable for the surfaces indicated.

C. Bond Breaker Tape: Polyethylene tape or other masking tape as recommended by manufacturer, to be applied to sealant-contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.

D. Sealant Backer Rod: Provide compressible rod stock polyethylene foam with a size and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrate and conditions under which the work shall be performed and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 JOINT PREPARATION

A. Thoroughly clean joints, removing foreign matter such as dust, oil, grease, water and surface dirt. Prime joint as required. Primer must adhere permanently or be entirely removed and replaced as required by joint condition.

B. Clean porous materials such as concrete, masonry or plaster, where necessary, by grinding, sand or water blast cleaning, mechanical abrading, acid washing or a combination of methods as required to provide a clean sound base surface for proper adhesion.

C. Clean non-porous surfaces such as metal and glass either mechanically or chemically. Remove protective coatings on metallic surfaces by a solvent that

leaves no residue. Use solvent with clean white cloths or lintless paper towels and wipe dry with same. Do not allow solvent to air dry without wiping. Clean joint areas protected with masking tape or strippable films as above after removal of tape or film.

D. Do not seal joints until they are in compliance with the drawings.

1. Joints to receive sealant shall be a minimum of 6 mm wide by 6 mm deep.

2. Joints in Concrete or Masonry: Unless indicated otherwise on drawings, depth of sealant shall be as follows:

   Depth of sealant shall be equal to the width of joints up to 13 mm wide. For joints between 13 mm and 25 mm wide, the depth shall be 13 mm. For expansion and other joints between 25 mm and 50 mm wide, depth shall be not greater than 13 mm deep. For joints exceeding 50 mm in width, depth shall be as recommended by the sealant manufacturer.

3. Joints in Metal: Joints between 6 and 13 mm shall have a sealant depth of 6 mm; joints between 13 and 25 mm shall have a sealant depth of 6 mm to 13 mm; joints over 25 mm shall have a sealant depth of 13mm.

4. Joints in Pre-cast Concrete Cladding Panels: Joint widths to be as shown on drawings and as specified in "PRECAST CONCRETE, GENERAL" section.

3.03 APPLICATION

A. Install backer rod material or joint filler at proper depth in joints to provide proper sealant dimension. Backer rod and joint filler material shall be of suitable size and shape so that when compressed (25 to 50%) they will fit in joints as required. Sealant shall not be applied without backer rod or joint filler material and if necessary, bond breaker strip.

B. Prime surfaces where required with primer as recommended by the sealant manufacturer.

C. Apply sealant under pressure with hand or power actuated gun or other appropriate means. Provide gun nozzle of proper size and provided with sufficient pressure to completely fill joints as detailed. Neatly point or tool joint surface to provide the contour indicated on the drawings or if not indicated, joint to be concave. When tooling light coloured sealants, use clean water-wet tool or tooling solution recommended by the sealant manufacturer.

D. Co-ordinate application of sealant with installation of pre-cast cladding panels to provide gasket and double sealant beads to vertical joints and double sealant to horizontal joints, beads as shown on drawing.

3.04 CLEANING

A. Clean adjacent surfaces free of sealant or soiling resulting from this work as work progresses. Use solvent or cleaning agent recommended by the sealant manufacturer. Exercise due care to prevent damage or discolouration to adjacent materials when removing excess sealant materials.

**** END OF SECTION ****

SECTION 08210

WOOD DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Work: The extent and location of each type of wood door is shown on the drawings and in schedules.

1.02 QUALITY ASSURANCE

A. Manufacturers: Obtain doors from a single manufacturer, to ensure uniformity in quality of appearance and construction, unless otherwise approved. All fire doors shall be clearly labelled “FIRE DOOR” in both Arabic and English on both sides and shall satisfy the requirements of NFPA 80.

B. Codes and Standards: Comply with the applicable requirements of the following codes and standards:

BS British Standards

459 Specification for Wooden Doors Part 4: Match boarded Doors.

476 Fire Tests on Building Materials and Structures.
Part 8:1972 - Test Methods and Criteria for The Fire Resistance of Elements of Building Construction.

Part 22:1987 - Methods for Determination of the Fire Resistance of Non-Load Bearing Elements of Construction.

Part 31 - Methods for Measuring Smoke Penetration Through Door sets and Shutter Assemblies.

Section 31.1:1983 - Method for Measurement Under Ambient Temperature Conditions.

1186 Specification for Timber for and Workmanship in Joinery.

Part 1:1986 - Specification for Timber.

1204 Specification for Synthetic Resin Adhesives (Phenolic and Amino Plastic) for Wood.

Part 1:1979 - Specification for Gap-Filling Adhesives.

Part 2:1979 - Specification for Close-Contact Adhesives.

4787 Specification for External and Internal Wood Door sets, Door Leaves and Frames.

Part 1:1980 - Specification for Dimensional Requirements.

5442 Classification of Adhesives for Construction.

Part 3:1979 - Adhesives for Use with Wood.

5588 Fire Precautions in the Design and Construction of Buildings.

Part 4:1978 - Code of Practice for Smoke Control in Protected Escape Routes Using Pressurization.

5750 Quality System, Part 1: The Design Manufacture and installation of custom made doors, door sets and wood interior products.

6262 Code of Practice for Glazing for Buildings.

NFPA National Fire Protection Association:

80 Standard for Fire Doors and Windows.

1.03 SUBMITTALS

A. Product Data: Submit type of wood door and include details of core and edge construction, include finishing specifications for doors to receive factory applied shop finish. Certifications as may be required shall also be included to show compliance with the specifications.

B. Shop Drawings: Submit shop drawings indicating the location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, requirements for factory finishing and other pertinent data; show full detail of wood door frames and installation, including anchorage. Include details of trim and mouldings and finish hardware.

C. Samples: The Engineer will review samples for fabrication, colour, texture and compliance with all other requirements and give approval accordingly. Submit samples for the following:

1. Exterior and interior door samples showing construction.

2. Fire rated door sample showing construction.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect wood doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with manufacturer's instructions for shop-finished doors. Provide protective coverings at the factory prior to shipping. Use heavy paper cartons and mark with identification required for proper installation. Ensure that moisture content on delivery to site strictly complies with BS 1186.

B. Fire-Rated Doors: Comply with manufacturer's instructions for precautions required to prevent moisture deterioration of fire-retardant salt. The specified performance is to be the minimum attained when tested for integrity in accordance with NFPA 80. Include for rebates on double leaf doors and for smoke stops as required.

C. Seals for Fire Rated Doors - Frame: An intumescent sealing strip must be made between the rear of the frame and the wall or partition opening.

Door Leaves: The heads of all door leaves shall be fitted with an exposed strip of intumescent sealing material. Both applications to conform with the requirements of NFPA 80.

D. Coordinate delivery of wood doors to comply with the requirements of the “PAINTING” section for sealing tops and bottoms of wood doors immediately upon delivery to job site.

PART 2 - PRODUCTS

2.01 MATERIALS AND COMPONENTS

A. General: Provide wood doors complying with applicable requirements specified herein. Face panels shall be manufacturer's standard.

B. Exposed Surfaces: Provide type shown or scheduled and as further specified. Provide same exposed surface material on both faces of each door unless otherwise indicated or directed.

D. Door Frames: Unless otherwise indicated, door frames shall be metal frames as per details shown on drawings.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine door frames and verify that frames are of the correct type and have been installed as required for proper hanging of corresponding doors and correct any conditions detrimental to the proper and timely installation of wood doors. Do not proceed with installation until satisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 INSTALLATION

A. Condition doors to average prevailing humidity in installation area prior to hanging.

B. Hardware: For installation see "BUILDERS HARDWARE" section and in accordance with BS 4787.

C. Installation Instructions: Install wood doors in accordance with Manufacturer's Instructions and as indicated.

D. Job Fit Doors: Fit doors to frame for proper fit and uniform clearance at each edge and machine for hardware. Seal cut surfaces after fitting and machining. Bevel non fire-rated doors 3 mm in 50 mm at lock and hinge edges.

E. Prefix Doors: Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

1. Clearances: For non fire-rated doors provide clearances of: 3 mm at jambs and heads; 3 mm at meeting stiles for pairs of doors; and 13 mm from bottom of door to top of decorative floor finish or covering. Except where undercut is scheduled, provide 20 mm clearance. Where threshold is shown or scheduled, provide 6 mm clearance from bottom of door to top of threshold.

F. Fire Rated Doors: Install in corresponding fire rated frames in accordance with NFPA 80. Provide clearances complying with the limitations of the authority having jurisdiction.

3.03 ADJUST AND CLEAN

A. Operation: Rehang or replace doors which do not swing or operate freely, as directed by the Engineer.

B. Prefinished Doors and Job-Finished Doors: Restore finish or replace doors damaged during installation, as directed by the Engineer.

C. Protect installed doors from damage or deterioration until acceptance of the work.

3.04 MEASUREMENT AND PAYMENT

A. Measurement: Wood doors shall be enumerated stating type and size of each door.

B. Payment for wooden doors shall be at the rate stated in the Bills of Quantities for each type and size. The rates of these works shall include for frames and for all necessary frame anchors, fixing accessories, louvers, fixed panels, glazing beads, glass including cutting to any size and area, sealants, mastics, weather

stripping, fixed panels, hoods, operating mechanisms painting and surface finishes, intumescent strips for fire doors, hardware as specified including removal after first fixing and replacing on completion of painting works, adjusting and leaving in perfect working order. The Contractor shall allow in his rates that dimensions of the items concern might change due to re-adaptation to suit condition on site.

**** END OF SECTION ****

SECTION 08400

ALUMINIUM WINDOWS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of aluminium windows, storefronts are indicated on drawings and includes but is not limited to the provision and installation of aluminium windows, doors and frames.

1.02 QUALITY ASSURANCE

A. Performance and Testing: Fabricate, assemble and erect units to meet or exceed the following performance requirements:

1. Thermal Movement: Fabricate components from manufacturer's stock systems which have been designed to provide for expansion and contraction resulting from ambient temperature range of 50°C.

2. Wind Loading: When tested in accordance with BS 5368 Part (3) the units shall withstand a uniform load of not less than 1.0 KPa, acting inward and also acting outward and the deflection of any member shall not exceed 1/175 of its span.

3. Air Infiltration: When tested in accordance with BS 4315 air infiltration shall not exceed 0.00015 m2/s/m crack length under a wind of 40 km/hr.

4. Water Infiltration: When tested in accordance with BS 4315 there shall be no water infiltration when water at 3.4 liters/m2/min. is applied under a pressure of 0.20 KA for a 15-minute test period.

B. Codes and Standards: Comply with the applicable requirements of the following codes and standards:

BS	British Standards
476	Specification for Fire Tests on Building Materials and Structures.
BSEN 499	Specification for Welding Consumables, Covered Electrodes for Manual Metal Arc Welding of Non-Alloy and Fine Grain Steels.
1449	Part 2: Stainless and Heat Resistant Steel Plate, Sheet and Strip.
4315	Methods of Test for Resistance To Air And Water Penetration.
4870	Specification for Approved Testing of Welding Procedures.

4871	Specification for Approved Testing of Welders Working to Approved Welding Procedures.
4873	Specification for Aluminium Alloy Windows.
5368 Part(3)	Specification for Wind Resistance Tests.
5411 Part(3)	Eddy Current Method for Measurement of Coating Thickness of Non-Conductive Coatings on Non-Magnetic Basis Metals.
6161(7)	Accelerated Determination of Light Fastness of Coloured Anodic Oxidation Coatings Using Artificial Light.
6213	Guide to Selection of Constructional Sealants.
6830	Specification for Continuously Hot-Dip Aluminium/Zinc Alloy Coated Cold Rolled Carbon Steel Flat Products.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications, recommendations and standard details for the specified products, including fabrication, finishing, accessories and other components of the work. Include certified test laboratory reports as necessary to show compliance with the requirements.

B. Shop Drawings: Submit shop drawings for the fabrication and installation of storefront and entrance units and associated components of the work. Include wall elevations, typical unit elevations and full size detail sections of every typical composite member. Show anchors, joint system, weather-stripping, expansion provisions and other elements not included in manufacturer's standard data, including glazing details.

C. Samples:

1. Submit samples of each required type and colour of aluminium finish on 300mm long sections and shapes and 150 mm squares of sheet aluminium as required for the units specified. Where colour or texture of finish will vary slightly for the work, include two or more pieces in each sample, to show the limits of such variations. Samples will be reviewed by the Engineer for color and texture only. Compliance with other requirements shall be the exclusive responsibility of the Contractor.

D. Tests Reports:

1. Submit written, certified test reports for the following tests required by this specification; record the dates, locations and methods of testing and interpret the test result.

   a. Air infiltration tests.

   b. Water penetration tests.

PART 2 - PRODUCTS

2.01 MATERIAL AND COMPONENTS

A. General:

2. All openings should be provided with stone concrete frame having the same thickness of the wall, and all stone lintels should be connected to structural elements.

B. Aluminum Windows:

1. Provide sizes, shapes and profiles as indicated for the windows and window wall system as per drawings.
2. Provide thickness as necessary to comply with the structural loading requirements, but not less than the following:

   a. Principal Extrusions: 2.5 mm minimum thickness.

   b. Principal Formed Sheet Members: 2.5 mm minimum thickness.

   c. Extruded Glazing Stops and Trim: 1.6 mm minimum thickness.

3. Provide aluminium alloy and temper for each shape, as recommended by the manufacturer to comply with the requirements of performance, fabrication, application of finish and control of colour. Comply with BS 4873.

4. Sealant: Unless otherwise indicated for sealants required within fabricated units, provide type recommended by manufacturer for joint size and movement, to remain permanently elastic, non-shrinking and non-migrating and approved by the Engineer. Comply with "JOINT SEALANTS" section for installation.

5. Glass and Glazing Materials: Provide glass and glazing materials which comply with requirements of “GLAZING” section.

2.

2.03 FABRICATION

A. General:

1. Sizes and Profiles: Required sizes, including profile requirements shall be indicated on approved shop drawings.

2.04 FINISHES

A. Preparation: After fabrication, prepare aluminium surfaces and carry out anodization in compliance with BS 1615.

B. Finish: Unless otherwise directed, provide electrostatic polyester powder coated aluminium finish, having a film thickness of not less than 25 microns, medium matte. Apply an approved temporary protective coating of clear acrylic lacquer.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrates and the conditions under which entrance and storefront units shall be installed and correct unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 INSTALLATION

A. Comply with manufacturer's specifications and recommendations for the installation of storefronts and entrances.

B. Set units plumb, level and true to line, without warp or rack of frames or panels. Anchor securely in place. Separate aluminium and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

C. Set sill members and other members in a bed of compound, or with joint fillers or gaskets to provide weather tight construction. Fillers and gaskets shall be installed during and after erection of components.

D. Refer to "GLAZING" section for installation of glass into the work.

3.03 MEASUREMENT AND PAYMENT

A. Measurement:

Aluminum panels, windows, doors and louvers shall be enumerated stating the type, number of leaves and dimensions, refer to the BOQ.

B. Payment:

Payment for electrostatic polyester powder coated dark bronze (or black to check the existing color at site) anodized panels, windows shall be at the rate inserted in the Bill of Quantities, which rate shall include all labor, plant, materials, equipment, fabrication, supply and installation, in addition to frames, sub-frames, transoms, sills, glazing, infill panels, intumescent strips, accessories, ironmongery, gaskets, sealants, anchors, insect screens to operable window and louvers and everything needed to complete the work.

**** END OF SECTION ****

SECTION 08700

BUILDERS HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The extent of builder's hardware is shown on the drawings, by the provisions of this section and in schedules. Builders hardware is hereby defined to include all items known commercially as builder's hardware, as required for swing and sliding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame. All builder's hardware sets, components and accessories shall be of stainless steel material type 316A.

B. The required types of builder's hardware and related items include (but are not necessarily limited to) the following:

1. Butts and Hinges.
2. Set of lever Handles
3. Lock cylinders and keys.
4. Lock and latch sets.
5. Flush Bolts.
6. Panic exit devices.
7. Push/pull units.
8. Door Closers.
9. Door control devices.
10. Protection plates.
11. Stripping and seals.
12. Key Control.
13. Door stops.

C. A cabinet reserved for the keys shall be provided at each building.

1.02 QUALITY ASSURANCE

A. Dimensions: Dimensions as given by the manufacturer's shall be subject to production tolerances of $\pm$ 0.25 mm.

B. Fire-Rated Openings: Provide hardware for fire-rated opening in compliance with BS 476. Provide only hardware which has been tested and approved for types and sizes of doors required.

C. Codes and Standards: Comply with the applicable requirements of the following:

BS - British Standards:

459	Doors.
476	Fire Tests on Building Materials and Structures.
1227	Hinges for General Building Purposes.
1245	Metal Door Frames. (Steel).
1449	Part 2: Stainless and Heat Resisting Steel Plate, Sheet and Strip.
3621	Thief Resistant Locks for Hinged Doors.
3827	Glossary of Terms Related to Builders Hardware.
4951	Builders Hardware: Lock and Latch Furniture (Doors).
5725 (1)	Panic Bolts and Panic Latches.
5872	Locks and Latches for Doors in Buildings.
7352	Specification for Strength and Durability Performance of Metal Hinges for Side Hanging Applications and Dimensional Requirements of Template Drilled Hinges.

1.03 SUBMITTALS

A. Manufacturer's Data; Builders Hardware: Submit manufacturer's product data, including illustrations, for each item of hardware. Include whatever information may be necessary to show compliance with requirements and include instructions for installation and for maintenance of operating parts and exposed finishes. Wherever needed, furnish templates to fabricators of other work which shall receive finish hardware. Transmit copy of applicable data to the Engineer.

B. Hardware Schedules; Builders Hardware: Submit 5 copies of the hardware schedule in the manner and format specified. hardware schedules are intended for coordination of the work. Review and acceptance by the Engineer does not relieve the Contractor of his exclusive responsibility to fulfil the requirements as shown and specified.

C. Meet with the Engineer or the Client and determine his requirements regarding keying of locks. Submit 5 copies of a separate key schedule, showing clearly

how the Client's final instructions on keying of locks have been fulfilled. Also a master key shall be submitted.

D. Samples; Builders Hardware:

1. Prior to submittal of the final hardware schedule and prior to delivery of hardware, submit one sample of each exposed hardware unit, finished as required and tagged with full description for coordination with the schedule. Sample board of all hardware units shall be kept at site office until completion of the project. Sample will be reviewed by the Engineer for design, colour and texture only. Compliance with other requirements is the exclusive responsibility of the Contractor.

2. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide secure lock-up for hardware delivered to the Site but not yet installed. Control the handling and installation of hardware items which are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses, both before and after installation.

1.05 JOB CONDITIONS

A. Coordination: Coordinate hardware with other work. Tag each item or package separately, with identification related to the final hardware schedule and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

B. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check the shop drawings of such other work, to confirm that adequate provisions are made for the proper installation of hardware.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION

A. General:

1. Hand of Door: The drawings show the direction of swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of the door movement as shown.

2. Base Metals: Produce hardware units of the basic metal and forming method indicated, using the manufacturer's standard metal alloy, composition, temper and hardness. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

3. Fasteners: Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

4. Tools for Maintenance: Furnish a complete set of specialized tools as needed for Company's continued adjustment, maintenance and removal and replacement of builder's hardware.

2.02 HINGES AND BUTTS

A. Templates and Screws: Provide template-produced units.

B. Provide hinges which will continuously support weights equal to or exceeding those recommended by the manufacturer for the weight of the door for which they are to be used.

C. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 2300 mm or less in height and one additional hinge for each 760 mm of additional height (as indicated in the BOQ).

2.03 LOCK CYLINDERS AND KEYING

A. General: Provide keying as specified herein.

B. Master Keying: Except as otherwise indicated, provide master keying system for the new facilities.

C. Equip locks with manufacturer's special 6-pin tumbler cylinder, with construction master key feature, which permits voiding of construction keys without cylinder removal.

D. Metals: Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.

E. Comply with the Keying Schedule for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

F. Key Quantity: Furnish 3 changes keys for each lock; 5 master keys for each master system. Furnish one extra blank for each lock.

G. Key Material: Provide keys of nickel silver only.

H. Deliver Keys to the Engineer.

2.04 LOCKS, LATCHES AND BOLTS

A. Strikes: Provide manufacturer's standard strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.

B. Lock Throw: Provide 19 mm minimum throw of latch and deadbolt used on pairs of doors.

C. Provide barrel bolts not less than 150 mm long and lever action flush bolts not less than 225 mm long having a satin chrome finish.

2.05 PUSH/PULL UNITS

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for matched pairs, but not for single units.

2.06 CLOSERS AND DOOR CONTROL DEVICES

A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use, where parallel arms are required for closers, provide closer unit one size larger than recommended for use with standard arms.

B. Unless otherwise specified do not install closers on the outside of any exterior door not on the corridor side of any room door. Wherever it is necessary to install a closer on the side of a door away from the butts, a parallel arm shall be used. Corner or soffit brackets will not be permitted. Corridor installation is acceptable where abutting walls prevent normal installation. All fastenings to the door shall be by six bolts or other type of through bolts acceptable to the Engineer.

2.07 STRIPPING AND SEALS

A. General: Unless otherwise directed, all exterior doors shall be provided with adequate weather-stripping to the approval of the Engineer.

B. Continuity of Stripping: Except as otherwise indicated, it is required that the stripping at each opening be continuous and without unnecessary interruptions at door corners and hardware.

C. Replaceable Seal Strips: It is required that the resilient or flexible seal strip of every unit be easily replaceable and readily available from stocks maintained by the manufacturer.

2.10 HARDWARE FINISHES

A. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible and except as otherwise indicated. Reduce differences

in colour and texture as much as commercially possible where the base metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for colour and texture. Provide finish on exposed cabinet hardware to match that of room door hardware unless otherwise indicated.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness & other qualities complying with manufacturer's standards.

2.11 SMOKE SEALS

A. Provide smoke seals for all corridor doors of adequate design approved by the Engineer.

2.12 SPARE PARTS

A. An adequate supply of spare parts or replacement material for builder’s hardware shall be provided at Contractor's expense to replace defective material, occurring prior to the 6-month follow-up inspection which will be carried out by Contractor and latch & lock manufacturers as described herein below. This shall include, but not limited to, locks, doors closers, door handle sets, etc. The exact amount of the spare parts shall be agreed upon after finalization of the master system schedule.

PART 3 - EXECUTION

3.01 HARDWARE MOUNTING HEIGHTS

A. Mount hardware units at the following locations on each door or door opening, except as otherwise specifically indicated, or required to comply with governing regulations and except as otherwise directed by the Engineer.

1. Lowest Hinge: 254 mm above floor to bottom of hinge.

2. Highest Hinge: 127 mm below top of door to top of unit.

3. Intermediate Hinges: Equally spaced between lowest and highest hinge units.

4. Lock and Latch Sets: Knobs centred 965 mm above floor.

5. Dead Lock: Cylinder and strike centred 1524 mm above floor.

6. Door Push/Pull Plate: Pull centred 1143 mm above floor, also centred 127 mm from door edge, unless stile width necessitates other location.

7. Arm Pull: Centre arm pull 1219 mm from floor, also centred 305 mm from edge of door.

8. Exit Device: Operating bar centred 1067 mm above floor.

9. Bolts, Head and Sill: Operating device centred not more than 1829 mm above floor unless otherwise directed.

10. Bolts, pulls and other special units: Units mounted at height recommended by manufacturer.

3.02 INSTALLATION

A. Install each hardware item in compliance with the manufacturer's installations and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protection with finishing work specified in the "FINISHES" sections. Do not install surface-mounted items until finishes have been completed on the substrate.

B. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

C. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

D. Cut and fit threshold and floor covers to profile of door frames, with metered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items.

E. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel which will not corrode in contact with the threshold metal.

3.03 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Instruct Client Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

D. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Contractor, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Client personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units.

3.04 HARDWARE SETS

A. Hardware sets are indicated at the schedule of hardware with the tender drawings. The Contractor shall make a complete schedule including types, dimensions and accessories, finishing and method of installation and submit to the Engineer for approval prior to ordering.

** END OF SECTION **

SECTION 10

GLAZING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Work: The extent of the glazing work is shown on drawings and in schedules and includes glazing and all associated accessories.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with the applicable requirements of the following codes and standards:

BS British Standards

476 Fire Tests on Building Materials and Structures.

Part 7:1987, Method for Classification of the Surface Spread of Flame of Products.

Part 22:1987, Methods for Determination of the Fire Resistance of Non-Load Bearing Elements of Construction.

952 Glass for Glazing.

Part 1:1978, Classification.
Part 2:1980, Terminology for Work on Glass.

2571 Specification for General Purpose Flexible PVC Compounds for Moulding and Extrusion.

4255 Rubber Used in Preformed Gaskets for Weather Exclusion from Buildings.

Part 1:1986, Specification for Non-Cellular Gaskets.

6206 Specification for Impact Performance Requirements for Flat Safety Glass and Safety Plastics for Use in Buildings.

6262 Code of Practice for Glazing for Buildings.

8000 Workmanship on Building Sites.

Part 7:1980, Code of Practice for Glazing.

PD Published Documents.

6512 Use of Elements of Structural Fire Protection with Particular Reference to the Recommendations given in BS 5588. Fire Precautions in the Design and Construction of Buildings.

Part 3:1987, Guide to the Fire Performance of Glass.

1.03 SUBMITTALS

A. Samples: Submit samples size 300 x 300 mm of each type of glass proposed, glazing compounds, sealants and glazing accessories.

B. Manufacturer's Literature: Submit manufacturer's literature containing technical and installation information.

C. Certificates: Submit certification from the manufacturer stating quality, thickness, type and grade.

D. Shop Drawings: Submit shop drawings and details of glass installation at framing members such as head, mullions, transoms, jambs and sills.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Glass: Crate glass securely and safely for delivery, handling and storage. Provide cushions at edges of glass to prevent damage. Protect glass faces from scratches and abrasions and in a dry, well ventilated location, carefully protected at all times from soiling, atmospheric condensation and other moisture. Replace damaged or defective glass with new glass at no additional cost. Deliver each piece of glass with factory labels intact, indicating glass type, quality and thickness and do not remove labels until installation has been accepted.

B. Glazing Materials: Deliver sealing materials in manufacturer's unopened containers, fully identified with trade name, colour, size, hardness, type, class and grade. Store each glazing and sealing material where they will be free from damage and in strict accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 GLASS

A. General: Furnish glass materials from an approved manufacturer.

B. Glass Materials:

1. Clear/Float Plate Glass: Polished plate or float glass wired, 6.0 mm thick unless otherwise indicated.

2. Clear/Float Plate Glass: Fully tempered 6.0 mm thick unless otherwise indicated.

3. Double Glazing: Outer layer glass 6 mm thick reflective tinted 6 mm gap in between and 6 mm thick inner sand blasted glass, unless otherwise indicated.

4. Opaque Glass: 6.0 mm thick unless otherwise indicated.

5. Mirrored Glass: 6.0 mm thick unless otherwise indicated.

6. Glass panels shall be double glazing with 12mm air space in between, an external 6mm thick tinted heat absorbing glass and 6mm thick internal sand blasted glass. A transparent reflective coating shall be applied to the external glass on surface 2. Glass panels shall have thermal characteristics not exceeding the following values:

a. Convection heat transfer coefficient: 2.50 W/m^2 K

b. Shading coefficient: 0.30

2.02 GLAZING SEALANTS/COMPOUNDS

A. General: Provide hardness of materials as recommended by the manufacturer for the required application and condition of installation in each case. Provide only compounds which are known (proven) to be fully compatible with surfaces contacted. Provide the following materials as required for the installation and as approved by the Engineer.

B. Polyvinyl Chloride Glazing Gaskets: Extruded, flexible PVC gaskets of the profile and hardness as required for watertight construction. Comply with BS 2571, or in another material and to standards approved by the Engineer. If rubber is used, then BS 4255 Part 1 shall apply.

C. Setting Blocks: Neoprene or other resilient blocks of 70-90 durometer hardness, tested for compatibility with sealants used.

D. Spacers: Neoprene or other resilient material of 40-50 durometer hardness, tested for compatibility with sealants used.

E. Cleaners, Primers and Sealants: Type recommended by sealant or gasket manufacturer.

F. Mirror Mastic: Type recommended by mirror manufacturer for spot application system, with less than 25% coverage and 3 mm-12 mm thickness of setting bed, with mirror supported only at lower edge.

G. Mirror Clips: Stainless Steel.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrates and the conditions under which glazing work shall be carried out and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

**** END OF SECTION ****

SECTION 09200

LATH AND PLASTER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of lath and plaster work is shown on the drawings and in schedules and includes interior and exterior plaster work, and fibreglass fabric lath.

1.02 QUALITY ASSURANCE

A. Fire-Resistance Rating: Fire rated assemblies shall comply with BS 476 and all applicable parts, or other design acceptable to the Engineer.

B. Allowable Tolerance for Finished Work: For flat surfaces, do not exceed 3.0 mm in 3.0 meters for bow or warp of surface and for plumb or level.

C. Codes and Standards: Comply with the applicable requirements of the following:

BS British Standards.

882 Specification for Aggregate from Natural Sources for Concrete.

890 Specification for Building Limes.

1199 Specification for Building Sands from Natural Sources.

3900 Methods of Tests for Paints.

4027 Specification for Sulphate Resisting Cement Type V.

5262 Code of Practice for External Rendered Finishes.

5492 Code of Practice for Internal Plastering.

8000 Workmanship on Building Sites.

Part 10:1989, Code of Practice for Plastering and Rendering.

D. Mock-up Installation: Prior to installation of plaster work, provide sample mock-up panels using materials specified for final work. Build sample panels at the site, of full thickness and approximately 1.2 meters x 1.2 meters. Demonstrate the proposed range of colors, textures and workmanship to be expected in the completed work, and submit samples to the Engineer for review.

Retain sample panels during construction as a standard for judging completed internal plaster work and external finishes system. Do not alter, move or destroy sample panels until all plastering work on internal surfaces and coating work on external surfaces has been completed.

1.03 SUBMITTALS

A. Manufacturer's Certificates: Submit manufacturer's certificates showing compliance with the specified material requirements and installation and workmanship instructions.

B. Samples: Submit 300 mm long samples of all accessories proposed.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Except for sand and water, deliver materials to the site in sealed containers or bags fully identified with manufacturer's name, brand, type and grade. Store materials in a dry, well-ventilated space, under cover, off the ground, and away from surfaces subject to dampness or condensation.

B. Accessories shall be bundled or delivered in their original containers bearing the name of the manufacturer and item identification.

1.05 JOB CONDITIONS

A. Protection:

1. General: Protect contiguous work from moisture deterioration and soiling, which may result from plastering operations. Provide temporary covering and whatever other provisions may be necessary to minimize harmful spattering of plaster on other work.

2. Finished door and window frames and other surfaces which do not receive a plaster finish shall be well protected during plastering or coating application.

B. Environmental Conditions:

1. General: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural or artificial. Apply and cure plaster as required by climatic conditions to prevent rapid dryout. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combination of these as required by the Engineer.

2. Temperature: Carry out plaster and coating work when air temperature ranges between 13°C and 35°C. Maintain temperature in a uniform range above 13°C for an adequate period prior to application of plaster, while plastering is being applied and until plaster is dry.

3. Hot Weather: No plastering or coating shall be carried out when temperature is above 35°C unless the Contractor provides adequate

cooling to maintain a uniform temperature below 35°C.

4. Cold Weather: In cold weather, the Contractor shall provide sufficient heat to be well distributed in all areas with deflection or protective screens in order to prevent concentrated or irregular heat on plastered or coated areas near heat source.

5. Ventilation: Provide adequate ventilation to properly dry interior plaster during and subsequent to its application.

PART 2 - PRODUCTS

2.01 CEMENT PLASTER

A. Portland Cement: To BS 4027. Provide white cement where required for white cement plaster and as directed.

B. Lime: To BS 890, special finishing hydrated lime. Lime shall not be used on exterior plaster.

C. Aggregates: Provide aggregate complying with requirements of BS 882 and observe maximum limitations on chlorides and sulphates in fine aggregates specified in Section 03300 "CAST-IN-PLACE CONCRETE". For base and finish coats provide aggregates of the following gradations:

1. Base Coat:

Standard Sieve	Percent Retained By Weight +2%	
	Minimum	Maximum
4.75 mm		- 0
2.36 mm	0	10
1.18 mm	10	40
600 microns	30	65
300 microns	70	90
150 microns	95	100

2. Finish Coat: Same as base coat except that 100% passing 2.36 mm

sieve.

D. Water: Clean, potable and free from, deleterious amounts of oils, salts, alkali, organic matter and other harmful materials.

2.02 PLASTER ACCESSORIES

A. Corner Beads: Not less than 0.6 mm galvanized steel for interior use and zinc coated for exterior use, formed with a head not exceeding 5 mm radius, with 50 mm wide expanded flanges.

B. Casing Beads: Not less than 0.7 mm galvanized steel for interior use and zinc coated for exterior use. Minimum 50 mm wide expanded flanges.

C. Expansion Control Joints: Galvanized bellows type with expansion flanges. In soffits use vent type control joints.

D. Two-Piece Control Joints: Manufacturer's Standard roll-formed pair of casing beads with modified back flanges providing positive slip joint action and dust barrier, adjustable for joint width variation of 3 mm to 16 mm.

E. Fasteners: Galvanized steel, of type and length suitable for adequate penetration of the substrate.

2.03 MIXES

A. Mixing:

1. General: Accurately proportion materials for each plaster batch with measuring devices of known volume.

2. Mechanical Mixing: Clean mixer of set or hardened materials before loading for new batch. Maintain mixer in continuous operation while adding materials and conform to mixing sequence and cycle of operations.

3. Hand Mixing: Unless otherwise specifically authorized by the Engineer, hand mixing is not permitted.

B. Mix Proportions by Volume: Unless otherwise specified comply with the requirements of BS 5492 for the proportioning of materials and manner of mixing the plaster for each required application. Establish mix proportions for each type and coat of plaster and submit to the Engineer for review.

1. Interior Plaster:

a. Dash Coat: One (1) part portland cement and 0-2 parts sand.

b. Base coat/scratch coat:

i. One-part cement and 0-1/12 parts lime.
ii. 2-1/4 -4 parts sand per sum of cementitious materials.

c. Finish Coat (Majoon):

i. One part portland cement and 0-1/4 parts lime.

ii. Three parts sand per sum of cementitious materials.

2. Exterior Plaster: Mix proportions for interior plaster are applicable except that lime shall not be used.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrates and the conditions under which portland cement plaster or coating work shall be carried out and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Prior to all plaster or coating work, carefully inspect the installed work of all other sections and verify that all such work is complete to the point where plastering or coating may properly commence.

C. Verify that the external coating system is installed in accordance with the manufacturer's instruction and recognised standards.

D. Verify that lath and plaster may be installed in accordance with the reference codes and standards and the design requirements.

E. Do not install plaster or coating work over any work, including mechanical and electrical which require inspection, until such inspections have been made.

F. Ensure that all required and necessary insulation has been installed to building surfaces, pipes and other items.

G. Examine construction, grounds, and accessories to insure that finished plaster surfaces will be true to line, level, and plumb, without requiring additional thickness of plaster. Maximum variation of surface to receive plaster shall be 6 mm in 1.2 m from the required plane when measured with a straight edge.

3.02 INSTALLATION

A. Installation of Support System:
1. General:

a. Standard: Unless otherwise specified, comply with the applicable requirements of BS 729.

b. Isolation: Where lathing and support system abuts building

structure horizontally, and where partition/wall work abuts overhead structure, isolate the work from structural movement sufficiently to prevent transfer of loading into the work from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support. Frame both sides of control and expansion joints independently, and do not bridge joints with furring and lathing or accessories.

c. Fixture Support Framing: Install supplementary framing, blocking and bracing where work is indicated to support fixtures, equipment, services, casework, heavy trim and furnishings and similar work requiring attachment and support.

2. Ceiling Suspension System: Secure hanger to structural support by connecting directly to structure where possible, otherwise connect to inserts, clips or anchorage devices or fasteners as indicated.

3. Plastering Accessories:

a. Anchor each flange of accessories not more than 200 mm on centers to plaster base.

b. Miter or cope accessory corners, and install with tight joints accurately aligned.

c. Set accessories plumb, level and true to line, with a tolerance of 3 mm in 3.0 meters.

d. Install metal corner beads at external corners and on corners of structural steel columns.

e. Install casing beads at terminations of plaster work, except where plaster is indicated to pass through other work and be concealed by lapping work, and except where special screens, bases or frames act as casing beads including interior metal door frames.

i. For exterior work, set casing beads 6 mm from abutting frames and other work (for application of sealant).

ii. Where plaster abuts concrete, set casing bead 6mm from concrete.

iii. Where interior plaster abuts exterior masonry, apply waterproof plastic adhesive tape on concealed face of bead.

iv. At "Control Joints" set pair of casing beads back to back, with metal strip behind anchored to only one side of joint.

B. Installation of Plaster:

1. General: Unless otherwise specified, comply with the applicable requirements of BS 5492.

2. Mechanically mix plaster materials; do not hand mix except where small amounts are needed which require less than one bag of cementitious material.

3. Grout hollow metal frames, bases and similar work occurring in plastered areas, with base-coat plaster material, and prior to lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout 150 mm lengths at each anchorage.

4. Sequence plaster installation properly with the installation and protection of other work, so that neither will be damaged by the installation of the work.

5. Plaster flush with frames and other built-in metal items or accessories which act as a plaster ground, unless otherwise shown. Where plaster is not terminated at metal by casing beads, cut base-coat free from metal before plaster sets and groove finish coat at the junctures with metal.

6. Plaster shall consist of three-coat work on lathed surfaces, two-coat work on masonry, and two-coat on exterior work.

7. Grounds and Screeds: Wherever permanent grounds are too far apart to serve as guides for rodding, install plaster screeds and establish true surface of screeds with rod, before screeds are set.

8. Do not use materials which are caked or lumpy, or are contaminated with foreign materials.

9. Place mixed plaster within a maximum of 2-1/2 hours after mixing, except during hot, dry weather, reduce maximum placing time as required to prevent premature stiffening of plaster. Do not re-temper stiffened plaster with additional water.

10. Apply dash coat as required on concrete or masonry surfaces prior to the application of basic or scratch coat.

11. Interior Application: In addition to dash coat and unless otherwise indicated, apply 2 coat plaster, i.e. scratch and finish coats, over direct-plastered concrete and masonry substrates to a total minimum thickness of 15 mm *(such as internal walls)* except that in horizontal applications total thickness shall not exceed 10 mm *(such as internal ceilings).* Thickness shall be measured from face of concrete, masonry, rigid insulation board, or back of metal lath as applicable.

12. Exterior Application: In addition to dash coat and unless otherwise indicated, apply 2 coat plaster, i.e. scratch and finish coats, over direct-plastered concrete and masonry substrates to a total minimum thickness of 20 mm *(such as external walls & ceilings).*

Thickness shall be measured from face of concrete, masonry, rigid insulation board, or back of metal lath as applicable.

C. Expansion/Contraction Joints for Cement Plaster and Lath Suspended Ceilings:

Place expansion/contraction joints at not further than 3 metre spacing in any direction. The area of panels bounded by expansion/contraction joints shall not exceed 9 square meters.

D. Ventilation Strips:

Ventilation strips shall be used for ventilating all dead air spaces. Where plenum or attic spaces are closed off by ceiling installation, ventilation shall be provided with a minimum of 35 cm sq. per square metre.

E. Moisture Retention, Curing:

1. Dampen previous plaster coats which have dried out prior to time for applications for next coat.

2. The Contractor is responsible for determining the most effective procedure for curing and time lapse between application of coats based on climatic and job conditions.

F. Cutting and Patching: Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs efflorescence, sweat-outs and similar defects, including areas of the work which do not comply with specified tolerances, and where bond to the substrate has failed. Sand smooth trowelled finishes lightly to remove trowel marks and arises.

G. Cleaning and Protection: Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces which are not to be plastered. Repair floors, walls and other surfaces which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean floors of plaster debris.

H. Painting: Galvanized fasteners, hangers and all accessories, shall not require finish painting after installation, unless otherwise directed by the Engineer.

** END OF SECTION **

SECTION 09512

GYPSUM AND DECORATIVE GYPSUM SUSPENDED CEILINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of gypsum ceilings and suspension systems is indicated on drawings and in schedules with the required associated and corresponding suspension systems.

1.02 QUALITY ASSURANCE

A. Installation: Install gypsum ceilings and suspension systems in strict compliance with the manufacturer's installation instructions and the approved shop drawings.

B. Coordination: Coordinate layout of gypsum ceilings with other work which penetrates or is supported by ceiling suspension system.

C. Fire Resistance: Ceilings shall comply with the requirements of BS 476, Part 4, unless otherwise directed.

D. Codes and Standards: Comply with the applicable requirements of the following codes and standards.

ASTM American Society for Testing and Materials

C 1395 Specification for Gypsum Ceiling Board

BS British Standards.

476 Fire Tests on Building Materials and Structures.

Part 4: Non-Combustility Test for Materials.

Part 7: Surface Spread of Flame Tests for Materials.

1052 Specification for Mild Steel Wire for General Engineering Purposes.

1494 Specification for Fixing Accessories for Building Purposes.

1554 Specification for Stainless and Heat Resisting Steel Round Wire.

1769 Specification for Unified Black Hexagon Bolts, Screws and Nuts Heavy Series.

8290 Code of Practice for Design of Suspended Ceilings.

ASTM American Society for Testing And Materials

A446 Steel Sheet, Zinc-Coated by the Hot-Dip Process, Structural.

B209 Aluminum and Aluminum-Alloy Sheet and Plate.

B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

C636 Installation of GYPSUM Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for gypsum ceiling materials required and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications. Include manufacturer's recommendations for cleaning and refinishing gypsum units, including precautions against materials and methods which may be detrimental to finishes and gypsum performances.

B. Samples: Submit set of 300 mm square samples for each gypsum unit required, showing full range of exposed color and texture to be expected in completed work. In addition, submit set of 300 mm long samples of runners, molding and trim and each fixing accessory.

C. Replacement Materials:

1. When work is completed, deliver stock of replacement material to Client for each type of met unit used in the work. Furnish full size units, matching installed materials, packaged and marked for identification.

2. Furnish not less than 1% of the total amount of each type of gypsum and other units installed.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver gypsum and other ceiling materials to the job site in original, unopened packages, bearing manufacturer's name and label identifying each type of met unit.

B. Storage Areas: Comply with the material manufacturer's recommendations for storage of units to be used in the work.

1.05 SPARE MATERIAL

A. The Contractor shall provide at his own cost spare material of 1% (one per cent) of each tile used in clean, marked spare for the Client's use.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Gypsum Ceilings:

Gypsum Board: Provide gypsum board and frame of 50mm overall thickness and of dimensions shown on drawings. Unless otherwise recommended by the manufacturer and approved by the Engineer, the minimum thickness of the gypsum board shall not be less than 15mm.

Gypsum Boards shall comply with the requirements of ASTM C 1395.

B. Accessories:

1. Moulding: Provide manufacturer standard moulding, unless otherwise shown on Drawings.

2. Access Panels: Where required, provide access panels of suitable size and construction for inspection and maintenance purposes. Panels shall be of similar construction and finish as that of the ceiling and shall be off manufacturer's standard product.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrates and the condition under which the gypsum ceiling work shall be performed, and correct any unsatisfactory conditions. Do not proceed with the gypsum ceiling work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of the gypsum ceilings.

B. Measure each ceiling area and establish layout of the gypsum units to balance the border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with approved ceiling plans.

3.03 INSTALLATION

A. Installation of suspended ceilings shall be in compliance with the manufacturer's instructions and approved ceiling drawings.

B. Ceiling suspension systems shall be installed true to line and level in compliance with approved shop drawings. Suspension depth shall comply with the requirements shown, unless otherwise directed. All anchors shall be in stainless steel (type 316). Hangers and supports shall be appropriate to the suspension system and shall be spaced in accordance with approved shop drawings.

C. Install edge mouldings of type required at perimeter of ceiling area and at locations where necessary to conceal edges of ceiling units. Miter corners accurately and connect securely.

D. For electro-mechanical work, the Contractor shall comply with the applicable requirements as specified.

3.04 ADJUST AND CLEAN

A. Clean exposed surfaces of gypsum ceilings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

** END OF SECTION **

SECTION 09310

CERAMIC FLOOR AND WALL TILES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The extent of tile work is shown on drawings and in schedules and includes but is not limited to the following:

1. Ceramic wall tiles.
2. Ceramic floor tiles (non slip).

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with the applicable requirements of the following codes and standards:

BS - British Standards:

882	Aggregates from Natural Sources for Concrete.
890	Building Limes.
1014	Pigments for Portland Cement and Portland Cement Products.
1199	Building Sands from Natural Sources.
3148	Tests for Water for Making Concrete.
4248	Supersulphated Cement.
5385	Wall and Floor Tiling.
6431	Ceramic Floor and Wall Tiles.
PD	Published Documents
6472	Guide to Specifying the Quality of Building Mortars.

B. Source: Provide materials obtained from only one source for each type of tile and color to minimize variations in appearance and quality.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for all materials required. Include certifications and other data as may be required to show compliance with these specifications.

B. Samples: Submit samples of each type, class and color of tile required, not less than 300 mm square on plywood or hardboard backing, and grouted as directed. Engineer's review will be for color, pattern and texture only. Compliance with all other requirements shall be the exclusive responsibility of the Contractor. The Engineer will make color selections from manufacturer's standard colors.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials and store on the site in original containers with seals unbroken and labels intact until time of use, in accordance with manufacturer's directions.

1.05 SPARE MATERIAL

A. The Contractor shall provide at his own cost spare material of 1% (one per cent) of each tile used in clean, marked cartons for the Client's use.

PART 2 - PRODUCTS

2.01 TILE

A. Provide the required sizes/dimensions of ceramic floor and/or wall tiles for the required locations, all as shown on drawings. Generally, ceramic wall tiles are of the following types:

- Unglazed non slip ceramic floor tiles
- Glazed ceramic floor tiles

B. Trim and Special Shapes: Rounded external corners and trim shapes at head, jamb and sills of openings, of same material and finish as glazed wall tile, and as follows:

1. Skirting: Skirting units having same matching types and texture as that of the floor tiles as stated above and of the sizes stated in the Contract Documents.

2. Trim at Top of Thin-Set Wainscots: Surface-bullnose or bullnose cap.

3. External Corners: Bullnose shapes, with an inside radius of not less than 19 mm, unless otherwise shown.

4. Internal Corners: Field-butted square, except use square corner, combination angle and stretcher type cap.

2.02 MORTAR AND GROUT

A. Portland Cement Mortar and Grout Materials:

1. As specified in BS 4248 and PD 6472 series of materials and installation specifications.

2. Colour Pigment: Mineral oxides, unaffected by lime, cement or weathering. use only when required for selected grout colour to BS 1014.

B. Commercial Cement Grout: A proprietary compound of Portland cement and additives, factory-blended to decrease shrinkage and increase moisture resistance.

C. Latex Grout: A proprietary compound composed of Portland cement with latex additive for a more flexible and less permeable grout.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrates and the conditions under which the tile work shall be carried out and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 INSTALLATION

A. General: Comply with the relevant sections of BS 5385, regarding the general applications of floor and wall tiling

1. Comply with all relevant conditions as set out in BS 6431 in respect of the quality of tiling. In all respects it will be the Contractor's responsibility to ensure that compliance takes place.

2. Handle, store, mix and apply proprietary setting and grouting materials in compliance with the manufacturer's instructions.

3. Extend tile work into recesses and under equipment and fixtures to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstruction edges and corners without disruption of pattern or joint alignment.

B. Setting Beds: Provide setting beds as shown on the drawings. When not otherwise indicated, provide one of the following, subject to the specified limitations.

1. Use Portland cement mortar setting beds for walls and floors where indicated as mud-set.

2. Use dry-set Portland cement mortar setting bed for walls and floors where indicated as thin-set.

C. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints

when adjoining tiles on floor, base, walls and trim are the same size. Lay out tile work and center tile fields both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.

3.03 ADJUST AND CLEAN

A. Cleaning: Unglazed tile may be cleaned with acid solutions only when permitted by the tile and grout manufacturer's printed instructions, but not sooner than 10 days after installation.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken unbounded or otherwise defective tile work.

C. Protection: Protect installed tile work with Kraft paper or other heavy covering during the construction period to prevent damage and wear.

** END OF SECTION **

SECTION 09420

PRECAST TERRAZZO TILE FLOORING

PART 1 - GENERAL

1.01 DESCRIPTION

The extent of precast terrazzo tile work is shown on drawings and in schedules and includes, but is not limited to precast terrazzo tile flooring, skirting stair treads and risers.

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1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with the applicable requirements of the following codes and standards:

BS - British Standards:

882 Specification for aggregates from natural sources for concrete.

890 Building Limes.

1014 Pigments for Portland Cement and Portland Cement Products.

1199 Specification for Building Sands from
1200 Natural Sources.

4131 Terrazzo Tiles.

4248 Specification for Super-Sulphated Cement.

4357 Specification for Precast Terrazzo Tiles.

5385 Wall and Floor Tiling.

8000 Workmanship on Building Sites.

Part II, Section 11.1:1989, Ceramic Tiles - Terrazzo Tiles and Mosaic.

PD Published Documents

6472 Guide to Specifying the Quality of Building Mortars.

B. Source: Provide materials obtained from only one source to minimize variations in appearance and quality.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical information and installation instructions for terrazzo tiles and accessories required. Include instructions for handling, storage, and protection of terrazzo and procedures for quality control.

B. Samples: Submit samples not less than 300 mm square, of colour, grade and finish of terrazzo to be provided. Include the full range of exposed colour and texture to be expected in the completed work.

C. Shop Drawings: Submit shop drawings showing elevations and plans for layout of terrazzo work and layout of divider strips.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver and handle terrazzo units carefully, so as to protect units from damage. Stack units off ground to prevent contamination by mud, dust or materials likely to cause staining or other defects. Units shall be protected when necessary , by a suitable weatherproof covering. Use non-staining materials for blocking and packing.

1.05 SPARE MATERIAL

A. The Contractor shall provide at his own cost spare material of 1% (one per cent) of each tile used in clean, marked cartons for the Client's use.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: BS 4248.

B. White Cement: Standard Non-Staining White Cement for grout.

C. Sand: BS 1199 and 1200.

D. Pigment for Coloured Grout: Provide pigments to BS 1014 for coloured grout that match colour of marble. Use commercial iron oxide, manganese dioxide, ultra-marine blue, chromium oxide or carbon black suitably compounded for use in grouting mortar. Do not exceed pigment to cement ratio recommended by manufacturer.

E. Water: Clean, potable.

F. Cleaner: Neutral chemical cleaner, free from crystallizing salts or water soluble alkaline salts, formulated for Portland cement terrazzo.

F. Sealer: Colourless, slip and stain resistant, non-yellowing penetrating sealer which will not disturb the colour or physical properties of the terrazzo surface.

2.02 FABRICATION OF PRECAST TERRAZZO

A. General: Unless otherwise directed, comply with BS 4131.

B. Precast Terrazzo Units:

1. Provide precast terrazzo units of the shapes and sizes required, polished on exposed faces.

2. Fabricate terrazzo tiles and skirtings, accurately cut to shape and dimensions shown and as detailed on drawings.

3. Cut and grind edges as required to ensure, uniform joint width and uniform sized units.

C. Tiles and Skirting: size and thickness are as stated in the Bill of Quantities.

D. Treads and Risers: size and thickness are as stated in the Bill of Quantities.

2.03 ACCESSORIES

A. Control and Movement Joints: Control and movements joints material shall be in compliance with Section 05805 “EXPANSION JOINT ASSEMBLIES”.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor must examine the substrate and conditions under which the work is to be performed and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 INSTALLATION

A. Match approved sample for terrazzo type, colour pattern and finish. Mix pigments with cement prior to mixing with aggregates.

B. Comply with BS 5385 and manufacturer's specifications and recommendations for preparation of substrate, proportioning mixes, installation of strips, and for placing, curing, grinding, grouting and finishing.

C. Extend tile work into recesses and under and behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions edges and corners without disruption of

pattern or joint alignment.

D. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints, when adjoining tiles on floor and skirting are the same size. Lay out tile work and center tile fields both directions in each space. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise directed.

E. Provide terrazzo tiles, and skirting without interruptions or seams.

F. Setting Beds: When not otherwise indicated, provide "mud set" setting bed not less than 50 mm thick, of Portland cement sand mortar (1:3).

G. Rubber Strips: Where indicated on drawings, provide non-slip rubber strip to the exposed edge of terrazzo flooring.

H. Curing: Cure and protect terrazzo flooring for a minimum of 3 days.

I. Clean terrazzo flooring after installation and finishing operations are completed.

J. Apply approved sealer to cleaned terrazzo surfaces in accordance with manufacturer's instructions. Apply maximum number of sealer coats recommended by manufacturer.

K. Final Cleaning: Clean terrazzo and machine buff as required when building is ready for occupancy.

** END OF SECTION **

SECTION 09510

ACOUSTICAL CEILINGS AND SUSPENSION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of acoustical ceilings is indicated on drawings and in schedules and includes but shall not be limited to mineral fibre acoustical board in suspension system.

1.02 QUALITY ASSURANCE

A. Installation: Install acoustical ceiling system in strict compliance with the manufacturer's installation instructions and the approved shop drawings.

B. Coordination: Coordinate layout of acoustical ceilings with other work which penetrates or is supported by ceiling suspension system.

C. Fire Resistance: Ceilings shall comply with the requirements of BS 476, Part 4, unless otherwise directed.

D. Codes and Standards: Comply with the applicable requirements of the following codes and standards.

BS British Standards.

476 Fire Tests on Building Materials and Structures.

Part 4: Non-Combustility Test for Materials.

Part 7: Surface Spread of Flame Tests for Materials.

729 Hot-dip Galvanised Coatings on Iron and Steel Articles.

1052 Specification for Mild Steel Wire for General Engineering Purposes.

1449 Specification for Steel Plate, Sheet and Strip, Section 1.15,1991 - Specification for Cold Rolled Narrow Strip Supplied for General Engineering Purposes.

1494 Specification for Fixing Accessories for Building Purposes.

1554 Specification for Stainless and Heat Resisting Steel Round Wire.

1769 Specification for Unified Black Hexagon Bolts, Screws and Nuts Heavy Series.

2994 Specification for Cold Rolled Steel Sections.

4870 Specification for Approval Testing of Welding Procedures.

4871 Specification for Approval Testing of Welders Working to Approved Welding Procedures.

8290 Code of Practice for Design of Suspended Ceilings.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for each acoustical ceiling materials required and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications. Include recommendations of the manufacturer for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performances.

B. Samples: Submit set of 300 mm square samples for each acoustical unit required, showing full range of exposed colour and texture to be expected in completed work. In addition, submit set of 300 mm long samples of runners, moulding and trim and each fixing accessory.

C. Replacement Materials:

1. When work is completed, deliver stock of replacement material to Client for each type of acoustic unit used in the work. Furnish full size units, matching installed materials, packaged and marked for identification.

2. Furnish not less than 1% of the total amount of each type of acoustical and other units installed.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical and other ceiling materials to the job site in original, unopened packages, bearing manufacturer's name & label identifying each acoustic unit type

B. Storage Areas: Comply with the material manufacturer’s recommendations for storage of units to be used in the work.

1.05 SPARE MATERIAL

A. The Contractor shall provide at his own cost spare material of 1% (one per cent) of each tile used in clean, marked cartons for the Client's use.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Suspended Ceilings:

1. **Mineral Fiber Acoustical Tiles**: Provide moisture and humidity resistant mineral fibre tiles size 600 x 600 mm, 13 mm thick, (AMF, KNAUF, USG or similar) on T24 ceiling Grid with Hanger wires and all fixing accessories and wall trim, tiles shall have square cut joints designed to fit exposed tee type grid suspension system. Tiles shall have surface texture, which will have to be approved by the Engineer.

2. **Aluminum Suspended Ceiling Tiles**: Provide Aluminum suspended ceiling tiles, size 600 x 600 x 0.6 mm thick with all fixing accessories and wall trim, Tiles shall be powder coated and backed with fleece. The framing shall be made with 2mm aluminum profiles.

3. **Aluminum strip**: Provide Aluminum strips, moisture and humid resistant 150 mm width

B. Ceiling Suspension System: Provide adequate suspension system in aluminium galvanised steel construction as a manufacturer standard item and suitable for ceiling system indicated. All materials and anchoring devices shall be in strict conformity with the applicable British Standard specified in this section and as per manufacturer's instructions.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrates and the condition under which acoustical ceiling work shall be performed and correct any unsatisfactory conditions. Do not proceed with the acoustical ceiling work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders and comply with approved ceiling plans.

3.03 INSTALLATION

A. Installation of suspended ceilings shall be in compliance with the manufacturer's instructions and approved ceiling drawings.

B. Ceiling suspension systems shall be installed true to line and level in compliance with approved shop drawings. Suspension depth shall comply with the requirements shown, unless otherwise directed. All anchors shall be in stainless steel construction. Hangers and supports shall be appropriate to the suspension system and shall be spaced in accordance with approved shop drawings.

C. Install edge mouldings of type required at perimeter of ceiling area and at locations where necessary to conceal edges of ceiling units. Miter corners accurately and connect securely.

D. For electro-mechanical work, the Contractor shall comply with the applicable requirements as specified.

3.04 ADJUST AND CLEAN

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**** END OF SECTION ****

SECTION 09912

PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Work: The extent of painting work is shown on the drawings and schedules and as herein specified.

B. The work shall include painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise indicated or specified. Surface preparation, priming and coats of paint specified shall be in addition to shop-priming and surface treatment specified under other sections of the work.

C. The work shall include field painting of all bare and covered pipes and of hangers, exposed steel and iron work and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise specified.

D. "Paint" as used herein means all coating system materials, including primers, emulsions, enamels, sealers and fillers and other applied materials whether used as prime, intermediate or finish coats.

E. Paint all exposed surfaces whether or not colours are designated in "schedules", except where the natural finish of the material is obviously intended and specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If colour or finish is not designated the Engineer will select these from standard colours available from manufacturer.

1.02 PAINTING NOT INCLUDED

A. The following categories of work are not included as part of the field-applied finish work, but are deemed to be as part of the work covered by other sections of these specifications:

1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections of metal fabrications, steel doors and similar items. Also for shop-fabricated or factory-built mechanical and electrical equipment or accessories.

2. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory finishing is specified for such items as, but not limited to, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets.

3. Finished Metal Surfaces: Metal surfaces of aluminium, stainless steel and similar finished materials will not require finish painting, except as otherwise indicated.

4. Operating Parts and Labels:

   a. Do not paint any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan, shafts unless otherwise indicated.
   b. Do not paint over any code-required labels, or any equipment identifications, performance rating, name or nomenclature plates.

1.03 QUALITY ASSURANCE

A. Provide finish coats which are compatible with the prime paints used. Review other sections in which prime paints are to be provided to ensure compatibility of the total coating systems for the various substrates.

B. Applicable Codes and Standards: The Codes and Standards generally applicable to the Work are listed hereinafter:

BS	British Standards.
1615	Anodic Oxidation Coatings on Aluminium.
4800	Schedule of Paint Colours for Building Purposes.
5493	Code of Practice for Protective Coatings of Iron and Steel Structures against Corrosion.
6150	Code of Practice for Painting of Buildings.

C. Mock-up:

1. Prepare for the approval of the Engineer sample areas of coatings using materials, methods and workmanship identical to those to be employed on the Work.
2. Prepare sample areas for each type of painting or coating at locations designated by the Engineer.

D. Tests: Where there is any question of dryness of surfaces, test surfaces. Test in the presence of the Engineer, with a reliable electronic moisture meter.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications, including paint label analysis and application instructions for each material specified.

B. Samples:

1. Submit samples for the Engineer's review of colour and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Provide listing of the material and application for each coat of each finish sample.

2. On 300 mm x 300 mm hardboard, provide samples of each colour and material, with texture to simulate actual conditions. Resubmit each sample as requested until required sheen, colour and texture is achieved.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and labels.

B. Provide labels on each container with the following information: Name or title of material; manufacturer's stock number and date of manufacture; manufacturer's name, contents by volume, for major pigment and vehicle constituents; thinning instructions; application instructions and colour name and number.

C. Store paint materials off the ground in covered sheds and take precautions to ensure that workmen and work area are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of painting systems.

1.06 JOB CONDITIONS

A. Do not apply water-base paints when the temperature of surfaces to be painted and the surrounding air temperature are below 10°C, unless otherwise permitted by the paint manufacturer's printed instructions.

B. Do not apply paint in rain, fog or mist; or when the relative humidity exceeds 85%, or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions. Painting may be continued during inclement
weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.01 MATERIAL QUALITY

A. Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best grade product will not be acceptable.

B. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only within recommended limits.

C. Provide paints of durable and washable quality. Do not provide paint materials which will not withstand normal washing as required to remove pencil marks, ink ordinary soil, etc., without showing discoloration, loss of gloss, staining or other damage.

2.02 COLOURS AND FINISHES

A. Surface treatments and finishes are indicated on the drawings and in the schedules of the contract documents.

B. Prior to beginning work, the Engineer will select colour from manufacturer's colour chips furnished by the Contractor for surfaces to be painted as per schedule of finishes and drawings.

C. Colour Pigments: Pure, non-fading, applicable types to suit the substrates and service indicated.

2.03 MATERIALS

A. See "schedule" at the end of this Section for material quality requirements.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the areas and conditions under which painting work shall be applied and correct any unsatisfactory conditions which are detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions otherwise detrimental to the formation of a durable paint film.

3.02 SURFACE PREPARATION

A. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

1. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items with workmen skilled in the trades involved.

2. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Provide cleaning solvents of low toxicity and a flash point in excess of 38°C. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

3. Ensure that all precast Panel surfaces to be painted are even, smooth and free from any irregularities, undulations, air gaps, pinholes, etc. Apply a filler material compatible with the approved painting systems to all such surfaces before the application of the paint system

B. Cementitious Materials:

1. Prepare cementitious surfaces of concrete, concrete block and cement plaster, if any, to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils and by roughening as required to remove glaze.

2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. Do not apply coatings over surfaces where the moisture content exceeds that permitted in the manufacturer's printed instructions.

3. Acid-etch concrete surfaces as required with a 5% solution of muriatic acid or other proprietary cleaner. Wash surfaces with clean water to remove all acid and neutralize with ammonia and rinse; allow to dry.

3.03 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and, if necessary, strain the material before using.

3.04 APPLICATION

A. General:

1. Apply paint by brush, roller or spray in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required. Spray paint uniformly with suitable equipment.

2. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between each coat application with fine sandpaper to produce an even smooth surface in accordance with manufacturer's directions.

3. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint until the paint film is of uniform finish, colour and appearance. Give special attention to ensure that all surfaces, including edges, corners, crevices, welds and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture in the same way as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

5. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.

6. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise specified.

B. Minimum Coating Thickness:

1. Unless otherwise specified, apply each material at not less than the manufacturer's recommended spreading rate, to provide a total dry film thickness of not less than 0.13 mm for the entire coating system of prime and finish coats for 3-coat work.

2. Unless otherwise specified, provide a total dry film thickness of not less than 0.09mm for the entire coating system of prime and finish coat for 2-coat work.

C. Scheduling Painting:

1. Apply the first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not re-coat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

D. Prime Coats:

1. Prime Coats: Apply a prime coat to material which is required to be painted or finished and which has not been prime coated by others.

2. Re-coat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat to ensure a finish coat with no brush-through or other defects due to insufficient sealing.

E. Completed Work: Match approved samples for colour, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.05 CLEAN-UP AND PROTECTION

A. Clean-up: During the progress of the work remove from the project daily all discarded paint materials, rubbish, cans and rags.

Upon completion of painting work, clean all window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damages by cleaning, repairing or replacing and repainting as required.

3.06 SCHEDULE OF PAINTING AND FINISHES

A. Provide the following type of painting:

1. Acrylic Resin Based Paint (Internal): Acrylic resin based paint shall be a textured emulsion decorative paint. The surface preparation and application shall be strictly in accordance with the manufacturer's instructions.

2. Polymeric Paint (External): Polymeric paint for external use where specified shall comprise of one layer of primer, one layer of Acrylic resin based textured paint and two finishing coasts of polyurethane paint first quality. The paint shall be from an approved manufacturer to a color, texture and finish as indicated on the drawings, as specified elsewhere and/or as directed by the Project Manager.

**** END OF SECTION ****

SECTION 10800

TOILET AND LAVATORY ROOMS ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide toilet accessories as indicated under Specialties.

B. Furnish inserts and anchoring devices which must be set in concrete, built into masonry, built into partitions or secured to partitions for the installation of toilet accessories. Coordinate delivery with other work to avoid delay.

1.02 QUALITY ASSURANCE

A. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same area, unless otherwise approved by the Engineer.

1. Stamped names or labels on exposed faces of units will not be permitted, except where otherwise indicated.

1.03 SUBMITTALS

A. Submit manufacturer's technical data and installation instructions for each toilet accessory for the Client's approval prior to placing order for items in accordance with the GENERAL CONDITIONS. Transmit copies of installation instructions to the Installer.

B. Submit one (1) full-size sample of each unit to the Engineer for approval of design and operation prior to placing order for items. Acceptable samples will

be returned and may be used in the work. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Provide setting drawings, templates, instructions and directions for installation of anchorage devices in other work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Provide toilet accessories complete with all mounting accessories and fasteners. Exposed finish of anchors shall match accessories.

B. Fabrication: Toilet shall be stainless steel and fabricated with welds ground smooth. Bending, flanging, drawing, forming and similar operations shall be performed in a manner to ensure that there are no ruptures, cracks, wrinkles, sharp exposed edges or other defects.

C. Schedule of Accessories:

1. Mirrors with shelves (MIR): Widths and heights shall be as indicated on drawings, with 6 mm minimum thickness. Mirror shall be glass with silvering, copper protective coating, and non-metallic paint coating. Provide not less than 0.9 mm thick backing plate of galvanized steel.

2. Robe Hook (RH): Stainless steel contoured 100.0 mm wide double robe hook with 50.0mm x 50.0mm flange.

3. Towel Paper Dispenser (TPD): 500 x 200 x 200 mm stainless steel, 20 gage minimum, surface-mounted. Provide hinged front equipped with tumbler lockset and spring latch bolt. Punch slots at sides as refill indicator. Provide not less than 400 multifold paper towel capacity.

4. Ablution Hose Hook (AHH): Stainless steel 75 mm diameter wall plate with tubular hook.

5. Toilet Paper Holder (TPH): Two supporting stainless steel arms with wall flanges concealed mounting brackets and roller

6. Soap Dispenser: Surface mounted, liquid soap dispenser with stainless steel piston, springs, and internal parts designed to dispense liquid soap or lather in measured quantity by pump action. Provide cover in stainless steel, with unbreakable window type refill indicator. Provide not less than 1.1 liter capacity.

PART 3 - EXECUTION

3.01 INSPECTION

A. Installer must examine the areas and conditions under which toilet accessories are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION

A. Use concealed fastening wherever possible.

B. Provide wall blocking, anchors, bolts and other necessary anchorages, and attach accessories securely to walls and partitions.

C. Install concealed mounting devices and fasteners fabricated of the same material as the accessories, or of galvanized steel, as recommended by manufacturer.

D. Install exposed mounting devices and fasteners finished to match the accessories.

E. Provide theft-resistant fasteners for all accessory mountings.

F. Secure toilet room accessories in accordance with the manufacturer’s instructions for each item and each type of substrate construction.

G. Install all toilet and bath accessories in accordance with mounting height and locations indicated on drawings.

** END OF SECTION *

SECTION 12

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of mechanical work includes but is not limited to the following:

1. Plumbing and fire protection systems.

2. Split type air conditioners, 4-way cassette room air conditioners, filters, etc.

3. HVAC control systems, including testing, adjusting and balancing.

1.02 COORDINATION OF MECHANICAL WORK

A. General:

1. Arrange mechanical work in a neat, well organized manner with piping and similar services running parallel with primary lines of the building construction and with a minimum of 2100 mm overhead clearance in exposed areas.

2. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.
3. Give right-of-way to piping, which must slope for drainage. Advise other trades of openings required in their work for the subsequent move-in of large equipment of mechanical work.

B. Coordination Drawings: For locations where several elements of mechanical (or combined mechanical and electrical) work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings (shop drawings) showing the actual physical dimensions (at accurate scale) required for the installation. Prepare and submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.

1.03 QUALITY ASSURANCE

A. Materials and workmanship shall comply with the applicable requirements of the following:

1. Specifications and drawings.

2. Codes and standards listed in these specifications.

3. Local regulations.

4. Equipment manufacturers instructions.

B. Welding: Qualify welding procedures, welders and operators in accordance with BS 2971 for shop and project site welding of piping work.

C. Brazing: Certify brazing procedures and operators in accordance with BS 1723 for shop and job-site brazing of piping work.

D. Testing and Coding of welders shall conform to BS 4871, Part 1:1982 and BS 4872, Part 1:1982.

1.05 MECHANICAL SYSTEM IDENTIFICATION

A. Piping System:

1. General: Provide adequate marking of piping which is exposed, including that which is concealed in accessible spaces. Provide either pre-printed color-coded plastic pipe markers or color-coded stencil painted markers. Indicate each pipe system by its generic name (abbreviated) as specified; except drainage and vent piping may be indicated by color-coding only. Comply with BS 1710. Include arrows to show direction of flow. Locate markers at terminations of lines and near major branches; near control valves and at equipment connections; where lines pass through walls, floors and ceilings; at access doors where piping is in concealed spaces; and at spacing of not more than 5.0 meters along each line for exposed piping.

1.06 ACCESS, CUTTING AND PATCHING

A. Access Units:

1. General: Provide access through other work for access to mechanical work. In general, and where possible, furnish or furnish-and-mount required access units in other trades work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required.

** END OF SECTION **

SECTION 15060

PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The requirements of this section apply to the piping systems specified elsewhere in these specifications.

1.02 QUALITY ASSURANCE

A. Manufacturer: Firms regularly engaged in the manufacture of piping products of types and sizes required and which have been in satisfactory use for not less than 5 years in similar service.

1.03 SUBMITTALS

A. Manufacturer’s Data: Submit manufacturer's product data including dimensions, sizes, weights, installation, instructions, storage instructions, and code compliance reports.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. General: Provide pipe and tube of the type, joint type, grade, size and weight (wall thickness or quality) indicated for each service. Where type, weight or quality is not indicated, provide proper selection as recommended by manufacturer for installation requirements, and comply with governing regulations and industry standards.

B. Domestic cold water pipes: PVC pressure pipe complying with ASTM D 1785 schedule 40. Fittings shall comply with ASTM D 2466 schedule 40 threaded and solvent weld socket pressure fittings.

C. Domestic Hot water pipes: CPVC pressure pipe complying with ASTM F 441 schedule 80. Fittings shall comply with ASTM F 439 for schedule 80 solvent welded joints.

D. Condensate Drains: Exposed condensate piping shall be butt-welded galvanized steel pipe schedule 40 to ASTM A53 grade B with screwed joints. Fittings will

be screw type forged. Concealed condensate drain piping shall be UPVC pressure pipe to ASTM D1785 schedule 40 with solvent welded joints.

E. Drainage (for Sanitary, Storm Drainage and Venting): UPVC un-plasticized polyvinyl chloride pipe and fittings complying with BS 4514. Waste pipes shall be UPVC to 5255. Soil, waste and rain water pipes buried under the buildings up to manholes shall be of UPVC to BS 4660, protected with concrete as necessary, except the joints which shall be left flexible. Pipes larger than 160 mm shall be to BS 5481. Equivalently UPVC drainage pipes shall be to the following European standard for non-pressure drainage pipes:

- Pipes installed above ground shall be to EN 1329 type B and BD (SDR41-S20) CR4 designation.

- Pipes installed underground up to 6m depth shall be to EN 1401 (SDR 41-S20) SN4 designation.

- Pipes installed deeper than 6m shall be to EN 1401 (SDR34 – S16.7) SN8 designation.

1. Fittings: UPVC socketed and solvent weld and push fit seal ring connections.

2. Joints: Solvent welded joints, and push fit seal ring connectors. Sealing rings shall be rubber to BS 2494 – Part 2 or alternatively to EN 681.

3. Design Temperature: 50 degrees C.

4. Non-pressure type.

F. Copper Pipes and fittings:

1. Pipe- Complying with ASTM – B: 88. All pipes shall be seamless hard drawn tubing type. Type L shall be used within the building and type K for underground installation.

   Joints in copper tubing installed under a concrete slab resting on the ground.

2. Soldered joint fittings shall be cast brass or bronze and shall be made in accordance with ASA B 16.22 and ASA B 16.18.

   Soldered joint fittings supply applications subjected to maximum water temperature of 65^0 C shall be made with 50-60 tin-lead solder and those applications up to 121^0 C. Water temperature shall be made with 95-5 tin-antimony solder.

   Heating and finishing of the joint shall be done in accordance with the recommendations of the manufacturer of the fittings.

G. Drainage pipework receiving high temperature water discharge: Cast iron pipes and fittings.

1. The systems shall be designed and installed in accordance with BS 5572, BS 8301 and the relevant sections of the Building Regulations.

2. Pipework of nominal diameters, 50mm to 300mm shall be installed using lightweight cast iron socket less soil pipe and fittings conforming to a British Board Agreement Certificate and meet with pr EN877.

3. Pipes shall be coated as follows:

   Pipes:

   Externally – One coat of red/brown acrylic based paint. Giving an average thickness of 40 microns.

   Internally – A 2 two-part epoxy lining ochre in colour, giving an average thickness of 130 microns. This comprises two components of epoxy resin to give internal protection and anticorrosive features.

   Fittings: Shall be protected internally and externally with a single coat of red powder epoxy resin electrostatically applied. This gives an average thickness of 70 microns with a minimum thickness of 40 microns.

   Couplings: Shall be stainless steel/chrome nickel steel or optional ductile iron protected with a red water based semi-gloss paint with an average thickness of 40 microns.

   Brackets: (Ductile Iron) Protected with a red water based semi-gloss paint, average thickness of 40 microns. (Or equivalent optional mild steel galvanized). Additional anti-corrosive wrapping shall be required for below ground drains pipework with either:

   - Polyethylene sleeving in accordance with ISO 8180.
   - Adhesive tapes, e.g. “Densotape”, Long Maflowrap” or similar.

4. Where pipes are cut on site, ends shall be cut clean and square with burrs removed. All cut ends shall be made good/re-coated strictly in accordance with the manufacturers’ recommendations.

5. All pipes and fittings shall be jointed by means of stainless steel/chrome nickel steel couplings, including setscrews and nuts, or optional ductile iron couplings. The couplings shall incorporate a synthetic EPDM rubber gasket as standard or Nitrile to special order. Earth continuity shall be provided for.

6. Joints to cast iron drainpipe and to other materials shall be made using

standard couplings or step couplings as described in clause (e), or traditional joint connectors.

7. Connection to small diameter waste and ventilating pipe work or other materials shall be made using mechanical “compression-fit” boss pipes or push–fit manifold or blank ends.

8. Products when embedded in concrete shall use only an all stainless steel coupling inclusive of stainless steel nuts and bolts, or ductile iron couplings.

2.02 PIPE FITTINGS

A. Unless otherwise specified or directed, provide pipe fittings that are of the type and class of material as that of the pipes where such fittings are installed.

2.03 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Insulating (Dielectric) Unions: Provide standard products recommended by the manufacturer for use in the service indicated, and which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

B. Welding Materials: Except as otherwise indicated, provide welding materials that comply with installation requirements.

C. Soldering Materials: Provide jointing materials as required to comply with installation requirements.

D. Brazing Materials: For pipe size of 54 mm and above provide brazing materials that comply with BS 1845.

E. Solvent Cemented Joints: Solvents for jointing PVC piping shall comply with BS 4346, Part 3.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently - leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1-1/2 mm misalignment tolerance.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by

diagrams, details and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Hold piping close to walls overhead construction columns and other structural and permanent - enclosure elements of the buildings; limit clearance to 12 mm where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 25mm clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Reducers on all vertical pipework shall be concentric. In all other positions eccentric reducers shall be fitted in a manner to maintain a level bottom and ensure that fluids are not collected at that point in the system. Where it is not possible to fit eccentric reducers the Consultant's approval shall be obtained before fitting concentric reducers. Reductions in all cases shall be made by the use of factory made fittings.

D. All branches shall be made by easy sweep tees, twin elbows or sweep crosses. Bends shall be used wherever possible. All sweep fittings and all sweep bends shall be of the long radius pattern except where the use of these fittings would stand pipework too far from wall surfaces and make for unsightly appearance, in which case short sweep tees and elbows may be used provided that the Consultant's written approval is obtained beforehand.

E. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures.

F. Piping System Joints: Provide joints of the type specified hereinbefore for each piping system, and as follows:

1. Thread pipe in accordance with BS 3643 cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

2. Weld pipe in accordance with BS 2971.

3. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets. Comply with BS 4504.

4. UPVC Pipe/Tube Joints: Comply with CP 312 and with manufacturer's instructions and recommendations.
5. Solder copper tube-and-fitting joints in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting,

and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

G. Installation of piping for domestic cold, hot and recirculated water, condensate return, cooling coil condensate, potable water, sanitary waste, vent.

H. Waste Systems Piping: Install waste piping pitched to drain with a minimum slope of 1% for pipes running in suspended ceilings. Buried pipes shall be pitched to drain with a minimum slope of 2%. All pipes subject to traffic especially under roads shall be protected with reinforced concrete.

I. Cooling Coil Condensate Piping: Install piping pitched to drain with a minimum of 1% run in the direction of condensate flow.

J. Grooved Pipe Mechanical Joints:

1. Grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to welding, threading or flanged methods. All grooved components shall be of one manufacturer and conform to local code approval and /or as listed by ANSI-B-31.9, ASME, UL/FM, IAMPO or BOCA. Grooved end product manufacturer to be ISO 9001 certified.

2. Mechanical couplings shall be rigid coupling for high pressure service. Couplings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12 or malleable iron conforming to ASTM A-47, Grade 32510.
Mechanical coupling bolts shall be heat treated carbon steel track head conforming to physical properties of ASTM A-183, minimum tensile strength bolts shall be cadmium plated to ASTM A-165. Gaskets shall be Grade ‘E’ EPDM compound conforming to ASTM d-2000 designation 2CA615A25B 24F17Z. Temperature operation range – 30˚F to +23˚F (-34˚C to +110˚C).

3. Fittings shall be full flow ductile or cast iron fittings, with grooves of shoulders designed to accept grooved end couplings.
Fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, or malleable iron conforming to ASTM A-47, Grade 32510.

4. Standard fittings and coupling shall be provided with an alkyd enamel finish.

3.02 PIPING TESTS

A. General: Provide temporary equipment for hydrostatic testing, including pumps and gauges. Test piping system before insulation is installed and remove control devices before testing. Test each section of each piping system independently

but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.

Unless otherwise specified, test each piping system at 150% of operating pressure indicated, but not less than 2 bar test pressure.

Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

Re-tests shall have to be carried out after completion of remedial works arising from initial test failures.

B. Domestic Cold and Hot Water: Comply with British Standards Institution CP 342, Part 2.

C. Waste System Piping: Test waste system in accordance with BS 5572.

3.03 CLEANING, FLUSHING, PURGING AND INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Inspect each run of each system for completion of joints, supports and accessory items. Pipework shall be tested prior to cleaning, flushing and purging.

B. Domestic Hot and Cold Water: At the completion of piping installation and testing, flush and sterilize in conformance to the latest codes (AWWA C601 or BS 6700) and to the satisfaction of the Engineer.

C. Cooling coil condensate: Clean and flush system, with clear water, of all dirt, metal chips, sand, and foreign matter. After flushing remove, clean and replace all strainer baskets or screens. Inspect each run of each system for completion of joints, supports, accessory items, and obvious leaks.

D. Waste Systems Piping: Flush out with water to assure full flow and inspect the system for obvious leaks.

E. Cleaning - Piping Systems:

1. Plug open ends of piping, valves and equipment except when actual work is being performed, to minimize accumulation of dirt and debris.

2. After installation is complete, place temporary screens at connections to equipment and at automatic control valves where permanent strainers are not provided.

3. Prior to the performance of tests, flush out piping that is to receive a hydrostatic test with clean water. Blow out piping that is to be air or gas pressure tested with compressed air.

4. Remove dirt and debris collected at screens, strainers and other points from the system.

5. After hydrostatic testing, blow out fuel oil lines with compressed air until dry.

6. Where noted, flush out fuel oil pipe lines with clean oil after lines are dry.

F. Supplemental Cleaning – Water:

1. After the piping system is installed, tested and flushed, completely clean the system to remove organics, rust and other foreign matter and provide protection of the metal surfaces in preparation for permanent water treatment.

2. Use a cleansing agent which will not in any way interact with any of the materials in the system to produce corrosion, form deposits, weaken, reduce the life or in any way have a detrimental effect on any system components.

3. Fill the system with clean water and add sufficient cleaning preparation to provide a concentration adequate to perform complete cleaning. Add the cleaning preparation at a point which will assure good mixing and complete dispersal throughout the system.

4. Provide temporary receivers or drums to accommodate any foam that may form.

5. Circulate the mixture of cleanser and water for a sufficient length of time to complete the cleaning.

6. Drain the system, flush with clean water, clean strainers and screens and refill the system.

G. Disinfection-Potable Water Systems:

1. Disinfect new or repaired potable water systems prior to use whenever samples from the system show any contamination after making a bacteriological examination. Take samples as required by the Department of Health. Use the following method:

a. Flush the pipe system with clean potable water until no dirty water appears at the outlets.

b. Fill the system or part thereof with a water-chlorine solution containing at least 50 ppm of chlorine and valve off the system or part thereof and allow to stand for 24 hours or, fill the system or part thereof with a water-chlorine solution containing at least 200 ppm of chlorine and allow to stand for 3 hours.

c. Following the prescribed standing time, flush the system with clean potable water until no excess chlorine remains in the water coming from the system.

d. Repeat the procedure if it is shown that contamination still persists in the system.

H. Valve Adjustment: After testing and putting piping systems into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

I. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touchup paint.

J. Gaskets: Gaskets for HVAC system shall be as directed by the Engineer.

END OF SECTION

SECTION 15080

PIPING ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The requirements of this section apply to the piping work specified elsewhere in these specifications.

1.02 QUALITY ASSURANCE

A. Manufacturers: Only manufacturers regularly engaged in the manufacture of piping products of types and sizes required, and which have been in satisfactory use for not less than five years in similar service are to be selected.

1.03 SUBMITTALS

A. Manufacturer's Data: For information only, submit selected manufacturer's product data and installation instructions for the required piping accessories.

PART 2 - PRODUCTS

2.01 MANUFACTURED PRODUCTS

A. General: Provide factory-fabricated piping accessories as indicated on the Drawings and specified herein for use in the service indicated. Provide products of the type and pressure-rating indicated for each service or, if not indicated, provide proper selection as required to comply with installation requirements. Provide sizes and connections matching pipe, tube, valve and equipment connections.

B. Flexible Joints: Changes in the character of the subsoil such as the moisture content, the bedding and compaction conditions, and the nature of the subsoil itself may cause differential settlement in any buried drains. Flexible joints should be used to provide flexibility, longitudinal travel and ease of jointing. They are available for all types of pipe and the pipe maker's recommendations regarding the making of the joints should be closely followed. It is important that the joint should be made with the sealing ring supplied by the manufacturer and that the manufacturer's recommendations should be followed where a lubricant is required. The jointing surface and sealing rings should be clean and dry prior to any application of recommended lubricant.

C. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish except primed-for-painting finish where painted finish is indicated for adjoining surface. Provide units sized to fit closely outside of pipe insulation (or

bare pipe where no covering is indicated). Where sleeves extend above floor finish, provide units with sufficient depth to conceal sleeves.

D. Fire Stops: Provide fire stops collars for all pipe-work crossing fire rated walls or slabs. Provide intumescent collars for plastic pipes above 50 mm diameter. If intumescent fire collars are not available for small diameter PVC pipes, fire sealant and mastic shall be used to seal around such pipes when crossing fire rated walls.

E. Strainers: Y-pattern configuration with removable monel or stainless-steel basket; maximum pressure drop 1.2 meters of water in clean strainer and 1.5 meters of water when two-thirds of perforations are blocked. Perforations shall be as follows:

	Perforation Size	No. of Perforation
Up to 32 mm pipe	0.4	150
40 mm to 100 mm	0.8	65
100 mm and above	1.2	25

2.02 FABRICATED ACCESSORIES

A. Drip Pans: Provide drip-pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 63 mm and reinforced either by structural angles or by rolling over 6.3 mm steel rod; provide flanges for drain connections.

B. Steel Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipes; remove burrs.

C. Cast Iron Pipe Sleeves: Fabricate from cast-iron pipe; remove burrs.

D. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 80 mm diameter pipe, and smaller, 20 gauge; 100 mm to 150 mm diameter pipe, 16 gauge; over 150 mm diameter pipe, 14 gauge.

2.03 MISCELLANEOUS MATERIALS

A. Pipe sleeve caulking by means of oakum and lead, except where another caulking system or material is indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF MANUFACTURED PRODUCTS

A. Expansion Compensators: Install expansion compensators where indicated and at all building expansion joints for adequate expansion of the piping system. Install in accordance with manufacturer's instructions.

B. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.

3.02 INSTALLATION OF FABRICATED PRODUCTS

A. Drip Pans: Install drip pans under pipes which pass over or close to electrical equipment, operating rooms, recovery rooms, and intensive care rooms. Support with bars or angles and brace to prevent sagging or swaying. A drain to be taken from the pan to discharge away from electrical equipment but be visible, so that rectification can be implemented.

B. Pipe Sleeves: Install pipe sleeves of the types indicated wherever piping passes through walls, floors ceilings, roofs and structural members of the work. Provide sleeves of adequate size, accurately centred on pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapour-barrier covering provide sleeve with sufficient clearance for installation of vapour barrier, but not less than 2 pipe sizes larger than piping run. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 6.3 mm above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 19 mm above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.

1. At interior partitions and ceilings install sheet metal sleeves.

2. At exterior penetrations install iron-pipe sleeves, both above and below grade.

3. Except as otherwise indicated, install steel-pipe sleeves.

4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated. Provide sufficient quantities of oakum and lead to make permanent weather tight closure between sleeve and piping, slightly recessed at exposed surface.

** END OF SECTION **

SECTION 15100

VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The requirements of this Section apply to the piping work as shown on Drawings and specified in other sections of these specifications.

1.02 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of valves, of types and sizes required, and which have been in satisfactory use for not less than five years in similar service.

B. Inspection of Castings: Provide valve bodies, bonnets and discs which have been inspected in accordance with manufacturer's standard written quality control procedure.

1. Marking of Valves: All valves shall have the manufacturer's name, material designation, pressure rating and size clearly marked on the outside of the body. In addition, all globe and check valves shall have arrow indication of flow direction.

2. Valve Types: Provide valves of same type by same manufacturer.

C. Hydrostatic Testing of Valves: Provide valves which have been tested in accordance with manufacturer's standard written test procedure and the applicable BS or ANSI Code.

1.03 SUBMITTALS

A. Preferred Manufacturers: Product names are given to indicate the quality or standard required in making a submission, but the Contractor is free to submit for approval materials or goods or alternative manufacturers provided they are not of a lesser standard than the named project.

B. Manufacturer's Data, Valves:

1. Submit manufacturer's product data including dimensions, sizes, end-connections, weights, and installation instructions.

2. Include instructions on repacking and repairing valves.

3. Include data indicating Code compliance and optional features.

4. Include required reports as prepared by manufacturers of valves.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide manufacturer's standard temporary protective coating on cast iron and steel valves, and provide factory-applied end-caps on valves. Maintain coating and end-caps through shipping, storage and handling, in adequate conditions to inhibit corrosion, prevent damage and eliminate dirt and moisture from inside of valves. During transportation and delivery, handle valves with care, using adequate lifting equipment. Do not drop or abuse valves. Store valves inside and protect from weather. Where coating has been removed or damaged and where valves are in environment which could reasonably be expected to cause rusting, protect valves with separate, durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 VALVE TYPES AND SIZES

A. General: Except as otherwise indicated, provide factory-fabricated valves of the type, body material and pressure class for use in service indicated. Where type or body material is not indicated, provide proper selection as determined by installation requirements, with pressure class selected from BS standards based on the maximum pressure and temperature in the piping system. Except as otherwise indicated, provide valve sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections. Valves larger than 50 mm diameter shall be rated PN16. Valve shall be flanged made of cast iron body and bronze trim. Where more than one type is indicated, selection is Contractor's option.

B. Isolating Valves:

1. Packing: Select valves, equipped with packing suitable for intended service and designed for repacking. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

2. For Domestic Water Service (cold and hot): Threaded Ends 50mm and Smaller: Non-dezincifiable copper alloy ball valve PN 25 with full bore hard chrome plated ball and virgin PTFE seats and stem seals, or wedge gate Type complying with BS 5154 NR stem. Hand-wheel or lock-shield as required. End connections screwed to BS 21 or capillary as required. PN 16 bar. 95/5 Tin/Antimony Soft Solder integral solder rings.

3. Flanged Ends 65mm and Larger: Nominal pressure PN 16, cast iron solid wedge gate type screw, NR stem and hand wheel. Stem and all parts in contact with water shall be resistant, complying with BS5163 flanges to BS4506, or butterfly valve cast or ductile iron body with replaceable EPDM seat, lugged wafer type, and extended neck. Pressure rating shall be at 16 bars.

4. For Cooling Water Circuits Services: (not applicable for this job)

a. Gate Valve Threaded Ends 50mm and Smaller: Nominal pressure PN20, Series A, bronze body, union bonnet, non rising stem, solid wedge gate valve to comply with BS 5154, threads to BS 21.

b. Gate Valve Flanged Ends 65 mm and Larger: Nominal pressure PN 16, iron body, bronze mounted, bolted bonnet, non-rising stem, inside screw, solid wedge gate valve to comply with BS 5150, flanges to BS 4504, or butterfly valve cast or ductile iron body with resilient replaceable EPDM seat, lugged wafer flangeless bronze disc type, extended neck, gear drive from size 200 mm diameter and above. Pressure rating shall be at 16 bars.

C. Globe Valves:

1. Packing: Select valves, equipped with packing suitable for intended service and designed for repacking. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

2. Composition Discs: Where required, provide suitable material for intended service. For steam throttling service, fit composition disc valve with throttling nut. For metal seated globe valves, provide hardened stainless steel disc and seat ring.

3. For Domestic Water Service: Threaded Ends 50mm and Smaller: Nominal pressure PN 16, bronze body, union bonnet, rising stainless steel stem, composition disc, complying with BS 5154, threads to BS 21.

D. Drain Valves:

1. For Low Pressure Drainage Service: Ball valve, threaded Ends 50mm and Smaller: Nominal pressure PN 16, Series B, bronze body, lever operated quarter turn, brass ball, PTFE seat, complying to BS 2872 & 2874, threads to BS 21 with hose adapter.

E. Ball Valves:

1. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.

F. Swing Check Valves:

1. Provide valves of bronze, regrinding, with seating angle 40° to 45°, unless composition disc is specified.

2. Provide stop plug as renewable stop for disc hanger, unless otherwise specified.

3. Provide disc and hanger as separate parts, with disc free to rotate.

4. Provide support hanger pins on both ends by removable side plugs.

5. Threaded Ends 50mm and Smaller: Nominal pressure PN 32, Series A, bronze body, screwed cap, horizontal swing, bronze disc, complying with BS 5154, threads to BS 21.

6. Flanged ends 65mm and larger: Nominal pressure PN16 iron body bronze trim, bolted cap resilient seated, horizontal swing, cast iron disc, complying with BS 5153, flanges to BS 4504.

G. Lift Check Valves:

1. General: Provide lift check valves, constructed of bronze or cast iron to suit service. Select valves of temperature/pressure rating (PN) to match operating conditions and with pressure containing parts of materials having at least physical properties of BS 1400 for bronze and BS 1452, grade 220 for cast iron valves. Castings shall be free of any impregnating materials.

a. Horizontal Lift Check Valves: Size to 50mm, straight pattern, threaded ends, pressure rated for 10 Bar saturated steam, renewable composition disc, screw-over cap, bronze body, complying with BS5154, Series 13, Threads to BS 21.

b. Vertical Lift Check Valves: Size to 50mm, straight vertical pattern, threaded ends, pressure rated for 10 Bar saturated steam renewable composition disc, screw-in hub, bronze body complying with BS 5154, Series B, threads to BS 21.

c. Spring Loaded Horizontal Lift Check Valves: Size to 50mm straight pattern, threaded ends, pressure rated for 10 Bar saturated steam, renewable composition disc, phosphor bronze wire spring, screw-over cap, bronze body threads to BS 21.

H. Double Regulating Valves:

1. Balancing valves up to size 50mm diameter shall be of bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure readout ports across valve seat area. Read out ports to be fitted with internal EPTA insert and check valve. Valve bodies to have 6mm NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position.

All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak tight at full rated working pressure. All valves to be provided with moulded insulation to permit access for balance and read out.

2. Balancing valves size 65mm diameter and above shall be of heavy duty cast iron flanged construction with flanged connections to BS 4504 suitable up to 175 psi working pressure.

   Valves size 65 and 80mm diameter shall have a brass ball with glass and carbon filled TFE seat rings. Valves size 100mm diameter and above shall be fitted with a bronze seat, replaceable bronze disc with EPDM seat insert and stainless steel stem. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak tight at full rated working pressure. All valves to be provided with moulded insulation to permit access for balance and read out.

I. Butterfly Valves:

1. Butterfly valves shall have cast or ductile iron body with resilient replaceable EPDM seat and shall be of the lugged wafer type, extended neck.

   Disc shall be aluminium bronze or stainless steel. Operator shall be infinite position with memory stop for sizes up to 150mm and gear drive for sizes 200mm diameter and above.

   Pressure rating shall be at 16 bars.

J. Strainers:

1. Strainers shall be full line size located ahead of all pumps and in locations as indicated on drawings. Bodies shall be bronze, screwed body, 'Y' type, up to 50mm size with 37% open mesh Monel or stainless steel metal screen & 1.4mm diameter holes, pressure rating 25 bars.

   For sizes 65mm and above, Iron body, flanged, "Y" type bolted cover flanged, tapped blow-off outlet, 37% open mesh Monel or stainless steel metal screen, with 1.4mm diameter holes, pressure rating 16 bars.

K. Pressure Reducing Valves (PRV)

Pressure reducing valves shall be of the self-contained, direct acting, spring loaded, diaphragm type, with stainless steel filter mesh (0.16mm) around the seat. Replacement of any part must be done without removing the valve body from the pipe. Pressure reducing valve shall be fitted with two pressure gauges.

1. Pressure reducing valve size up to 50mm dia shall have brass body, threaded connections, steel adjustment spring not in contact with water NBR diaphragm and seals, stainless steel or synthetic valve material, set pressure to appear on a set point scale, set pressure to maintain constant even when fluctuation on the inlet side occurs.

   Inlet pressure up to 25 bars.

   Outlet pressure from 1.5 to 6 bars. Pressure gauge shall be connected to the valve.

2. Pressure reducing valves size from 65mm dia and larger shall have cast iron body, flanged, synthetic coating inside and outside (toxically safe)

steel adjustment spring not in contact with water, brass seat,EPDM diaphragm set pressure to maintain constant even when fluctuation on the inlet side occurs. Set pressure to appear on a scale.

Inlet pressure depending on application 16 to 25 bars.

Outlet pressure from 1.5 to 6 bars.

Pressure gauge shall be connected to the valve.

L. Backflow Preventers

1. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013, AWWA C506; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valves which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2. Double Check Valve Assemblies: ANSI/ASSE 1012 AWWA C506; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

M. Air Vents:

1. Provide air vents at high points in installations wherever deemed necessary.

2. Automatic air vents shall have gunmetal or brass bodies, non ferrous or stainless steel floats and guides and non corrodible valves and seats. Each automatic air vent shall be controlled by a lock shield valve. Air release pipes shall be run to discharge at the nearest visible point – to be agreed with the Engineer.

N. Bronze angle pattern relief valve threaded connections to BS 21 fitted with top cover, lever and padlock with 360 – rotation facility. Disk: DZR brass or bronze or gunmetal. Seat housing: DZR brass or bronze. Springs: zinc plated carbon steel rated PN 20.

O. Flexible pump connectors:

1. Flexible connectors shall be used to protect mechanical equipment by relieving piping stresses caused by piping misalignment. Rubber material shall be Neoprene for cover and tube. Flexible connection shall be able to withstand an internal pressure of 10 bars. Size up to 50mm dia shall have galvanized double union ends threaded twin rubber sphere

type. Sizes larger than 50mm dia shall be of the single sphere floating flange type.

2.02 VALVE FEATURES

A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by installation requirements.

1. Bypass: Provide manufacturer's standard bypass piping and valving where indicated on the drawings.

2. Flanged: Valve flanges complying with BS 4504 (cast iron).

3. Threaded: Valve ends complying with BS 3643 (bronze).

4. Solder-Joint: Valve ends complying with BS 864, Part 2.

B. Trim: Valve components sustaining system pressure including stems (shafts) and seats shall be manufactured from bronze materials, of standard alloy recognized in valve manufacturing industry:

1. Non-Metallic Disc: Non-Metallic material selected for service indicated in accordance with manufacturer's published literature.
2. Renewable Seat: Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.

3. Extended Stem: Increase stem length by 50mm minimum, to accommodate insulation applied over valve.

4. Inside Screw, Non-Rising Stem: Stem and hand wheel designed to rotate without rising when valve is operated from closed to open position.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Except as otherwise indicated, comply with the following requirements:

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Applications Subject to Shock: Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.

D. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves in condensate service and in other services where corrosion is indicated or can be expected to occur.

E. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shut off of metal seated valves.

F. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

G. Fluid Control: Except as otherwise indicated, install gate, ball or globe valves complying with the applicable BS. Where throttling is indicated or recognized as principal reason for valve, install globe valves.

H. Install Check Valves where indicated and where flow reversal is obviously not desirable but can be expected to occur.

** END OF SECTION **

SECTION 15250

INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of insulation work is indicated on drawings and schedules and by the requirements of this section.

B. Insulation material shall be applied to the following:

1. Domestic hot and recirculating water piping.

2. Coil condensate drain piping.

3. Hot and cold surfaces of mechanical equipment.

4. Refrigerant piping.

1.02 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of pipe and ductwork insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. General Requirements:

1. Insulating materials shall be selected for use in accordance with, and comply with all applicable requirements of BS 5422 and CP 3005.

2. Material shall be odourless, non-hygroscopic, non-toxic, non-combustible, not decompose, not support fungoid life and not attract vermin or rodent attack. Adhesives shall, additionally, be non-

combustible after application and shall have no detrimental effect if dissolved in potable water.

3. All materials, including fixing and finishing materials shall be rated Grade "P" when tested for ignitability in accordance with BS 476:5.

4. Materials shall be rated "low flammability" as defined in BS 2972.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data on all types of insulation specified hereinafter.

B. Certification: Provide certificates or other data as necessary to show compliance with these specifications and governing regulations. Include proof of

compliance for test of products for fire rating, corrosiveness, and compressive strength.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect insulation against dirt, water and chemical and mechanical damage. Do not install-damaged insulation; remove from project site.

B. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp, or label, affixed showing fire hazard ratings of the products.

C. Store insulation in original wrappings and protect from weather and construction traffic.

PART 2 - PRODUCTS

2.01 PIPING SYSTEM INSULATION

A. Material: Provide glass fibre preformed pipe insulation material wrapped with a vapour barrier jacketing and having the following properties:

1. Thermal Conductivity: 0.032W/m°C at a mean temperature of 25°C.

2. Temperature Limits: -51°C to 232°C.

3. Jacket Permeance: 0.0012 g/MNs.

4. Insulation density: 64 kg/m^3 for domestic hot water piping.

B. Insulation thickness to conform to the following:

1. Domestic Hot and Recirculating Hot Water Piping: Insulation shall be 25mm thick for pipe sizes up to 40mm and 40mm thick for pipe sizes 50mm thru 100mm and 50mm thick for larger pipe sizes. Pipes running in walls or embedded under tiles shall be installed with 9mm thick closed cell elastomeric rubber insulation.

2. Condensate Drain Piping and exposed cold water pipe on roof: Insulation thickness shall be 13mm of closed cell elastomeric rubber insulation, 65 kg/m^3 density.

C. Insulation jacket to be white kraft paper bonded to aluminum foil, reinforced with glass fibre-yarn. The kraft paper shall be permanently treated to assure permanent fire and smoke safety and to prevent corrosion of foil. An adhesive shall be used to seal the insulation jacket. The longitudinal lap of the jacket shall

have a pressure sensitive tape closure system. The tape shall be protected by a strip of release paper which is pulled off prior to application to pressure sensitive tape. Butt strips shall also be furnished in order to totally seal the system.

D. Apply 6 ounce polyester mesh wrap on all completed pipework insulation with 50% overlap, finished with 2 coats of approved fungus resistant mastic such as to form a complete vapour barrier.

E. Insulated fittings shall be covered with one piece PVC insulation fitting covers. Fittings covers to be secured by staples, bands or pressure sensitive tape applied to the ends of adjacent pipe covering. Fittings shall have a maximum temperature rating of 200°C and a thermal conductivity of 0.036 to 0.04 W/m°C at a mean temperature of 38°C.

F. On condensate pipes, longitudinal jacket laps shall be sealed with adhesive and butt joints and wrapped with 75 mm wide strip of jacket material and sealed with adhesive. Fitting cover edges to be sealed with vapour barrier adhesive and circumferential edges to be covered with vapour barrier tape over-lapping a minimum of 50 mm on each side of joint.

G. Cladding: Provide 0.80 mm thick corrosion resistant aluminum sheeting or alternatively resin compound for insulated piping installed in outdoor locations, fan rooms, mechanical rooms, and exposed runs in areas with no suspended ceiling. Provide two coats of waterproof sealing mastic for runs in outdoor locations. Cladding shall be fixed with self-tapping stainless steel screws, with all necessary accessories.

H. Refrigerant pipes shall be thermally insulated with moulded factory shape sectional pipe covering closed cell elastomeric foam rubber insulation with density 65-80 kg/m^3 having a thermal conductivity factor of 0.037 W/m.k at 20 deg. C and 0.040 W/m. K at 40 deg. C.

1. Insulation thickness shall be 13mm or 19 mm as recommended by supplier.

2. Insulate and finish valves and fittings in the same manner and same thickness as piping in which such items are installed.

3. External refrigerant pipe insulation shall be covered with 20 x 20 woven glass cloth cover. The cloth cover shall be protected and coated with two coats of waterproof sealant.

2.02

2.03 ACOUSTIC INSULATION

A. All low pressure ductwork shall be lined with acoustic insulations up to the first take off point, or 3 meters from the fan/unit outlet

B. Duct acoustic lining shall be 25mm thick, fiberglass, 24 kg/m^3 density with a thermal conductivity of 0.035 Watts/m/deg C with approved coating on inside

C. Liner will be attached by a fire resistant adhesive such as Benjamin Foster 81-99, or equivalent. In addition, mechanical fasteners shall be used on 400mm centres on top and side sections. These fasteners must be spot-welded to the inside to the duct and must not perforate the duct.

D. All abutting edges must be caulked and at the extremities of lining shall have a sheet metal nosing of at least 40mm length.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the substrate and the conditions under which insulation is to be installed and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer and shall be witnessed by a third party approved inspection company.

3.02 GENERAL APPLICATION REQUIREMENTS

A. Where external surface temperature of equipment is indicted to be below ambient temperature in the space (for any phase of operation), and including

surfaces which have a recognized possibility for condensation (sweating), insulate and apply jacket and vapour seal on equipment.

3.03 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapour-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation, as applied to adjoining pipe run. Install factory moulded, precut or job fabricated units (at Contractor's option) except where a specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

I. In addition to the insulation specified above, pipes that are exposed in traffic areas such as mechanical rooms and pipes exposed to outdoor conditions such as those installed on roofs shall be cladded with aluminium sheets. Cladding shall be strapped at not more than 400mm on centres.

J. Pipe Hanger Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 75mm wide vapour barrier tape or band

over the butt joints. For cold piping apply wet coat of vapour barrier lap cement on butt joints and seal joints with 75mm wide vapour barrier tape or band.

3.05 PROTECTION AND REPLACEMENT

A. Replace damaged insulation, which cannot be repaired satisfactorily, including units with vapour barrier damage and moisture saturated units.

B. Protect insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 15400

PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The extent of plumbing fixtures and equipment work is indicated on the drawings and by the requirements of this section.

B. The types of fixtures and equipment required for the project include but are not limited to the following:

1. Floor Drains
2. Cleanouts for Pipes
3. Hot Water Generators (Storage type) (EWH).
4. Water closet, European
5. Lavatories

1.02 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of plumbing fixtures and equipment of the types, styles and configurations required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data for the plumbing fixtures and equipment including rough-in drawings, templates, instructions and directions for installation of water and drain piping.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver fixtures individually wrapped in factory-fabricated fibreboard type containers or wooden crates.

B. Handle fixtures carefully to prevent breakage, chipping, denting, and scoring items; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise indicated, provides manufacturer's standard materials and components as indicated by published product information and as required for

a complete installation. All exposed pipes, fittings and accessories shall be chrome plated. Plumbing fixtures design, style and shape shall be subject to approval by the Engineer.

2.02 PLUMBING FIXTURES AND EQUIPMENT

A. Floor Drains:

1. Floor Drain: Shall be made of UPVC material. Shall have one vertical outlet of 50 mm diameter. Strainer shall be made of chrome plated cast brass or plastic material.

B. Cleanout: Cleanouts on concealed piping shall be extended through and terminate flush with finished wall or floor pits or chaps may be left in the wall or floor, provided they are of sufficient size to permit removal of the cleanout plug and proper cleaning of the system. Where it is necessary to conceal a cleanout plug a chrome plated brass cover plate or plastic plate or stainless steel as required for each building shall be provided which will permit ready access to the plug. Cleanouts shall be of the same nominal size as the pipes up to 100 mm diameter and not less than 100 mm for larger piping.

D. Electric Water Heater:

1. Hot water heaters shall be horizontal type installed above false ceiling shown on drawings. Heaters shall be fitted with immersion heater to give the maximum output kW. Vessel shall be constructed of thick steel pressure tested at 12 bars. Vessel shall be glass-lined with titanium or magnesium anode protection. Entire vessel and electrical controls shall be engaged in a rectangular or cylindrical sheet metal enclosure with baked enamel finish. Tank shall be insulated with minimum 25 mm injected polyurethane (0% CFC). Enclosure shall have hinged locking doors over electric controls. Heating elements shall be complete with prewired terminal leads, control with circuits, master pilot switch, etc. A thermostatic control of contacts shall be provided to balance the water heating input to the actual demand. (Five-year warranty shall be provided). A safety valve shall be provided at cold water inlet. Electric Heating Coil capacity and storage capacity as shown on drawings.

2. Quality Assurance:

a. Manufacturers: Firms regularly engaged in the manufacturer of water heaters of the types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

b. Comply with National Electrical Code (NFPA 70) or equivalent as applicable to installation and connection of electric water heaters.

c. Provide water heaters and safety relief valves complying with ASME Code or equivalent and stamped with appropriate code

symbols.

3. Product Delivery, Storage and Handling:

   a. Handle water heaters carefully to prevent external and internal component damage, breakage, denting and scoring enclosure finish. Do not install damaged water heaters; either replace damaged components or return water heater to factory for replacement.

   b. Store water heaters in a clean dry place. Protect water heaters from weather, dirt, fumes, water construction debris and physical damage.

4. Installation:

   a. Install water heaters where shown, in accordance with equipment manufacturer's written instruction, and with recognized industry practices, to ensure that water heaters comply with requirements and serve intended purposes. Comply with requirements of local codes and applicable NFPA and ASME Boiler sand Pressure Vessel Codes and Standards.

   b. Coordinate with other work (plumbing, piping) as necessary to interface installation of water heaters with other components of system.

E. Water Closets:

1. European Water Closet: Water closet shall be wall mounted type, made of heavy duty vitreous china. It shall be provided with built-in "P" trap, plastic seat, brass holding bolts, washers, nuts, china caps. The unit shall come with the following trim and accessories.

   Concealed flushing cistern 4.5-9 lit., interruptible flush cycle made of sound-insulating EPS module for masonry-in, removable front plate for inspection, WC fixing bolts, PE outlet bend DN 80, reducing piece Ø80/100mm, 15mm chrome plated angle valve.
   Unit shall be insulated against condensation.

F. Lavatories:

2. European Lavatory: Lavatory shall be made of heavy duty white colored vitreous china. It shall have an oval shape for fixing into countertop, size to suit dimensions shown on drawings. with self-closing basin mixer with mixing device similar to GROHE CONTROMIX P

It shall come with the following trim and accessories:

Fixation set kit.

15 mm chrome plated mixer with mousseur.

15 mm chrome plated angle valves with blue and red indices.

32 mm chrome plated P-trap.

32 mm chrome plated pop-up waste set.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall examine the installation of domestic water and soil piping stubs and terminations to verify actual locations, and shall examine areas and conditions under which plumbing fixtures shall be installed. Water or drain pipes (connected with the fixtures) found to be wrongly installed, shall be corrected before installing fixtures.

3.02 INSTALLATION

A. General: Install plumbing fixtures and equipment in accordance with manufacturer's written instructions and in accordance with the applicable regulation and recognized industry practices to insure that products serve the intended function.

B. Coordinate with other work, including water and drain piping as necessary to interface installation of plumbing fixtures, properly with other work.

3.03 SUPPORTS

A. All fixtures and equipment shall be mounted level, sure, rigid and flush with wall or floor as required.

B. Drill holes carefully to avoid chipping block or tile.

C. All supports shall be concealed unless noted otherwise.

D. Furnish and set all hangers, supports, brackets, etc., for proper installation of all fixtures and equipment. Supports shall be in accordance with recommendations of fixture manufacturer, and if built into partitions or walls, shall be set as wall construction progresses. Contractor shall be responsible for stability of all fixtures and furnishing all chair carriers or other materials necessary to accomplish this. Exact mounting height shall be as approved by the Engineer.

E. If not factory primed or coated, prime all concealed supports with one coat of rust-resistant primer.

3.04 FIXTURES

A. Locate, place, level and secure all plumbing fixtures and trim specified in this Section and make all connections to drainage system, hot water supply system, and cold water supply system.

B. Make adequately sized connections to all supply lines and drains and make all required reductions and increases in pipe or tubing size as required to make connections to faucets, P-traps, and piping systems.

C. Water supplies to all fixtures shall be valved at fixture.

D. All fixtures shall be left thoroughly clean and free from all marks and foreign substances.

E. Place and install basins and seal around edges with suitable silicone sealant.

F. Contractor shall replace all leaky faucets and valves prior to final inspection.

G. Adjust all flush valves for quiet operation, minimum pressure required to cleanse bowls, and period of flush.

H. All faucets shall have visible indices. All trim shall be permanently stamped with manufacturer's identification clearly visible after installation.

I. Caulk around all fixtures and adjacent surfaces with a white silicone sealant, fungicidal type.

** END OF SECTION **

SECTION 15500

FIRE FIGHTING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Extent of Work: The extent of the fire fighting systems work is indicated on the drawings and defined in these specifications, and includes (but not necessarily limited to) the following:

1. Hose reel cabinets.
2. Portable fire extinguishers.

1.02 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of fire protection materials and equipment of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. Spare parts for the fire protection equipment shall be readily available locally.

B. Specialist Sub-Contractor: A firm with at least 5 years of successful installation experience on projects with fire protection systems similar to that for this project.

C. Design and Approvals: The design, layout and installation details shall conform to the drawings and as stated herein. The Contractor shall make detail shop drawings and obtain approval from the Engineer.

D. Local Fire Service Headquarters: Comply with governing regulations pertaining to fire protection systems.

E. Certificate of Installation: Submit certificate upon completion of fire protection systems work stating that the work has been completed and tested in accordance

with Fire Service Headquarters requirements and that there are no defects in the system and it is operational.

F. Fire Protection Devices: Fire protection devices shall meet the requirements of the NFPA and should conform to British Standard 5423.

1.03 SUBMITTALS

A. Submit manufacturer's data of fire protection system equipment and accessories.

B. Operating and maintenance instruction for equipment and systems.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portable Fire Extinguisher-(Type FE-2): 4.5 kg Carbon dioxide type. The unit shall have a steel painted in black body, pull in squeeze handle and a double braided hose and a non-conducting discharge horn.

B. Portable Fire Extinguisher (Type FE-1): 6 kg capacity ABC multi-purpose dry chemical, enameled steel container with pressure-indicating gage, for Classes A, B, and C fires. Provide manufacturer's standard mounting brackets for above extinguishers.

C. Hose Reel Cabinets (FHC-1): Cabinets shall be of two compartments type and be made from 1 mm thick steel all welded construction. Surface mounted (exposed) cabinets shall be provided with an inner lip approximately 20 mm wide all around the front opening for strength. Recessed mounted cabinets shall be provided with a 25 mm wall flange. Cabinet doors shall have continuous stainless steel hinge (brass) and shall have Georgian glass front sized for maximum visibility of entire contents. Each cabinet shall house a hose reel, and a 6Kg ABC dry chemical extinguisher type FE-1. Size of cabinets shall be such that the inner space accommodates the specified components. The cabinet space shall allow for easy swinging of the hose reel out of the cabinet. Cabinet door hinge shall allow 180˚ door swing so as not to offer any obstruction to the hose being run out in either direction. A decal fixed to the door glass should bear the words "FIRE HOSE REEL" in red letters in accordance with BS 5306. Finish of cabinets internal and external surfaces shall be in baked red enamel.

E. Hose Reels: Furnish and install Hose Reels where indicated. Hose Reels shall be in accordance with BS 5274 "Fire Hose Reels for Fixed Installations" 1976. The Reel shall contain a 30-meter-long synthetic jacket hose to BS 6391: 1983. The Hoses shall be 25 mm dia. The Hose Reel shall turn on automatically when 1.5 - 1.8 meters of Hose is withdrawn from the Reel. The control valve shall consist of a diecast non-ferrous alloy housing with machined waterway, precision machined valves and 40 mm screwed inlet. Hydraulic sealing shall be by means of "O" Ring Seals. The side plates shall be 559 mm diameter pressed steel finished in red stove enamel. The guide arm shall be of all purpose pattern to allow operation in any location. The nozzle shall be a high impact plastic Shut

Off Nozzle. The Hose Reel shall be tested to 20 bar. The Hose Reel shall be of the swinging type. Hose racks may be submitted as an alternative subject to the approval of local fire authority.

F. Hose Reel Cabinets (FHC-2): similar to FHC-1 but surface mounted type.

G. Siamese Connection Assembly: Shall be installed for the use of Fire Brigade, as shown on the drawings. The Siamese connection assembly shall be gunmetal with two inlets. Each inlet shall consist of a 65mm instantaneous female coupling and a non-return valve and protected with a cap secured by a suitable length of chain. The Cooping shall conform to BS 336. The Siamese connection assembly shall have 100mm dia flanged outlet for attachment to the wet main. The Siamese connection shall be finished with red color paint. The Siamese connection assembly shall be located 760mm above ground level. The Siamese connection assembly shall be UL listed and FM approved.

H. Mounting Brackets: Provide manufacturer's standard bracket designed to prevent accidental dislodgement of extinguishers, or proper size for type and capacity of extinguisher indicated, in manufacturer's standard plate finish.

PART 3 - EXECUTION

3.01 INSTALLATION OF FIRE PROTECTION SYSTEMS

A. Portable Fire Extinguishers: Provide fire extinguishers of the type and at the locations indicated based on the area fire protection requirements.

END OF SECTION

SECTION 15764

SPLIT AIR CONDITIONERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The extent of split room air-conditioners work is indicated by requirements of this section. Units are hereby defined to include, but not by way of limitation,

refrigeration compressors, direct-expansion coils, filters, fans, and air-cooled condensers.

B. The types of split air-conditioning units required for project include the following:

1. Split air conditioner.
2. 4 ways cassette.

1.02 QUALITY ASSURANCE

A. Manufacturer's: Firms regularly engaged in manufacture of air-conditioners, of types, sizes and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Guarantee: Air conditioning units shall include a one (1) year warranty on all parts and labor after acceptance by the Engineer. Additionally, they shall include a five (5) year parts warranty on motor compressor units.

C. NFPA Compliance: Comply with the applicable provisions of NFPA Stds. 70, 90A and 90B, pertaining to construction and installation of self-contained air conditioning units, or applicable BS standard.

D. Flame-Smoke Rating: Except as otherwise indicated, provide self-contained air conditioning unit thermal insulation with flame-spread rating of 25 or less, fuel-contributed of 50 or less, and smoke-developed rating of 50 or less.

E. AMCA Standards: Comply with Air Movement and Control Association standards as applicable to testing and rating fans, or applicable BS standard.

F. ARI Certification: Provide air conditioning units which comply with Air Conditioning and Refrigeration Institute standards 210 and 270, ARI 310 and display ARI's certification symbol, or equivalent international certification.

G. UL Compliance: Provide air conditioning units whose electrical components have been listed and labeled by Underwriters Laboratories.

H. ANSI/ASHRAE Compliance: Comply with installation requirements of ANSI/ASHRAE 15: "Safety Code for Mechanical Refrigeration," ANSI/ARI 310, and ASHRAE Standard 90-75 Section 6.3.

I. Instruction of Personnel: At completion of the work, the Contractor shall furnish a competent service man to instruct Client's personnel in the proper operation and maintenance procedures to be followed. The instruction shall be given for a total of five (5) full working days; not including time spent trouble-shooting and adjusting the system as required by this Contract. At Client's option the

instruction period may be postponed in part or in whole until a later period within the year following the completion of the Work.

1.03 SUBMITTALS

A. Submit manufacturer's data on packaged air-conditioning units, including drawings showing overall dimensions of unit, operating weights, and auxiliary equipment.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air conditioning units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle air conditioning units carefully to avoid damage to components, enclosures, and finish. Do not install-damaged components; replace and return damaged components to air conditioning unit manufacturer.

C. Store air conditioning units in clear dry place and protect from weather and construction traffic.

PART 2 - PRODUCTS

2.01 SPLIT ROOM HEAT PUMP AIR CONDITIONERS

A. Condensing Unit: To be suitable for operation in 44°C ambient temperature air cooled, horizontal or vertical air discharge type as indicated on drawings, comprising a compressor, condenser coil, condenser fan and motor, refrigerant receiver, charging valve and controls, four-way reversing valve, electric heating element, assembled in a common casing. Unit to be tested at factory and supplied complete with refrigerant and dehydrated compressor oil.

B. Compressor: Sealed, hermetic type, mounted on external spring isolators, with crankcase heater and in-built thermal overload protection.

C. Condenser Coil: Heavy gauge seamless copper tubes mechanically bonded to aluminum plate fins corrosion protected with protective coating. Condensers shall be precoated with a tough abrasion resistant epoxy coating. It is to be circuited for sub-cooling.

D. Condenser Fan and Motor: Fan to be propeller type, weatherproofed, statically and dynamically balanced, directly driven by a totally enclosed, permanently lubricated, resiliently mounted electric motor, with Class F insulation and in-built thermal overload protection.

E. Condensing Unit Casing: Heavy gauge galvanized steel, zinc phosphatized and finished with baked enamel, fully weatherproofed for outdoor installation. Casing is to have openings for power and refrigerant connections and removable

panels for easy access to internal components. Control panel is to have a hinged access door.

F. Condensing Unit Controls: To be factory wired and tested. They are to include high and low pressure switches, compressor overload device, positive acting timer to prevent short cycling of compressor on power interruption, crankcase heater, condenser fan contactors and circuit breakers.

G. Evaporator Unit: Wall hung, floor mounted or ceiling as indicated.

Evaporator Unit is to consist of DX coil, one or more centrifugal fans, electric motor, and condensate drain pan, galvanized steel casing panels, filter, electric junction box and fan switch.

H. Evaporator Coil: Staggered 12mm O.D. heavy wall seamless copper tubes mechanically bonded to aluminum fins, with 16mm solder joint copper tube connections and manual air vent. Coil is to be leak tested at factory to 2352 KPa minimum air pressure under water.

I. Evaporator Unit Casing: Decorative or cabinet type as indicated on the drawings, 18 gauges galvanized steel sheet braced and reinforced for maximum rigidity, thermally and acoustically insulated with fiberglass blankets fastened with waterproof adhesive.

J. Evaporator Fans: Centrifugal, forward curved, non-overloading type, directly connected to fan motor for decorative mini-split units and belt driver for large cabinet units, statically and dynamically balanced and designed for whisper quiet operation. Materials are to be high strength and corrosion resistant.

K. Evaporator Motor: Shaded pole, 3-speed type for mini-split units, with built in thermal overload protection and bronze sleeve type bearings with oil reservoirs. Motor to be resiliently mounted.

L. Evaporator Condensate Drain Pan: 18 gauge galvanized steel, projecting under entire length and width of coil including headers and return bends, valves and fittings. Pan is to be treated against corrosion, insulated and pitched for positive drainage and unit installed level.

M. Evaporator Fan Switch for mini-split units: 3-speed with "OFF" provided with each unit from factory, decorative wall plate remote type, or incorporated in console type units.

PART 3 - EXECUTION

3.01 INSPECTION

A. Contractor shall examine areas and conditions under which air-conditioning units are to be installed and notify the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to

the Engineer.

3.02 INSTALLATION OF SPLIT ROOM AIR CONDITIONING UNITS

A. Install split room air conditioning units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including electrical work as necessary to interface installation of self-contained air-conditioning units with other work.

C. Condensate shall be drained to the outside or as indicated on plans.

3.03 GROUNDING

A. Provide positive equipment ground for self-contained air-conditioning unit components.

3.04 TESTING

A. Upon completion of installation of packaged air conditioners, start-up and test equipment in accordance with ARI standards, or equivalent BS standard, operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Work: The extent of test-adjust-balance (TAB) work is indicated by the requirements of this section, and is defined to include, but is not necessarily limited to air distribution systems, steam, hydronic distribution systems and associated equipment, and apparatus of AC work. The work consists of setting velocity and volume (flow), adjusting facilities provided for the system, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the work as required by the contract documents.

B. The components of testing, adjusting and balancing specified in this section include the following as applied to HVAC/Plumbing/Mechanical services equipment:

1. Air Conditioning Units.
2. Piping Systems.

1.02 QUALITY ASSURANCE

A. Staff: Provide appropriate and experienced staff for the test-adjust-balance of the systems, preferably a specialist independent commissioning company with at least five years of proven experience in TAB work.

B. Codes and Standards: comply with the applicable requirements of the following Codes and Standards:

1. NEBB Compliance: Comply with NEBB's "Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems" as applicable to HVAC air and hydronic distribution systems and associated equipment and apparatus.
2. AABC Compliance: Comply with AABC's Publication No. 12173, "National Standards for Field Measurements and Instrumentation, Total System Balance", as applicable to HVAC air and hydronic distribution system and associated equipment and apparatus.
3. Industry Standards: Comply with CIBSE or ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.
4. Comply with local codes / regulations for testing / certification of

systems/components.

1.03 SUBMITTALS

A. Submit method statements in advance for approval of each system to be tested.

B. Submit certified test report signed by the Test and Balance Supervisor who performed the TAB work. In addition, have the report certified by the Professional Engineer who is familiar with TAB work and also with the project and who is registered in the jurisdiction where the test is conducted.

C. Include identification and types of instruments used and their most recent calibration date with submission of final test report.

D. Submit biographical data on engineer, who is to directly supervise the test, adjust and balance work.

1.04 JOB CONDITIONS

A. Do not proceed with testing, adjusting and balancing work until the work to be TAB'ed has been completed and is operable. Ensure that there is no latent residual work still to be completed.

B. Do not proceed until the work scheduled for TAB'ing is clean and free from debris, dirt and discarded building materials.

PART 2 - PRODUCTS

2.01 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used for patching holes in insulation, ductwork and housing which have been cut or drilled for test

purposes, including access for test instruments, attaching jigs and similar purposes.

B. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

C. Refer to other sections for patching of holes in insulation, ductwork, and housings which have been cut or drilled for test purposes. In each case, patching shall be completed by the original Installer.

2.02 TEST INSTRUMENTS

A. Utilize test instruments and equipment for the TAB work required, of the type, precision and capacity as recommended in the following TAB standards:

1. NEBB's Procedural Standard for Testing-Adjusting-Balancing of Environmental Systems.

2. AABC's National Standard for Field Measurements and Instrumentation, Total Balance System.

3. BS 4718 - Testing Code for noise level.

PART 3 - EXECUTION

3.01 TESTING

A. Tester shall examine the installed work and conditions under which testing shall be done to ensure that work has been completed, cleaned and is operable, and notify the Engineer in writing of conditions detrimental to the proper completion of the test-adjust-balance work. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to the Tester.

B. Test, Adjust and balance the environmental systems and components, as indicated, in accordance with the procedures outlined in the applicable standards.

C. Test, adjust and balance systems during the summer for air conditioning systems and during winter for heating systems including at least a period of operation at outside conditions within 4^0C wet bulb temperature of maximum summer design condition and within 6^0C dry bulb temperature of minimum winter design condition specified previously. When seasonal operation does not permit measuring the final temperature reading then take the final temperature readings when the seasonal operation does permit.

D. Prepare report of test results including instrumentation calibration reports, in format recommended by the applicable standards.

E. Patch holes in insulation, duct work and housings, which have been cut or drilled for test purposes, in a manner recommended by the original installer.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers and similar controls and devices, to show final settings

at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

G. Prepare a report of recommendations for correcting unsatisfactory HVAC performances when systems can not be successfully balanced; including, where necessary, modifications which exceed requirements of the contract documents for HVAC work.

H. Test all Mechanical Services/Plumbing components to demonstrate its satisfactory operation for the intended use and to meet capacities/other requirements.

I. Retest, adjust and balance system subsequent to significant system modifications and resubmit test results.

END OF SECTION

SECTION 16000

ELECTRICAL - GENERAL PROVISIONS

PART 1 - GENERAL

1.01 EXAMINATION

A. Examine conditions at the job site where electrical work is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

1.011 SCOPE OF WORK

A. This Specification covers the methods, materials and standards that shall be used for the general electrical installations of the Building Works

1.02 EXTENT OF WORK

A. The extent of the electrical works includes the supply of materials and equipment, delivery to site, labor, installation, testing and commissioning of all electrical services as detailed or referred to in these specifications and/or shown on the drawings, including all other associated work such as supporting structure and ancillary works, attendance, etc., and the like.

B. All equipment and/or accessories not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary for the proper and normal operations of the various systems shall be included.

C. Without restricting the generality of the foregoing, the electrical installation of the project includes the supply and installation and testing of the equipment and materials detailed in the following specification sections:

1. Equipment Electrical Connections
2. Electrical Raceway Systems (conduits, trays, trunking).
3. Wires and Cables.
4. Wiring Devices.
5. Electric Motors.
6. Distribution Boards.
7. Earthing and Earth Fault Protection and lighting system
8. Lighting Control System
9. Interior Lighting.
10. Fire Alarm and Detection Systems.
11. Telephone/Computer Data systems.
12. Generators.
13. Transformer
14. CCTV system
15. Central emergency lighting system

D. The Contractor shall carry out a thorough inspection of all items of electrical equipment for damage prior to locating the equipment and proceeding with the electrical installation

E. No variation shall be permitted without the written consent of the Engineer, who shall reserve the right to request the substitution of the correct materials and/or equipment.

F. The Contractor shall be responsible for the full protection of all materials supplied to him, or handed to him by others, for incorporating in the works against damage or loss until the works are handed over to the Engineer.

G. Unless specifically waived in each instance, testing procedures shall be performed in the presence of the Engineer.

H. Materials and devices shall be inspected prior to installation by the Engineer as part of the work of this section before and after installation to ensure that they are of the quality and type specified herein, free of manufacturing defects and subsequent damage, and that they have been installed in the proper manner.

I. In all aspects the quality of equipment and documentation shall be governed by BS 5750 Quality Systems.

1.03 CODES AND STANDARDS

A. All materials and equipment used in electrical installations shall comply as a minimum with the latest relevant recommendation(s) or specification(s) of the GCC. In the absence of such recommendation(s) or specification(s) all such materials shall comply with the latest recommendation(s) or specification(s) of the International Electro-Technical Commission (IEC) and if these are not available to the latest relevant British Standard Specification(s) (BSS). If standards mentioned above contradict with the specification then the requirements of this specification shall apply.

B. Electrical installation shall conform to the latest editions and is to be executed in accordance with the following codes and standards.

1. EDD/R - Regulations of Electrical Installations.
2. IEC 60079 - Electrical Apparatus for Explosive Gas Atmosphere.
3. IEC 60364 - Electrical Installations of Buildings.
4. IEC 60621 - Electrical Installations for outdoor site under heavy conditions.
5. BS 7671 - Requirements for Electrical Installations.

The entire completed electrical installations shall be to the satisfaction of the Engineer.

1.05 SUBMITTALS

A. The Contractor shall submit to the Engineer shop drawings and catalogs for equipment, materials

B. Shop drawings shall be submitted for the following equipment and systems as applicable:

1. Electrical Raceways.
2. Cables and Wires.
3. Distribution Boards.
4. Lighting Fixtures and Lamps.
5. Earthing and Earth Fault Protection & lightning system.
6. Fire Alarm and Detection System.
7. Telephone and Computer System.
8. Generators.
9. CCTV system
10. MATV system
11. Access Control System
12. Public address system
13. Flight information system
14. Central emergency lighting system

.

C. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

D. The Shop Drawings shall show the position, dimensions, scheme, arrangement and fixing of all electrical equipment.

E. The Drawings are not intended to show exact locations of the electrical equipment. The Contractor shall coordinate the electrical installation with other trades and the actual supplied equipment.

F. Verify the exact locations and mounting heights of equipment, lighting fixtures, switches and receptacles prior to installation.

G. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction.

H. A sheet of transparent rigid plastic shall be used to completely cover this chart to prevent damage, all labels and notices shall be engraved in Arabic and English languages.

1.06 COORDINATION WITH OTHER WORKS

A. The electrical installation work must be coordinated with the building work and work of other services. The drawings and specifications shall be carefully examined and information regarding building materials and equipment supplied by others obtained from the respective source to determine the extent, type and location of all wiring required. All holes and openings in slabs and walls which may be required for the passage of electrical conduits, trunking and cables must be determined and information regarding them passed on to building contractors so that they may be provided for at the time of pouring of concrete or construction of walls, breaking of concrete, cutting and patching of the structure shall be limited to a minimum and carried out only after securing the concent of the supervising Engineer.

1.07 SAMPLES

A. Samples of wires, cables, conduits, boxes, switches, sockets, push-buttons and other items shall be submitted for approval before their acceptance for installation. .

1.08 COMMISSIONING

A. The Contractor shall be responsible for satisfying himself as to the correctness of the electrical and mechanical connections to all work supplied and installed by him under the Contract before such work is put into operation.

B. After the connection of power supply to the installations, the Contractor shall commission all sections of the electrical installations and demonstrate to the Engineer or his Representative that the entire electrical installation is in perfect working order. Where equipment of a specialized nature is involved, the Contractor shall, if necessary or requested by the Engineer seek and obtain at his own cost the services of specialist and/or commissioning engineers from the suppliers/manufacturers.

** END OF SECTION **

SECTION 17

WIRES AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work to be performed includes, but is not necessarily limited to, all work involved with the supply and installation of wires and cables and the associated connectors and terminal boards used in electrical power distribution systems.

B. The types of wires and cables required for the project include the following:

1. Low Voltage Cables (600/1000 V & 450/750 V).

a. Single Core PVC insulated cables 450/750V.

b. Multicore XLPE/PVC 600/1000V cables.

1. 400 V, outgoing circuit cables shall be 4-core, XLPE 600/1000-volt grade.

c. Multicore PVC/PVC 600/1000 V cables.

d. Control cables shall be XLPE/SWA/PVC. The number and cross section of cores is to be chosen to suit circuit conditions, but the minimum size shall be 2.5 mm square.

e. Cables supplying 3-phase A.C. motors shall be 4-core XLPE. The fourth core shall be used as the earth conductor, i.e., the black coloured conductor. Green/yellow sleeving should be fitted on this fourth conductor at each end so as to identify it as an earth conductor cable.

f. Fire resistant cable for fire alarm system.

g. Multimode fiber optic cable, 24 strands to allow connection with the local network of the fire alarm system, the BMS, the access control and the data.

1.02 QUALITY ASSURANCE

A. The Contractor is responsible for the quality of all purchased items and as such must develop and submit a supplier Quality Inspection Plan for review. The inspection plan shall cover those items intended for shop inspection and the procedures for carrying out same.

B. Manufacturer: Cables and wires shall be the products of a manufacturer regularly engaged in manufacture of cables and wires of types and sizes required and complying with the requirements of the listed standards and whose products have been in satisfactory use in similar service for not less than 5 years.

C. Codes and Standards: Comply with requirements of the latest edition of the following codes and standards except as herein specified:

1. BSI - British Standard Institution:

BS 5467	Specification for cables with thermo-setting insulation for electricity supply for rated voltages of up to and including 600/1000V and up to and including 1700/3300V.
BS 6004	Specification for PVC insulated cables (non-armoured) for electric power and lighting.
BS 6007	Specification for rubber-insulated cables for electric power and lighting.
BS 6121	Mechanical cable glands
BS 6231	Specification for PVC insulated cables for switchgear and control gear wiring.
BS 6234	Specification for polyethylene insulation and sheath of electric cables.
BS 6346	Specification for PVC Insulated Cables for Electricity Supply.
BS 6360	Specification for conductors in insulated cables and cords.
IEC 60364	Electrical installation of buildings.
IEC 60885	Electrical test methods for electric cables.

1.03 TESTS AND ACCEPTANCE CRITERIA

A. Testing: Prior to energization, cables and wires shall be checked for the following:

1. Continuity of circuitry.

2. Short circuits.

3. Insulation resistance test, including procedure, equipment required (such as 500V megger) and acceptable values for resistance in accordance with recognized standards.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data including specifications, installation instructions, dimensions and general recommendations for each type of cable.

B. Shop Drawings: Submit dimensioned drawings of cables routing showing accurately layouts of cables installation and their spatial relationship to associated equipment and details of installation.

PART 2 - PRODUCTS

2.01 GENERAL

A. Wires: All wires used in the lighting and small power installation shall be as indicated on the schedule of points. The minimum size shall be 2.5 mm5 except low voltage switching control wires. The identification of final sub-circuit conductors shall be by colour coding. The phases, neutral and earth conductors shall have the following colour coding:

R Phase	:	RED
Y Phase	:	YELLOW
B Phase	:	BLUE
Neutral	:	BLACK
Earth	:	GREEN OR GREEN/YELLOW

B. Cables: Cables installed in this project shall comply fully with the requirements of this specification.

1. Size of Cables: The cables are sized for the prevailing climatic conditions.

2. Cables Routes: The Contractor shall prepare drawings to scale showing the cable routes, type of fixing, placing of brackets. He shall draw up diagrams indicating sizes and types. These drawings shall be submitted to the Engineer.

3. The Contractor shall demonstrate that the proposed cable insulation will not deteriorate in the high ambient temperature in the vicinity of the equipment for which the Contractor shall be deemed to have knowledge.

2.02 MATERIALS

A. Single Core Cables:

1. Single core cable shall be with copper conductors, and PVC insulation 450/750 volt grade, to BS 6004. Cables having insulation of butyl rubber (to BS 6007), silicon rubber (to BS 6007) or other heat resistant cables to the appropriate BS shall be used in the positions and areas as indicated.

2. The core shall be stranded for 4 mm2 and above.

3. The cable shall be coloured throughout the whole length in accordance with the specification and the BS standard.

4. The cable shall be delivered to site with each coil having its seal intact and bearing the name of the manufacturer, classification, size, description of cable, length and grade.

PART 3 - EXECUTION

3.02 INSTALLATION

A. General:

1. All wiring shall be installed in accordance with the applicable provisions of EDD/R-1 Regulations and as indicated on the Drawings. Detailed wiring diagrams including designations, tagging marks, labelling etc., shall be submitted for approval before implementation.

2. The number and sizes of wires and conduits indicated on the drawings are for guidance only. It is the Contractor's responsibility to supply and install the exact number and sizes of wires required by the equipment to be installed and to provide the right size conduits for this number of wires. The Contractor shall install as many wires and conduits as required and necessary for a complete electrical system and shall provide adequately for the equipment actually to be installed at no extra cost.

B. Core Identification: The color identification for multicore P.V.C. cables shall be as follows:

Type of Cable	Colour Identification
Two Core	RED & BLACK
Three Core	a) RED, YELLOW, BLUE; or b) RED, BLACK (Neutral), GREEN/ YELLOW (Earth).

Four Core	RED, YELLOW, BLUE & BLACK or RED, YELLOW, BLUE & GREEN/ YELLOW

The color identification for single core cables shall be as follows:

Phase Conductor RED, YELLOW, BLUE

Neutral Conductor BLACK

Earth Conductor GREEN or GREEN/YELLOW

C. PVC Insulated Cables for Lighting and Power Installation:

1. No conductors small than 2.5 sq.mm shall be used other than for panel control wiring.

2. Flexible cables for heaters shall be of special heat resisting cable (e.g. Butyl rubber) of appropriate cross sectional area.

3. All cables shall be adequately supported and run clear of heating pipe.

4. All cables shall be prevented by spacing, insulation, or other means from coming into contact with water pipes, telephones and bell installed.

5. Under no circumstances will FR cables be run inside metal conduits.

6. Under no circumstances will through joints be allowed in underground FR cables and joints will only be permitted in the FR cables installed in buildings on instruction from the Engineer.

D. Underground cables:

1. Underground armoured cables to be laid in trenches shall be installed as follows except when mentioned otherwise in the electrical drawings:

   a. 150 mm thick of fine sand bed to be maintained below and above the cables.

   b. In all cases approved type of concrete cable tiles to be laid above the armoured cables.

   c. Trench to be backfilled approximately 500 mm.

   d. Warning tape to be positioned prior to final backfilling.

2. Underground cables crossing main roads shall be drawn through PVC ducts of appropriate sizes with concrete envelope. Empty underground ducts for future use shall be provided with draw ropes and properly plugged at both ends. Mandrill of diameter slightly less than the pipe, or duct shall be drawn through.

E. Terminations:

1. Power and control cables shall be terminated to the equipment by using brass glands compression type complete with PVC shrouds and brass earth rings.

2. All the cable gland accessories, reducers, adopters, locknuts etc., shall be of brass only.

3. Terminations of motor leads and main power connections shall be of the compression type. Where this is not possible claw type washers shall be used.

4. Tools for making off the compression joints shall be those recommended by the manufacturer and shall be of the correct size for the lugs and ferrules.

5. Termination of cables to control panels, junction boxes and enclosures shall in all cases terminate in a minimum size terminal block using termination pins with plastic identification markers.

6. At each end of a cable run markers shall be installed for cable identification and should be placed on the inside of the glanding plate, in an easily reached position.

7. Single core cables are to be identified by coloured tape over the cable above the gland.

8. Screened cables shall be so terminated that additional insulating sleeves are fitted over the screen to prevent the possibility of contact with the main conductor.

9. At all termination points the insulation shall be bared so that no exceeding conductor is exposed outside the termination or that bared conductor is not damaged during the stripping operation.

F. Labelling:

1. All controls, push-buttons, switches etc., likely to be operated by personnel in the course of their normal duties shall be permanently labelled. Inscriptions shall be in English/Arabic as per Engineer’s request.

2. All cabinets and boxes shall bear clear external marking of their function and the areas covered.

3. All sub-circuits in distribution boards and fuse boards shall be correctly and clearly labelled in ink or type setting.

   The sub-circuit label diagram attached to the inside of the distribution board cover shall also be marked up to indicate the electrical drawing number of the system being fed from the distribution board.

** END OF SECTION **

SECTION 16163

MAIN DISTRIBUTION BOARD

A. Main distribution boards (MDB) shall be of the free standing cubicle multi-tier type incorporating encapsulated 3 phase and neutral high conductivity shrouded copper busbars, ACB's, MCCB's. change over switch, fuse switches, distribution units, metering panels, all necessary CTs, bus coupler(s) and the like as required. The main distribution equipment shall be equipped with humidistat controlled heaters in each cubicle.

B. MDB's shall be designed to operate on a 220/127V 3 phase and neutral 60 Hz supply and shall have a minimum short circuit rating as indicated on drawings. MDB's shall comply with BS 60439: Part 1 multi-cubicle type FBA form – 4, type 6.

C. MDBs shall be equipped with all-necessary circuit breakers and components as detailed on the drawings.

D. All air circuit breakers shall be triple-pole withdrawable type. They shall have manually operated spring charge closing mechanisms and three dual-magnetic (long time delay for selective tripping). Breakers shall have a push bottom on the escutcheon of the breaker for instantaneous tripping.

E. All circuit breakers shall be temperature compensated at the manufacturer's works to give the current rating indicated on the drawings at 50 deg. C. Non compensated breakers will not be approved. A formal certificate will be required from the manufacturer confirming that the breakers have been suitably temperature compensated. All ACB's/MCCB's shall comply with BSEN 60947-2.

F. The cubicle shall be front operated with a mechanical ON/OFF position indicator and shall be designed and tested in accordance with relevant standards.

G. The cubicle shall be capable of being extended in either direction for further MCCB's as necessary. The panel shall be type test assembly and a certificate confirming the short circuit with stand capacity shall be forwarded.

H. The main incoming supply shall be complete with a flush mounted unbalanced polyphaser kWh meter, an ammeter, CTs, phase to phase voltmeter and power factor meter. Each meter shall have a phase selector switch and indication lamps and set for the main incoming supply.

I. The MDB shall be complete with adjustable gland plates, clamps, cables boxes for the incoming and outgoing circuits. There shall be adequate channel frames, drilled or slotted for ease of assembly, to support cable tails, clamps and terminations within the cubicles. All entries and openings shall be vermin-proof.

All live conductive parts shall be shielded in such a manner that they cannot be accidentally touched when the doors are open.

J. The degree of protection of the MDB enclosure shall comply with BS 5490 and IEC 529 and upgraded to meet the actual protection requirement as dictated by the location at site.

K. Contractor shall provide calculation for the heat generated inside the panel due to its own components and method of heat extraction.

M. The bus bars shall run in a dedicated cubicle with proper access. The neutral busbar shall have the same size as the phase busbar.

**** END OF SECTION ****

SETION 16420

EMERGENCY LIGHTING

PART 1 - GENERAL

1.01 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NEPA)

NFPA 101 (2006) Life Safety Code, 2006 Edition

NFPA 70 (2005; TIA 2005) National Electrical Code

UNDER WRITERS LABORATORIES (UL)

UL 924 (2001; R 2005 e8) Standard for Emergency Lighting and Power Equipment

1.02 GENERAL REQUIREMENTS

Material, Equipment, and fixture Lists shall be submitted showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

1.03 SUBMITTALS

Ministry approval is required for submittals with a "G" designation; submittals not having a "G" designation is for contractor Quality Control approval and for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD -01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted in accordance with paragraph entitled, General Requirements, "of this section.

SD-02 Shop Drawings

Installation drawing shall be submitted for the Central Emergency Lighting System indicating location of installed fixture.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Emergency Lighting Egress Units
Emergency Fluorescent Lighting
Central Emergency Lighting Systems
Accessories

SD-06 Test Reports
Test reports shall be submitted showing result of system
Operational tests for emergency lighting systems.

SD-07 Certificates
Certificates shall be submitted for the following conformance with the referenced
Standards contained in this section.
Emergency Lighting Egress Units
Emergency fluorescent lighting
Central Emergency Lighting Systems Accessories

PART 2 - PRODUCTS

2.01 PRODUCT STANDARDS

Emergency lighting units shall conform to UL 924 and NFPA 101. Emergency lighting units shall be furnished completely with wiring and mounting devices and ready for installation at the locations indicated. Fixtures shall be equipped with lamps.

2.02 EMERGENCY LIGHTING EGRESS UNITS

Emergency lighting units shall be complete self-contained units with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, indicator lights, on /off switch, and test switch, in accordance with UL 924 for TYPE I (emergency light set), Class I (rechargeable storage battery-powered unit) or style D (non-refillable nickel-cadmium battery), as indicated.

Batteries shall be rated not less 12 volts.

Battery charger shall include a dry-type full-wave rectifier with two charging rates, one to automatically maintain the battery in a fully charged state under normal conditions and the other to automatically recharge the battery to a fully charged state within 12 hours after continuous discharge of 1 ½ hours though the connected lamp load.

Batteries shall have capacity and rating to supply the lamp load with maintained 87.5 percent power, minimum, for 1.5 hours, or the battery-lamp combination shall maintain 60 percent, minimum, illumination. Batteries shall be maintenance-free nickel cadmium type. Minimum normal life shall be 10 years.

Unit enclosure shall be fabricated from sheet steel not less than 1.3 millimeter. Cover shall provide access to the battery and battery-charger compartments and

shall have a full-length piano hinge and a latching device. Component parts within the enclosure shall be protected from dust, moisture, and oxidizing fumes from the battery. Interior surfaces of enclosure shall be coated with a corrosion-resistant gray baked-enamel finish.

Lamp heads shall be mounted on the top or wall mounted, of the unit enclosure except where otherwise indicated and shall be fully adjustable in the horizontal and vertical planes. The lamp head mounting assembly shall be steel construction with nickel or chromium plating. Exterior housing of the lamp shall be formed from nickel or cadmium-plated sheet steel.

Lamp shall be the sealed-beam type halogen, rated not less than 12 watts at the specified dc voltage.

An amber "ready-for-use on alternating current" indicating light, a red "recharging on alternating current indicating light, and a momentary-contact pushbutton test switch shall be mounted on the cover of the unit enclosure. The amber indicating light shall indicate, when illuminated, that the unit is electrically connected to the normal ac supply source and that the battery is fully charged. The momentary-contact pushbutton test switch shall transfer unit from normal supply to battery supply and shall test operation of equipment under simulated ac source power failure.

The under-voltage relay shall be the self-clearing type and shall automatically connect the lamp load to the battery supply upon failure of the alternating current supply. An on off toggle switch shall be mounted inside the unit enclosure to disconnect the battery from the lamp load when the units is taken out service for maintenance purposes. The relay shall energize when the ac supply falls to 70 percent of normal voltage.

Emergency lighting units shall be provided with angle iron mounting shelves and with a protective screen designed by the equipment manufacturer for this purpose. The mounting shelf and screen shall be coated with a corrosion-resistant finish in accordance with manufacture's standard practice.

Emergency lighting units shall be suitable for operation on the ac supply circuit to which they are to be electrically connected.

2.03 EMERGENCY FLUORESCENT LIGHTING

Each unit shall have an automatic power failure device, test switch, pilot light, and fully automatic high / low trickle charger in a self-contained solid-state, temperature compensated power-pack. The battery shall be sealed-wet type with capacity as required to supply power to provide a minimum of 6500 lumens per square meter using a 40-watt rapid start lamp. The battery shall be sealed and maintenance-free for a period of not less than 15 years under normal operating conditions.

2.04 CENTRAL EMERGENCY LIGHTING SYSTEMS

A central power system shall provide emergency power at 230 volts, 60 hertz, for a minimum period of 90 minutes. The system shall be designed to handle surges during loss and recovery of the voltage. The system shall deliver its full rated output to designated lamp load. The power source shall be batteries or backup ac source.

2.4.1 Operation

Upon loss of normal supply voltage, the system shall automatically disengage itself from the normal input line, switching to a self-contained inverter with built-in protection when the output is shorted or overloaded. When normal line voltage resumes, the emergency system shall automatically switch back to normal operation. The transfer switch for this function shall be sized to handle 125 percent of full load. Battery systems shall include self-contained inverters with overload protection.

2.4.2 Charger

The battery charger shall be completely automatic, maintaining the batteries in a fully charged condition, and shall recharged the batteries to full capacity within 24-hours after full discharge in accordance with UL 924.

2.4.3 Batteries

The batteries shall be sealed nickel-cadmium type and shall be maintenance-free for a period of not less than 15 years under normal operating conditions.

2.4.4 Accessories

Visual indicators shall be provided to indicate power, inverter power, and battery charger operation. Low-voltage test switches to simulate power failure by interrupting the input line, voltage meter, electrolyte detector to automatically disable the charging circuit in the event of a fault, and law voltage cutoff to prevent extreme battery power dissipation shall be provided.

2.4.5 Enclosure

A free standing cabinet shall be provided with floor stand and shall be constructed of 2.7 millimeter sheet steel with baked-on enamel finish and locking type latch.

PART 3 - EXECUTION

3.01 INSTALLATION

Emergency lighting unit shall be permanently fixed in place and shall have wiring to each unit installed in accordance with NFPA 70 The branch circuit feeding the unit equipment shall be the same panel bus or branch circuit as that serving the normal lighting in the area and shall be connected ahead of area switches. Emergency lighting fixtures that are remotely connected to the emergency lighting unit shall have circuit wiring kept independent of all other wiring and equipment and shall not enter the same conduit, cable, box, or cabinet with other wiring unless the fixture is supplied from two sources.

Mounting heights of emergency lighting units and remote lamps shall be a minimum of 2100 millimeter above the finished floor.

3.02 FIELD TESTING

Emergency lighting units shall be demonstrated to operate satisfactorily in the presence of the contracting officer.

System operational tests shall be performed in accordance with referenced standards in this section.

END OF SECTION

SECTION 16510

INTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work to be performed includes, but is not necessarily limited to supply, installation, connection and testing of all the interior lighting system and lighting control system.

1.02 QUALITY ASSURANCE

A. The Contractor is responsible for the quality of all its purchased items and as such, must develop and submit a Supplier Quality Inspection Plan for review by the Engineer. The inspection plan shall cover those items intended for shop inspection and the procedures for carrying out same.

B. Manufacturer: The components of the interior building lighting and the lighting control system shall be the standard products of a manufacturer regularly engaged in manufacture of such components of types and sizes required and complying with the requirements of the listed standards and whose products have been in satisfactory use in similar service for not less than 5 years, European standards and manufacturers.

C. Codes and Standards: Comply with requirements of the following codes and standards except as herein modified.

1. BSI - British Standard Institution:

BS 4533	Luminaires.
BS 5042	Specification for bayonet lampholders.
BS 5225	Photometric data for luminaires.
BS 5266	Emergency lighting.
BS 5499	Fire safety signs, notices and graphic symbols.
BS 7671	Requirements for Electrical Installations.
BSEN 60238	Specification for Edison screw lamp holders.

2. IEC - International Electrotechnical Commission:

IEC 60238	Edison screw lampholders.
IEC 60598	Luminaires.
IEC 60926	Starting devices (other than glow starters). General and safety requirements.
IEC 60927	Starting devices (other than glow starters). Performance requirements.

1.03 TESTS AND ACCEPTANCE

A. Material Test: Unless requirement is waived, materials shall be tested and manufacturer's test reports certifying that materials meet the requirements of the listed standards shall be submitted.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit following manufacturer's data:

1. Full detailed technical Manufacturer Catalogues showing the type of the fitting proposed, photometric data, rated voltage, max. working temperature, type and size of internal wiring etc.

2. Full technical details of the ballast including manufacturer, type of insulating material, max. temperature rise.

3. Full technical details of the power factor correction capacitor, including manufacturer, voltage, frequency, capacitance, number, integral discharge resistor etc.

4. Sample of each of the proposed lighting fitting to be submitted where requested.

B. Shop Drawings: Submit dimensioned drawings of each luminaire. Submit dimensioned reflected ceiling lighting layout.

PART 2 - PRODUCTS

2.01 GENERAL

A. The types of luminaires for interior lighting required shall include the following:

a. LED Recessed Panel lighting.
b. LED Spot and downlights,

B. The applications of luminaires for interior lighting shall include the following:

a. General lighting.
b. Emergency lights.

C. Luminaires shall be of the type, size and rating indicated on the drawings, complete with, but not necessarily limited to, lamps, lampholders, reflectors, control gear and wiring.

D. Luminaires shall be suitable for trouble free use on 127 Volts, 60 Hertz.

E. Each luminaire shall be protected against environmental conditions in which the luminaire will be installed and shall comply with individual specification of

each type of luminaire described.

F. Wiring: Within the luminaire, the wiring shall not be less than 1.5mm².

1. Wiring insulation within luminaires shall be thermal resistance and flame retardant.

G. Construction:

1. Sheet steel housings used in luminaires shall not be less than 0.6 mm or heavier when required. Sheet steel reflectors shall have a thickness of not less than 0.8 mm. Aluminum reflectors shall have a thickness of not less than 1 mm.

2. All metalwork shall be mitered, welded and smoothed. The metal parts of the luminaire shall be completely free from burrs and tool marks. Solder shall not be used in any part of the luminaire for jointing.

3. Recessed luminaires shall be constructed so that control gear is replaceable without removing housing from ceiling.

H. All luminaires shall be capable of operating continuously in the ambient conditions specified.

Any reduction in performance due to abnormal ambient or operating conditions shall be notified at the time of submittal.

I. All luminaires shall be suitable for mounting on or suspension from a conduit box or mounting to a flat surface and shall be complete with conduit or glanded cable entry facility.

J. All luminaires shall be complete with all necessary lamps, control gear, reflectors, diffusers, baffles or visors to form a complete unit to allow the luminaire to function and produce the photometric performance, in accordance with manufacturers published data and/or that specified herein.

K. The lighting control system shall be centralized at the control room and shall be achieved via contactors in association with lighting panels dedicated to individual floor levels.

2.02 LUMINAIRES

A. The luminaires shall be as specified on Luminaire Schedule drawings, European standards and manufacturers.

2.03 EMERGENCY LIGHTING

A. Self-contained emergency lights, suitable for use on 230 volts, 50 Hz current and shall consist of:

1. Battery with a capacity of at least 3 hours for operation in case of power failure.

2. Automatically controlled, solid-state, two-rate charger.

3. A transfer relay.

4. Switch for controlling the lamp circuit.

5. Signals to indicate when the lamp circuit is in position to provide emergency protection, and to indicate high-charge rate.

6. Test switch for testing the lamps and battery.

7. One (1) 8W tube or as appropriate.

8. Appropriate indication and arrow or exit lights.

Nickel cadmium battery.

10. Exit sign shall be in Arabic and English.

2.05 CONTROL GEAR

2.06 LIGHTING CONTROL

The lighting control panels shall include contactors, selector switches, pilot lamps and any other components necessary for complete installation and functioning.

A. Operating Selector Switch:

The operating selector switch shall include the following:
AUTO: The lighting control is handled by the BMS
MAN: The lighting control is handled manually (manual override)
OFF: The circuit is switched off

PART 3 - EXECUTION

3.01 INSTALLATION STANDARD

A. Internal Luminaires: Luminaires shall be arranged for surface or pendant mounting as required by the general structure and decor of the building. Where a suspended ceiling is provided, recess mounted luminaires shall be fitted unless otherwise specified or noted on the drawings. All conduit boxes for mounting off luminaires shall be metal. PVC boxes shall not be used.

1. Recess Mounted:

   a. All recess mounted luminaires shall preferably be suspended independently of the ceiling in which they are fitted. Where such an arrangement is not possible or practical and the luminaires are to be fitted in and supported by the ceiling, the Contractor shall ensure that the suspended ceiling is suitably strengthened to carry the additional weight.

   b. The connection between the permanent wiring and the luminaire shall be made using a heat resistant flexible cable connected to a 2 amp 3 pin plug and socket, conduit box mounted adjacent to the luminaire and accessible on removal of the luminaire.

   c. The flexible cable shall be three core type, one core being used as the circuit protective and earth bonding conductor. Where the cable forms the connection to a tungsten lamp luminaire it shall be rated for operation at 150°C minimum.

   d. The minimum cross-sectional area of any conductor forming part off a multi-core flexible cable shall be 1 sq. mm.

   e. All recess mounted luminaires shall be designed and fitted to give access for lamp replacement and general maintenance from below, unless otherwise specified.

C. General:

1. Flush mounted recessed luminaires shall be installed so as to completely eliminate light leakage within the luminaire, and between the luminaire and adjacent finished surface.
2. Indoor luminaire positions shown on the drawings shall not be scaled. The Contractor shall coordinate the exact luminaire position with the false ceiling tiles, air outlets and with any other equipment or building details involved.

3. Certain luminaires are shown in provisional position. They shall be exactly located as soon as the final layout of the equipment is known and lay-out submitted for approval to the engineer.

4. Luminaires shall be installed at the indicated heights shown on the drawings or indicated in the specification.

** END OF SECTION **

SECTION 16660

EARTHING AND EARTH FAULT PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work to be performed includes, but is not necessarily limited to, all work involved with the construction and assembly of a complete electrical earthing and bonding system as specified herein.

1.02 QUALITY ASSURANCE

A. The Contractor is responsible for the quality of all its purchased items and as such, must develop and submit a supplier quality inspection plan to review. The inspection plan is to cover those items intended for shop inspection and the procedures for carrying out same.

B. Manufacturer: Components of earthing and earth fault protection shall be the standard products of a manufacturer regularly engaged in manufacture of components of types and sizes required and complying with the requirements of the listed standards and whose products have been in satisfactory use in similar service for not less than 5 years.

C. Codes and Standards: Comply with requirements of the following codes and standards except as herein modified:

1. BSI - British Standard Institution

BS 7430	Code of Practice for Earthing.
BS 7671	Requirements for Electrical Installations.

2. IEC - International Electro Technical Commission

IEC 60364-5-54	Earthing arrangements and protective conductors.

1.03 TESTS AND ACCEPTANCE CRITERIA

A. Earthing system shall be tested to assure mechanical and electrical continuity and compliance with the requirement of the standards. The overall resistance between any point on the earth installation and the general mass of the earth shall be less than 2.0 ohms.

B. Material Test: Unless requirement is waived, materials shall be tested and manufacturer's test reports certifying that materials meet the requirement of the listed standards shall be submitted.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data including specifications, and dimensions for equipment and materials.

B. Shop Drawings: Submit the following:

1. Submit dimension and layout of the exact routing of all main earth loops with indication of cable, bus bar and connector cross-sections.

2. Details of all connectors and mounting details.

3. Details of earthing of switchboards, motor control centers, final distribution boards, motors and various types of equipment.

4. Details of earthing pit.

PART 2 - PRODUCTS

2.01 GENERAL

A. Every means of earthing and every protective conductor shall be selected and erected to satisfy the requirements of the listed standard.

B. All switchboards, motor control centers, motor starter panels, and final distribution boards shall have a copper earth bar to which shall be connected the earth conductor of the equipment.

C. Main equipotential bonding conductors shall connect to the main earthing terminal for that installation extraneous conductive parts including: main water pipes, main gas pipes, other devices pipe and ducting, risers of air conditioning systems, and metallic parts of the building structures.

D. Local supplementary bonding connections shall be made to metal parts where those parts are extraneous conductive parts and are simultaneously accessible with exposed conductive parts or other extraneous parts and where local equipotential bonding is provided Metalwork which may be required to be bonded includes baths, metal pipes, switches and taps.

E. A circuit protective conductor of minimum cross-sectional area 2.5 sq.mm. stranded copper PVC insulated shall be drawn in with every circuit installed in conduit or trucking. The protective conductor and any trucking or tray system, together with the metallic sheathing of all cables, shall be electrically and mechanically solidly bonded with the earthed metal of switchgear, conduit boxes, distribution boards, motors and all other electrical apparatus, fixed/or connected by the Contractor.

F. All apparatus or part thereof not solidly connected to the conduit and cable

system shall be connected in an approved manner by solid copper conductor secured by substantial bonding clamps.

G. The Contractor shall test every complete earth loop circuit comprising cables or cable sheaths and core conductors and these shall comply with the maximum values specified in the standards.

2.02 EARTH ELECTRODES

A. The earth electrode shall be copper weld rod of 20 mm diameter and extensive type. It shall have a spike at one end and driving head at the other. The sectional rods shall be coupled with strong bronze couplers. The coupler shall be threaded to fit the rod section. For driving the rod into the ground threaded steel stud shall be used. A brass clamp of suitable size shall be provided for clamping the earth conductor to the earth rod. The top of earth electrode shall be enclosed in a concrete or brick lined pit with removable concrete or metal cover. Earth electrode shall be connected to its associated earth conductor through a link, which will be mounted above ground in an accessible position and as close as possible to the earth electrode. Each link shall confirm a bolted copper link studs, nuts and washers to take earth conductor and bolted lug for the cable connection to the electrode. The length of the electrode shall not be less than 3 m.

B. A loop type, low impedance, earthing system shall be installed in mechanical rooms, switchboards rooms, interconnecting all non-domestic equipment such that at least two earthing connections are provided for each major equipment.

The loop shall consist of 4 x 25 mm copper tape fixed by brass spacing saddles and brass countersunk screws at 600 mm centers, all through joints being trimmed and riveted. Two opposite points of the loop shall be connected to two separate earth electrodes.

C. The earthing system shall be earthed by sets of earth electrodes. The earth resistance of each electrode shall be measured separately and if not 2 ohms or less, a longer electrode, or sectional electrodes shall be used to obtain approximately double length.

If a 2-ohm resistance is still unobtainable, another similar set of electrodes shall be installed, except that not over six separate electrodes need be installed at one location. Each earth electrode shall be enclosed in a concrete pit covered with an appropriate inspection cover.

The earth resistance shall be measured in normally dry conditions, and not less than 48 hours after rainfall.

D. Switchboards, motor control centers and similar large items of enclosed electrical equipment shall be connected so that the earth bus contained in each item is connected at each end to a different point in the earthing system. The earth bus then becomes a part of the earthing system.

E. An earthing conductor shall be connected between the distribution board and the earthing system. The earthing conductor shall be connected to the earthing bus. The bus shall contain screw terminals to which the earthing conductor of each branch circuit shall be connected.

F. Each branch circuit from a distribution board or other distribution equipment shall contain an insulated earthing conductor which shall be connected to the earthing bus in the distribution equipment, and to the receptacle, fixture, motor or other device, served by the branch circuit. The size of the earthing conductor shall be as required by the applicable standard.

G. Where items require the use of 4 core XLPE/SWA/PVC, or PVC/SWA/PVC cables. The cable armor shall be used as the earth continuity conductor. Earthing system shall be of the radial type.

H. Where cables supply 3 phase A.C. motors they shall be 4 core with the fourth used as the earthing lead and suitably color coded at each end.

I. On motor control centers or switchboards a copper earthing bar having a cross section of 50 x 10 mm will be fitted along the entire length of the board, and this earth bar will be solidly bonded to sub-station earth bar. All outgoing cables from a control center shall be installed such that the earth continuity conductor or associated earth cable is effectively bonded to this main earth bar.

J. Where thermoplastic or PVC conduits or PVC trucking is installed a separate earth protective conductor shall be run inside the enclosure to ensure complete earth continuity throughout the system.

K. Where the protective earth conductor is formed by galvanized steel conduit, trucking or metal ducting, then the earthing arrangements shall be carried out in accordance with EDD/R-1.

L. An instrumentation earth shall be provided adjacent to the main earth bar and connected to it by a removable link.

2.04 ELECTRICAL EARTHING CONDUCTORS:

A. All earthing conductors shall be copper conductor materials only. Materials shall be in conformity with the codes and standards and those specified elsewhere herein for electrical systems. Earthing conductors shall be as follows:

1. Copper tape of minimum size 25 x 4 mm.

2. Soft drawn copper stranded conductors, PVC covered.

3. Insulated copper conductors run in conduits.

2.05 EARTHING CONNECTORS AND DEVICES

A. Connectors and devices used in the earthing systems shall be of copper or bronze materials, and applicable for the use whether specified by manufacturers or otherwise required. All connectors and devices shall be compatible with the surfaces being bonded or shall be suitably surfaced or coated and comply with EDD/R-1.

B. Where steel conduits are not effectively earthed by firm contact with an earthed enclosure, earthing bushings shall be used on at least one end of the conduit run. The bushings shall be designed to screw onto the end of the conduit and have a separate screw type connector for the earthing wire.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All non-current carrying metal parts of electrical equipment and switchboard shall be solidly earthed and complete earth continuity shall be maintained in all parts of the installation conforming to the regulations of the applicable codes.

** END OF SECTION *

SECTION 16721

FIRE ALARM AND DETECTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: The work covered by this specification comprises all materials, installation, labour, services, and all equipment and materials necessary to install, operate, test, and commission, including, but not limited to, the under-mentioned items:

1. Fire alarm control panel.
2. Fire detectors.
3. Fire alarm manual station.
4. Audio/visual fire alarm device.
5. Sitting of control equipment, audio/visual alarm, detectors and fire alarm manual stations.
6. Cabling and wiring.
7. Inspection, testing and commissioning.

1.02 QUALITY ASSURANCE

A. The Contractor is responsible for the quality of all its purchased items and as such, must develop and submit a Supplier Quality inspection plan for review by the Engineer. The inspection plan is to cover those items intended for shop inspection and the procedures for carrying out same.

B. Manufacturer: Fire alarm and detection system shall be the standard products of a manufacturer regularly engaged in manufacture of fire alarm and detection system of type and sizes required and complying with the requirements of the listed standards and whose products have been in satisfactory use in similar service for not less than 5 years and shall be installed by a specialist.

C. Codes and Standards: Comply with the requirements of the following codes and standards, except as herein modified:

1. BSI - British Standard Institution:

BS 5445 Components of automatic fire detectors system.

BS 5446 Components of automatic fire alarm systems for residential purposes. Part 1 Point-type smoke detectors.

BS 5839 Fire Detection and Alarm Systems for Buildings.

BS 7671 Requirements for Electrical Installations.

2. NFPA Standards

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's data on fire alarm and detection systems including, but not limited to, specifications, installation instructions, operation of each component and of the system. Also include standard of typical riser and wiring diagrams.

B. Shop Drawings: Submit shop drawings showing equipment construction, device locations, connecting wiring of the entire fire alarm and detection system, raceway layout, including wiring and riser diagrams.

C. As-Built Drawings:

1. On completion of the installation, adequate instructions on its use shall be supplied to the person responsible for the use of the premises. The Contractor shall draw the attention of the user to the condition of false alarm and servicing.

2. The Contractor shall supply the user with a logbook.

3. As-built drawings shall be provided to the user showing the position of the various items of equipment, junction boxes, etc, and the sizes and routes of all cables and wires. Wiring diagrams of junction boxes and distribution cases and circuit diagrams of the fire alarm system shall be included.

1.04 TESTING AND COMMISSIONING

A. Field Tests:

1. Insulation of Cable and Wires: Insulation testing of installed cables and wires shall be made at 500 Vd.c. and the insulation resistance to earth and between conductors of the installed cables and wires shall be in accordance with the requirements of EDD/R-1.

2. Earthing: Earth continuity and earth-loop impedance shall be tested to ensure compliance with the requirements of EDD/R-1.

3. Commissioning Test: The entire system shall be tested to ensure that it operates satisfactorily and that:

   a. The alarm devices comply with the specifications.

   b. All trigger devices and alarm points function correctly.

   c. All ancillary equipment functions correctly.

   d. Any connections to a fire brigade center operates correctly.

PART 2 - PRODUCTS

2.01 ADDRESSABLE FIRE ALARM CONTROL PANEL

A. Fire Alarm Panel: The addressable fire alarm control panel shall have in addition to the standard features the following ones:

1. Microprocessor controlled.

2. Self-contained and wall mountable.

3. Integral switch mode power supply and battery chargers.

4. 48-hour Ni-Cd battery back-up.

5. Alarm circuits.

6. Twin auxiliary relays configurable for Fire, Fault and/or Warning operation.

7. RS485 Computer communication.

B. Indications:

1. Liquid crystal displays event in Address/form and type of event.

2. Zone indicators indicate any fire off fault conditions and which zone.

3. Buzzers for fire/fault audible indication.

C. User Controls:

1. Essential controls for Fire and Evacuate = Start sounders, stop sounders, Reset.

2. Silence fault buzzer facility.

3. Test for liquid crystal display and zone indicators.

2.02 FIRE ALARM MANUAL STATION

A. The unit shall be of the surface mounted pattern, colored red.

B. The unit shall be capable of flush mounting using a stainless steel surround and adaptor plate.

C. The enclosure shall be suitable for conduit entry from above, below or rear.

D. Terminals shall be provided for normally open or normally closed operation, shall be capable of accepting cable up to a size of 4 sq mm cross sectional area and rated to carry continuously a current of 10 amps at 230 Volts AC or 8 amps at 12/24 Volts DC.

E. The unit shall be inscribed in the Arabic language.

2.03 SMOKE DETECTORS

A. Smoke detectors shall generally be of the surface mounting type suitable for mounting on a pre-wired base, itself mounted on a 51 mm diameter BS conduit box.

B. The enclosure shall be formed of white engineering grade plastic and contacts shall be gold plated brass and/or beryllium.

C. The detectors shall be rated for operation on a DC supply in the range of 16-32 volts with a quiescent supervisory current of 70-150 uA and shall be capable of carrying a continuous alarm current of 80 mA minimum.

D. Local LED indication of operation shall be provided and the facility for connection of a similar remote indication shall be included.

E. Smoke detectors shall be suitable for incorporation in ducted air sampling systems and where such an application is specified the sampling equipment shall form a standard accessory.

F. Smoke detectors shall conform to BS 5445 Part 7 and shall be of the optical type as approved by the Engineer.

G. Optical type:

1. Shall encompass a pulsed light beam and photo sensor so set and housed as to be insensitive to general ambient light level variations.

2. The unit shall be designed to operate on the basis of light scatter due to presence of smoke.

H. For addressable system the detector shall be mounted on an addressable base.

2.05 AUDIBLE ALARMS

A. Audible alarm units shall be sirens or electronic sounders as indicated on the drawings.

B. Audible alarm sounders shall be colored red and shall be inscribed in the Arabic/ English language.

C. The units shall be designed to operate at 230 Volts AC to be compatible with the automatic detection system.

D. Audible alarm sounders shall be designed for surface mounting over a concealed or

surface mounted standard 51 mm BS conduit box, providing back entry connection.

E. All units shall incorporate radio and television interference suppression or be of a design free of generating such interference.

F. Electronically operated sounders shall have the availability of selection of a continuous or warbling note.

G. The minimum sound output shall be not less than 96 dB (A) at 1m.

H. A volume control shall be provided.

PART 3 - EXECUTION

3.01 WIRING

A. The fire alarm system shall be installed using fire retardant cables. Conductor cross sectional area shall be 1.5 sq mm minimum.

B. The installation shall be surface or concealed type in accordance with the general installation standard as specified. Conduit systems used for fire alarm wiring shall not be utilized for any other service.

C. Each monitored fire alarm circuit shall be wired in true parallel configuration. Spur connections shall not be made.

D. Fire alarm accessories shall generally be surface mounted over a standard conduit box, even though the general installation is of recessed pattern.

E. The supply to the fire alarm panel shall be derived from a switch to that service and capable of being locked in the "ON" position. The switch or circuit breaker shall be colored RED and shall be distinctly labelled "FIRE ALARM - DO NOT SWITCH OFF" in the language specified.

F. Joint in a cable shall be enclosed in a suitable and accessible junction box labeled "FIRE ALARM".

G. Cables fixed to surfaces shall be neatly run and securely fixed at suitable intervals.

H. Fire alarm system should be so installed and constructed so that it does not cause any kind of radio interference.

3.02 INSTALLATION OF THE COMPONENTS

A. Fire alarm components shall be installed directly to conduit outlet boxes at the following mounting heights above finished floor level, measured to the center of box unless stated otherwise.

1. Fix manual call station semi-recessed at 1400 mm height.

2. Automatic smoke and heat sensors: Ceiling mounted.

3. Alarm sounder: 2400 mm above finished floor.

4. Outdoor alarm: Fix where indicated and approved by the Engineer.

5. External response indicators: Fix beside or above doors as directed by the Engineer.

B. Indicator/alarm panels shall be sited adjacent to the main entrance of the building such as to be fully visible from outside the building.

C. Manual station, heat detectors and smoke detectors shall be sited in accordance with

the minimum distances specified in BS 5839 as a minimum standard of installation but shall be increased in number as necessary to provide a full and effective system.

D. Audible alarm units shall provide the minimum levels of audibility specified.

** END OF SECTION **

SECTION 16783

CCTV SYSTEM

A. GENERAL

The Contractor shall provide fully functional and operational CCTV and Security Systems in accordance with the Drawings.

B. SYSTEM DESCRIPTION

The complete system shall be based on IP solutions. All the above mentioned systems are to be connected directly to the Digital Video Recorder located within the building.

In addition to each sub system performing its own role, the role of each sub system is also to interact with each other and pass the relevant information to the main system. This enables the main system operators to monitor entire security system activities from one console and two monitor screens.
The Contractor shall provide all necessary hardware, software to monitor the cameras access control system from the manager office in the kindergarten floor and the floor above.

C. MATERIALS

Cameras and recorders

The cameras installed should be wide-angle video cameras.
They shall operate continuously, so that at all times, a record is kept of the image of all cameras, in a sequence of at least 24 hours. They continuously show the date and time on the recorded picture.

Digital Video Recorder

A Digital video recorder DVR cabinet is located in the manager room and it is connected to a LED monitor screen 32 inches.
The Cabinet DVR is with a hard disk 2 TB, allowing to view 4 channels in separate windows on the monitor.

Cameras

The indoor CCTV camera dome drive system shall consist of a discreet, miniature camera dome high resolution, 2.8 mm, 1.3 MP, optical and digital zoom, auto switch day and night vision, auto focusing, motorized zoom lens, quick-installing in wall or in-ceiling mounted versions designed for indoor surveillance applications.

The camera system consists of an integrated high resolution, and high performance and sensitivity sensor, the lens shall be equipped with auto-focus with a manual override facility.

The exterior CCTV camera is a vary focal lenses, 1.3 Mega Pixels, weatherproof with auto switch day and night vision with a higher sensitivity nighttime monochrome mode.

END OF SECTION